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OREGON
ENVIRONMENTAL QUALITY
COMMISSION MEETING
MATERIALS 05/18/2000

State of Oregon
Department of Environmental Quality

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Request for Revocation

Permit for the Storage and Treatment of Hazardous Waste

Umatilla Chemical Disposal Agent Facility
ID NO. ORQ 000 009 431

Environmental Quality Commission
May 18, 2000

Staff Report

State of Oregon

Department of Environmental Quality Memorandum

Date: April 17, 2000

To: Environmental Quality Commission

From: Langdon Marsh, Director

Subject: Agenda Item K, EQC Meeting, May 17-18, 2000
Request for Revocation of Permit No. ORQ 000 009 431
[Umatilla Chemical Agent Disposal Facility (UMCDF)]

Statement of Purpose

The purpose of this staff report is to present to the Environmental Quality Commission (EQC or Commission) the results of the Department of Environmental Quality (DEQ or Department) review of public comments received October 18-December 17, 1999, and selected exhibits submitted during legal proceedings (G.A.S.P., et al., v. EQC, et al., Case No. 9708-06159, Multnomah County Circuit Court). The Department undertook this review in response to a request for reconsideration and/or revocation of the Umatilla Chemical Agent Disposal Facility (UMCDF) Hazardous Waste Storage and Treatment Permit (approved by the Commission in February, 1997).

Background

In August 1997 a legal challenge to the UMCDF permits was filed in Multnomah County Circuit Court (Case No. 9708-06159) by G.A.S.P. (a local Hermiston organization), the Sierra Club of Oregon, Oregon Wildlife Federation, and 22 individuals (collectively referred to as "G.A.S.P., et al.," or the "Petitioners"). The Petitioners challenged the validity of the hazardous waste and air permits ("UMCDF Permits") issued by the Commission and the Department ("Agencies") in February, 1997.

On December 14, 1998, the Petitioners (through Counsel) sent a letter to the Commission and the Department requesting a "Contested Case Hearing and Other Relief" (see Attachment A). The Department denied the clearly stated request for a contested case hearing (see Attachment B), but did not at the time interpret the remainder of the letter as a request for revocation or reconsideration of the UMCDF Permits. During the final hearing before the Multnomah County Circuit Court on June 1, 1999, the Agencies agreed to treat the December 14, 1998 letter from the Petitioners as a Request for Revocation.

Because of the volume of material, and the complexities of the subjects, the Agencies have held two public comment periods (including oral testimony before the Commission) and conducted several meetings and worksessions.

Authority of the Commission with Respect to the Issue

The criteria for unilateral modification of the UMCDF permit are set forth at 40 CFR 270.41 which is incorporated in pertinent part by reference at OAR 340-100-0002, 340-105-0041 and Division 106 (see Attachment C). Causes for unilateral modification of a hazardous waste treatment facility permit (as opposed to modifications requested by the Permittee) include:

1. Material and substantial alterations or additions to the permitted facility or activity occurring after permit issuance. *See* 40 CFR 270.41(a)(1);
2. New information which was not available at the time of permit issuance and would have justified different permit conditions. *See* 40 CFR 270.41(a)(2);
3. New statutory, regulatory, or judicially mandated standards. *See* 40 CFR 270.41(a)(3);
4. "Acts of God" or uncontrollable circumstances warranting revised compliance schedules. *See* 40 CFR 270.41(a)(4).

Causes for termination of a permit are contained in 40 CFR 270.43, which states that "the following are causes for terminating a permit during its term, or for denying a permit renewal application":

1. Noncompliance by the permittee with any condition of the permit. *See* 40 CFR 270.43(a)(1);
2. The permittee's failure in the application or during the permit issuance process to disclose fully all relevant facts, or the permittee's misrepresentation of any relevant facts at any time. *See* 40 CFR 270.43(a)(2); or
3. A determination that the permitted activity endangers human health or the environment and can only be regulated to acceptable levels by permit modification or termination. *See* 40 CFR 270.43(a)(3).

Alternatives and Evaluation

The Commission may decide that the information submitted by the Petitioners and by other Commenters does not meet the criteria for unilateral modification or revocation of the UMCDF HW Permit. Alternatively, the Commission may instruct the Department to open the UMCDF Hazardous Waste Storage and Treatment Permit (HW Permit) for modification with respect to specific items of concern. When a permit is modified under 40 CFR 270.41, only the conditions subject to modification are reopened. The Commission also has the option to revoke the UMCDF HW Permit.

Summary of Public Input Opportunities

A public comment period was held open from October 17 through December 18, 1999. On November 19, 1999, the Commission held a special worksession related to UMCDF which included oral testimony from the Petitioners in support of their Revocation Request.(Refs. 1, 2) There were a total of four written comments submitted during the public comment period. A full copy of all comments received during the public comment period was sent to the Commission on January 25, 2000.(Ref. 3) A written transcript of the testimony provided at the November 19, 1999 worksession was sent to the Commission on February 1, 2000.

Two comments were received in December, 1999 (listed in Attachment G) that are not specifically discussed in the sections below. The first was from the Oregon Water Resources Department (DEQ Item No. 99-2273[1]) offering the Department assistance in review of any water right issues related to UMCDF. The second was from Nathan and Allison Butz, and Andrew Butz (DEQ Item No. 99-2193) expressing their support for the revocation of the UMCDF permits.

In addition to the comments received during the public comment period, the Department has reviewed over 120 documents that were submitted during the legal proceedings for Case No. 9708-01659 ("exhibits"). A full copy of the exhibits, and selected motions and correspondence from the legal proceedings, were provided to the Commission on November 3, 1999.(Refs. 4, 5) This information was also sent to the Petitioners and to the UMCDF Information Repositories for reference and public review (see Attachment D).

A public comment period related to the UMCDF carbon filter system was held from July 19 through September 20, 1999. On August 18, 1999, the Commission held a special worksession that included comments and presentations concerning the UMCDF carbon filter system.(Ref. 6) On November 19, 1999, the Commission accepted the Department's recommendation that the carbon filter system be retained in the UMCDF design.

Review Methodology

The Petitioners cite the exhibits that were submitted during legal proceedings (and subsequent oral and written comments) to support their arguments related to specific subject areas. The general approach the Department took in reviewing and responding to the exhibits was to examine the legal briefs and various correspondence (including the Petitioner's December 14, 1998 letter) to find instances where a particular exhibit was referenced, and in what context. The exhibits then were reviewed more closely,

[1] The DEQ's Chemical Demilitarization Program maintains a database of documents related to the Umatilla Chemical Agent Disposal Facility. Most documents are assigned a record number for tracking purposes.

and the Department assessed whether or not a given exhibit supported the Petitioner's argument. This assessment, and the Department's conclusions, were not based solely on the contents of any individual exhibit. The Department reviewed each exhibit in the context of the totality of information available from not only the Petitioners, but also from other public comments, and from any additional information in the Department's records related to a specific subject area.

The Department followed the same general approach when reviewing comments received from other members of the public during the public comment period, including oral testimony from November 19, 1999. The Department reviewed the comment and any supporting documentation, and assessed the merits of a Commenter's argument.

The review by the Department was made somewhat more difficult because many of the exhibits are only excerpts, sometimes very small excerpts, from much larger documents. The Department attempted to obtain a full copy of any excerpted document or referenced transcript (from various Utah court proceedings), especially since the citations in the legal briefs were often to pages that were not included in an exhibit excerpt. In other cases, a document citation was provided, but no specific page numbers were given. In addition, the Department found that many of the citations in the legal documents referenced incorrect exhibit numbers, although it was usually possible to determine which exhibit was intended. In some cases, referenced pages of transcripts (that had not been included in the exhibit as originally submitted) have been included here in attachments.

Exhibits 1-22 were the Affidavits of Legal Standing of the individual Petitioners in G.A.S.P., et al., v. EQC, et al. The Affidavits were not included in the review of exhibits for this Staff Report (A listing of the Affidavits can be found in Attachment R.). Some exhibits were reviewed previously during the proceedings related to the carbon filter system used in the pollution abatement system at UMCDF. Exhibits related to the carbon filter system were not reviewed again here, except in the context of new comments that were received during the public comment period opened for the Request for Revocation (see Section 1).

Throughout this Report the term "Petitioner" will be used to refer to comments received from persons or organizations that were Plaintiffs in the legal proceeding, or from their Counsels. The term "Commenter" will be used when referring to comments received from members of the public (individuals or organizations) that were not parties in G.A.S.P., et al., v. EQC, et al. [2]

[2] The OCPR authors were offended when the Department's 1999 PFS Staff Report referred to them as "Petitioners." Although the use of the term "Petitioners" was inaccurate, since the OCPR was not actually one of the parties in the legal proceedings, the Department does not in any way consider the term pejorative or "belittling," and apologizes for any unintentional offense.

Organization of Staff Report

Due to the voluminous amount of written material reviewed for preparation of this Staff Report, the Department's review presented below does not always respond specifically to each and every exhibit and/or Comment. A complete listing of exhibits submitted during legal proceedings (in numerical order) can be found in Attachment D, beginning on page D-12. A table listing all of the comments and their attachments is included as Attachment G. For ease of reference, the comments of G.A.S.P., et al. (without attachments) are contained in Attachment E and the comments received from the Oregon Clearinghouse for Pollution Reduction (also without attachments) are contained in Attachment F.

For the purposes of this review, the material was grouped together (usually by subject area) into a series of summary tables which are included as Attachments G through R. Each attachment begins with a table that includes descriptions of the various documents. In some cases, additional material related to a particular subject was added to an attachment. The Department reviewed the material and prepared a list of general subject areas for review and comment. Each subject area is discussed in Sections 1 through 9 below.

Generally, each of the sections begins with a listing of related exhibits/comments, a description of the exhibit or comment, and where the particular document was cited. A more detailed discussion of the exhibit/comment is then presented, followed by the Department's conclusions for each subject area. Some documents are referenced in more than one section because the document was related to more than one subject area. Table 1 on the following page lists each section number, its subject area, and the related attachments. Table 2 lists each attachment, its subject area and/or contents, and the exhibits and/or comments that are listed in the attachment, if applicable.

Table 1. Summary of Sections with Subject Areas and Related Attachments.

SECTION	PAGE	SUBJECT AREA	RELATED ATTACHMENTS
1	9	Pollution Abatement System Carbon Filter System (PFS)	A, E, F, G, H, I
2	12	Dioxin Issues: Toxicity, Non-Cancer Effects, And The Use Of A "Reference Dose" For Dioxin Non-Cancer Effects	A, E, G, J, N, S, U
3	18	The Acute Toxicity And The Chronic Health Effects Of Low Level Exposures To Chemical Warfare Agents	A, E, G, K
4	24	Human Health Risk Assessments	A, E, G, L, N, P
5	28	Incineration Vs. "Alternative Technologies"	A, E, G, M, O, P, S, T
6	33	The Risk Of Storage Vs. The Risk Of Incineration	A, M, N, P
7	37	Performance Of The Tooele Chemical Agent Disposal Facility (TOCDF)	A, E, G, N, O, S, U
8	49	Treatment of Secondary Wastes	A, E, G, N, P, Q, U, V
9	54	Emergency Preparedness and the September, 1999 Industrial Exposure Incident At UMCDF	E, F, W

Table 2. List of Attachments, by Subject Area		
Attach-ment #	**Subject Area**	**Related Exhibit/Comments**
A	"Request for Contested Case Hearing and Other Relief," DEQ Item No. 98-1247, Letter from Stuart A. Sugarman and Richard E. Condit (on behalf of G.A.S.P., et al.) dated December 14, 1998	Exhibit 69
B	Denial of "Request for Contested Case Hearing," DEQ Item No. 99-0264, Letter from Langdon Marsh, Director, Department of Environmental Quality, dated February 4, 1999	Exhibit 70
C	"Authority to Modify Hazardous Waste Facility Permits," DEQ Item No. 99-1344, Memorandum from Larry H. Edelman, Oregon Department of Justice, dated August 4, 1999	Not applicable
D	Transmittal Memoranda and Table of Contents only from "Documentation Related to Case No. 9708-06159, G.A.S.P., et al., v. Environmental Quality Commission, et al.," Volumes 1 and 2, August, 1997 to June, 1999	Not applicable
E	"Comments of G.A.S.P., Sierra Club, Oregon Wildlife Federation, et al., In Support Of Their Request To Suspend And Revoke Permits For The Umatilla Chemical Demilitarization Facility"	Comment C-5 (without attachments)
F	"Comments on the Request for Revocation of Permits" Submitted by Oregon Clearinghouse for Pollution Reduction	Comments C-3, C-3A, and C-3B (without other attachments)
G	Comments received during the "request for revocation" comment period. (October 18-December 17, 1999)	Comments C-1, C-2, C-3, C-4, C-5 and Exhibits C-75, C-76, C-77, C-78, C-79, C-80
H	"Exhibit 74" documents reviewed during the comment period for the carbon filter system	74 (lists 28 documents)
I	Documents related to the carbon filter system. See also Attachment H.	57, 58, 66, 67, 68, 71, 72, 73
J	Documents related to dioxin issues, including toxicity, noncancer effects, and EPA's use of a "reference dose" for dioxin noncancer effects	35, 38, 39, 40.1, 40.3, 40.6, 45, 54, 55, 56

Table 2. List of Attachments, by Subject Area (Continued)		
Attach-Ment #	**Subject Area**	**Related Exhibit/Comments**
K*	Documents related to the acute toxicity and/or the chronic health effects of nerve and blister agents	40, 40.2, 40.4, 40.5, 41, 50, 51, 52, 53
L*	Documents related to health risk assessments in general, and the UMCDF Pre-Trial Burn Health and Ecological Risk Assessment.	27, 28, 37.1, 37.2
M*	Documents related to the use of alternative treatment technologies and the risk of storage	48, 63, 65
N	Transcripts from various Utah proceedings (Court and USHW Board)	23, 24, 25, 26, 30, 33, 34, 36, 42, 43, 44.1, 44.2, 47, 49, 59, 64
O*	Miscellaneous Documents related to the Tooele Chemical Agent Disposal Facility	31, 32, 46
P	Documents Related to the Confederated Tribes of the Umatilla Indian Reservation	29
Q*	Documents related to the treatment and/or off-site disposal of secondary wastes	60, 61, 62
R	Affidavits of Legal Standing from Petitioners	1 through 22
S	Legal rulings related to the Tooele Chemical Agent Disposal Facility (Tooele, Utah)	Not Applicable
T	"Evaluation of Demonstration Test Results of Alternative Technologies for Demilitarization of Assembled Chemical Weapons: A Supplemental Review," National Research Council, 2000	Not Applicable
U	Additional Transcript Excerpts and Expert Witness Declaration from various Utah-related proceedings (State and Federal Courts and USHW Board)	25, 30, 33, 34, 47
V	Listing of documents related to the Dunnage incinerator	Not Applicable
W	A Report on the September 15, 1999 Industrial Accident at the Umatilla Chemical Agent Disposal Facility	Not Applicable
X	Facility Startup Checklist	Not Applicable

* Attachments with an * contain documents related to the subject of the Attachment, in addition to the "Table of Comments and Exhibits."

Review of Comments and Exhibits

1. POLLUTION ABATEMENT SYSTEM CARBON FILTER SYSTEM (PFS)

1.A. Applicable Attachments and Exhibits/Comments

- Attachment A, Exhibit 69 (December, 1998 "Revocation Request")
- Attachment E, Comment C-5 (Comments of G.A.S.P., et al.)
- Attachment F, Comment C-3 (Comments of Oregon Clearinghouse for Pollution Reduction)
- Attachment G, Comments C-3, C-3B, C-3C, C-3D, C-4, C-5, C-75
- Attachment H, Exhibits 74, 74.1, 74.2, 74.3, 74.301, 74.302, 74.303, 74.304, 74.305, 74.306, 74.307, 74.308, 74.309, 74.31, 74.311,74.312, 74.313, 74.314, 74.315, 74.316, 74.317, 74.318, 74.319, 74.32, 74.321, 74.322, 74.323, 74.324, 74.325
- Attachment I, Exhibits 57, 58, 66, 67, 68, 71, 71.1, 72, 72.1, 73

1.B. Description and Summary of Documents

The "Petitioners' Request for Hearing and Other Relief on Remand" (December 14, 1998; DEQ Item No. **98-1247**, Exhibit 69, included as Attachment A) requested that the Commission and the Department "Acknowledge that the Army's proposed incineration technology is inadequate without additional protection from a PAS carbon filter system ("PFS"), and that such a system is unproven, untested, and cannot be utilized at UMCDF." The Petitioners' December, 1999 comments reiterate their concerns about the PFS, and incorporate the comments of the Oregon Clearinghouse for Pollution Reduction (OCPR) by reference.

A copy of the comments of G.A.S.P., et al. (without attached exhibits) is included in Attachment E, and the comments of the OCPR (without attachments) are located in Attachment F. A table that includes a description of the exhibits and attachments to each set of comments can be found in Attachment G.

"Exhibit 74" (see document listing in Attachment H) was received as part of Case No. 9708-06159 (Multnomah County Circuit Court of the State of Oregon) and is titled "*An Analysis of Kriistina Iisa's Report Concerning the Emission of Dioxin and the Use of PAS Carbon Filters for the Oregon Environmental Quality Commission.*" Exhibit 74 was reviewed as part of the Department's Staff Report in November, 1999.[Ref. 7] Attachment I lists an additional 10 documents that were previously reviewed by the Department and considered by the Commission during proceedings related to the PFS.

The comments submitted by the OCPR focused primarily on responding to the Department's review of Exhibit 74 that was presented to the Commission in November, 1999. OCPR questions the Department's and the Commission's reliance on a contractor's review of Exhibit 74 [because] "The large majority of E&E's business comes from DOD and EPA. Reasonable persons would not hire them as an independent source to review Army submissions." OCPR also questions the qualifications of the Ecology and Environment (E&E) authors, does not believe that the E&E review was a "a fair examination of our points," and that the Department (and the Department's contractors) purposefully "characterize[d] [OCPR] in unflattering terms" when responding to Exhibit 74 in November, 1999.

OCPR provides a critique of the report prepared by E&E, and responds to the Department's Staff Report from November, 1999. OCPR also cites the affidavit (Exhibit C-75) of the former Permits Coordinator for the Tooele Chemical Agent Disposal Facility (TOCDF) and the testimony of an Army representative (Comment C-3D) during a legal proceeding related to the Pine Bluff (Arkansas) Chemical Agent Disposal Facility. OCPR states that "We know what DEQ could have learned about carbon filter and dioxin emissions from those depositions and could have, but did not include them in their report."

[The OCPR comments (Comments C-3 and C3-A) also included an abstract of a document titled "Air-Quality Dispersion Modeling in Complex Terrain Near the Umatilla Chemical Agent Disposal Facility." This document is discussed in Section 9.]

1.C. <u>Discussion</u>

The issues covered by the PFS-related documents in Attachments E, F, G, H, and I were already discussed and reviewed by the Department and the Commission during the proceedings conducted in 1999. On November 19, 1999, the Commission accepted the Department's recommendation that the PFS be retained in the UMCDF design. The following discussion is limited to those documents and/or comments that were not addressed in previous Department reviews, primarily the comments of the OCPR.

The OCPR comments related to the E&E review of Exhibit 74 pointed out instances where OCPR believes that E&E was in error concerning E&E's review of the dioxin-related documents that were referenced by Dr. Iisa in responding to EQC questions regarding dioxin formation and control during the 1996 draft permit review process. (see Section 2 for further discussion of documents related to issues about dioxin.)

OCPR also cites the allegations of Mr. Gary Harris (Attachment G, Exhibit C-75), and the sworn deposition of Mr. Harris that was recently taken in Utah, as documentation of "known problems with the use of carbon bed filters." Mr. Harris' allegations, and their applicability to UMCDF, are discussed in Section 7. The testimony of Mr. Martin Hopkins (Attachment G, Comment C3-D) is related to the decision by the Army not to install the PFS at the Tooele facility. OCPR cites this testimony and asks why "Utah regulators found the courage to ask the Army hard questions about carbon filter technology and our DEQ does not?"

1.D. Department Conclusions

The Department is fully aware that E&E has contracts with the U.S. Department of Defense but believes that there is not an inherent conflict of interest, in part because of the separation between different organizational segments of E&E . Prior to commencement of the work associated with UMCDF, E&E performed a conflict of interest review and did not identify any conflicts related to the facility or their work assignments with DEQ.

Although the specific documents were not available at the time of the November 1999 decision concerning the carbon filters at UMCDF, the information about the PFS contained in the allegations of Mr. Gary Harris and the testimony of Mr. Hopkins was already known to the Department and to the Commission.

The Department reviewed the OCPR "rebuttal" of the E&E critique of Exhibit 74. The Department does not agree with OCPR concerning the interpretation of the content and conclusions of the various references found in the Iisa report of 1996.

The Petitioners (Comment C-5, pp. 21-24) state that the EQC has failed "to consider the human health and environmental risks associated with operation of pollution abatement system carbon filter units." The Petitioners cite several documents to support their contention that the PFS presents "significant risks" to both workers and the public. The documents cited by the Petitioners in Comment C-5 were all documents previously reviewed by the Department and the Commission, and subjects of oral testimony given before the Commission in August, 1999.

The Department stands by the content and conclusions of the November 1999 Staff Report, including the review of Exhibit 74 that was prepared by E&E, and the subsequent Commission decision related to the use of the carbon filters at UMCDF. The comments provided by OCPR and the Petitioners in December, 1999 do not provide a basis for changing the Department's conclusion and recommendation that the PFS should be retained in the UMCDF design.

2. DIOXIN ISSUES: TOXICITY, NON-CANCER EFFECTS, AND THE USE OF A "REFERENCE DOSE" FOR DIOXIN NON-CANCER EFFECTS

2.A. Applicable Attachments and Exhibits/Comments

- Attachment A, Exhibit 69 (December, 1998 "Revocation Request")
- Attachment E, Comment C-5 (Comments of G.A.S.P., et al.)
- Attachment G, Comment C-5
- Attachment J, Exhibits 35, 38, 39, 40.1, 40.3, 40.6, 45, 54, 55, 56
- Attachment N, Exhibit 47
- Attachment S, Legal rulings related to the Tooele Chemical Agent Disposal Facility
- Attachment U, Additional transcript excerpts from Utah proceedings

2.B. Description and Summary of Documents

Exhibit 35 is a nine-page excerpt from the EPA's three volume "Health Assessment Document for 2,3,7,8-Tetrachlorodibenzo-p-Dioxin(TCDD) and Related Compounds (External Review Draft)," dated August, 1994. [Cited in Item No. **98-1275** (p. 41)][3]

Exhibit 38 is a one-page excerpt from the "Final Screening Risk Assessment" for the Pine Bluff Chemical Agent Disposal Facility, by the United States Army Center for Health Promotion and Preventive Medicine, dated October, 1997. The excerpted page contains a discussion of how the infant breast milk pathway was calculated in the Pine Bluff Health Risk Assessment (using a dioxin non-cancer reference dose). [Cited in Item No. **98-1275** (p. 43)]

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[3] The DEQ's Chemical Demilitarization Program maintains a database of documents related to the Umatilla Chemical Agent Disposal Facility. Most documents are assigned a record number for tracking purposes. The following Item Numbers are cited in this section (reference to "Case No. 9708-06159" means G.A.S.P., et al., *v.* EQC, et al., Multnomah Circuit Court, decided in June, 1999):

- No. **98-1247**: "Request for Contested Case Hearing and Other Relief," letter dated December 14, 1998 (See Attachment A)
- No. **98-1275**: "Petitioners' Memorandum Supporting Cross Motion for Summary Judgment," August 20, 1998 (Case No. 9708-06159)
- No. **98-1285**: "Petitioners' Additional Documentary Evidence," November 10, 1998 (Case No. 9708-06159)
- No. **99-0704**: "Petitioners' Opposition to Respondents' Supplemental Motion for Summary Judgment," April 12, 1999 (Case No. 9708-06159)
- No. **99-2201**: "Comments of G.A.S.P., et al., in Support of Their Request to Suspend and Revoke Permits for [UMCDF]," December 17, 1999 (See Attachment E)

Exhibit 39 is an Affidavit from Dr. Peter deFur, dated July, 1998, about the cancer and non-cancer effects of dioxins. Dr. deFur reviewed the TOCDF Health Risk Assessment and states his belief that the TOCDF Health Risk Assessment is "not complete without adding the non-cancer risks from dioxin exposure to all target groups or individuals, and especially to fetuses, infants and young children..." [Cited in Item No. **98-1275** (p. 44-45, p. 55) and in Item No. **99-2201** (p. 32)]

Exhibit 40.1 is part of a collection of papers from Exhibit 40. This paper is titled "Public Health Effects of Chemical Weapons Incineration" Richard Clapp, Ph.D., dated March, 1998. Dr. Clapp discusses the toxicity and health effects of dioxins and dioxin-like compounds and states his belief that the Health Risk Assessments undertaken for the chemical agent incineration facilities are "inadequate and incomplete" because the failure to account for dioxin and dioxin-like compounds. [Cited in Item No. **99-2201** (p. 32)]

Exhibit 40.3 is part of a collection of papers from Exhibit 40. This paper is titled "Critique of Chemical Weapons Incineration Risk Assessment," by Peter deFur, Ph.D., dated March, 1998. Dr. deFur discusses the issues surrounding the cancer and non-cancer effects of dioxins and states his belief that the TOCDF Health Risk Assessment is "not complete without adding the non-cancer risks from dioxin exposure to all target groups or individuals, and especially to fetuses, infants and young children..." [Cited in Item No. **99-2201** (p. 32)]

Exhibit 40.6 is part of a collection of papers from Exhibit 40. This paper is titled "Synthetic Chemicals as Endocrine Disruptors," by Peter deFur, Ph.D., and Carolyn Raffensperger, M.A., J.D., dated March, 1998. Dr. deFur and Ms. Raffensperger describe the endocrine system and the effects of chemicals known as endocrine disruptors, and the pathways through which human exposure occurs. The authors urge individuals to take action to reduce exposures, and also state that "to act responsibly and with precaution in light of the known effects of endocrine disruption in animals and humans and the uncertainty of the extent of human exposure, the Army must shut down the existing [chemical weapons] incinerators and choose alternative technologies with no toxic emissions." [Cited in Item No. **99-2201** (p. 32)]

Exhibit 45 is a Fact Sheet titled "EPA Special Report on Endocrine Disruption," from the EPA dated February, 1997. The fact sheet discusses EPA's findings concerning the effects of endocrine disrupters on human health and the environment. [Cited in Item No. **98-1275** (p. 55)]

Exhibit 47 is an excerpt from testimony during the Utah Solid and Hazardous Waste Control Board hearing held March 18-20, 1997. The Petitioners cite the testimony of Dr. Brent Finley (pp. 877-878 of the transcript) regarding the use of a dioxin reference dose, but the testimony of Dr. Finley was not actually included in the Exhibit submitted to the Department. Mr. Finley's testimony is included here in Attachment U, page U-1. [Cited in Item No. **98-1275** (p. 58)]

Exhibit 54 is a two-page excerpt from a document titled "Toxicological Profile for 2,3,7,8-Tetrachloridibenzo-p-Dioxin," dated June, 1989 by the Syracuse Research Corporation for ATSDR (U.S. Public Health Service) and EPA. [Cited in Item No. **98-1285** (p. 5); Item No. **99-0704** (p. 11); and in Item No. **99-1247** (p. 7)]

Exhibit 55 is two-page excerpt from a document titled "Drinking Water Criteria Document for 2,3,7,8-Tetrachlorodibenzo-p-Dioxin," dated March, 1985 by the EPA Environmental Criteria and Assessment Office. [Cited in Item No. **98-1285** (p. 5); Item No. **99-0704** (p. 11); and in Item No. **99-1247** (p. 5)]

Exhibit 56 is a one-page excerpt from the "Final Times Beach Site Multimedia Risk Assessment," dated March, 1995, by the EPA. The exhibit is a table that lists the "Toxicity Values for Chemicals of Potential Concern—Noncancer Effects." [Cited in Item No. **98-1285** (p. 6); Item No. **99-0704** (p. 11); and Item No. **99-1247** (p. 5)]

2.C. Discussion

The Petitioners cite the exhibits in Section 2.B to document the effects of exposure to dioxin and dioxin-like compounds and to support the arguments that, contrary to the Department's assertions, there is a dioxin "non-cancer reference dose" in use by EPA and that "the Agencies erred in failing to consider the 1 pg/kg/day non-cancer standard."[4]

The Petitioners state that the EPA's 1994 "Dioxin Health Assessment" concluded that an appropriate reference dose for non-cancer effects from dioxin exposure would be 10 to 1000 times less than the current national background exposure levels for dioxin. This leads to the Petitioner's conclusion that since most adult persons in the U.S. are already exposed to background levels of dioxin higher than one pg/kg/day, then there should be absolutely no additional dioxin exposure allowed. Therefore, because dioxin can be formed in high temperature combustion sources, TOCDF and UMCDF should not be allowed to operate.

Similar arguments concerning the effects of dioxins, the use of a non-cancer reference dose for dioxin, and the potential for a chemical agent incineration facility to emit dioxins, were presented by the Petitioners during the UMCDF permitting process in 1996. Many of the same documents submitted to the State of Oregon were used by the Chemical Weapons Working Group, et al. during various legal proceedings in Utah. Dioxin issues were argued extensively before the Utah

[4] "1 pg/kg/day" in this context refers to the exposure of a person to one picogram of dioxin per kilogram of body weight per day. This level of dioxin exposure is not expected to have an adverse health effect of any sort, including cancer. A picogram is one-trillionth of a gram.

Solid and Hazardous Waste Board (USHW) and the U.S. District Court. Attachment S contains various rulings by the USHW, the U.S. District Court in Utah, the Utah Court of Appeals, the U.S. Court of Appeals, and the U.S. District Court for the District of Columbia.

On August 13, 1996, the U.S. District Court in Utah (Chemical Weapons Working Group, Inc., et al., Plaintiffs, vs. United States Department of the Army, et al., Defendants, Civil No. 2:96-CV-425C) ruled in favor of the Defendants. Dioxin and the use of reference doses were just a few of the many issues argued before the District Court during this case. In the Court's "Findings of Fact" related to "Dioxin Hazards" (Attachment S, page S-5) the Court stated:

> "The evidence indicates that the existence and amount of the health risks associated with exposure to background levels of dioxin, and the likely significance and effects of the incremental increases in the dioxin levels due to the operation of TOCDF, are largely uncertain. The conflicting opinions offered by the experts who presented testimony in this case emphasize the fact that the effects of dioxin at various levels of exposure are far from settled issues within the scientific community.
>
> "Plaintiffs rely to a great extent on the draft document "Health Assessment Document for 2,3,7,8 Tetrachlorodibenzo-p-Dioxin (TCDD) and Related Compounds" (Dioxin Reassessment) issued by EPA in 1994, which by its terms is not to be cited or quoted. Certain of the findings in the Dioxin Reassessment were questioned in significant areas by EPA's Science Advisory Board in 1995. The document is still under review and does not currently represent a final position of the EPA.
>
> "Plaintiffs also rely on a "reference dose" of 1 picogram/kg/day level noted by the Agency for Toxic Substances and Disease Control (ATSD) in 1989 to establish harm to humans. However, this reference dose is derived by dividing the lowest level at which adverse effects are shown in animals by 1,000 in order to conservatively account for unknown factors. Accordingly, although this "reference dose" may indicate a safe level for exposure, it does not follow that exceeding this level is likely to result in harm.
>
> "The EPA Dioxin Reassessment itself states that the use of such a reference dose would be "inappropriate" and of "doubtful significance." [Dioxin Reassessment, p. 9-84] The evidence presented indicates that this level of exposure is already exceeded in most industrialized areas of the world. Although plaintiffs argue that any increase in the levels of dioxin exposure is unacceptable, the danger associated with relatively small increases is far from certain, and the evidence presented by plaintiffs is insufficient to support a finding that such danger is likely to be significant."

In a section titled "New information regarding dioxin harms" in its "Conclusions of Law" the Court (Attachment S, page S-10) goes on to say that:

> "...the EPA 1994 dioxin reassessment's analysis is at best an indication that the debates regarding the effects of dioxin are still ongoing. The wide range of expert testimony presented to the court during the hearing on plaintiff's motion makes clear that the seriousness of the dioxin threat is far from settled."

Exhibits 39, 40.3, and 40.6 are documents authored by Dr. Peter deFur that are dated after the August, 1996 ruling from the Utah District Court. Exhibit 40.1, by Dr. Richard Clapp, is also dated after August, 1996. However, Dr. deFur and Dr. Clapp both submitted declarations, and Dr. deFur testified, during a subsequent hearing before the Utah District Court. The declarations and testimony submitted during the March, 1997 hearing before the Utah District Court were essentially the same content as noted in the above exhibits.

On March 24, 1997, the U.S. District Court in Utah (Chemical Weapons Working Group, Inc., et al., Plaintiffs, vs. United States Department of the Army, et al., Defendants, Civil No. 2:96-CV-425C) once again ruled in favor of the Defendants, finding that "None of the new evidence presented by plaintiffs undermines the court's prior finding." In the Court's "Findings of Fact" related to "Screening Health Risk Assessment" (Attachment S, page S-25) the Court stated:

> "As they did with their first motion, plaintiffs rely heavily on a draft chapter of the EPA's "Health Assessment Document for 2, 3, 7, 8, Tetrachlorodibenzo-p-Dioxin (TCDD) and Related Compounds" (Dioxin Reassessment). However, this document, which by its terms is not to be cited or quoted, remains subject to review by EPA's Science Advisory Board and possible public comment and does not represent the EPA's final position. The court finds that scientific knowledge regarding health risks associated with dioxin exposure and the methods to assess the health impacts of dioxin emissions at TOCDF remains unchanged since the previous hearing."

Further information about the EPA's 1994 "Dioxin Health Assessment" can be found in Attachment S (page S-67) in a ruling by the U.S. District Court of Appeals for the District of Columbia. The Chemical Weapons Working Group, et al., attempted to force EPA to produce documents related to the 1994 Dioxin Health Assessment. The Court denied the motion on January 19, 1999, stating (page S-69):

> "...the Court finds highly creditable the agency's assertion that release of draft information could mislead the public. Decl. of William H. Farland at 12-13. "The public may misinterpret information in the drafts as the most up-to-date information on dioxin toxicity available from the Agency, even though the documents do not reflect official EPA views, but only the preliminary views of the primary authors." Id. at 13. In fact, it appears that Plaintiffs seek the documents [**9] precisely because they believe it is the latest EPA information on the health effect of dioxins.
>
> "The Court finds that the documents sought by the Plaintiffs are protected by the deliberative process privilege. Release of the documents would likely stifle candid communication within the agency, lead to public confusion, and violate the integrity of the decision-making process."

The testimony of Dr. Brent Finley (Exhibit 47) cited by the Petitioners was taken before the Utah Solid and Hazardous Waste Control Board (USHW Board) in March, 1997. (The USHW Board is

the State of Utah's equivalent of the Oregon Environmental Quality Commission.) The USHW Board heard much the same evidence that was presented to the Utah District Court, and in an Order dated July 22, 1997 (Attachment S, page S-39), the Board found that "The Petitioners failed to present evidence refuting the conclusions of the [TOCDF Screening Health Risk Assessment]" (page S-49). The Board cited Dr. Finley's testimony as part of the basis for their finding. (Exhibit 47 as originally submitted did not include Dr. Finley's testimony before the USHW Board. A transcript of his testimony is included here in Attachment U, beginning on page U-1.)

Exhibit 38 shows that the Health Risk Assessment conducted for the Pine Bluff Chemical Agent Disposal Facility used an "average daily dose" to calculate an infant's dioxin exposure from the breast milk pathway. This reflects current EPA guidance in how to calculate such an exposure pathway.

2.D. Department Conclusions

The Petitioners argue that "The analysis of human health and environmental risks posed by dioxin and dioxin-like compounds relied upon by the EQC/DEQ is flawed and seriously underestimates the risks of these dangerous chemicals" (Attachment E, page E-32). The Department does not dispute the toxicity of dioxin and dioxin-like compounds. The issue is how to estimate the risks posed by these types of compounds. The Department has relied upon, and will continue to rely upon, the most current EPA Health Risk Assessment guidance available.

The Umatilla Chemical Agent Disposal Facility Pre-Trial Burn Human Health Risk Assessment (HRA) conducted in 1996[Ref. 8] used the most current EPA guidance available at the time. The Department expects to conduct the Umatilla "Post-Trial Burn" HRA with more recent EPA guidance. In October, 1998, the EPA published a Federal Register Notice and opened a public comment period for a "Peer Review Draft" of a "Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities." [Ref. 9] The EPA's 1998 Draft HRA Protocol includes discussion of how a risk assessment should account for the risks of non-cancer effects from dioxin. Regardless of the Petitioner's statements to the contrary, the Department notes that the EPA's 1998 Draft HRA Protocol clearly states that the "U.S. EPA has not developed reference doses for any of the [dioxin/furan] congeners" (p. 2-42 of the draft HRA Protocol).[5]

[5] The Department encourages the Petitioners to direct their comments related to calculating the risk of dioxin exposure to the EPA. The EPA has already published one "Errata" document (August 2, 1999) for the 1998 Peer Review Draft of the HRA Protocol based on comments received from peer reviewers and members of the general public.

The Department concludes that the arguments presented by the Petitioners related to the use of a dioxin "non-cancer reference dose" are not sufficient reason to re-visit the UMCDF Pre-Trial Burn HRA conducted in 1996, nor to change the Commission's finding that the UMCDF will not have any adverse effects on public health or the environment. The Department will continue to rely on the most current EPA guidance available when conducting human health and ecological risk assessments related to UMCDF. The information reviewed does not provide a basis for unilateral modification or revocation of the UMCDF HW Permit.

3. THE ACUTE TOXICITY AND THE CHRONIC HEALTH EFFECTS OF LOW LEVEL EXPOSURES TO CHEMICAL WARFARE AGENTS

3.A. Applicable Attachments and Exhibits/Comments

- Attachment A, Exhibit 69 (December, 1998 "Revocation Request")
- Attachment E, Comment C-5 (Comments of G.A.S.P., et al.)
- Attachment G, Comment C-5
- Attachment K, Exhibits 40, 40.2, 40.4, 40.5, 41, 50, 51, 52, 53; and additional Gulf War and toxicity-related documents

3.B. Description and Summary of Documents

Exhibit 40 is a collection of papers titled "Public Health and Chemical Weapons Incineration" by the Kentucky Environmental Foundation, dated March, 1998. The mission of the Kentucky Environmental Foundation (as described in the website of the Chemical Weapons Working Group) is "to further the cause of safe disposal of chemical weapons and environmental democracy by improving public access to information, coalition building, fostering cooperation between government and citizens, and encouraging grassroots participation in the decision-making process." [Cited in Item No. **98-1275**[6] (p. 46) and in Item No. **99-2201** (p. 32)]

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[6] The following Item Numbers are cited in this section:

- No. **98-1247**: "Request for Contested Case Hearing and Other Relief," letter dated December 14, 1998 (Attachment A)
- No. **98-1275**: "Petitioners' Memorandum Supporting Cross Motion for Summary Judgment," August 20, 1998 (Case No. 9708-06159)
- No. **98-1285**: "Petitioners' Additional Documentary Evidence," November 10, 1998 (Case No. 9708-06159)
- No. **99-0704**: "Petitioners' Opposition to Respondents' Supplemental Motion for Summary Judgment," April 12, 1999 (Case No. 9708-06159)
- No. **99-1751**: "First Supplemental Petition for Review," April 5, 1999 (Case No. 9708-06159)
- No. **99-1752**: "Petitioners' Reply to Opposition to Motion for Relief," January 19, 1999 (Case No. 9708-06159)

Exhibit 40.2 (one of the collection of papers in Exhibit 40) is titled "Toxic Exposures and Chronic Illnesses," by Howard Urnovitz, Ph.D. (Scientific Director, Chronic Illness Research Foundation, Berkeley, California) . Dr. Urnovitz discusses the implications of various research projects related to chronic illnesses and Gulf War Syndrome that indicate exposures to a combination of chemical compounds can have synergistic and additive effects.

Exhibit 40.4 (one of the collection of papers in Exhibit 40) is titled "Toxicology of Chemical Agents," by Robert Ginsburg, Ph.D. (Research Director, Midwest Center for Labor Research, Chicago). Dr. Ginsburg reviewed the literature on the toxicity of the agents GB and VX. He found that "evaluation of the potential effects from exposure to low levels of these chemicals is difficult because of complications arising from the chemicals' extremely high acute toxicity." Dr. Ginsburg recommends further testing of sub-acute exposure effects because "despite the limitations in testing, long-term consequences from low-level exposure to nerve agents as well as commercial organophosphate pesticides have been demonstrated."

Exhibit 40.5 (one of the collection of papers in Exhibit 40) is titled "Health Effects of Low-level Exposure to Nerve Agent," by Jerry Buccafusco, Ph.D. (Professor of Pharmacology and Toxicology, Medical College of Georgia and Director, Neuropharmacology Laboratory, Department of Veterans Affairs Medical Center, Augusta, Georgia). Dr. Buccafusco discusses the research conducted by the Medical College that found that chronic low-level exposure to an organophosphorus agent "produced a subtle but reproducible memory impairment."

Exhibit 41 is a copy of a news article from The Oregonian newspaper dated July 29, 1998 by James Long. The article is titled "Nerve gas danger underestimated." The article was reporting the results of a study conducted by the National Research Council. (see Exhibit 50)

Exhibit 50 is an excerpt from a report by the National Research Council (NRC) in 1997 that is titled "Review of Acute Human-Toxicity Estimates for Selected Chemical Warfare Agents." The NRC recommended that some changes be made to the toxicity values used by the Army to assess the effects of chemical agents on soldiers. [Cited in Item No. **98-1247** (pp. 5-6); Item No. **98-1275** (p. 47); Item No. **98-1285** (pp. 2-3); Item No. **99-0704** (p. 8); Item No. **99-1751** (p. 4); and in Item No. **99-2201** (pp. 24-27)]

Exhibit 51 is an excerpt of a review conducted by the "Environment Committee" of the "Armed Forces Epidemiological Board" in July, 1996, titled "Long-term Health Effects Associated with Sub-Clinical Exposure to GB and Mustard." The document states that it was prepared at the request of the Assistant Secretary of Defense (Health Affairs) to conduct a literature review and to

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- No. **99-2201**: "Comments of G.A.S.P., et al., in Support of Their Request to Suspend and Revoke Permits for [UMCDF]," December 17, 1999 (Attachment E)

critique and comment on the question "Are there observable long-term health effects associated with exposure to Sarin (GB) and mustard at concentrations below that needed to cause acute signs, symptoms, or injury?" The review states that "The long-term effects of limited exposures to sub-clinical doses of GB and HD are unclear, but the data included in this review suggest that health effects would not be detectable." The review concludes, however, that much further research work needs to be done. [Cited in Item No. **98-1247** (p. 6); Item No. **98-1275** (p. 54); Item No. **98-1285** (pp. 3-4); Item No. **99-0704** (p. 9); and in Item No. **99-2201** (pp. 27-28)]

Exhibit 52 is titled "105th Congress Report - Gulf War Veteran's Illnesses: VA, DOD Continue to Resist Strong Evidence Linking Toxic Causes to Chronic Health Effects," dated November, 1997 by the Committee on Government Reform and Oversight (House of Representatives). This exhibit is a copy of a report prepared in response to requests by Gulf War veterans. [Cited in Item No. **98-1247** (p. 6); Item No. **98-1275** (p. 54, lines 3-5); Item No. **98-1285** (pp. 4-5); Item No. **99-0704** (p. 10); and in Item No. **99-2201** (pp. 28)]

Exhibit 53 is a September, 1998 report by the U.S. General Accounting Office titled "Chemical Weapons: DOD Does Not Have a Strategy to Address Low-Level Exposures. [Cited in Item No. **98-1247** (p. 7); Item No. **98-1285** (p. 5); Item No. **99-0704** (p. 10); and in Item No. **99-2201** (pp. 28-31)]

3.C. Discussion

The Petitioners cite Exhibit 40 (with 40.2, 40.4, and 40.5) to support the statement that "studies of non-lethal agent exposures and chemicals containing ingredients similar to agent demonstrate that impacts to brain function and behavior may be likely." Exhibits 51, 52, and 53 are related to the ongoing research effort in identifying the cause of what has become known as the "Gulf War Syndrome." The Petitioners cite these Exhibits in stating that "low level agent exposure alone or in combination with other chemicals can generate a range of disturbing health effects." The Petitioners cite these documents to counter the Department's statement that there was insufficient information available concerning the Gulf War Syndrome to incorporate into the UMCDF Pre-Trial Burn Health Risk Assessment at the time it was conducted in 1996.

The Department was not able to incorporate Gulf War information into the 1996 UMCDF Health Risk Assessment because so much of the research being conducted was still in the early stages, and it was apparent, even at that time, that Gulf War veterans had been exposed to an incredible myriad of potentially health-damaging situations. The possibility of low-level nerve agent exposure was only one of the types of exposures under consideration as a possible cause of the health problems being exhibited by Gulf War veterans.[Refs. 10, 11]

The list of possible Gulf War veterans' exposures now include:

- chemical warfare agents;
- Pyridostigmine Bromide (an inoculation given to Gulf War soldiers as protection against nerve agents);
- biological warfare agents (anthrax, botulism toxins);
- infectious diseases (leishmaniasis, sandfly fever, malaria, dengue fever, etc.);
- immunizations (hepatitis A and B, yellow fever, rabies, cholera, etc.);
- depleted uranium;
- pesticide use (malathion, chlorpyrifos, lindane, DEET, and the flea collars that some veterans wore to combat the insects);
- smoke from the oil well fires in Kuwait;
- petroleum products [used for dust suppression, fuel (for vehicles and for heaters, stoves, and generators), to burn human waste, and as an ingredient in "Chemical Agent Resistant Coating" paint];
- the desert environment (high temperatures in the daytime reaching 130 degrees Fahrenheit, sand particulate);
- psychological and physical stressors (sudden mobilization, combat, accidents, etc.); and
- general exposures inherent to military service (propellants from ammunition, solvents, noise, vibration, blast impacts, etc.).

The Centers for Disease Control (CDC) sponsored a "Research Planning Conference" in February, 1999 with the purpose of obtaining "broad public input into the development of a multi-year research plan investigating relationships of chemical exposures to illnesses among Gulf War veterans." A copy of the "Background Document on Gulf War-Related Research" prepared for the conference is included in Attachment K, page K-7. A more recent report (January, 2000) by the Government Accounting Office (GAO) titled "Management Actions Needed to Answer Basic Research Questions" is also included in Attachment K (page K-41). The GAO concludes that "basic questions about the causes, course of development, and treatments of Gulf War veterans' illnesses remain unanswered" ("Results in Brief," page K-44). The GAO report states that there are 151 research projects being monitored by the "Research Working Group of the Persian Gulf Veterans' Coordinating Board," and most of those are still ongoing.

The Utah Citizens Advisory Commission was interested in whether the Gulf War Syndrome was a cause for concern about the Tooele Chemical Agent Disposal Facility (TOCDF) and requested that the CDC assess the public health risk associated with the emissions from TOCDF. In a letter to the Utah Advisory Commission (Attachment K, page K-73), the CDC replied:

"In your letter to CDC, you also asked us to address the current concern of some people that the stack emissions from the incinerator could lead to health effects similar to those associated with "Gulf War Syndrome." We, too, have seen this concern raised in the popular media. However, on the basis of the information available, we do not feel that this concern is well founded. Our reasons follow:

1. The symptoms described by the Gulf War veterans are diverse and often vague. They are not specific for symptoms associated with acute exposure to the chemical agents contained at the stockpile sites.
2. The Johnston Atoll incinerator (which is similar to the Tooele incinerator) has been operating for approximately seven years. WE are unaware of any information that shows any similarities between health problems reported on the island and the symptoms associated with Gulf War Syndrome.
3. The cause of Gulf War Syndrome is still subject to considerable debate and many hypotheses. Research is underway to investigate these issues and CDC will monitor the developments in this research.

If new information is produced to better support the hypothesis that Gulf War Syndrome is caused by exposure to chemical agent, we will examine it closely and let the Utah CAC, and others, know of our findings. However, in the absence of such information, we feel that it is prudent to reduce the existing stockpile storage risk by continuing to pursue the baseline recommended destruction technology, incineration, in a safe and deliberate manner."

The National Research Council's (NRC) "Review of Acute Human-Toxicity Estimates for Selected Chemical Warfare Agents" referenced in Exhibits 41 and 50 was made available in 1998. The Petitioners contend that the NRC report proves that "chemical warfare agents are even more dangerous than originally thought," and that "the EQC was misled concerning a critical aspect of the permitting process (i.e., the likely toxicity of CW Agents)."

Numerous agencies involved with the oversight of the Army's chemical demilitarization program were interested in the potential impact of the NRC "Acute Toxicity" report. Shortly after the NRC report was released, the Department requested that Ecology and Environment review the report to determine if the toxicity estimates of the NRC would have any impact on the UMCDF Health Risk Assessment. E&E concluded that "the toxicity values presented in the NRC document are not applicable for use in a risk assessment for the general population." A copy of the E&E review memorandum to the Department can be found in Attachment K (page K-77).

The Army Program Manager for Chemical Demilitarization was also concerned, and requested that the CDC review the report and "assess the adequacy of protection to the workforce and local community" (see Attachment K, page K-79). The Centers for Disease Control came to the same conclusion as E&E, and stated in a letter to the Army in October, 1998 (page K-81), that "the occupational and General Population Limit exposure levels were developed to protect the workers and civilians around the chemical stockpile and demilitarization sites and CDC continues to believe that theses limits are still valid and protective of human health and safety." The Army

responded to an inquiry from the Alabama Department of Environmental Management (page K-83) and prepared a media release and "question and answer" sheet (page K-87).

3.D. Department Conclusions

The Department does not concur with the Petitioners that either the Commission or the Department has been "misled" concerning the toxicity of chemical warfare agents. The Department monitors new information as it is available, and assesses its applicability, if appropriate, to the demilitarization activities being conducted at UMCDF (such was the case with the NRC "Acute Toxicity" Report). The Department concurs that research being conducted by agencies studying the Gulf War Syndrome (and new review of old research) indicates that there may be adverse health effects from low-level exposures to organophosphorus agents, including the nerve agent GB. However, researchers have not concluded that low-level nerve agent exposure is a "cause" of Gulf War Syndrome, and in fact some studies have ruled out nerve agent exposure as a cause.

The Department notes, however, that the definition of "low-level exposure" is not clear.[Ref. 11] The Petitioners believe that incineration will result in emissions of chemical agents either through routine operations or through upset conditions and/or accidents. That leads to the assertion that UMCDF will be a source of chronic "low-level" nerve agent exposure for local communities, which will therefore result in health effects similar to those seen in Gulf War veterans. The Department does not believe that it is reasonable to equate barely detectable (if detectable at all) emissions from a highly engineered and controlled combustion unit (which includes a pollution abatement system followed by carbon filtration) with the "emissions" resulting from the open detonation of a large chemical agent ammunition dump.

The Centers for Disease Control agrees that the stack emissions from a chemical agent disposal facility are unlikely to lead to health effects similar to those associated with "Gulf War Syndrome." There is a risk of catastrophic accident (and subsequent population exposure to chemical warfare agent) as long as the chemical weapons stockpile remains stored at the Umatilla Chemical Depot. The Department believes, like the CDC, that the best way to reduce the risk is to remove the hazard, which will be accomplished through the safe operation of the UMCDF.

The Department has determined that the operation of UMCDF will not pose chronic health risks to the population. That determination is based on the use of exposure limits published by the CDC, site-specific information, and conservative exposure scenarios, all analyzed with health risk assessment guidance from the EPA that has been accepted by the greater scientific community. The Department will continue to use the most recent toxicity data and guidance available to assess

the risks of UMCDF to public health and the environment. The Department will also continue to monitor the progress of Gulf War research studies and the applicability of results to health risk assessment-related activities being undertaken at UMCDF.

The Department concludes that the arguments presented by the Petitioners related to the toxicity of chemical warfare agents and the health effects of low-level exposures do not provide a basis for the unilateral modification or revocation of the UMCDF Hazardous Waste Permit.

4. HUMAN HEALTH RISK ASSESSMENTS

4.A. Applicable Attachments and Exhibits/Comments

- Attachment A, Exhibit 69 (December, 1998 "Revocation Request")
- Attachment E, Comment C-5 (Comments of G.A.S.P., et al.)
- Attachment G, Comments C-4, C-5
- Attachment L, Exhibits 27, 27.1, 27.2, 27.3, 27.4, 27.5, 27.6, 28, 28.1, 28.2, 37.1, 37.2 (Also includes an excerpt from EPA's 1998 Health Risk Assessment Protocol, beginning on page L-5)
- Attachment N, Exhibit 26
- Attachment P, Exhibit 29, 29.1, 29.2

4.B. Description and Summary of Documents[7]

Exhibit 26 is the "Affidavit of John Houston Miller" dated June 3, 1996. The origin of this affidavit is not clear, but it is assumed to be a document generated in CWWG v. U.S. Army (Case No. 96-CV-0425C). Dr. Miller is a "Professor of Chemistry at George Washington University in Washington, D.C." His Affidavit states that the TOCDF health risk assessment did not adequately account for upset emissions; that the calculated destruction removal efficiency will not be valid

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[7] The following Item Numbers are cited in this section:

- No. **98-1247**: "Request for Contested Case Hearing and Other Relief," letter dated December 14, 1998 (See Attachment A)
- No. **98-1275**: "Petitioners' Memorandum Supporting Cross Motion for Summary Judgment," August 20, 1998 (Case No. 9708-06159)
- No. **98-1285**: "Petitioners' Additional Documentary Evidence," November 10, 1998 (Case No. 9708-06159)
- No. **99-0704**: "Petitioners' Opposition to Respondents' Supplemental Motion for Summary Judgment," April 12, 1999 (Case No. 9708-06159)
- No. **99-2201**: "Comments of G.A.S.P., et al., in Support of Their Request to Suspend and Revoke Permits for [UMCDF]," December 17, 1999 (See Attachment E)

when chemicals are in low concentrations (below 1000 ppm); and that TOCDF relied on inadequate JACADS data. Dr. Miller provides a list of various chemicals that were not included in the JACADS data that TOCDF relied on. [Cited in Item No. **98-1275** (p. 35)]

Exhibit 27 is an Affidavit from Thomas Bodley Stibolt Jr. (Senior Physician with Norwest Permanente and a Clinical Associate Professor of Medicine at Oregon Health Sciences University) and Lisa P. Brenner (Staff Scientist and President of Oregon Clearinghouse for Pollution Reduction), dated August 19, 1998. Drs. Stibolt and Brenner reviewed the Pre-Trial Burn Health Risk Assessment for UMCDF and state that DEQ did not follow "appropriate scientific steps" in the Health Risk Assessment and that there were "important unanswered questions." [Cited in Item No. **98-1275** (p. 39 and p. 61); Item No. **98-1247** (p. 4); Item No. **99-0704** (p. 7); and Item No. **99-2201** (p. 33)]

Exhibit 27.1 (an attachment to Exhibit 27) is titled "Review of the inhalation modeling compounds and standards used in the RA for human health effects," dated August 17, 1998, by Lisa Brenner & Tom Stibolt. Issues of concern to the authors include the restriction of the UMCDF HRA's analysis to only those compounds included in the EPA guidance; the level of "acceptable" risk; the lack of consideration of "non-cancer" effects and the failure of the Department to perform an "acute risk assessment."

Exhibit 27.2 (an attachment to Exhibit 27) is titled "A Listing of the Compounds that PRC claims should be included in the modeling analysis," dated August 16, 1998, by Lisa Brenner and Tom Stibolt. Includes three tables titled (1) "Carcinogenic Effects Via Inhalation: Presentation and Additions"; (2) "Non-Carcinogenic Effects: Additions and Qualitative Comparisons" and (3) "A Listing of the Compounds that PRC claims should be included in the modeling analysis."

Exhibit 27.3 (an attachment to Exhibit 27) is titled "Table 1 - Comparison of Potential PICS, Recommended PICS, and Proposed Emission Rates, November 5, 1996, by PRC Environmental Management. Exhibit 27.3 is a table from a report prepared by PRC Environmental Management ("Air Quality Dispersion and Deposition Review and Evaluation of the Draft Pre-Trial Burn Risk Assessment of Combustion By-Products for the Proposed Umatilla Chemical Demilitarization Facility").

Exhibit 27.4 (an attachment to Exhibit 27) is an excerpt from a document titled "Fundamentals of Risk Analysis and Risk Management," 1997, Vlasta Molak, editor. The portion of the two-page excerpt highlighted here is a sentence that states "The U.S. EPA defines negligible risk of cancer as that smaller than 1:1,000,000."

Exhibit 27.5 (an attachment to Exhibit 27) is an excerpt from the "Umatilla Chemical Agent Disposal Facility Phase 1 Quantitative Risk Assessment, dated September, 1996, by Science Applications International Corporation (SAIC). The excerpt discusses which exposure pathways are modeled in the QRA, and the dose-response equations that are used.

Exhibit 27.6 (an attachment to Exhibit 27) is titled "Technical Aspects of the Model and the Air Quality Impact Analysis," dated August, 1998, by Thomas Stibolt and Lisa Brenner. The Authors do not believe that the Department followed correct guidance in the selection and formatting of meteorological data used in the 1996 UMCDF HRA.

Exhibit 28 is an Affidavit from Trygve P. Steen, dated August 20, 1998, affirming his support for the work of Lisa Brenner and Tom Stibolt contained in Exhibit 27. **Exhibit 28.1** is an article titled "Thinking of Biology - Science, environmental risk assessment, and the frame problem, dated September, 1994, by Kristin S. Shrader-Frechette. The article discusses the use of a "two-value frame" vs. a "three-value frame" when making risk assessment decisions. **Exhibit 28.2** is the Curriculum Vitae of Trygve P. Steen, dated June, 1998. [Cited in Item No. **98-1275** (p. 40 and p. 61; Item No. **98-1247** (p. 4); Item No. **99-0704** (p. 7); and Item No. **99-2201** (p. 33)]

Exhibit 29 is an Affidavit by Mr. James R. Wilkinson (Program Manager for Special Sciences and Resources Program, Department of Natural Resources, Confederated Tribes of the Umatilla Indian Reservation), dated August 19, 1998. The Affidavit states that it is the "personal view of the author, and does not represent the views of the tribal government." Mr. Wilkinson's Affidavit outlines many of the Tribes' concerns, which include the State of Oregon's failure to "adequately consider the impacts of hazardous waste from the incineration of chemical weapons on the Tribe's treaty reserved resources." Mr. Wilkinson also states that the "risk assessment methods used by the DEQ and EQC are not reflective of the Tribe's cultural habits and practices" and that the state "neglected to consider important local meteorological data." Mr. Wilkinson also cites the report prepared by PRC Environmental Management (see Exhibit 27) and states that the "Tribe is concerned about the effects of the Products of Incomplete Combustion and other emissions from the proposed incinerator that were not adequately studied by the DEQ or EQC." [Cited in Item No. **98-1247** (p.4); Item No. **98-1275** (p. 40 and p. 61, line 2); Item No. **98-1275** (pp. 64-65); Item No. **99-0704** (p. 7); and Item No. **99-2201** (p. 33)]

Exhibit 29.1 is an attachment to Exhibit 29 titled "Resolution of the CTUIR Board of Trustees. This document is a Resolution of the Board of Trustees of the Confederated Tribes of the Umatilla Indian Reservation, dated January, 1996. The Resolution requests that there be a "one year moratorium on consideration of the Army's incinerator request, pending the completion, in cooperation with the CTUIR, of an analysis of the relative capabilities presented by alternate chemical disposition technologies and the relative risks those technologies pose to the members and residents of the CTUIR as compared to incineration and to continued storage of these weapons."

Exhibit 29.2 is an attachment to Exhibit 29. It is the text of a presentation given to the EQC in November, 1996, titled "Lines Drawn in the Sand: A Review of Challenges, Opportunities, and Options for Chemical Weapons Disposal, by Donald Sampson, Armand Minthorn, and J.R. Wilkinson. Mr. Sampson outlined CTUIR concerns with UMCDF, including the inadequacies of health risk assessments to account for unique Tribal lifestyles. Mr. Sampson proposed that the chemical weapons stockpile be reconfigured to reduce risks and that a Governor's Task Force be established to review alternatives to incineration.

Exhibit 37.1 is a document titled "1997 Declaration of the Environmental Leaders of the Eight on Children's Environmental Health, dated July 27, 1998, from the Office of Children's Protection. [Cited in Item No. **98-1275** (p. 42)]

Exhibit 37.2 is an Executive Order from the White House titled "Protection of Children From Environmental Health Risks and Safety Risks," dated April 21, 1997. This is President Clinton's Executive Order governing the establishment of a Task Force on "Environmental Health Risks and Safety Risks to Children" and directing federal agencies to ensure that they have addressed environmental health risks and safety risks that might disproportionately affect children. [Cited in Item No. **98-1275** (p. 42)]

4.C. Discussion

The Petitioners believe that the 1996 UMCDF Pre-Trial Burn Health Risk Assessment [Ref. 8] ("1996 UMCDF HRA") failed to "thoroughly and properly assess the impacts of the Army's proposed incineration facility" and to "consider impacts of incineration on sensitive populations (i.e., children, elderly, persons with illness)." The Comments submitted to the Department in December, 1999 (and the exhibits submitted as support for those Comments), reflect comments previously received by the Department. The Department understands that the Petitioners and Commenters do not believe that previous Department responses were adequate, and that the Department failed to consider and incorporate their concerns in the 1996 UMCDF HRA.

The 1996 UMCDF HRA was conducted using the most recent guidance available at the time from the EPA, modified to incorporate Umatilla site-specific information as much as possible. Health Risk Assessment guidance is an ever-evolving science, and by its very nature it requires permittees, regulatory agencies, and policy-makers to make assumptions, calculations, and decisions every step of the way on what to include, and (sometimes more importantly) what not to include. Ultimately, risk management decisions must be made, and sometimes those decisions must be made in the face of incomplete, conflicting, and/or uncertain information.

The EPA guidance used for the 1996 UMCDF HRA has been superceded by the updated 1998 HRA guidance.[Ref. 9] The new guidance specifically assesses risks to children of farmers and fishers; recommends a hierarchy of existing acute toxicity values and modeling specifics for evaluating acute risks; contains a process for quantifying fugitive emissions; and includes algorithms for new and updated exposure pathways.

The EPA included these items in the new guidance partially in response to public concerns, but also to reflect the latest in risk assessment science and to incorporate the experience gained from conducting and reviewing risk assessments that used the 1994 guidance. A copy of the Table of Contents and the introduction chapter of the new protocol is included in Attachment L. A flow chart of the "Human Health Risk Assessment Process" can be found on page L-22.

The Department will be conducting another UMCDF HRA when data become available from UMCDF Trial Burns. As part of the preparation for that process, all Surrogate and Agent Trial Burn Plans will be reviewed to insure that Trial Burns will include sampling of compounds of potential concern identified in the latest HRA guidance, or compounds that have become a concern through analysis of waste feeds and/or operations of other chemical demilitarization facilities. The Permittee is required to submit updated Trial Burn Plans no less than 180 days prior to the scheduled Trial Burn.

Submittal of an updated Trial Burn Plan is a Class 2 Permit Modification Request, which will allow for a public comment period. In addition, the Department has retained Ecology and Environment, Inc. to prepare the UMCDF "Post-Trial Burn" HRA Workplan, and will be inviting Tribal and public participation in the development of the HRA Workplan.

4.D. Department Conclusions

The information submitted by the Petitioners and Commenters related to Health Risk Assessment has already been considered by the Department and the Commission. There will be additional opportunities for public participation in the Health Risk Assessment process, to include the development of Trial Burn Plans and the Post-Trial Burn HRA Workplan to incorporate new guidance and Umatilla site-specific information. The Department concludes that the findings of the UMCDF Pre-Trial Burn Human Health Risk Assessment conducted in 1996 are still valid. The information submitted by the Petitioners and Commenters does not provide a basis for unilateral modification or revocation of the UMCDF HW Permit.

5. INCINERATION VS. ALTERNATIVE TREATMENT TECHNOLOGIES

5.A. Applicable Attachments and Exhibits/Comments

- Attachment A, Exhibit 69 (December, 1998 "Revocation Request")
- Attachment E, Comment C-5 (Comments of G.A.S.P., et al.)
- Attachment G, Comments/Exhibits C-5, C-79, C-80
- Attachment M, Exhibits 48, 63, and "Perspectives on the Umatilla Quantitative Risk Assessment Results," SAIC, September, 1996
- Attachment O, Exhibit 46
- Attachment P, Exhibit 29, 29.1, 29.2
- Attachment S, Legal rulings related to the Tooele Chemical Agent Disposal Facility
- Attachment T, "Evaluation of Demonstration Test Results of Alternative Technologies for Demilitarization of Assembled Chemical Weapons—A Supplemental Review," National Research Council, 2000.

5.B. Description and Summary of Documents

Exhibit 29 is an Affidavit by Mr. James R. Wilkinson (Program Manager for Special Sciences and Resources Program, Department of Natural Resources, Confederated Tribes of the Umatilla Indian Reservation), dated August 19, 1998. The Affidavit states that it is the "personal view of the author, and does not represent the views of the tribal government." Mr. Wilkinson's Affidavit outlines many of the Tribes' concerns about the permitting of UMCDF, including that the DEQ and EQC did not adequately consider the use of alternatives to incineration, nor was their sufficient consideration given to reconfiguration of the chemical weapons stockpile to reduce storage risks. [Cited in Item No. **98-1247**[8] (p.4); Item No. **98-1275** (p. 40, p. 61, and pp. 64-65); Item No. **99-0704** (p. 7); and Item No. **99-2201** (p. 33)]

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[8] The following Item Numbers are cited in this section:

- No. **98-1247**: "Request for Contested Case Hearing and Other Relief," letter dated December 14, 1998 (See Attachment A)
- No. **98-1275**: "Petitioners' Memorandum Supporting Cross Motion for Summary Judgment," August 20, 1998 (Case No. 9708-06159)
- No. **98-1285**: "Petitioners' Additional Documentary Evidence," November 10, 1998 (Case No. 9708-06159)
- No. **99-0704**: "Petitioners' Opposition to Respondents' Supplemental Motion for Summary Judgment," April 12, 1999 (Case No. 9708-06159)
- No. **99-2201**: "Comments of G.A.S.P., et al., in Support of Their Request to Suspend and Revoke Permits for [UMCDF]," December 17, 1999 (See Attachment E)

Exhibit 29.1 is an attachment to Exhibit 29 titled "Resolution of the CTUIR Board of Trustees. This document is a Resolution of the Board of Trustees of the Confederated Tribes of the Umatilla Indian Reservation, dated January, 1996. The Resolution requests that there be a "one year moratorium on consideration of the Army's incinerator request, pending the completion, in cooperation with the CTUIR, of an analysis of the relative capabilities presented by alternate chemical disposition technologies and the relative risks those technologies pose to the members and residents of the CTUIR as compared to incineration and to continued storage of these weapons."

Exhibit 29.2 is an attachment to Exhibit 29. It is the text of a presentation given to the EQC in November, 1996, titled "Lines Drawn in the Sand: A Review of Challenges, Opportunities, and Options for Chemical Weapons Disposal," by Donald Sampson, Armand Minthorn, and J.R. Wilkinson. Mr. Sampson outlined CTUIR concerns with UMCDF and the permitting process and proposed that the chemical weapons stockpile be reconfigured to reduce risks and that a Governor's Task Force be established to review alternatives.

Exhibit 46 is a document titled "From the Journals of Gary Millar" dated September 9, 1996. The Petitioners contend that Exhibit 46 shows that the "project managers at TOCDF expressed significant concerns about various aspects of operations" and that the "problems reflected in these documents are not indicative of a mature technology that is capable of protecting human health or the environment consistent with state and federal standards." [Cited in Item No. **98-1275** (page 56)]

Exhibit 48 is an excerpt of the "Annual Status Report on the Disposal of Chemical Weapons and Materiel for Fiscal Year 1997, dated September, 1997, by the Department of Defense. The excerpt includes a project schedule and discussion of the current status of each stockpile site. [Cited in Item No. **98-1275** (p. 63)]

Exhibit 63 is an excerpt of the Final Environmental Impact Statement for "Pilot testing of Neutralization/Biotreatment of Mustard Agent at Aberdeen Proving Ground, Maryland," dated July, 1998, by the U.S. Army Program Manager for Chemical Demilitarization. The Aberdeen Chemical Agent Disposal Facility will use neutralization followed by biotreatment to destroy the stockpile of mustard agent stored at the Aberdeen Proving Ground. [Cited in Item No. **98-1247** (p. 8); Item No. **98-1285** (p. 8); and Item No. **99-0704** (p. 13); and Item No. **99-2201** (p. 35)]

Exhibit/Comment C-79 is an excerpt of the "Assembled Chemical Weapons Assessment Program, Supplemental Report to Congress," dated September, 1999, by the Department of Defense. [Cited in Item No. **99-2201** (pp. 34-35)]

Exhibit/Comment C-80 is a letter dated February 22, 1999 from the Director of the Waste Management Administration, Maryland Department of the Environment to the Installation Commander of Aberdeen Proving Ground, Maryland. The letter approves a modification to the Aberdeen Proving Ground's "Controlled Hazardous Substances Permit" to include the Aberdeen Chemical Agent Disposal Facility (which will use neutralization to destroy the mustard agent stockpile stored at Aberdeen Proving Ground). [Cited in Item No. **99-2201** (pp. 35-36)]

5.C. Discussion

The Petitioners state that "non-incineration alternatives must be considered by the EQC/DEQ and implemented at UMCDF in order to comply with the statutory mandate to ensure use of best available technology and that there will be no major adverse effect on public health and safety or the environment of adjacent lands" (Attachment E, page E-35). The Petitioners cite the Assembled Chemical Weapons Assessment (ACWA) Program mandated by Congress, and present the 1999 ACWA "Supplemental Report to Congress" (Exhibit 79) that "document[s] two technologies capable of fully treating all munitions and agents (General Atomics Neutralization/Super Critical Water Oxidation) and munitions containing mustard agent only (Parsons/Allied Signal Neutralization/Biotreatment). The Petitioners believe that "both ACWA demonstrated technologies would provide substantial benefits for the disposal of the Umatilla stockpile from both human health and environmental perspectives. Both technologies are superior to incineration."

Some of the demonstration testing conducted for alternative treatment technologies for the chemical weapon stockpiles have shown promising results. The Department notes, however, that the testing conducted to date has been limited in nature and scope and that none of the proposed treatment technologies has been tested as an integrated system. The National Research Council (NRC) prepared a report in 1999 titled "Review and Evaluation of Alternative Technologies for Demilitarization of Assembled Chemical Weapons." After the results of the ACWA demonstration testing program became available the NRC prepared a "Supplemental Review" titled "Evaluation of Demonstration Test Results of Alternative Technologies for Demilitarization of Assembled Chemical Weapons." A copy of the NRC's "Supplemental Review" is included in Attachment T.

The NRC Supplemental Review in Attachment T includes an update to the complete list of the original 1999 "General Findings and Recommendations" on page T-40. The document also contains descriptions of the alternative technologies that underwent the ACWA demonstration testing. In addition to the update to their original findings, the NRC added three "Supplemental General Findings" (Attachment T, page T-17):

Supplemental General Findings

The results of the demonstration tests did not significantly affect the committee's original general findings and recommendations and, in some cases, confirmed them. The committee's review of the results of the demonstration tests, however, led to the following new general findings.

General Finding 1. Based on the committee's assessment of the maturity of the various unit operations (as summarized in Table ES-1), none of the three technology packages is ready for *integrated* [emphasis in original] pilot programming, although certain unit operations are sufficiently mature to bypass pilot testing (e.g./, hydrolysis of agent).

General Finding 2. The demonstration test were not operated long enough to demonstrate reliability and long-term operation.

General Finding 3. The committee reiterates that none of the unit operations has been integrated into a complete system. The lack of integration remains a major concern as a significant obstacle to full-scale implementation.

In the "Petitioners' Memorandum Supporting Motion for Summary Judgment" (DEQ Item No. 98-1275, dated August, 1998) the Petitioners cite the schedule shown in Exhibit 48 as evidence that the selection of an alternative technology for the Umatilla site would not have resulted in a delay of the destruction of the stockpile at Umatilla. In Comment C-5 the Petitioners cite exhibits 63 and C-80 as further evidence that alternatives to incineration are available and fully mature. The Department and the Commission were aware that the Army had selected neutralization technologies for the treatment of the stockpiles at Newport, Indiana, and Aberdeen, Maryland.

Although the schedule in Exhibit 48 is very out of date (September, 1997), the Department concurs with the Petitioners' statement that the schedule shows that the sites at Maryland and Indiana were (at the time) projected to complete operations before Umatilla. However, it should be noted that the construction and systemization times for each facility are almost identical. It is the processing time that extends the time bar to the end of 2005 at Umatilla, because the Umatilla stockpile is not only much larger than either Indiana or Maryland, but also much more diverse in agent munition types. Umatilla has about 220,000 individual items to process (three agent types), compared to a total of 3500 ton containers (no munitions involving explosives or propellants or munitions that require a disassembly process) at the other two sites. Aberdeen stores only mustard agent, Indiana only VX nerve agent.

The possibility of using the neutralization process for the mustard stored at the Umatilla Chemical Depot [which constitutes 63% (by weight) of the total agent stored at Umatilla] was discussed extensively during the UMCDF permitting process. There were several reasons that the mustard neutralization process did not appear feasible for Umatilla, including the delay in stockpile destruction and the fact that the neutralization process requires copious amounts of water (in short supply in eastern Oregon) that then must be treated before discharge.

Mr. Gary Millar (former EG&G General Manager of TOCDF) testified before the USHW Board in December, 1996. Mr. Millar's "journal" (see Exhibit 46), a letter he wrote in 1996, and his testimony before the USHW Board were reviewed by the Utah District Court in subsequent legal proceedings. The Petitioners contend that Exhibit 46 shows that the "project managers at TOCDF expressed significant concerns about various aspects of operations" and that the "problems reflected in these documents are not indicative of a mature technology that is capable of protecting human health or the environment consistent with state and federal standards." The Utah District Court, upon review of Mr. Millar's testimony in March, 1997 (Attachment S, page S-23) stated:

> "Mr. Millar's testimony under oath belies many of the concerns raised in the November 9, 1996 letter. On December 12, 1996, Mr. Millar testified to the Utah Board that TOCDF was being operated safely and that state regulatory agencies charged with overseeing the facility were doing a "good job" keeping TOCDF operations and the public safe. Mr. Millar further testified that he never intended his letter to become public and that he considered the issues raised therein to concern EG&G's internal management, not plant safety."

5.D. Department Conclusions

In the 1997 "Findings and Conclusions of the Commission and Order"[Ref. 12] granting the HW Permit to UMCDF, the Commission (¶ 75, pp. 20-21) found that:

E. Alternative technologies reviewed, with the exception of neutralization, are years away from actual operational availability.

F. Neutralization technology for HD, while currently undergoing laboratory bench-scale study, would entail lengthy delay at Umatilla due, among other constraints, to the need for staging of construction to allow energetics destruction by incineration prior to construction and operation of neutralization facilities.

G. With the exception of neutralization, technologies reviewed appear to involve little impact on natural resource consumption. Neutralization of HD could, however, have significant implications for water consumption and disposal, and would need substantial ecological impact analyses.

H. Alternative technologies reviewed face testing and operational hurdles which would add years of delay to the agent destruction program at Umatilla.

I. Comparative costs of alternative technologies is considered a factor only with respect to neutralization of HD which would add significantly to costs of agent destruction at Umatilla by necessitating construction of a neutralization facility in addition to the proposed incinerators.

The Department has concluded that the Commission findings in 1997 have proven correct with respect to the length of time that will be needed to sufficiently develop alternative technologies to a point where they could be considered for the Umatilla stockpile. The information provided by

the Petitioners and Commenters does not provide a basis for unilateral modification or revocation of the UMCDF HW Permit.

6. THE RISK OF STORAGE VS. THE RISK OF INCINERATION

6.A. Applicable Attachments and Exhibits/Comments

- Attachment A, Exhibit 69 (December, 1998 "Revocation Request")
- Attachment M, Exhibit 65 (also includes a summary of the Umatilla "Quantitative Risk Assessment," beginning on page M-3)
- Attachment N, Exhibit 64
- Attachment P, Exhibit 29, 29.1, 29.2

6.B. Description and Summary of Documents

Exhibits 29, 29.1 and 29.2: Affidavit of J.R. Wilkinson. See Section 5.B for a description of these exhibits.

Exhibit 64 is an excerpt from the testimony of Mr. Gary Boyd on July 29, 1996 during proceedings for the Utah District Court in CWWG, et al. *v.* U.S. Army, et al. (Case No. 96-CV-0425C). Mr. Boyd (of Science Applications International Corporation) was one of the authors of the TOCDF Quantitative Risk Assessment (QRA). Mr. Boyd's testimony was related to the methodology used to conduct the TOCDF QRA specifically, and QRAs in general. [Cited in Item No. **98-1247**[9] (pp. 8-9); Item No. **98-1275** (p. 46); and in Item No. **98-1285** (p. 8)]

Exhibit 65 is a report from the U.S. Department of Health and Human Services (DHHS) Public Health Service Agency for Toxic Substance and Disease Registry titled "Public Health Assessment for US Army Umatilla Depot Activity, dated September, 1997. The Assessment was prepared by the DHHS to "evaluate the possible pathways of exposure to contamination at the former Umatilla Depot Activity" as part of a review of the "Superfund" sites at the Umatilla Depot. [Cited in **98-1285** (p. 9)]

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[9] The following Item Numbers are cited in this section:

- No. **98-1247**: "Request for Contested Case Hearing and Other Relief," letter dated December 14, 1998 (See Attachment A)
- No. **98-1275**: "Petitioners' Memorandum Supporting Cross Motion for Summary Judgment," August 20, 1998 (Case No. 9708-06159)
- No. **98-1285**: "Petitioners' Additional Documentary Evidence," November 10, 1998 (Case No. 9708-06159)

[Note: Exhibit 65 is cited by the Petitioners as "shatter[ing] the myth, still perpetuated by the Army, that the risk of storage is greater than the risk of incineration." Review of Exhibit 65 showed that it was a document prepared solely to address the risks of the various "Operable Units" identified during "Superfund" clean-up work that is ongoing at the Umatilla Chemical Depot. None of the Operable Units involve the chemical weapons storage area, and the document does not address the chemical weapons storage risk at all. No further discussion of Exhibit 65 is provided here.]

6.C. Discussion

The Petitioners argue that the Department and the Commission "improperly relied on the [UMCDF Phase 1] QRA to provide substantial evidence regarding the determination that the risk of continued storage was more significant than incineration [because] the QRA cannot provide support for such a conclusion." They cite the testimony of Mr. Boyd and point out that that "QRA provides very limited information which is unsuited for the analyzes [sic] the DEQ/EQC were mandated to perform" [and that] the QRA "fails to consider the following issues: impacts of routine emissions from the stack, chronic exposure risks from emissions, the risks from products of incomplete combustion, the risks from exposure to the by-products of agent degradation, the risks and impacts to wildlife, the risks associated with the use of alternative technologies."

The Petitioners state that "it does not appear from the record that the EQC/DEQ considered the limitations of the QRA." On the contrary, the Phase 1 UMCDF Quantitative Risk Assessment[Ref. 13] was considered by both the Department and the Commission to be a significant document in the determination that the risks of storage of the chemical weapons stockpile at the Umatilla Chemical Depot far outweighed the risks posed by the operation of the UMCDF. The Commission heard directly from Mr. Boyd about the QRA on November, 15, 1996,[Ref. 14] and understood that the QRA was not intended to assess the public health and environmental risks posed by emissions from UMCDF. Attachment M contains a summary document prepared by SAIC titled "Perspectives on the Umatilla Quantitative Risk Assessment Results."

These same arguments about the QRA were submitted during various proceedings in Utah related to the TOCDF. The USHW Board found in July, 1997 (Attachment S, page S-44) that for "individuals living closest to TOCDF, the risks resulting from continued storage are one hundred times greater than the risks resulting from disposal operations." In March, 1997, the Utah District Court also made similar findings about the TOCDF QRA, stating that "on average, 34 days of continued storage of the stockpile incurs a public risk equal to that associated with the 7.1 years of TOCDF agent operations. If rare events such as earthquakes and aircraft accidents are removed from the assessment, the finding is stronger—the risk to the public from the entirety of TOCDF's operations is equaled by the risks of only 2.3 days of continued storage" (Attachment S, page S-24). The Phase 1 UMCDF QRA came to similar conclusions concerning the risk of storage at Umatilla, stating that "the annual risk to the individuals closest to the facility is about 90 times greater per year for continued storage versus disposal operations" (Attachment M, page M-7).

The Affidavit of Mr. Wilkinson (Exhibit 29) states that the EQC and DEQ failed to adequately assess the risks of incineration vs. continued storage, and that the EQC and DEQ should have considered reconfiguration of the M-55 rockets to reduce the risks of storage (which would allow additional time to study alternative treatment technologies). In fact, the EQC heard direct testimony on November 22, 1996 about the possibility of "reconfiguration" of munitions, especially rockets.(Ref. 15)

An M-55 rocket is constructed as a one-piece unit (approximately six feet long) that contains chemical agent, explosives, and propellants. Unlike some of the other munitions, it is not possible to "separate" the energetic components (i.e., remove a fuze, or some other part containing an explosive), except by shearing the rocket apart.

"Reconfiguration" of the M-55 rockets to reduce storage risks has been considered by the Army only in terms of an action that would be taken in an extreme emergency, such as evidence that there is an imminent danger of auto-ignition. M-55 rockets, especially those filled with the nerve agent GB (sarin), are considered one of the highest risk munitions at Umatilla for several reasons. An M-55 rocket is constructed of aluminum (approximately twice the thickness of a soda can), and after extended storage GB nerve agent begins to corrode the aluminum. GB-filled munitions are the most common source of vapor leaks detected in the Umatilla storage igloos, and GB-filled rockets make up more than half of the total "leaker munitions."

There is considerable concern, and ongoing study, about the effects of GB nerve agent inside a rocket. GB is known to increase the rate of depletion of the stabilizer chemical contained in the rocket propellant. The liquid nerve agent, in time, corrodes the seals between the rocket segments, allowing the chemical agent (in vapor or liquid form) to come into contact with the propellant, which can accelerate the depletion of the stabilizer (hence the concern about "auto-ignition").

Reconfiguration of M-55 rockets would involve removal of the rockets from the igloos, transport of the pallets into an engineering-controlled facility, drainage of the chemical agent, and "disassembly" (by shearing) of the rocket segments. Each movement of any munition, let alone an M-55 rocket, presents inherent risks. Reconfiguration of rockets would involve (1) forklift movement from an igloo stack; (2) forklift movement into a transport container; (3) truck movement of the transport container into a controlled facility; (4) forklift movement out of the transport container; (5) manual movement of each rocket from the pallet to a conveyor; (6) automated movement of the rocket into an explosives containment room; (7) punching the rocket to drain the liquid chemical agent; and (8) shearing the rocket into segments.

Each of the eight transport and disassembly steps just described will also take place during the disposal operations of UMCDF. But during disposal operations, the movement of the rockets is followed immediately by high temperature incineration of both the liquid agent and the rocket segments (including the explosives and propellants), whereas a reconfiguration operation would return the liquid agent and the component parts to storage.

6.D. Department Conclusions

The Department did not misunderstand, and does not believe that the Commission misunderstood, the purpose, scope, and results of the UMCDF Phase 1 Quantitative Risk Assessment. The risk of catastrophic releases from the chemical weapons stored at the Umatilla Chemical Depot remains far and above the risk of UMCDF operations. The Department believes that the movement of M-55 rockets, most of which have been in storage for at least 40 years, should be kept to an absolute minimum prior to final disposal. The reconfiguration of M-55 rockets should remain an option only for the most dire of emergencies. The information provided by the Petitioners does not provide a basis for unilateral modification or revocation of the UMCDF Hazardous Waste Permit.

7. HISTORY AND ISSUES RELATED TO THE TOOELE CHEMICAL AGENT DISPOSAL FACILITY (TOCDF)

7.A. Applicable Attachments and Exhibits/Comments

- Attachment A, Exhibit 69 (December, 1998 "Revocation Request")
- Attachment E, Comment C-5 (Comments of G.A.S.P., et al.)
- Attachment G, Comments/Exhibits C-5, C-75, C-76, C-77, C-78
- Attachment N, Exhibits 25, 26, 30, 33, 34, 42, 43, 44.1, 44.2, 47
- Attachment O, Exhibits 31, 32
- Attachment S, Legal rulings related to the Tooele Chemical Agent Disposal Facility
- Attachment U, Additional transcript excerpts from Utah proceedings

7.B. Description and Summary of Documents

7.B.1 *Documents related to chemical agent releases and potential worker exposures at TOCDF*

Exhibit 25 is an excerpt from the deposition of Mr. Timothy Thomas (TOCDF Project Manager for the U.S. Army Program Manager for Chemical Demilitarization) given on February 5, 1998 during proceedings for the Utah District Court in CWWG, et al. *v.* U.S. Army, et al. (Case No. 2:96-CV-0425C). Petitioners cite p. 30 of this exhibit as showing that Mr. Thomas "recanted" his testimony about agent releases that was given during the USHW Board hearing in March, 1997 (see also Exhibit 43). [Cited in Item No. **98-1275**[10] (p. 41 and p. 54)] {**NOTE**: Exhibit 25 did not, in several cases, contain the actual pages cited. Missing transcript excerpts from Exhibit 25 have been included in Attachment U.}

Exhibit 30 is a one-page excerpt of the deposition of James Cudahy (President of Focus Environmental, Inc., an environmental engineering firm that specializes in the design, permitting and technical evaluation of hazardous waste incineration and other thermal treatment systems) given on February 16, 1998 during proceedings for the Utah District Court in CWWG, et al. *v.* U.S. Army, et al. (Case No. 2:96-CV-0425C). Mr. Cudahy testified on behalf of the U.S. Department of Justice as an expert witness. [Cited in Item No. **98-1275** (p. 40 and p. 54); Item No. **99-0704** (p. 7)] {**NOTE**: Mr. Cudahy provided extensive testimony for the Defendants as an expert witness in the field of incinerator design and engineering. During the course of the Utah proceedings he submitted numerous declarations, some of which are included in Attachment U, beginning on page U-47.}

Exhibit 31 is an Affidavit of Pat Costner (Senior Scientist, Science Unit of Greenpeace International) dated July 27, 1998 stating that Ms. Costner reviewed information concerning the MC-1 bomb incident at TOCDF (see Exhibit 32) and that she believes the incident resulted in a "significant" release of agent out the stack at TOCDF on March 30, 1998. [Cited in Item No. **98-1275** (p. 40 and p. 44); Item No. **98-1247** (p. 5); Item No. **99-0704** (p. 7); and in Item No. **99-2201** (p. 12)]

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[10] The following Item Numbers are cited in this section:

- No. **98-1247**: "Request for Contested Case Hearing and Other Relief," letter dated December 14, 1998 (See Attachment A)
- No. **98-1275**: "Petitioners' Memorandum Supporting Cross Motion for Summary Judgment," August 20, 1998 (Case No. 9708-06159)
- No. **99-0704**: "Petitioners' Opposition to Respondents' Supplemental Motion for Summary Judgment," April 12, 1999 (Case No. 9708-06159)
- No. **99-2201**: "Comments of G.A.S.P., et al., in Support of Their Request to Suspend and Revoke Permits for [UMCDF]," December 17, 1999 (See Attachment E)

Exhibit 32 is a copy of "TOCDF Unusual Occurrence Report: Metal Parts Furnace Feed Rate Exceedance" (dated April 2, 1998) that describes the event that occurred on March 30, 1998, related to insufficient draining of an MC-1 bomb that was subsequently processed through the MPF. [Cited in Item No. **98-1275** (p. 40 and pp. 43-44); Item No. **98-1247** (p. 4); Item No. **99-2201** (p. 12); and in Item No. **99-0704** (p. 7)]

Exhibits 33 and 34 are excerpts of the deposition of Mr. Richard Holmes given on April 14, 1998 during proceedings for the Utah District Court in CWWG, et al. *v.* U.S. Army, et al. (Case No. 2:96-CV-0425C). Mr. Holmes was an employee of the Army "Program Manager for Chemical Stockpile Disposal based in Edgewood, Maryland. [Cited in Item No. **98-1275** (pp. 40 and 44); Item No. **98-1275** (p. 44), Item No. **98-1247** (p. 5); and Item No. **99-2201** (p. 12)] {**NOTE**: Exhibits 33 and 34 did not, in some cases, contain the actual pages cited. Missing transcript excerpts from Exhibits 33 and 34 have been included in Attachment U.}

Exhibit 42 is an excerpt of the testimony of Deborah Ng (Chemical Engineer with the Utah DEQ's Division of Solid and Hazardous Waste, Chemical Demilitarization Section) during a hearing before the Utah DEQ Solid and Hazardous Waste Control Board on March 19, 1997. The exhibit excerpt focuses on the testimony of Ms. Ng related to agent analysis, although it is testimony given later by Ms. Ng that is cited to support the statement that "ACAMS placed in the TOCDF stack have not been tested to determine their actual effectiveness in drawing in and testing stack gases." [Cited in Item No. **98-1275**, p. 51, line 3.]

Exhibit 43 is an excerpt of the testimony of Mr. Timothy Thomas (TOCDF Project Manager for the U.S. Army Program Manager for Chemical Demilitarization) given on March 3, 1997 during proceedings for the Utah District Court in CWWG, et al. *v.* U.S. Army, et al. (Case No. 2:96-CV-0425C). The excerpt focuses on Mr. Thomas' testimony related to the inability of TOCDF to identify the cause of numerous ACAMS alarms at the common stack and the analysis of the waste feed. [Cited in Item No. **98-1275** (p. 56) and in Item No. **99-2201** (p. 12)]

Exhibit 44.1 includes excerpts from proceedings of the Utah Solid and Hazardous Waste Board hearing held March 18-20, 1997. The excerpts include portions of the examination of Dennis Downs (Manager of the Utah DEQ Division of Solid and Hazardous Waste) related to concrete cracking and leaks into the HVAC carbon filter vestibules); the examination of Scott Anderson (Manager of the Hazardous Waste Branch of the Utah Division of Solid and Hazardous Waste) regarding concrete cracks and professional conduct by HW staff; and the examination of Martin Gray (Manager of the Chemical Demilitarization Section of the Hazardous Waste Branch of the Utah Division of Solid and Hazardous Waste) regarding the HVAC carbon filter vestibule leaks). [Cited in Item No. **98-1275** (pp. 54 and 56)]

Exhibit 44.2 includes excerpts from proceedings of the Utah Solid and Hazardous Waste Board hearing held March 18-20, 1997. The excerpts include portions of the examination of Deborah Ng (Chemical Engineer, Utah DEQ) related to risk assessments and the examination of Mr. Donald Smith (Quality Assurance Program Development Coordinator, EG&G) regarding vestibule and concrete leaks. [Cited in Item No. **98-1275** (pp. 38, 54, and 56-57)]

Exhibit 47 is an excerpt from the testimony of Mr. Timothy Thomas during the Utah Solid and Hazardous Waste Control Board hearing held March 18-20, 1997 that focuses on agent releases and concrete cracks at TOCDF. [Cited in Item No. **98-1275** (p. 54)] {**NOTE**: Exhibit 47 did not contain all of the actual pages cited. Missing transcript excerpts from Exhibit 47 have been included in Attachment U.}

Exhibit C-75 is an Affidavit dated December 16, 1999, from Mr. Gary E. Harris, a former employer of EG&G who worked at TOCDF until 1996. Mr. Harris states that he "supervised Environmental Engineers, Permitting Technicians and other technical and non-technical staff" and that he "was involved in preparation of emergency and contingency plans as well as permitting, compliance, and trial burn testing. Mr. Harris' Affidavit contains 128 separate allegations related to the operation of TOCDF. [Cited in Item No. **99-2201** (pp. 10, 14, and 15)]

The Affidavit submitted as Exhibit C-75 was arranged numerically, but later publication of the Affidavit by the Chemical Weapons Working Group provided the following subject area breakdown:

- Agent Monitoring;
- Emissions/Releases;
- Lessons Learned Program;
- Munitions Storage, Handling & Tracking;
- Permit Modifications;
- Permit Violations;
- Questionable Procedures;
- Risk Assessments;
- System Inadequacies/Failures;
- Trial Burns;
- Waste Characterization, Handling & Tracking; and
- Worker Exposures

Exhibit C-76 is an internal EG&G (the Army's contractor at the Tooele facility) memorandum dated October 15, 1999, related to the use of the Depot Area Agent Monitoring System (DAAMS). The memorandum was prepared by Messrs. Guello and Burton in response to a request to "explain...the differences in methods used for DAAMS tube analysis" and "how these different methods may have lead to misinterpretation by investigators." The Memorandum concluded that there was a misinterpretation of a DAAMS analytical result that led to an ACAMS result being incorrectly identified as "unconfirmed" during an incident that occurred on June 4, 1999 due to a power outage at TOCDF. The authors of the Memorandum recommend that the report in question be revised, and that "it is advisable to review all reports that used DAAMS data in the decision making process." [Cited in Item No. **99-2201** (pp. 12-13)]

Exhibit C-77 is a letter dated August 6, 1999 from EG&G's "Deputy General Manager—Risk Management" to the "Administrative Contracting Officer" of the Department of the Army's Industrial Operations Command. The letter transmits a report ("Occurrence Report No. 99-05-26-A1") related to a confirmed agent reading in the Toxic Maintenance Area at the Tooele facility and the exposure of workers to agent. [Cited in Item No. **99-2201** (p. 14)]

7.B.2 ***Documents related to the analysis of waste feed to the furnaces at TOCDF***

Exhibit 25 is an excerpt of the deposition of Mr. Timothy Thomas (TOCDF Project Manager for the U.S. Army Program Manager for Chemical Demilitarization) given on February 5, 1998 (see description in Section 8.B.1). The excerpt focuses on testimony related to analysis of chemical agent, especially from ton containers. [Cited in Item No. **98-1275** (p. 47)]

Exhibit 42 is an excerpt of the testimony of Deborah Ng (Chemical Engineer with the Utah DEQ's Division of Solid and Hazardous Waste, Chemical Demilitarization Section during the course of Hearing before the Utah DEQ Solid and Hazardous Waste Control Board on March 19, 1997. The excerpt focuses on the testimony of Ms. Ng related to agent analysis. [Cited in Item No. **98-1275** (p. 51)]

Exhibit 43 is an excerpt of the testimony of Mr. Timothy Thomas (TOCDF Project Manager for the U.S. Army Program Manager for Chemical Demilitarization) given on March 3, 1997 during proceedings for the Utah District Court in CWWG, et al. *v.* U.S. Army, et al. (Case No. 2:96-CV-0425C). The excerpt focuses on Mr. Thomas' testimony related to the inability of TOCDF to identify the cause of numerous ACAMS alarms at the common stack and the analysis of the waste feed. [Cited in Item No. **98-1275** (p. 56) and in Item No. **99-2201** (p. 12)]

Exhibit C-78 is a document titled "Issue and Directed Actions with Fact Sheet" related to the "Agent Quantification System Tank Problems Requiring Repeat Draining of Rockets." The Issue paper describes the problems encountered with M-55 rocket lots that contain thickened/gelled agents, and proposed/actual solutions for limiting processing delays due to insufficient rocket drains. [Cited in Item No. **99-2201** (p. 14)]

7.B.3 *Documents related to TOCDF Trial Burns and Destruction Removal Efficiency*

Exhibit 26 is the "Affidavit of John Houston Miller" dated June 3, 1996. The origin of this affidavit is not clear, but it is assumed to be a document generated in CWWG v. U.S. Army (Case No. 96-CV-0425C). At the time of this Affidavit, Dr. Miller was a Professor of Chemistry at George Washington University in Washington, D.C. His Affidavit states that the calculated TOCDF destruction removal efficiency will not be valid when chemicals are in low concentrations (below 1000 ppm). [Cited in Item No. **98-1275** (p. 35)]

Exhibits 33 and 34 are excerpts of the deposition of Mr. Richard Holmes ("group leader for site support" within PMCSD's Operations Team at Edgewood, Maryland) given on April 14-15, 1998 as part of Case No. 2:96-CV-0425C. The excerpt in Exhibit 33 is primarily related to the M-55 rocket processing and the failure of the DFS at TOCDF to pass a TSCA trial burn. [Cited in Item No. **98-1275** (p. 44), Item No. **98-1247** (p. 5); and Item No. **99-2201** (p. 12)] {**NOTE**: Exhibits 33 and 34 did not, in some cases, contain the actual pages cited. Missing transcript excerpts from Exhibits 33 and 34 have been included in Attachment U.}

Exhibit C-75 is an Affidavit dated December 16, 1999, from Mr. Gary E. Harris, a former employer of EG&G who worked at TOCDF until 1996. (see description in Section 7.B.1) [Cited in Item No. **99-2201** (pp. 10, 14, and 15)]

Exhibit C-78 is a document titled "Issue and Directed Actions with Fact Sheet" related to the "Agent Quantification System Tank Problems Requiring Repeat Draining of Rockets." The Issue paper describes the problems encountered with M-55 rocket lots that contain thickened/gelled agents, and proposed/actual solutions for limiting processing delays due to insufficient rocket drains. [Cited in Item No. **99-2201** (p. 14)]

7.C. Discussion

7.C.1 *Discussion of Chemical Agent Releases and Potential Worker Exposures at TOCDF*

The "Petitioner's Memorandum Supporting Cross Motion for Summary Judgment and Opposing Respondent's Motion for Summary Judgment" (August 20, 1998; DEQ Item No. **98-1275**) contends that the Army's Automatic Chemical Agent Monitoring System (ACAMS) has "not been validated as a stack monitoring device and it is unclear at best whether ACAMS can detect certain agents or agent by-products at sufficient levels of sensitivity." The Petitioners also contend that "TOCDF's stack ACAMS are unreliable and cannot determine in an accurate and timely fashion when chemical warfare agents are being released through the stack," and that it is an "Army myth" that there have been "no confirmed releases of nerve agents from the stack at TOCDF."

The Petitioners also state that because "TOCDF has experienced agent migration or leaks into areas where agent is not supposed to be present," then it is "...clear that the Army is unable to fully control and contain nerve and blister agents." Many of the exhibits cited are related to testimony in various Utah proceedings about concrete cracking (that resulted in a liquid leak of decontamination solution from an upper to a lower area), agent migration into observation corridors (which are not usually expected to experience agent vapor incursions), and incidents of worker exposures (and the Army's definition of "exposure").

Exhibits 42, 43, 44 and 47 are all excerpts of testimony taken before the Utah Solid and Hazardous Waste Control Board (USHW Board) in March, 1997. In their Order dated July 22, 1997 (see Attachment S) the USHW Board reviewed the "Operational Incidents" (see page S-45), which included the liquid leaks through concrete cracks, agent migration into observation corridors and into the Heating, Ventilation, and Air Conditioning (HVAC) vestibules, worker exposures, and agent emissions in the stack gases. The USHW Board stated that they "[found] no evidence sufficient to justify revocation or termination of the Army and EG&G's permit on these grounds." The USHW Board went on to state (page S-46) that:

> "21. During the shakedown period three events occurred that caused Respondents to immediately shut down operations: detection of low levels of agent in two filter unit containment vestibules, leakage of a small quantity of decontamination fluid passing through hairline cracks in a second level cement floor to a first floor electrical room, and minor agent migration into an observation corridor. Two of the incidents involved trace amounts of chemical agent migrating to unintended areas. None resulted in harm to TOCDF personnel, the public or the environment. Descriptions of the events and corrective actions taken in response to each event have been adequately explained to the Board and Executive Secretary, and were adequately addressed by the Army and EG&G.

> "22. With regard to the other incidents described in paragraph 19 above, the Board finds that: adequate backup generators are in place at TOCDF, and there has never been an occasion when the backup power system failed to operate upon loss of power; the fire suppression system test and temporary HVAC imbalance was properly responded to and TOCDF personnel have received corrective training; the agent quantification system anomaly has been corrected; hot cut out procedures are a normal part of facility operations, and appropriate workers are equipped with protective equipment; and stack effluent gases are appropriately monitored by ACAMS and DAAMS system and the agent readings in the ACAMS TREND reports were challenges to the monitoring equipment and not releases of agent."

The ruling of the U.S. District Court of Utah in March, 1997 also contains extensive discussion of many of these issues (Attachment S, beginning on page S-17). The Court concluded that:

> "The overall record of operations at TOCDF does not support plaintiffs' claim. Although there have been problems at the facility, some of which required the suspension of operations, none of the events caused harm to TOCDF personnel, the public, or the environment. There is no evidence that human injury or environmental harm is inevitable or likely. In fact, the record suggests that TOCDF's safety equipment and procedures are effective in preventing such harms." (see page S-26, paragraph 3)

Exhibits 25, 30, 33, and 34 are all excerpts of depositions taken during more recent proceedings of the Utah District Court, most related in one form or another to the possibility that there have been agent releases from the TOCDF. The incident related to the processing of an undrained bomb (the subject of Exhibits 31 and 32) is discussed extensively in the April 14, 2000 ruling of the Utah District Court (see pp. S-72 through S-76). The Department believes that the incident described in Exhibit C-77 (related to a "hot cut-out" of workers) was also reviewed as part of the recent Utah District Court proceedings. The Utah District Court issued its "Findings of Fact and Conclusions of Law" on April 14, 2000 (Attachment S) and concluded that (pp. S-89 and S-90):

> "...the evidence presented at trial was not sufficient to establish the following:
>
> i. that chemical agent has been released into the environment outside TOCDF;
> ii. that any TOCDF personnel or visitors have been injured through exposure to chemical agent;
> iii. that the safety practices of TOCDF violate the terms of the TOCDF permits;
> iv. that the gelling of agent in rockets and defendants' proposal to the State of Utah to incinerate rockets containing more than a 5% heel is in violation of defendants' permits or poses a threat to health and the environment;
> v. that the low pH factor of some of the chemical agents and defendants' means of incinerating it violates defendants' permits or poses a threat to health and the environment;
> vi. that defendants have failed to properly categorize agent waste; and
> vii. that defendants have failed to comply with the terms and requirements of their permits from the State of Utah.

Exhibits C-75, the Affidavit from Mr. Gary Harris, contains numerous allegations about questionable procedures and operations occurring at TOCDF, and at the Chemical Agent Munitions Disposal System (CAMDS). Mr. Harris was deposed during proceedings currently underway before the USHW Board (Sierra Club, Chemical Weapons Working Group, and Vietnam Veterans of America Foundation's "Third Request for Agency Action"). Mr. Harris was withdrawn as a witness in the USHW Board proceedings (due to health reasons), before the completion of the deposition. The Department has received and reviewed copies of the transcripts of from Mr. Harris' depositions taken on November 22 and 23, 1999 and February 2-5, 2000.[Ref. 16, 17] The vast majority of Mr. Harris' allegations are specific to the CAMDS and/or the TOCDF facility. The Utah DEQ and the USHW Board are investigating the allegations.

Exhibit C-76, an internal EG&G (the Army's contractor that operates TOCDF) memorandum contains a description of the procedures used to "confirm" an agent detection reading by the Automatic Continuous Agent Monitoring System (ACAMS). The memorandum states that there was at least one incident where there should have been a confirmation of an agent detection, but because of a "misinterpretation" of the data from the Depot Area Agent Monitoring System (DAAMS), the agent reading of the ACAMS was not confirmed. The memorandum recommends that all previous incidents involving confirmation of an ACAMS reading with a DAAMS analysis be reviewed to assess whether the correct confirmation procedure was used. It is the Department's understanding that this review is taking place and that the results will be made available in May.

7.C.2. ***Discussion of the analysis of waste feed to the furnaces at TOCDF***

The "Petitioner's Memorandum Supporting Cross Motion for Summary Judgment and Opposing Respondent's Motion for Summary Judgment" (August 20, 1998; DEQ Item No. **98-1275**) contends that the Department has not "...address[ed] significant problems assessing what is in the munitions that will be incinerated" and that "chemical warfare agents contained in the stockpiled munitions may have a substantial amount of degradation by-products." The comments submitted by the Petitioners (Attachment E, page E-15) cite Exhibit C-78 as an indication that "the Army has been aware of the gelling/solidification problem for some time and recognizes that the condition of the agents in the munitions effects [sic] the waste analysis."

Exhibits 42 and 43 contain excerpts of testimony taken before the Utah Solid and Hazardous Waste Control Board (USHW Board) in March, 1997. Exhibit 25 is an excerpt of testimony taken during the recent proceedings of the Utah District Court. Exhibit C-78 ("Issue and Directed Actions with Fact Sheet" related to the "Agent Quantification System Tank Problems Requiring Repeat Draining of Rockets") describes the problems encountered with M-55 rocket lots that contain thickened/gelled agents.

Neither the USHW Board (see excerpt of the Board Order in Section 7.B.1) nor the Utah District Court found the evidence compelling enough to merit modification or revocation of the TOCDF permit. The Utah District Court's "Findings of Fact and Conclusions of Law" issued on April 14, 2000 discusses waste characterization (paragraph 6, pp. S-78 and S-79), and the issue with agent gelling (paragraph 7.e. on page S-81) and concluded that the evidence was not sufficient to establish that the process used to incinerate rockets containing gelled agent and chemical agent with a low pH factor poses a threat to health and the environment, or that the TOCDF has failed to properly categorize agent waste (see items iv., v., and vi., listed in Section 7.B.1 above.)

7.C.3 *Discussion of TOCDF Trial Burns and Destruction Removal Efficiency*

The "Petitioner's Memorandum Supporting Cross Motion for Summary Judgment and Opposing Respondent's Motion for Summary Judgment" (August 20, 1998; DEQ Item No. **98-1275**) contends that the Deactivation Furnace System (DFS) is incapable of meeting the Destruction Removal Efficiency (DRE) requirements, especially for the emissions of Polychlorinated Biphenols (PCBs). The Petitioners cite the failure of the DFS to meet the requirements of the Toxic Substances and Control Act (TSCA) during a trial burn in 1997.

The Department was aware that the DFS TSCA trial burn in 1997 was unsuccessful in demonstrating the required DRE for PCBs during one of the three test runs conducted. Subsequent investigations (by the EPA, the Utah DEQ, and the Permittees) revealed that a particular type of gasket being used in the furnace system was contributing to PCB contamination. The gaskets were replaced, and the subsequent TSCA trial burn was completed successfully. The TOCDF DFS is now permitted to process rockets (which contain PCBs in the packing material). The same type of testing will be required for the DFS at UMCDF prior to full operations.

Exhibit 26 is an affidavit that states that the required "six nines" DRE (that is, 99.9999% destruction of the chemical agent) cannot be demonstrated when the waste being fed contains very low levels (below 1000 ppm) of chemical agent. This information was considered by the Utah District Court in 1996, including the review of Dr. Miller's affidavit by Mr. James Cudahy disputing the allegation that a 99.9999% DRE cannot be achieved at low organic concentrations (see the declaration of James Cudahy in Attachment U, page U-57). The Utah District Court found in August, 1996, that "plaintiffs have not shown a likelihood of success on the merits of their claim that there is an existing or threatened future violation of TSCA." (see Attachment S, p. S-11, paragraph 16.) The Utah District Court affirmed that opinion in the April, 2000 ruling, concluding that "the DFS will meet the 6-9s DRE" (see page S-84).

Exhibit C-78 discusses the Agent Quantification System (AQS) and the problems encountered with draining munitions that contain thickened or gelled agent. The Issue Paper states that rocket lots known to be susceptible to problems with gelled agent were purposely not used during agent trial burns to avoid any delays during actual testing. The Petitioners cite Exhibit C-78 (Attachment E, page E-15) to support the Petitioners' contention that the "the Army was able to manipulate the trial burn process at TOCDF in order to avoid being tested in ways that might result in failure." This included "avoid[ing] testing actual conditions that are repeatedly experienced during operations" such as rejecting containers with solidified agent and sawing ton containers in half before processing.

The trial burn plans, and the subsequent trial burn results at TOCDF have been extensively reviewed by incineration experts (see the declarations of James Cudahy contained in Attachment U, beginning on page U-47), regulatory agencies (including the Utah DEQ and the U.S. EPA), federal courts, and oversight agencies, including the Centers for Disease Control (see Attachment K, page K-73) and the National Research Council (NRC). The NRC recently prepared an "Update on National Research Council Recommendations" related to TOCDF (included as Attachment O). The report contains extensive review of the trial burns conducted at TOCDF (see "Trial Burns," beginning on page O-33).

7.D. Department Conclusions

Most of the evidence submitted in support of the revocation request currently under consideration by the Oregon Environmental Quality Commission (including the material submitted to the Multnomah County Circuit Court during G.A.S.P., et al., *v.* EQC, et al.) has already been extensively reviewed by similar bodies in Utah (subject to discovery, depositions, testimony, and cross examination). In the most recent "Findings of Fact and Conclusions of Law" issued on April 14, the Utah District Court concluded that (page S-90):

> "Although there have been problems in the operation of TOCDF, there was no evidence that TOCDEF personnel, the public, or the environment have been harmed by these operations. Further, the evidence at trial indicated that when an operational incident occurred, defendants took steps to improve procedures and implement additional safety measures to prevent similar incidents from occurring. There was no evidence at trial that chemical agent has ever been released from the common stack into the environment and the evidence demonstrated that the release of non-agent emissions from the common stack have been, and continue to be, well within regulatory guidelines."

The Department concurs with the findings of the Utah District Court and the USHW Board that operations at TOCDF do not pose a threat to either public health or the environment. The Department does not believe that UMCDF poses such a threat either. This does not imply that the Department ignores the operational experience being acquired at TOCDF that is applicable to the operation of UMCDF. The Department receives an extensive amount of information about the operations of both TOCDF and JACADS from a variety of sources, and acts on that information when appropriate.

For example, the tendency of concrete to settle and eventually crack is a well-known phenomenon. However, the consequences of a crack in a sidewalk or a driveway are clearly not the same as a crack in a concrete floor at a hazardous waste processing facility, as highlighted by the liquid leak at TOCDF. The Department has taken a very aggressive stance with the Permittees at UMCDF to ensure that concrete cracking at UMCDF would not result in a hazardous waste migration or release to the environment.

The Department has required the Permittees to develop and institute a concrete crack mitigation program, and issued a Notice of Noncompliance when the Permittees failed to repair a crack promptly, as required by the program. The Department has also required extensive "flood-testing" of elevated slabs during construction to ensure that any cracks are identified and promptly repaired. Department inspectors were present at many of these flood tests to make sure they were conducted in accordance with the approved methods. There is also an ongoing inspection requirement to insure that the integrity of floor coatings is maintained throughout operations.

All UMCDF trial burn plans will be submitted as Class 2 Permit Modification Requests, which require a public comment period. Both the "Surrogate" and "Agent" Trial Burn Plans will be made available to the public for review and comment. One of the many items that the Department will be looking for in Trial Burn Plans is whether the proposed test plan reflects expected operational conditions. The Army is conducting a study on which agent lots processed so far have contained a high percentage of gelled or thickened agents, and is providing that information to the Department and to the Umatilla Chemical Depot. This will allow both the Department and the UMCDF to estimate how many munitions at Umatilla might contain gelled agents, and to plan accordingly.

The Department shares the Petitioners' concerns about whether the methodology used by the Army to "confirm" chemical agent readings has been correctly applied. However, the Department notes that although there have been numerous ACAMS alarms at TOCDF, the NRC believes that most, if not all, were "false positives" (of alarms that occurred between August 1996, and October, 1998). The NRC has recommended that the Army work to improve the reliability and accuracy of agent detection systems, and notes in their 1999 report (see pp. O-44 through O-47) that the Army is investigating new technologies for the real-time detection of chemical agent.

The Department concludes that the information provided by the Petitioners related to the history of operations at TOCDF does not provide a basis for unilateral modification or revocation of the UMCDF Hazardous Waste Permit.

8. TREATMENT OF SECONDARY WASTES

8.A. Applicable Attachments and Exhibits/Comments

- Attachment A, Exhibit 69 (December, 1998 "Revocation Request")
- Attachment E, Comment C-5
- Attachment G, Exhibit/Comments C-5, C-75
- Attachment N, Exhibits 23, 24, 25, 26, 33, 49, 59
- Attachment P, Exhibit 29
- Attachment Q, Exhibits 60, 61, 62
- Attachment U, Additional transcript excerpts from Utah proceedings
- Attachment V, Documents related to the Dunnage incinerator

8.B. Description and Summary of Documents[11]

Exhibits 23 and 24 are excerpts from the testimony of Mr. John Cluff on July 17-18, 1996 during proceedings for the Utah District Court in CWWG, et al. *v.* U.S. Army, et al. (Case No. 96-CV-0425C). Petitioners use John Cluff's testimony (pp. 45-49 of this transcript) to support the contention that the BRA is not being operated at TOCDF due to "mechanical problems" and that the Army decided not to burn the Demilitarization Protective Ensemble (DPE) suits in the Dunnage incinerator (DUN) because of concern over the incineration by-products from the suit material. At the time of this deposition, John Cluff was the "Assistant Project Manager for

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[11] The following Item Numbers are cited in this section:

- No. **98-1247**: "Request for Contested Case Hearing and Other Relief," letter dated December 14, 1998 (See Attachment A)
- No. **98-1275**: "Petitioners' Memorandum Supporting Cross Motion for Summary Judgment," August 20, 1998 (Case No. 9708-06159)
- No. **98-1285**: "Petitioners' Additional Documentary Evidence," November 10, 1998 (Case No. 9708-06159)
  No. **99-0704**: "Petitioners' Opposition to Respondents' Supplemental Motion for Summary Judgment," April 12, 1999 (Case No. 9708-06159)
- No. **99-2201**: "Comments of G.A.S.P., et al., in Support of Their Request to Suspend and Revoke Permits for [UMCDF]," December 17, 1999 (See Attachment E)

Systemization and Operations" working for the U.S. Army's Program Manager for Chemical Demilitarization (PMCD) field office at TOCDF. [Cited in Item No. **98-1275** (pp. 32 and 34)]

Exhibit 25 is an excerpt from the deposition of Mr. Timothy Thomas (TOCDF Project Manager for the U.S. Army Program Manager for Chemical Demilitarization) given on February 5, 1998 during proceedings for the Utah District Court in CWWG, et al. *v.* U.S. Army, et al. (Case No. 2:96-CV-0425C). [Cited in Item No. **98-1275** (p. 33)] {**NOTE**: Exhibit 25 did not, in several cases, contain the actual pages cited. Missing transcript excerpts from Exhibit 25 have been included in Attachment U. See page U-39 for the transcript excerpt related to the use of the DUN.}

Exhibits 29, 29.1 and 29.2: Affidavit of J.R. Wilkinson. See Section 5.B for a description of these exhibits.

Exhibits 33 and 34 are excerpts of the deposition of Mr. Richard Holmes given on April 14, 1998 during proceedings for the Utah District Court in CWWG, et al. *v.* U.S. Army, et al. (Case No. 2:96-CV-0425C). At the time of this deposition Mr. Holmes was an employee of the Army's "Program Manager for Chemical Stockpile Disposal" based in Edgewood, Maryland. The Petitioners cite Mr. Holmes' deposition related to the Army's intention to use the DUN and what types of wastes were to be fed to the DUN. [Cited in Item No. **98-1275** (p. 33)]

Exhibits 49 and 59 include an excerpt from the deposition of Robert Bruce Perry dated July 16, 1996 taken during proceedings for the Utah District Court in CWWG, et al. *v.* U.S. Army, et al. (Case No. 96-CV-0425C). (Exhibits 49 and 59 are duplicates.) The excerpt is primarily related to the use of the DUN at TOCDF. Mr. Perry identifies himself as the Chief of the Risk Management Quality Assurance Office with PMCD. [Cited in Item No. **98-1247** (p. 8); Item No. **98-1285** (p. 7); Item No. **99-2201** (p. 10)]

Exhibit 60 is an "Information Paper" regarding dioxin emissions from the DUN prepared by LTC John Ontiveros dated May 21, 1996. The Information Paper discusses the causes of dioxin formation and test results from the DUN operation at JACADS that indicate the DUN will be the greatest source of dioxin emissions at the demilitarization facilities. [Cited in Item No. **98-1247** (p. 8); Item No. **98-1285** (p. 7), and Item No. **99-0704** (p. 13)]

Exhibit 61 is an EG&G memorandum dated July 28, 1998 discussing the discontinuing of BRA operations at the at the Tooele Facility and inviting affected employees to apply for other available positions at TOCDF. [Cited in Item No. **98-1247** (p. 8); Item No. **98-1285** (p. 7), and Item No. **99-0704** (p. 13)]

Exhibit 62 is a table titled "TOCDF Hazardous Waste Off-Site Disposal Activities"(undated, but appears to have been faxed by the Utah DEQ in June, 1998.). The Petitioners have described this as a Table prepared by the Utah Division of Solid and Hazardous Waste that is a compilation of data (from 8/96 through 3/98) that shows the enormous off-site waste disposal needs of the Tooele Facility. [Cited in DEQ Item No. **98-1247** (p. 8); Item No. **98-1275** (p. 35); Item No. **98-1285** (p. 7), and Item No. **99-0704** (p. 13)]

Exhibit C-75 is an Affidavit from Mr. Gary E. Harris, a former employer of EG&G who worked at TOCDF until 1996. See Section 7.B.1 for a description of this exhibit (The Affidavit submitted as Exhibit C-75 was arranged numerically. [Cited in Item No. **99-2201** (pp. 10, 14, and 15)]

8.C. Discussion

The processing of the chemical weapons stockpile at the Umatilla Chemical Depot will produce a wide variety of what is referred to as "secondary wastes." The Waste Analysis Plan in the UMCDF Hazardous Waste Storage and Treatment Permit (HW Permit)[Ref. 18] lists the wastes expected to be generated during operations of UMCDF, and describes the analysis required for each waste prior to final disposal. The Waste Analysis Plan (WAP) describes the physical and chemical analyses the UMCDF will perform before hazardous wastes are stored, treated, or transported off-site. The current WAP retains the DUN as a treatment unit, and lists the wastes that were intended for the DUN.

There are other wastes, such as DPE suits, for which there is no currently identified treatment technology. (The DPE suits were removed as a DUN waste stream prior to the issuance of the UMCDF draft HW Permit in 1996.) Some of the wastes without approved treatment technologies were wastes that were identified through operations at JACADS and TOCDF and were subsequently added to the UMCDF waste streams. The Department expects that the Permittees will submit a Permit Modification Request seeking approval to modify the HW Permit to allow many of those wastes to be treated in existing (permitted) units, such as the Deactivation Furnace System (DFS) or the Metal Parts Furnace (MPF).

The Petitioners contend that the Brine Reduction Area (used to de-water the brines produced from the Pollution Abatement Systems) is not "viable," and will not be operated at UMCDF. The Department does not dispute that the Brine Reduction Area (BRA) is not currently being used at TOCDF and that the Utah DEQ has approved the off-site shipment of liquid brines for treatment at a commercial facility. The Department believes that the BRA can function effectively as a treatment unit to de-water brines, and will require that brines be treated prior to shipment off-site. Many of the problems experienced at TOCDF with the BRA were related to the performance of

the BRA Pollution Abatement System, which are correctable through conditioning of the gases to remove moisture prior to the baghouse, and through the use of different filter media for the bags used in the baghouse.

The HW Permit contains extensive requirements for the operations of the BRA (Module V), to include certification by an independent engineer to attest to the structural integrity and the suitability of the BRA to handle hazardous wastes, and the successful completion of Performance Tests. Each batch of brine must be analyzed for the presence of chemical agent prior to processing, and only brines that are agent-free may be processed. Regardless, the Department is still requiring that the emissions from the BRA stack be monitored for chemical agent, the same as any of the other stacks at UMCDF.

The Department has always acknowledged, and planned for, the need to ship wastes such as ash, slag, brine salts, and scrap metal off-site after treatment at UMCDF. The Permittees are required to meet stringent requirements for analyzing and characterizing the wastes, and off-site shipments must be sent only to approved disposal facilities. The Department monitors the activities at TOCDF quite closely, and has been aware for some time that the DUN and the BRA are not in use at TOCDF, nor does it appear that the Army intends to put either into operation at TOCDF any time soon.

This does not necessarily mean that the Army will, or can, make those same decisions for UMCDF. The Department has been quite clear to the Army that the BRA must be operated to insure that no liquid wastes will be sent off-site. The table in Exhibit 63 that lists off-site waste shipments from TOCDF illustrates a concern that is shared by the Department, and we believe by the public at large. The Department notes that 91% of the approximately 45 million pounds of wastes listed on this table consists of spent decontamination solution and liquid brines. These liquid wastes will be treated on-site at UMCDF (spent decontamination solution will be injected into the secondary combustion chambers of the liquid incinerators and brines will be treated in the BRA).

The Army informed the Department in August, 1998 that the DUN for UMCDF was being put on "hold," pending evaluation of other treatment technologies for wastes originally destined for the DUN.[Ref. 19] The Army gave a presentation to the Commission in August, 1999[Ref. 6] and proposed that the Commission allow the Army to proceed with a Permit Modification Request to insert a "Compliance Schedule" into the UMCDF HW Permit that would require the Army to meet milestone dates in their development of alternate secondary waste treatment technologies. The main reason given by the Army was one of economics. The Army representatives stated that although the DUN could process secondary waste, the throughput capability was limited and it was very expensive to operate. The Army representatives stated their belief that with modifications to the design they could improve the throughput rate and the reliability of the DUN system, but because of cost and schedule issues they preferred to evaluate other possible technologies.

The Commission responded to the August presentation with a letter [Ref.20] to the Assistant Secretary of the Army and the Program Manager for Chemical Demilitarization expressing the Commission's concern about the information presented in August (see Attachment Q, page Q-3). The Commission wrote:

> "The UMCDF hazardous waste permit that the Commission approved in 1997 permitted five treatment units for all *[emphasis in original]* waste stored at the Umatilla Chemical Depot, to include the wastes generated by any activities (past, present, or future) related to the storage, treatment, or disposal of the chemical weapons stockpile. The Dunnage incinerator was the treatment unit designated for secondary wastes. The Army has now come before the Commission, almost three years later and with 60% of the facility constructed, and informed us that the Dunnage incinerator is 'too expensive' and has 'throughput' problems."

The Commission's letter went on to state that:

> "The Commission learned from the Army that the existing permitted DUN must be modified to improve processing throughput and efficacy. We believe the Army should move forward immediately with implementing improvements to the design of the Dunnage incinerator and any permit modifications should be approved by the Department prior to the start of hazardous waste operations. This approach will provide a degree of assurance for the Commission that the Army is committed to implementing a technology at Umatilla that is capable of processing the agent contaminated secondary wastes."

The Army's response[Ref. 21] to the Commission's letter states that "we are beginning the effort to design the specific changes to the Dunnage Incinerator which are necessary to improve its performance" (page Q-5). The Department is expecting a Class 3 Permit Modification Request related to the Dunnage incinerator to be submitted in August, 2000.

At the August, 1999 meeting the Army also proposed that the Department participate in an "Integrated Product Team" (IPT) that the Army was forming to address the secondary waste issues at UMCDF. The IPT has met seven times since October, 1999. Through the IPT process, and in meetings held as follow-up to the August, 1999 presentation to the Commission, the Department has become aware of numerous documents prepared by the Army or its contractors related to secondary waste treatment. These documents include various studies that have been conducted during the research and development of alternate secondary waste treatment technologies (such as the "Carbon Micronization System" for spent charcoal and the "Thermal Destruction System" for DPE suits), and studies and reports related to possible design modifications to the Dunnage Incinerator to improve its capacity and its performance.

Most of these documents were received between October 1999 and April 1, 2000, and the Department has not yet completed review of the contents of all of the documents. Attachment V contains a list of documents currently under review that are specifically related to the design of the Dunnage Incinerator.

8.D. Department Conclusions

The Department and the Commission share the public's concern that secondary wastes generated from the operation of UMCDF, and wastes generated over the years at the Umatilla Chemical Depot, not become "legacy wastes" for Oregonians to deal with for years to come. The Department, the Commission, and the Governor's office have consistently held the position that all agent-related wastes at the Umatilla Chemical Depot must be treated at UMCDF and/or shown to be free of chemical agent before shipment to any permitted off-site disposal facility.

The Department is anticipating further Permit Modification Requests related to both the Brine Reduction Area and the Dunnage Incinerator, both of which will include opportunity for further public comment. Therefore, the Department has concluded that the information submitted by the Petitioners related to the treatment of secondary wastes at UMCDF does not provide a basis for unilateral modification or revocation of the UMCDF Hazardous Waste Permit.

9. EMERGENCY PREPAREDNESS AND THE SEPTEMBER, 1999 INDUSTRIAL EXPOSURE INCIDENT AT UMCDF

9.A. Applicable Attachments and Exhibits/Comments

- Attachment E, Comment C-5
- Attachment F, Comment C-3
- Attachment W, Report on the September 15, 1999 Industrial Accident at UMCDF

9.B. Description and Summary of Documents

(No specific exhibits related to this subject area were submitted. See discussion of Comments below in Section 9.C.)

9.C. Discussion

On September 15, 1999 numerous workers located in the Munitions Demilitarization Building (MDB) at UMCDF experienced sudden breathing difficulties and had to evacuate the building. Thirty-four workers were ultimately transported to the Good Shepherd Community Hospital in Hermiston for treatment of symptoms including breathing difficulty, throat irritations, and nausea. Five employees were admitted to the hospital for observation. The source and nature of the

contamination that affected the workers on September 15 remains unknown, although there is no evidence that any chemical warfare agents were involved.[Ref. 22]

The emergency response activities of Raytheon Demilitarization Company and the Umatilla Chemical Depot to the incident on September 15 have been highly criticized by the public and by state and federal agencies. Oral comments at the November 19, 1999 meeting of the Environmental Quality Commission[Ref. 2] and written comments received during the public comment period (Attachment E) expressed the public's concern over the handling of the September 15 incident at UMCDF.

The Governor's office established an investigation team consisting of the Oregon Department of Environmental Quality, Oregon Emergency Management, Oregon Occupational Safety and Health Administration, and the Oregon Health Division ("Agency Team"). On April 20, 2000, the Agency Team released its report on the September 15 incident (Reference 22, included here as Attachment W).

The Agency Team Report states (p. W-3):

> "The Agency Team concurs with the Army and Raytheon findings that there is sufficient evidence to indicate that this was not a chemical event (for reasons so stated in their reports). However, the Team has identified failures in the following areas:
>
> - Site Evacuation and Medical Evacuation
> - Communication between the On-Post and Off-Post Emergency Response Communities, medical facilities and the public
> - Communication between the Army, Raytheon and the employees"

The Agency Team essentially concurred with the concerns of the Commenters, and states that (p. W-3, W-4):

> "The Agency Team has determined that the response actions by RDC were inadequate and seriously jeopardized the health and welfare of employees. An area of particular concern is how and when the decision was reached and by whom, that this incident was not caused by a chemical agent release. The timing and accuracy of this decision was crucial for all subsequent response actions. We remain unclear how the decision was reached. It is problematic that the UMCD and RDC did not implement the Chemical Accident/Incident Response Action (CAIRA) Plan until such time that monitoring of the storage igloos confirmed that a release of chemical agent did not occur. The results of chemical agent monitoring were not available for three hours following the incident."

The Oregon Clearinghouse for Pollution Reduction (OCPR) included in its comments (Attachment F, p. F-2) a copy of an abstract from a report titled "Air Quality Dispersion Modeling in Complex Terrain Near the Umatilla Chemical Agent Disposal Facility, Hermiston, Oregon," by Dr. Halstead Harrison of the University of Washington. A full copy of Dr. Harrison's report was received on January 11, 2000.[Ref. 23] Dr. Harrison performed air dispersion modeling of emissions from UMCDF using a dispersion model of his own design ("WPUFF") and found that the model "suggest[ed] infrequent plume 'hits' in the neighboring communities...but at concentrations several hundred fold higher than annual averages."

The Department's Air Quality Division (Technical Services) conducted a review of his results (but not of the actual model) and concluded that "his conclusions do not reveal any new relationships between near and far-source impacts, nor between short and long-term averaging time impacts."[Ref. 24] Because the WPUFF model appeared to be more suited for assessing short-term impacts in real-time, such as that needed for guiding emergency response activities during release events, the Department requested a technical review of Dr. Harrison's report by Innovative Emergency Management, Inc. (IEM), a firm with extensive experience in the modeling of accidental releases.[Ref. 25]

IEM had significant concerns about the ability of the WPUFF model to produce valid results due to a variety of errors. A copy of both the Department's and IEM's review have been transmitted to Dr. Harrison.

9.D. Department Conclusions

The Department concurs with the Commenters that there were significant failures in responding to the incident on September 15, 1999. It is the Department's understanding that most of the recommendations in the Agency Team Report have already been acted upon by Raytheon and the Umatilla Chemical Depot. Although this incident did not involve any chemical agents, the response of the Permittees in caring for injured workers and informing the off-post communities was inadequate and unacceptable. However, the Department believes that the new procedures in place will insure a better response in the event of any similar incidents. The Department has concluded that the actions of the Permittees related to the September 15, 1999 incident do not provide a basis for unilateral modification or revocation of the UMCDF HW Permit.

Upon review of the dispersion modeling report submitted by the OCPR, the Department has concluded that, even if the errors identified by IEM are corrected, the WPUFF model is not applicable to the type of modeling conducted by the Department to assess chronic health risks. The report by Dr. Harrison does not provide a basis for unilateral modification or revocation of the UMCDF HW Permit.

Conclusions

The Department has reviewed all of the Exhibits submitted during the legal proceedings for G.A.S.P., et al., *v.* Environmental Quality Commission, et al. (Case No. 9708-06159), the various arguments presented in the motions and oral arguments during the case, the written and oral comments of the Petitioners received during two public comment periods, and all other public comments received. The Department has concluded that the information reviewed does not meet the criteria established in either 40 CFR 270.41 or 40 CFR 270.43 for cause to unilaterally modify or terminate the UMCDF HW Permit.

Intended Future Actions

The Department will complete its review of the documents related to the Dunnage incinerator (listed in Attachment V) prior to review of the Class 3 Permit Modification Request related to the Dunnage incinerator (expected to be received in August, 2000).

Department Recommendation

The Department recommends that the Commission deny the Request for Revocation dated December 14, 1998 from G.A.S.P., et al..

Attachments *See Table 2 on pages 7 and 8 for a list of Attachments.*

Reference Documents (available upon request)

1. *"Minutes of the Two Hundred and Eightieth Meeting of the Environmental Quality Commission, November 18-19, 1999,"* Environmental Quality Commission (DEQ Item No. 99-2276).
2. *"Transcript of Proceedings, Public Comment on a Request to Revoke the Umatilla Chemical Weapons Depot Permits,"* before the Environmental Quality Commission, November 19, 1999 (DEQ Item No. 00-0181).
3. *"Transmittal of comments received during the Umatilla Chemical Agent Disposal Facility (UMCDF) 'Request for Revocation' Comment Period,"* Memorandum from the Department of Environmental Quality (Hermiston office) to the Environmental Quality Commission, January 25, 2000 (DEQ Item No. 00-0129).

State of Oregon
Department of Environmental Quality Memorandum

DEQ Item No. 00-0690 (92.93)

Date: May 18, 2000

To: Environmental Quality Commission and other Interested Parties

From: Sue Oliver
Chemical Demilitarization Program
DEQ, Hermiston

Subject: **Correction Pages to Umatilla Staff Report for the May 18, 2000 Meeting**

Agenda Item K, EQC Meeting, May 17-18, 2000
Request for Revocation of Permit No. ORQ 000 009 431
[Umatilla Chemical Agent Disposal Facility (UMCDF)]

An error was found in the Staff Report for the "Request for Revocation" of the UMCDF Hazardous Waste Permit. A section in the "Intended Future Actions" on Page 57 was inadvertently omitted. Please replace pages 57-58 of your copy with the attached replacement pages 57-58. The only change is additional information in the "Intended Future Actions" section, mostly related to the "Startup Checklist" that was included as Attachment X in the Staff Report.

My apologies for the error. Please call me at 541-567-8297 (ext. 26) if you have any questions.

Conclusions

The Department has reviewed all of the Exhibits submitted during the legal proceedings for G.A.S.P., et al., *v.* Environmental Quality Commission, et al. (Case No. 9708-06159), the various arguments presented in the motions and oral arguments during the case, the written and oral comments of the Petitioners received during two public comment periods, and all other public comments received. The Department has concluded that the information reviewed does not meet the criteria established in either 40 CFR 270.41 or 40 CFR 270.43 for cause to unilaterally modify or terminate the UMCDF HW Permit.

Intended Future Actions

The Department will complete its review of the documents related to the Dunnage incinerator (listed in Attachment V) prior to review of the Class 3 Permit Modification Request related to the Dunnage incinerator (expected to be received in August, 2000). The Department will continue to oversee the construction activities at UMCDF and to process other Permit Modification Requests submitted by the Permittees.

The Department considers the decision to start thermal operations to be as critical as the original decision to approve the Hazardous Waste Permit. On April 6, 2000 the Department sent a letter to the Permittees with an attached "UMCDF Startup Checklist" (See Appendix X). The Startup Checklist was developed as part of a process that the Department will use to assess the readiness of UMCDF to begin thermal operations. The Department is developing specific evaluation criteria for each item on the Checklist, and intends to open a public comment period prior to submitting a recommendation to the Commission on whether to allow the commencement of thermal operations at UMCDF.

Department Recommendation

The Department recommends that the Commission deny the Request for Revocation dated December 14, 1998 from G.A.S.P., et al..

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PAGE REVISED MAY 18, 2000

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18. *"Permit for the Storage and Treatment of Hazardous Waste,"* Umatilla Chemical Agent Disposal Facility, Permit No. ORQ 000 009 431, February, 1997 (as modified) (DEQ Item No. 98-1455).

19. *"Decision Being Pursued to Remove the Dunnage Incinerator (DUN) from the UMCDF Scope,"* Letter from the U.S. Army Program Manager for Chemical Demilitarization to the Oregon Department of Environmental Quality, August 18, 1998 (DEQ Item No. 98-0584).

20. *"Follow-up to August 18, 1999 Environmental Quality Commission Meeting,"* Letter from the Chair of the Environmental Quality Commission to the Assistant Secretary of the Army and the U.S. Army Program Manager for Chemical Demilitarization, September 24, 1999 (DEQ Item No. 99-1640). (See Attachment Q to this Staff Report.)

21. Letter from the U.S. Army Program Manager for Chemical Demilitarization to the Chair of the Environmental Quality Commission (response to EQC letter of September 24, 1999), December 17, 1999 (DEQ Item No. 99-2272) (See Attachment Q to this Staff Report.)

22. *"A Report on the September 15, 1999 Industrial Accident at the Umatilla Chemical Agent Disposal Facility,"* by Oregon Department of Environmental Quality, Oregon Emergency Management, Oregon Occupational Safety and Health Administration, and the Oregon Health Division, April 20, 2000. (DEQ Item No. 00-0582) (See Attachment W to this Staff Report)

23. *"Air Quality Dispersion Modeling in Complex Terrain near the Umatilla Chemical Agent Disposal Facility,"* Dr. Halstead Harrison, University of Washington, January, 2000. (DEQ Item No. 00-0119)

24. *"'WPUFF' modeling report submitted by Dr. Halstead Harrison,"* Memorandum from Wayne C. Thomas to Langdon Marsh, Department of Environmental Quality, January 24, 2000. (DEQ Item No. 00-0010)

25. *"Technical Review of 'Air Quality Dispersion Modeling in Complex Terrain near the Umatilla Chemical Agent Disposal Facility'"* Innovative Emergency Management, Inc., March 20, 2000. (DEQ Item No. 00-0391)

Approved:

Section: _____

Division: _____

Report Prepared By: Sue Oliver

Phone: (541) 567-8297, Ext. 26

Date Prepared: April 20, 2000

ATTACHMENT A

"Request for Contested Case Hearing and Other Relief"
(DEQ Item No. 98-1247)

Letter from Stuart A. Sugarman and Richard E. Condit
Attorneys at Law
(on behalf of G.A.S.P., et al.)
to
Members of the Environmental Quality Commission
and
Director, Department of Environmental Quality

December 14, 1998

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FILE

98-1247

STUART A. SUGARMAN

ATTORNEY AT LAW

3430 S.E. BELMONT ST., SUITE 101
PORTLAND, OREGON 97214

(503) 234-2694 EMAIL: BLC@HEVANET.COM *FAX* (503) 234-1330

14 December 1998

HAND DELIVERED

Carol Whipple, Chair
Melinda Eden
Linda McMahan
Mark Reeve
Tony Van Vliet
EQC Commissioners

Langdon Marsh
Director, DEQ
6th Floor
811 SW 6th
Portland, OR 97204

Re: Request for Contested Case Hearing and Other Relief

Dear Commission members and Director Marsh:

We write on behalf of G.A.S.P., Sierra Club, Oregon Wildlife Federation, Karyn Jones, Susan Jones, Heather Billy, Deborah Burns, Janice H. Lohman, Leandra Phillips, Merle C. Jones, Cindy Beatty, Andrea E. Stine, Dorothy Irish, Mary Bloom, Robert J. Palzer, Janet Nagy, Ladonna King, John Spomer, Christine Clark, Stuart Dick, Gail Horning, David Burns, Pius A. Horning, Karla Stuck, and Melanie Beltane, regarding the proposed Umatilla Chemical Demilitarization Facility (UMCDF). As you know, the Multnomah County Circuit Court issued a decision on 6 December 1998 remanding this matter to the EQC/DEQ. Your task is now to have a hearing to evaluate the use of Pollution Abatement System (PAS) carbon filters and to decide whether they are a critical component (as most of the commission stated earlier) or merely an "extra safety precaution" as was claimed in circuit court. See Opinion and Order on Cross Motions for Summary Judgment (ORDER) at 17 - 18, 27. In the process, you obviously need to consider our clients' evidence regarding the fitness of incineration as a disposal technology and the character and competence of the Army to ensure proper operation of the facility.

Our clients (Petitioners before the Court) urge the EQC and/or DEQ to implement a contested case process in order to provide balance and fairness in a process that has been tilted

heavily in favor of proponents of incineration. There can be little fairness in a process that has critically important factual and technical questions at issue when neither the Commission nor other interested parties have the opportunity to hear witnesses testify under oath. Moreover, it is essential that all parties be permitted, through a reasonably administered adversarial process, to test the credibility and reliability of the statements and documents offered in support of each parties' position. Meaningful public participation is mandated by federal law. See 42 U.S.C. §§ 6926, 6974. Our clients are not afraid to submit to such scrutiny, nor should those who are interested in finding the truth be afraid to present their material in such a format. Too much is at risk in this type of decision to do otherwise.

With this thought of fairness firmly in mind, our clients urge the Environmental Quality Commission (EQC) and Department of Environmental Quality (DEQ) to reveal the truth and have the courage to stand up to the Army (and its ever shifting rhetoric and claims) and reach a new decision concerning UMCDF. As you know, the truth is that the EQC relied on the installation and operation of PAS carbon filters to provide the public health and environmental protection necessary given the emissions expected from normal operations of the Army's incineration technology and the history of serious malfunctions.

EQC members know that they told the public in private as well as public meetings that they could not support the Army's incineration technology without PAS carbon filter protections in place. For example, former EQC Chairperson Lorenzen stated:

> The combination of incinerators as designed with the carbon filters, in my opinion, clearly point to best available technology that can destroy these weapons in a timely manner and do it in a safe manner that will not harm the residents in this area, both me, my children and my children' s children that hopefully will live on our family farm in generations to come. For that reason, I will also support the permit application by the Army . . . So with that lengthy discussion, I think we have, we now have a general consensus of where we're going to be coming out . . .

Statement of Henry Lorenzen at EQC meeting rendering permit decision, 22 November 1996. AR 2351 (CD 3B, Folder 12B, p.35). No Commission member expressed disagreement. Commission Chair Lorenzen continued to stress the vital importance of PAS carbon filters.

> Well, I'll start, Lang, and I'll tell you the one thing I want to make certain is included in here in language as explicit as possible, that at least from my perspective, and I hope from the remainder of the Commission' s perspective with regard to the discussion, **but from my perspective, the conclusion that this is best available technology is absolutely hinged upon the inclusion of activated carbon filters on the output of the incinerators,** and that if that, if for any reason in the future it appears that that is not feasible and practical, that then we need to, the Commission needs to start this process all over again, and to take a very hard look at the prospect of alternate technology. And included in that would not only be technology for destruction of the weapons systems itself, but also for the destruction of mustard agent. **That I would like to make certain that that**

> **foundation is very explicitly built within the finding on best available technology**.

AR 2351 (CD 3B, Folder 12B, p.37) (emphasis added). Chairperson Lorenzen went a step further and spoke on behalf of all commission members when, at the EQC hearing on Motion for Reconsideration on 5 June 1997, when he responded to Petitioners' counsel's suggestion the Army would attempt to circumvent the PAS carbon filter requirement when seeking the EQC's permit to operate the facility:

> I think this Commission could not be clearer in its requirement that those carbon filters be on there and that they function properly, that if they're not, this permit is not going to go forward and they're not going to operate this facility . . . [carbon filters are] the very foundation for the approval of this particular permit . . . [and if they're] not going to be able to put those things on there and make them operate, this facility is not going to operate.

CD4B, Folder DEQ1, AR 2889, p. 4. The Commission apparently agreed with its chair's statements. Counsel responded "I'm glad you're stating that and I saw some heads nodding on the Commission and I sincerely hope that's the Commission's policy when the time comes." Id. See also Chair Lorenzen's statements at the EQC's 7 February 1997 hearing concerning permit conditions,

> the Commission did strengthen the language relating to carbon filters and . . . the conclusion of best available technology is specifically dependent upon the utilization of carbon filters on the exhaust of each of the incinerators. . . **[M]y conclusion that this is the best available technology is specifically dependent upon the additional protection that will be provided by these filters . . . they are an integral part of this permit and that if there is a substantial request for modification to these filter systems, in my mind, it would then open the permit again for a thorough reevaluation of best available technology.**

Id. at 14. Commissioner Tony Van Vliet also stated on the record that he found the PAS carbon filters crucial to his decision to grant the permit when he said ". . . it looked to me as if the safety factor that was built in on this with the carbon filters and everything . . . helped me make my decision." AR 2351 (CD 3B, Folder 12B, p.29).

No Commission member expressed disagreement with the Commissioner's statement. Judge Marcus, however, opined that the EQC's findings were not explicit enough to reflect the Commissioners' reliance on PAS carbon filters. ORDER at 27.

We, and the public, now call upon the EQC to demonstrate that its members keep their commitments to the public, by re-opening the record and considering again (in light of our clients extensive new evidence on the carbon filter issue) whether to choose the Army's proposed incineration system over other alternatives. The EQC was mislead about the Army's ability to utilize a PAS carbon filter technology and the toxicity of the chemical warfare (CW) agents

currently stored at Umatilla and elsewhere. In addition, evidence now available demonstrates that the Commissioners were misinformed about several other important issues, including the fact that a reference dose (RfD) for the non-cancer impacts of dioxin does exist and is used by EPA. In support of the referenced issues and other matters our clients wish to raise, we offer the documents listed below for your initial consideration, or in the case of documents already in the administrative record, your re-consideration. In order to limit possible confusion, we will reference the documents being offered in the same manner as was done before the Circuit Court.

Petitioners' Exhibits 27, 28, and 29. Affidavits of Lisa Brenner and Tom Stibolt, Tryge Steen, and J.R. Wilkinson. These affidavits describe the failings of the previous EQC/DEQ process. In particular these affidavits support Petitioners' well founded concerns that the EQC/DEQ failed to: (i) thoroughly and properly assess the impacts of the Army's proposed incineration facility; (ii) fully evaluate alternative technologies; (iii) consider impacts of incineration on sensitive populations (i.e., children, elderly, persons with illness); (iv) assess the current environmental burdens of the area; and (v) compare the risks of storage, storage after reconfiguration, alternative technologies and incineration.

As a public entity, the EQC, its members, and the DEQ have an obligation to protect public health and the environment to the maximum extent possible by ensuring that the disposal process chosen would not have a major adverse effect. When this type of critical new information arises, it is critical that matters be reevaluated. Thus, the DEQ/EQC are obliged to determine if the Army's incineration system would cause a major adverse effect on public health or the environment. See Exhibit 27, Affidavit of Lisa Brenner and Tom Stibolt, Attachments A - C; Exhibit 28, Affidavit of Tryge Steen; Exhibit 29, Affidavit of J.R. Wilkinson at ¶ ¶ 8 – 16. The EQC/DEQ must ensure that new hearings address this central question.

Another of the many features of this new evidence are exhibits, which Petitioners intend to submit, concerning what has come to be known as the MC1 Bomb Incident at the Tooele, Utah facility. A summary of the specifics of that incident are described below. It is important to note that incidents like this one demonstrate why the current incineration technology is unsafe and not the best available technology (BAT).

On March 30, 1998, an Army contractor at TOCDF knowingly overfed nerve agent GB (sarin) into the metal parts furnace (MPF) in one or more MC-1 bombs that had not been adequately drained, causing the MPF to automatically shutdown due to extreme overheating resulting from the high BTU value of the overfed agent. U.S. Army, Unusual Occurrence Report, Metal parts Furnace Feed Rate Excellence, March 30, 1998.

Approximately 80 pounds of agent GB were fed into the MPF, approximately seven times the allowable limit under the Utah DEQ hazardous waste permit (the permit allows a 5% heel for MC-1s containing 220 pounds of agent before draining). Id.

With the burners off in the primary and secondary combustion chambers of the MPF, poor combustion conditions resulted, as indicated by very high carbon monoxide readings, with agent still in the furnace. Id. An agent monitor (ACAMS) in the duct alarmed at the maximum value

(higher than five hundred and eleven (511) times the allowable stack concentration (ASC) for agent GB). The stack monitors approximately 100 feet down stream did not alarm. ** Id. The Army admits these facts but claims no agent GB escaped the stack. However, the Army cannot identify the chemical that admittedly did escape the stack nor can the Army (or EG&G) identify the toxicity of this unknown compound that was released. Exhibit 34, page 12, Chemical Weapons Working Group v. U.S. Army, Case No. 2:96CV0425C, U.S. District Court District of Utah, Deposition testimony of Richard Holmes at 248, 258.

The Army denial that agent GB was released from the stack when GB was overfed to the furnace causing a shutdown resulting in an immediate agent alarm in the duct leading to the stack, and poor combustion conditions with agent in the furnace, is simply not credible, particularly given the inability to identify a non-agent chemical causing the alarm. There is a high probability that a large amount of agent GB was released into the environment during this incident and that the alarms failed to detect the release. Exhibit 31, Affidavit of Pat Costner dated July 27, 1998.

Exhibit 50. Excerpts from the National Research Council's "Review of Acute Human-Toxicity Estimates for Selected Chemical Warfare Agents" (NRC Toxicity Review). Petitioners offer this document to establish that the EQC was mislead concerning a critical aspect of the permitting process (i.e., the likely toxicity of CW agents). Such information is critical to assessing the best available technology (BAT), and establishing emissions standards/limits, as well as determining appropriate emergency procedures. The EQC has not reviewed and considered this information. The NRC Toxicity Report states in part:

> The U.S. Army's Chemical Defense Equipment Process Action Team (CDEPAT) recently conducted an extensive review of the scientific basis for toxicity estimates in use by the Army for several chemical-warfare (CW) agents: GA, GB, GD, GF, VX, and HD. Following a detailed analysis of the toxicity of these agents and using contemporary methods of analysis, **CDEPAT concluded that many of the human-toxicity estimates in use would not protect the soldier adequately (CDEPAT 1994). Recalculations of the potencies of several of the CW agents are greater than previously determined. As a result, lower exposure levels of CW are expected to elicit adverse effects.**

NRC Toxicity Review at 17 (emphasis added). Thus, the Army has known that the toxicity data concerning the referenced CW agents was incorrect since as early as 1994. Two years before this permit was issued. Yet, the NRC Toxicity Report was not issued until December 1997, and only became publicly known sometime after that date.

The report also makes the following statement regarding individual sensitivity to CW agents:

> The U.S. Army's original purpose for developing human-toxicity estimates for CW agents was to enable it to predict the number of casualties that would occur during an offensive action in which the goal was to kill or incapacitate a certain fraction of

> the enemy forces (for example, killing or incapacitating a minimum of 50% of the least-sensitive (most-resistant) individuals). Such an approach would actually result in more than half of the exposed individuals dying (the "bonus effect"), because **a certain percentage of those exposed would be expected to be more susceptible than the least-sensitive individual.**

NRC Toxicity Report at 1 (emphasis added). Thus, the sensitivity of individuals to nerve agent is a critically important factor when considering accidents and emissions involving CW agents. The EQC/DEQ did not complete such an analysis. Consequently, its actions approving the permit for the Umatilla Chemical Demilitarization Facility (UMCDF) must be rejected as inconsistent with the statute (ORS 466.010(1)(b)(A), 466.055(5)) and as not being supported by substantial evidence.

Exhibit 51. "Long-term Health Effects Associated with Sub-clinical Exposures to GB and Mustard – A Review Conducted by the Environment Committee Armed Forces Epidemiological Board (July 18, 1996)." This document responds in part to the EQC's/DEQ's position in court that the effects of low-level impacts from agents were addressed in an addendum to the risk assessment. *See* AR 2377 (CD1, Folder 10B, Addendum p. 5.) This statement is misleading as the term "addressed" suggests the issue was considered substantively. This is not the case. The Addendum states that "[a]t the time the PreRA [pre-trial burn risk assessment] was conducted, additional data on Gulf War veterans was not available." Id. This statement ignores information that was available through the Army.

> **There are no "No Observable Effects Levels" (NOELS) established with any degree of confidence for any of the chemical agents.** These NOELS would be useful for answering questions related to DESERT STORM, but also for establishing workplace and general population exposure limits for demilitarization efforts. Exhibit 51 at 6 (emphasis added).

This means that exposure to low-levels of agent should be assumed to have some adverse effect. Yet, neither the EQC/DEQ nor their contractor took this into consideration when evaluating BAT, emissions, and accidents involving chemical warfare agents.

Exhibit 52. "Gulf War Veterans Illnesses: VA, DOD Continue to Resist Strong Evidence Linking Toxic Causes to Chronic Health Effects" by the Committee on Government Reform and Oversight. This report from a committee of the U.S. Congress provides further rebuttal to the EQC's/DEQ's arguments in court, and supports Petitioners' contention that low-levels (i.e., non-lethal concentrations) of agents must be fully evaluated for potential long term impacts. The report specifically states as part of its findings that "[e]xposures to low levels of chemical warfare agents and other toxins can cause delayed, chronic health effects." Exhibit 52, Findings in Brief # 11 (p. 6). The information and conclusions of the report establish that the Petitioners were correct to be concerned about low-level agent impacts and demonstrates that the Agencies and their contractor clearly erred when they refused to fully assess this issue.

Exhibit 53. "Chemical Weapons: DOD Does Not Have a Strategy to Address Low-Level Exposures" by the U.S. General Accounting Office (GAO) (September 1998). This report notes that "[p]ast research indicates that low-level exposures to some chemical warfare agents may result in adverse short-term performance and long-term health effects." Exhibit 53, GAO Report at 3. This confirms Petitioners' earlier analysis that the Army has information indicating that low-level impacts were critical to evaluate. It is uncertain whether the Army provided and the EQC/DEQ evaluated the "[p]ast research" referred to by the GAO.

Exhibit 54. Excerpts from the "Toxicological Profile for 2,3,7,8-Tetrachlorodibenzo-p-Dioxin" (ATSDR June 1989). Much like the concerns regarding the toxicity and low-level impact of chemical warfare agents, in court, the EQC/DEQ also attempted to downplay the concerns raised by Petitioners and others about the dioxin that will be created at UMCDF and emitted into the environment. Specifically, the Agencies argued that Petitioners' claim that there is a reference dose (RfD) used to assess the non-cancer impacts of dioxin is incorrect. Both the U.S. Environmental Protection Agency (EPA) and the U.S. Agency for Toxic Substances and Disease Registry (ATSDR) utilize a 1 pg/kg/day reference dose for dioxin. Exhibit 54 at 93 - 94.

Exhibit 55. Excerpts from "Drinking Water Criteria Document for 2,3,7,8-Tetrachlorodibenzo-p-Dioxin" (EPA Preliminary Draft March 1985). This document provides further support that the Agencies erred in failing to consider the 1 pg/kg/day non-cancer standard in the absence of any "new" standard adopted by EPA or the Agencies.

Exhibit 56. Excepts from "Final Times Beach Risk Assessment Volume I" (EPA March 28, 1995). This document provides yet additional support for the need to use, at a minimum, a 1 pg/kg/day reference dose when assessing non-cancer impacts from dioxin – an action not taken by the Agencies. Table 5-2 establishes that EPA currently uses a non-cancer reference dose for reproductive impacts of dioxin. The Table also notes that "[r]eproductive toxicity is one of several potential adverse human effects the chronic [sic] oral RfD is applicable." Exhibit 56, Table 5-2 n. c.

Exhibit 57. Excerpts from "Review of Systemization of the Tooele Chemical Agent Disposal Facility" (NRC March 1996). This report notes the NRC's recommendation for further study of carbon filters. Exhibit 57 at 26 – 27. This means that there was significant doubt about whether carbon filters could be utilized.

Exhibit 58. Excerpts from DOD's "Interim Status Assessment for the Chemical Demilitarization Program" (DOD April 15, 1996). In this report the DOD concludes that "the addition of the PFS [carbon filters] may not contribute to any measurable reduction in risk and may actually be the source of new risk to both workers and to the public." Exhibit 58 at 4-7. The DOD indicates that an evaluation (i.e., "screening risk evaluation") will be conducted as a first step in addressing the risks associated with carbon filters. This assessment has not been completed to date.

Note that Exhibit 57 and 58 were published before the EQC approved the permit. Moreover, Dr. Iisa did not refer to or discuss in her testimony or brief report the fact that the Army was undertaking a risk analysis regarding the possible use of carbon filters. Dr. Iisa's report does not cite these reports. Either Dr. Iisa ignored this information or it was withheld. In either case, the fact that the Army had not even completed its own assessment on the use of carbon filters means the EQC's decision to rely on carbon filters for a BAT analysis was not supported by substantial evidence.

Exhibit 59. Excerpts from the Deposition of Robert Bruce Perry dated July 16, 1996. At the time of the deposition, Mr. Perry was a high level official in the Army's chemical weapons disposal program. Regarding the use of the dunnage incinerator (DUN) at the Tooele facility Mr. Perry testified: "I did not review the DUN for readiness because we are not going to use it." Exhibit 59, Perry Deposition (Depo.) at 231. Mr. Perry confirmed that there were concerns about the DUN and that it would not be used "initially." Id.

Exhibit 60. "Information Paper" regarding dioxin emissions from the DUN, dated May 21, 1996. This document appears to have been prepared by LTC John Ontiveros. The paper reflects the Army's concern about dioxin emissions from the DUN and discusses eliminating the DUN. The reason it appears the Army did not inform the EQC/DEQ that it wanted to drop the DUN from the proposed incineration system was "in order to prevent another 3+ year permit application review and approval process." Exhibit 60 at 2.

Exhibit 61. EG&G Memo regarding discontinuing operation of the brine reduction area (BRA) at the Tooele facility, dated July 28, 1998. This memo confirms the decision to stop operating the BRA. It is highly unlikely the BRA will be operated at UMCDF.

Exhibit 62. Table prepared by the Utah Division of Solid and Hazardous Waste compiling data concerning the enormous off-site waste disposal needs of the Tooele facility. The data cover the period August 1996 through March 1998. During that period over 45 million pounds of hazardous waste was disposed of off-site. Such off-site waste disposal needs were not considered in the risk assessment or by the EQC/DEQ in its BAT determination.

Exhibit 63. Excerpts from "Pilot Testing of Neutralization/Biotreatment of Mustard Agent at Aberdeen Proving Ground, Maryland – Final Environmental Impact Statement" (Army/PMCD July 1998). This document confirms the Army's decision to implement the use of neutralization / biotreatment for bulk stored mustard agent (HD). Almost seventy percent of the HD stored at Umatilla is in bulk storage and could be disposed of using this technology. Note that the Army's discussion of potential impacts reveals "[n]o adverse human health impacts are expected from exposure to atmospheric emissions ..." Exhibit 63, Table 2.8 at 2-24.

Exhibit 64. Excerpts from the testimony of Army expert Gary Boyd, dated July 29, 1996. Mr. Boyd had a substantial role in the preparation of the quantitative risk assessment (QRA) for the Tooele facility. During cross examination Mr. Boyd described the limits of a QRA. The EQC/DEQ in the instant case improperly relied on the QRA to provide substantial evidence regarding the determination that the risk of continued storage was more significant than

incineration. The QRA cannot provide support for such a conclusion. Mr. Boyd's testimony reveals that the QRA fails to consider the following issues:

- ·Impacts of routine emissions from the stack
- ·Chronic exposure risks from emissions
- ·The risks from products of incomplete combustion (PICs)
- ·The risks from exposure to the by-products of agent degradation
- ·The risks and impacts to wildlife
- ·The risks associated with the use of alternative technologies

Exhibit 64 at 931 – 932, 937 – 938. It does not appear from the record that the EQC/DEQ considered the limitations of the QRA.

Petitioners will soon offer, for the first time, Steven W. Jones v. EG&G Defense Materials, Inc., ARB Case No. 97-129 (Final Decision and Order of the U.S. Department of Labor dated September 29, 1996). In this decision the Department of Labor determined that the Army's contractor at the Tooele facility illegally fired former Safety Manager Steven W. Jones. The Department concluded: "EG&G demonstrated indifference to the steps taken by Jones, as Safety Manager, to ensure compliance with environmental safety and regulations." Exhibit 65 at 25. Thus, the Army's contractor was found to have violated the federal Resource Conservation and Recovery Act and the Clean Air Act. For its part, the Army refused to provide witnesses during the adjudicatory process. Moreover, the Army has failed to dismiss or discipline EG&G for these serious violations of law. On November 24th the Department decided to reconsider the case. However, such reconsideration will not change the finding that Mr. Jones was illegally fired.

Our clients intend to offer additional evidence, including expert testimony, regarding the issues raised herein when the EQC/DEQ advises us of the process they will employ to fully and fairly evaluate this information. As noted previously, we anticipate the Commissioners and Department providing contested case hearings. Our clients urge that new hearings be commenced within forty-five (45) days of your receipt of this letter.

In order to be prudent and sensitive to the issues raised herein, the EQC/DEQ should order the Army and its contractors to cease construction of incinerator specific components only. Because the Army's incineration technology is in significant doubt, no further taxpayer dollars should be spent on an incineration system. Our clients want to encourage prompt action concerning the deadly chemicals stored in Umatilla, but not at the expense of human health and appropriate environmental protection.

Finally, to sum up, our clients request the following actions by the EQC/DEQ:

(1) Provide a contested case hearing on the issues raised by the Court, our clients, and/or other parties or concerned citizens within forty-five (45) days of receipt of this letter;

(2) Acknowledge that the Army's proposed incineration technology is inadequate without additional protection from a PAS carbon filter system, and that such a system is unproven, untested, and cannot be utilized at UMCDF. Similarly acknowledge that the incineration system offered by the Army will not be deployed at Umatilla because the Army's dunnage incinerator and brine reduction area simply do not work. The failings of the PAS carbon filters, dunnage incinerator, and brine reduction area must be fully contemplated by the EQC/DEQ

(3)Fully consider the information offered by our clients today in light of the EQC's and DEQ's obligations to ensure no "major adverse impact" and that UMCDF will employ the best available technology.

We appreciate the full and prompt attention of the EQC to the matters discussed herein. We look forward to resolving these issues in a full and fair public process.

Respectfully Submitted,

Stuart Sugarman, OSB #92137

Richard E. Condit, Attorney
2525 Arapahoe Ave., Suite E4-309
Boulder, CO. 80302
303-444-1188 ext. 219

Counsel for G.A.S.P., Sierra Club, and OWF et al.

SAS.ss

Enclosures

cc: Henry Lorenzen, past EQC Chair (w/enclosures)
Steve Bushong (w/enclosures)

ATTACHMENT B

"Request for Contested Case Hearing"
(DEQ Item No. 99-0264)

Letter from Langdon Marsh
Director, Department of Environmental Quality
to
Stuart A. Sugarman and Richard E. Condit
Attorneys at Law

February 4, 1999

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Oregon
John A. Kitzhaber, M.D., Governor

Department of Environmental Quality
811 SW Sixth Avenue
Portland, OR 97204-1390
(503) 229-5696
TDD (503) 229-6993

February 4, 1999

Stuart A. Sugarman
3430 S.E. Belmont St. Suite 101
Portland OR 97214

Richard E. Condit
2525 Arapahoe Avenue, Suite E4-309
Boulder CO 80302

RE: Umatilla Army Depot
Request for Contested Case Hearing

Dear Mr. Sugarman and Mr. Condit:

This letter is in response to your letter dated December 14, 1998 requesting the Environmental Quality Commission to schedule a contested case process evidence regarding the permit.

The Commission will be considering a revised order at its March 19, 1999 meeting. Prior to that time, the Commission will be accepting written comments on the revisions to the order. You should receive the public notice within the next few weeks. As such, we are denying your request for a contested case hearing on this matter.

Sincerely,

Langdon Marsh, Director
Department of Environmental Quality

cc: Sue Oliver, Hermiston DEQ
EQC Members

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99-1344

HARDY MYERS
Attorney General

DAVID SCHUMAN
Deputy Attorney General

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DEPARTMENT OF JUSTICE
GENERAL COUNSEL DIVISION

MEMORANDUM

STATE OF OREGON
DEPARTMENT OF ENVIRONMENTAL QUALITY
RECEIVED
AUG 09 1999
HERMISTON OFFICE

DATE: August 4, 1999

TO: Carol A. Whipple, Chair
Environmental Quality Commission

FROM: Larry H. Edelman, Assistant Attorney General
Natural Resources Section

SUBJECT: Authority to Modify Hazardous Waste Facility Permits

This memorandum is to provide guidance regarding the legal bases for modification, revocation, and/or termination of a hazardous waste treatment facility permit issued pursuant to applicable federal and state regulations. The issue is addressed in the context of the Umatilla Chemical Agent Disposal Facility permit and the Environmental Quality Commission's authority to modify that permit if it were to find new evidence or changed circumstances.

This memorandum addresses only bases for unilateral permit modification, not modifications at the request of the permittee.[1]

Criteria for Permit Modifications

The criteria for unilateral modification of a hazardous waste facility permit are set forth at 40 CFR 270.41 which is incorporated in pertinent part by reference at OAR 340-100-0002, 340-105-0041 and Division 106. Causes for unilateral modification of a hazardous waste treatment facility permit include:

1. Material and substantial alterations or additions to the permitted facility or activity occurring after permit issuance. *See* 40 CFR 270.41(a)(1);

2. New information which was not available at the time of permit issuance and would have justified different permit conditions. *See* 40 CFR 270.41(a)(2);

3. New statutory, regulatory, or judicially mandated standards. *See* 40 CFR 270.41(a)(3);

[1] Modifications at the request of the permittee are governed by 40 CFR 270.42.

COPY

4. "Acts of God" or uncontrollable circumstances warranting revised compliance schedules. *See* 40 CFR 270.4(a)(4).

Causes for unilateral modification, revocation and reissuance include:

1. Cause exists for permit termination under 40 CFR 270.43 (grounds for termination in turn include noncompliance with any permit condition, failure by the permittee to disclose all relevant facts in the application or misrepresentation of relevant facts at any time, or a determination that the permitted activity endangers human health or the environment);

2. The permit issuing authority has received notification of a proposed permit transfer.

The hazardous waste facility permit issued to the Army and Raytheon references in paragraph I.C.1 the regulatory bases for modification, revocation or termination described above. Paragraph I.C.2 of the Umatilla permit additionally references applicable state law at ORS 466.170 regarding Commission authority to revoke the permit on a finding of violation of the statute, rules, or a material condition of the permit.

Paragraph I.C.3 references ORS 466.200 which provides authority to the Department to halt operations under the permit if there is reasonable cause to believe there is a clear and immediate danger to the public health, welfare or safety or to the environment from continued facility operation.

Finally, paragraph I.C.4 of the permit provides for reopening of the permit if Congress or the President makes substantial changes in the Chemical Weapons Demilitarization Program or in CSSEP.

Initiation of Permit Modification, Revocation, Termination

Hazardous waste facility permits may be modified, revoked, reissued, or terminated either at the request of any interested person (including the permittee) or upon the initiative of the permitting body. 40 CFR 124.5. All requests must be in writing and must contain facts or reasons supporting the request. In the case of the Umatilla permit, the Commission is the permit issuing body and would, therefore, be the entity authorized to make unilateral permit modifications. Revocation or termination proceedings would most likely be conducted as contested cases governed by the Administrative Procedures Act.

If the Commission denies a request for modification, revocation, or termination it must send the requester a brief, written response giving a reason for the decision. Denials are not subject to public notice, hearing, or comment. OAR 340-106-0005. Denials by the Commission are subject to judicial review under ORS 183.480 as orders in other than a contested case. OAR 340-106-0005(1)(c).

COPY

Procedure for Modification

The procedure for unilateral permit modifications by the Commission is not precisely specified in the statutes or rules. Preparation of a modified draft permit is required. 40 CFR 270.41. The procedures for public notice, comment and public hearing then become applicable. 40 CFR 124.10; 124.11; 124.12. The most logical procedure would appear to be for the Commission to direct the Department to prepare a modified draft permit which would be processed similarly to a new or reissued permit, i.e. noticed for public comment and hearing. 40 CFR 124.12(a)(3) incorporated by reference in OAR 340-100-002 as modified by Division 106. As with permit issuance, the Commission would then have the option of providing for contested case review of the modified permit by the permittee and/or interested persons.

LHE/GEN26561

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ATTACHMENT D

Transmittal Memoranda and Table of Contents
From
"Documentation Related to Case No. 9708-06159,
G.A.S.P., et al., v. Environmental Quality Commission, et al."

August, 1997 to June, 1999

Volumes 1 and 2

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Oregon
John A. Kitzhaber, M.D., Governor

Department of Environmental Quality
Eastern Region
Hermiston Office
256 E Hurlburt
Hermiston, OR 97838
Phone: (541) 567-8297
FAX: (541) 567-4741
TTY: (503) 229-6993

State of Oregon
Department of Environmental Quality **Memorandum**
DEQ Item No. 99-1882 (600.01)

DATE: November 3, 1999

TO: Melinda Eden
Tony Van Vliet
Linda McMahon
Mark Reeve
Harvey Bennett
Langdon Marsh
Larry Edelman
Stephen Bushong

FROM: Sue Oliver
DEQ, Hermiston

SUBJECT: Transmittal of Documentation Related to the "Request for Revocation" of the Umatilla permits.

Enclosed for your information are Volumes I and II of "Documentation Related to Case No. 9708-06159." These two volumes include copies of various legal filings, and all 74 Exhibits that were submitted by the Petitioners during the proceedings related to Case No. 9708-06159. The public comment period on the revocation request was opened on October 18, 1999 and is scheduled to close on December 17, 1999. The Petitioners have been given one hour to present oral comments (on November 19) related to the Exhibits. The Department is reviewing each of the Exhibits and will present the review at a later meeting (we anticipate that this will be on the EQC's February meeting agenda).

For your information, I have also included a list of legal filings and significant events and correspondence during the course of the legal proceedings related to this case. Not every document on the list was included in the two-volume set of documentation.

If you have any questions please contact me at 541-567-8297, ext. 26.

Enclosures:
Volumes I and II of "Documentation Related to Case No. 9708-06159"
"List of legal filings, hearings, and significant correspondence" (DEQ Item No. 99-1881)

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LIST OF LEGAL FILINGS, HEARINGS, AND SIGNIFICANT CORRESPONDENCE

GASP, ET AL. v. EQC AND DEQ
UMATILLA PERMITS
MULTNOMAH COUNTY CIRCUIT COURT CASE NO. 9708-06159

Documents that are shaded were included in the 2-volume set labeled "Documentation Related to Case No. 9708-06159" that was assembled for the public comment period (October 18, 1999 through December 17, 1999)

DATE	TITLE OF DOCUMENT	DEQ ITEM NO.
8-22-97	Petition for Review	98-1264
9-25-97	Respondent's Motion for Designation as Complex Case	98-1263
9-29-97	Respondent's ORCP 21E Motions to Strike	98-1262
10-8-97	U.S. Army's Unopposed Motion to Intervene	98-1260
10-9-97	Petitioner's First Request for Admissions	98-1257
10-9-97	Petitioner's First Request for Production of Documents	98-1258
10-17-97	Petitioner's ORCP 23 Motion for Leave to Amend Petition and Response to Respondent's ORCP 21 Motions	98-1253
10-30-97	Answer of Intervenor	98-1249
11-6-97	Respondent's Answer to Petition for Review	98-1250
4-13-98	Respondent's Memorandum in Support of Motion for Summary Judgment	98-1423
8-20-98	Petitioner's Memorandum Supporting Cross Motion for Summary Judgment and Opposing Respondent's Motion for Summary Judgment (includes exhibits 1 through 49)	98-1275
8-20-98	Petitioner's Cross Motion for Summary Judgment	98-1276
9-30-98	Respondent's Reply Memorandum in support of Motion for Summary Judgment and in Opposition to Cross-Motion for Summary Judgment Includes Exhibits 1-3 (and copy of Utah Court of Appeals Decision)	98-1287
10-23-98	Oral Arguments before Judge Marcus	N/A
11-10-98	Petitioners' Additional Documentary Evidence In Support of Reversal and/or Remand of the EQC's/DEQ's Permit Decisions (includes exhibits 50 through 65, plus a revised version of exhibit 27 from 8-20-98 filing)	98-1285
11-23-98	Letter from Judge Marcus regarding new evidence and schedule for ruling.	98-01282
11-30-98	Respondents' Memorandum In Response to Petitioners' Additional Documentary Evidence.	98-1279
12-6-98	Opinion and Order on Cross Motions for Summary Judgment	98-1277

DATE	TITLE OF DOCUMENT	DEQ ITEM NO.
12-14-98	Petioners send a letter to the EQC and DEQ requesting a Contested Hearing and Other Relief	98-1247
12-28-98	Petitioners' Motion For Relief From An Order Of The Court, Or For Supplemental Relief (Includes Exhibits 66 and 67)	98-1419
1-13-99	Respondents' Memorandum In Oppostion to Motion For Relief From Order	99-0087
1-19-99	Petitioners' Reply To Opposition to Motion For Relief (Includes Exhibit 68)	99-1752
1-22-99	Hearing before Judge Marcus (Petition for Motion for Relief is denied)	N/A
1-29-99	Order Regarding Motion For Relief (Denial)	99-0661
2-4-99	Letter from Langdon Marsh denying request for contested case hearing (reply to petitioners' December 14 1998 letter)	99-0624
3-25-99	Respondents' Supplemental Motion for Summary Judgment	99-0494
4-5-99	Petitioners' First Supplemental Petition for Review (Includes Exhibits 69 and 70)	99-1751
4-12-99	Petitioners' Opposition to Respondents' Supplemental Motion for Summary Judgment (Includes Exhibits 71-74)	99-0704
4-22-99	Respondents' Memorandum in Opposition to Motion for Leave to File First Supplemental Petition for Review	99-1859
4-22-99	Respondents' Reply in Support of Supplemental Motion for Summary Judgment	99-1860
4-29-99	Respondents' Memorandum in Opposition to Motion for Leave to File Second Supplemental Petition for Review	99-0738
5-10-99	Petitioners' Reply Supporting Motions for Leave to File First and Second Supplemental Petitions for Review	99-0834
6-1-99	Hearing for Oral Arguments before Judge Marcus	N/A
6-1-99	Opinion and Order Denying Supplemental Petitions and For Final Judgment	99-0942
7-2-99	Notice of Appeal and Designation of Record	99-1259

SLLE

State of Oregon
Department of Environmental Quality Memorandum

DEQ Item No. 99-1876 (600.01)

To: Information Repositories for the Umatilla Chemical Agent Disposal Facility

From: Wayne C. Thomas (WCT) 11/3/99
Program Manager
Umatilla Chemical Agent Disposal Program

Date: November 3, 1999

Re: Invitation to Comment on Request for Revocation of Permits

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Documentation related to Case No. 9708-06159
(G.A.S.P., et al. *v.* Environmental Quality Commission, et al.)

The records of the Department of Environmental Quality (DEQ) indicate that you are an Information Repository for information related to the Umatilla Chemical Depot and the Umatilla Chemical Agent Disposal Facility (Hazardous Waste Treatment and Storage Permit I.D. No. ORQ 000 009 431). The Department has recently opened a public comment period on a Request for Revocation" of the Umatilla Chemical Agent Disposal Facility permits. The enclosed binders contain information related to the Request for Revocation. Please place the binders (Volume I and Volume II) with your information related to the Umatilla facility.

If you have any questions please contact Wayne C. Thomas of the Department of Environmental Quality at (541) 567-8297, ext. 22.

COPY

State of Oregon
Department of Environmental Quality Memorandum

To: Karyn Jones
G.A.S.P.

From: Wayne C. Thomas WCT 11/5/99
Program Manager
Umatilla Chemical Agent Disposal Program

Date: November 5, 1999

Re: Transmittal of Documentation Related to the "Request for Revocation" of the Umatilla Permits [DEQ Item No. 99-1915 (600.01)]

Enclosed for your information are Volumes I and II of "Documentation Related to Case No. 9708-06159." These two volumes include copies of various legal filings, and all 74 Exhibits that were submitted by the Petitioners during the proceedings related to Case No. 9708-06159. The public comment period on the revocation request was opened on October 18, 1999 and is scheduled to close on December 17, 1999.

COPY

State of Oregon
Department of Environmental Quality

Memorandum

To: Richard Condit
Attorney at Law

From: Wayne C. Thomas
Program Manager
Umatilla Chemical Agent Disposal Program

WCT 11/5/99

Date: November 5, 1999

Re: Transmittal of Documentation Related to the "Request for Revocation" of the Umatilla Permits [DEQ Item No. 99-1916 (600.01)]

Enclosed for your information are Volumes I and II of "Documentation Related to Case No. 9708-06159." These two volumes include copies of various legal filings, and all 74 Exhibits that were submitted by the Petitioners during the proceedings related to Case No. 9708-06159. The public comment period on the revocation request was opened on October 18, 1999 and is scheduled to close on December 17, 1999.

COPY

State of Oregon
Department of Environmental Quality Memorandum

To: Lieutenant Colonel Thomas F. Woloszyn
Commander
Umatilla Chemical Depot

From: Wayne C. Thomas WCT 11/5/99
Program Manager
Umatilla Chemical Agent Disposal Program

Date: November 5, 1999

Re: Transmittal of Documentation Related to the "Request for Revocation" of the Umatilla Permits [DEQ Item No. 99-1914 (600.01)]

Enclosed for your information are Volumes I and II of "Documentation Related to Case No. 9708-06159." These two volumes include copies of various legal filings, and all 74 Exhibits that were submitted by the Petitioners during the proceedings related to Case No. 9708-06159. The public comment period on the revocation request was opened on October 18, 1999 and is scheduled to close on December 17, 1999.

Cf: Raj Malhotra, PMCSD
Jay Bluestein, Raytheon

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Table of Contents i

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Volume I "Documentation Related to Case No. 9708-06159" iii

List of Petitioners' Exhibits iv

Following Page xii:

Chance to Comment Form

Agenda for the November 18-19, 1999, meeting of the Environmental Quality Commission

"DOCUMENTATION RELATED TO CASE NO. 9708-06159"
G.A.S.P., ET AL. V. ENVIRONMENTAL QUALITY COMMISSION, ET AL.
RELATED TO THE
UMATILLA CHEMICAL AGENT DISPOSAL FACILITY (UMCDF)

BACKGROUND

In August 1997 a legal challenge to the UMCDF permits was filed in Multnomah County Circuit Court (Case No. 9708-06159) by G.A.S.P. (a local Hermiston organization), the Sierra Club of Oregon, Oregon Wildlife Federation, and 22 individuals (collectively referred to as the "Petitioners"). The Petitioners challenged the validity of the hazardous waste and air permits issued by the Environmental Quality Commission (EQC) and the Department of Environmental Quality (DEQ) ("Agencies") in February, 1997. A final judgment affirming the Agencies' decisions to issue hazardous waste and air permits for UMCDF was entered in June, 1999. (The Petitioners have appealed that decision to the Oregon Court of Appeals. The appeal is currently pending.)

The Petitioners contend that there is new information since the issuance of the permits that provides a basis for revocation. The information submitted by the Petitioners consists of 74 "Exhibits" representing approximately 120 individual documents, plus various letters and comments submitted to the Agencies by the Petitioners.

In connection with the Circuit Court case, the EQC and DEQ made a commitment to the Court that a letter written by the Petitioners to the Agencies on December 14, 1998, (see Exhibit 69 in Volume II) would be treated as a request for revocation of the permits under applicable regulations. A public comment period was opened on October 18 and will close on December 17, 1999.

Volume I contains copies of various legal filings during the course of the lawsuit proceedings, some of which make specific references to one or more of the Exhibits (Volume I includes Exhibits 1-25, Volume II includes Exhibits 26-74). Volume I also contains (immediately following this Table of Contents) the "Chance to Comment" form and an Agenda for a meeting of the Environmental Quality Commission scheduled for November 18-19, 1999. The EQC will be accepting oral testimony on November 19 about this issue.

If you have any questions about this material-please call the Hermiston office of the DEQ at 541-567-8297. Written comments should be received by the DEQ no later than 5:00 p.m., December 17, 1999. The mailing address is Wayne C. Thomas, DEQ – Hermiston Office, 256 E. Hurlburt, Suite 105, Hermiston, OR 97838. The facsimile number is (541) 567-4741.

VOLUME I

"DOCUMENTATION RELATED TO CASE NO. 9708-06159"
G.A.S.P., ET AL. *v.* ENVIRONMENTAL QUALITY COMMISSION, ET AL.
UMATILLA CHEMICAL AGENT DISPOSAL FACILITY

This list is organized chronologically by date.
The tabs in Volume I are arranged by "DEQ Item No." for ease of reference.

DATE	TITLE OF DOCUMENT	DEQ ITEM NO.
8-22-97	Petition for Review	98-1264
4-13-98	Respondent's Memorandum in Support of Motion for Summary Judgment	98-1423
8-20-98	Petitioner's Memorandum Supporting Cross Motion for Summary Judgment and Opposing Respondent's Motion for Summary Judgment (References Exhibits 1 through 49) (Exhibits 1-25 are in Volume I, 26-49 are in Volume II)	98-1275
9-30-98	Respondent's Reply Memorandum in support of Motion for Summary Judgment and in Opposition to Cross-Motion for Summary Judgment	98-1287
11-10-98	Petitioners' Additional Documentary Evidence In Support of Reversal and/or Remand of the EQC's/DEQ's Permit Decisions (References Exhibits 50 through 65, see Volume II)	98-1285
11-30-98	Respondents' Memorandum In Response to Petitioners' Additional Documentary Evidence.	98-1279
12-6-98	Opinion and Order on Cross Motions for Summary Judgment	98-1277
12-14-98	Petioners send a letter to the EQC and DEQ requesting a Contested Hearing and Other Relief	98-1247
12-28-98	Petitioners' Motion For Relief From An Order Of The Court, Or For Supplemental Relief (References Exhibits 66 and 67, see Volume II)	98-1419
1-13-99	Respondents' Memorandum In Oppostion to Motion For Relief From Order	99-0087
1-19-99	Petitioners' Reply To Opposition to Motion For Relief (References Exhibit 68)	99-1752
1-29-99	Order Regarding Motion For Relief (Denial)	99-0661
3-25-99	Respondents' Supplemental Motion for Summary Judgment	99-0494
4-5-99	Petitioners' First Supplemental Petition for Review (References Exhibits 69 and 70, see Volume II)	99-1751
4-12-99	Petitioners' Opposition to Respondents' Supplemental Motion for Summary Judgment (References Exhibits 71-74, see Volume II)	99-0704
6-1-99	Opinion and Order Denying Supplemental Petitions and For Final Judgment	99-0942

List of Petitioner's Exhibits (Case No. 9708-06159)

Exhibit Number	*Title*	*Date of Document*	*Author*	*Volume No.*
1	Karyn Jones' (and GASP) Standing Affidavit	17-Aug-98	Karyn Jones	I
2	Dr. Robert J. Palzer's (and Sierra Club's) Standing Affidavit	07-Aug-98	Dr. Robert J. Palzer	I
3	Cindy Beatty's Standing Affidavit	17-Aug-98	Cindy Beatty	I
4	Christine Clark's Standing Affidavit	18-Aug-98	Christine Clark	I
5	David Burn's Standing Affidavit	12-Aug-98	David Burns	I
6	Debra Burn's Standing Affidavit	11-Aug-98	Debra Burns	I
7	Gail L. Horning's Standing Affidavit	17-Aug-98	Gail L. Horning	I
8	Heather Billy's Standing Affidavit	13-Aug-98	Heather Billy	I
9	Janet S. Nagy's Standing Affidavit	17-Aug-98	Janet S. Nagy	I
10	Karla Stuck's Standing Affidavit	13-Aug-98	Karla Stuck	I
11	LaDonna King's Standing Affidavit	17-Aug-98	LaDonna King	I
12	Pius Horning's Standing Affidavit	17-Aug-98	Pius Hornings	I
13	Stuart Dick's Standing Affidavit	14-Aug-98	Stuart Dick	I
14	Andrea E. Stine's Standing Affidavit	10-Aug-98	Andrea E. Stine	I
15	Merle Jones' Standing Affidavit	17-Aug-98	Merle Jones	I
16	Janice H. Lohman's Standing Affidavit	15-Aug-98	Janice Lohman	I
17	John Spomer's Standing Affidavit	17-Aug-98	John Spomer	I
18	Susan L. Jones' Standing Affidavit	17-Aug-98	Susan L. Jones	I
19	Leandra Phillips' Standing Affidavit	15-Aug-98	Leandra Phillips	I
20	Melanie Beltane's Standing Affidavit	18-Aug-98	Melanie Beltane	I
21	Dorothy Irish's Standing Affidavit	13-Aug-98	Dorothy Irish	I

List of Petitioner's Exhibits (Case No. 9708-06159)

Exhibit Number	*Title*	*Date of Document*	*Author*	*Volume No.*
22	Paul Loney's Standing Affidavit for Oregon Wildlife Federation	20-Aug-98	Paul Loney, Oregon Wildlife Federation	I
23	Deposition of John K. Cluff (CWWG, et al. v. U.S. Army, et al.; Case No. 96-CV-0425C; TOCDF)	17-Jul-96	John Cluff	I
24	Deposition of John K. Cluff (CWWG, et al. v. U.S. Army, et al.; Case No. 96-CV-0425C; TOCDF)	18-Jul-96	John Cluff	I
25	Deposition of Timothy W. Thomas (CWWG, et al. v. U.S. Army, et al.; Case No. 2:96-CV-0425C; TOCDF)	05-Feb-98	Timothy Thomas	I
26	Affidavit of John Houston Miller	03-Jun-96	John Houston Miller	II
27	Affidavit of Thomas Bodley Stibolt Jr. and Lisa (Elizabeth) P. Brenner	19-Aug-98	Thomas Bodley Stibolt Jr. & Lisa P. Brenner	II
27.1	Review of the inhalation modeling compounds and standards used in the RA for human health effects	17-Aug-98	Lisa Brenner & Tom Stibolt	II
27.2	A Listing of the Compounds that PRC claims should be included in the modeling analysis	16-Aug-98	Lisa Brenner and Tom Stibolt	II
27.3	Table 1 - Comparison of Potential PICS, Recommended PICS, and Proposed Emission Rates	16-Aug-98	PRC Environmental Management	II
27.4	Fundamentals of Risk Analysis and Risk Management	01-Jan-97	Vlasta Molak, editor	II
27.5	Umatilla Chemical Agent Disposal Facility Phase 1 Quantitative Risk Assessment	01-Sep-96	Science Applications International Corporation	II
27.6	Technical Aspects of the Model and the Air Quality Impact Analysis	17-Aug-98	Thomas Stibolt and Lisa Brenner	II
28	Trygve P. Steen's Affidavit	20-Aug-98	Trygve P. Steen	II
28.1	Thinking of Biology - Science, environmental risk assessment, and the frame problem	01-Sep-94	Kristin S. Shrader-Frechette	II
28.2	Curriculum Vitae of Trygve P. Steen	01-Jun-98	Trygve P. Steen	II
29	James R. Wilkinson's Affidavit	19-Aug-98	James R. Wilkinson	II

List of Petitioner's Exhibits (Case No. 9708-06159)

Exhibit Number	*Title*	*Date of Document*	*Author*	*Volume No.*
29.1	Resolution of the CTUIR Board of Trustees	17-Jan-96	Donald Sampson, Chairman	II
29.2	Lines Drawn in the Sand: A Review of Challenges, Opportunities, and Options for Chemical Weapons Disposal (presented to the Oregon EQC)	14-Nov-96	Donald Sampson, Armand Minthorn, J.R. Wilkinson	II
30	Deposition of James Cudahy (CWWG, et al. v. U.S. Army, et al.; Case No. 2:96-CV-0425C; TOCDF)	16-Feb-98	James Cudahy	II
31	Affidavit of Pat Costner	27-Jul-98	Pat Costner	II
32	TOCDF Unusual Occurrence Report: Metal Parts Furnace Feed Rate Exceedance	02-Apr-98	Michael J. Rowe, Timothy Thomas, Harold Oliver	II
33	Telephonic Deposition of Richard Holmes (CWWG, et al. v. U.S. Army, et al.; Case No. 2i96-CV-0425C; TOCDF)	14-Apr-98	Richard Holmes	II
34	Continuation of the Telephonic Deposition of Richard Holmes (CWWG, et al. v. U.S. Army, et al.; Case No. 2i96-CV-0425C; TOCDF)	15-Apr-98	Richard Holmes	II
35	Health Assessment Document for 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD) and Related Compounds Volume III of III (External Review Draft)	01-Aug-94	U.S. Environmental Protection Agency	II
36	Cross-examination of John K. Cluff (CWWG, et al. v. U.S. Army, et al.; Case No. 2:96-CV-0425C; TOCDF)	25-Jul-96	John Cluff	II
37.1	1997 Declaration of the Environmental Leaders of the Eight on Children's Environmental Health	27-Jul-98	Office of Children's Protection	II
37.2	Executive Order: Protection of Children From Environmental Health Risks and Safety Risks	21-Apr-97	The White House	II
38	Final Screening Risk Assessment Resource Conservation and Recovery Act Part B Pine Bluff Chemical Agent Disposal Facility	08-Oct-97	United States Army Center for Health Promotion and Preventive Medicine	II
39	Affidavit of Dr. Peter deFur	31-Jul-98	Dr. Peter deFur	II

List of Petitioner's Exhibits (Case No. 9708-06159)

Exhibit Number	*Title*	*Date of Document*	*Author*	*Volume No.*
40	Public Health and Chemical Weapons incineration	01-Mar-98	Kentucky Environmental Foundation	II
40.1	Public Health Effects of Chemical Weapons Incineration	01-Mar-98	Richard Clapp	II
40.2	Toxic Exposures and Chronic Illnesses	01-Mar-98	Howard Urnovitz	II
40.3	Critique of Chemical Weapons Incineration Risk Assessment	01-Mar-98	Peter deFur	II
40.4	Toxicology of Chemical Agents	01-Mar-98	Robert Ginsburg	II
40.5	Health Effects of Low-level Exposure to Nerve Agent	01-Mar-98	Jerry Buccafusco	II
40.6	Synthetic Chemicals as Endocrine Disruptors	01-Mar-98	Peter deFur and Carolyn Raffensperger	II
41	Nerve gas danger underestimated, study says	29-Jul-98	James Long, The Oregonian	II
42	Examination of Deborah Ng; Utah DEQ Solid and Hazardous Waste Control Board; Hearing on TOCDF Permit Modification; Transcript of Proceedings	19-Mar-97	Deborah Ng	II
43	Examination of Timothy Thomas (CWWG, et al. v. U.S. Army, et al.; Case No. 2:96-CV-0425C; TOCDF), Transcript of Preliminary Injunction Hearing	03-Mar-97	Timothy Thomas	II
44.1	Examination of Dennis Downs, Scott Anderson, and Martin Grey; Utah DEQ Solid and Hazardous Waste Control Board; Hearing on TOCDF Permit Modification; Transcript of Proceedings	18-Mar-97	Downs; Grey; Anderson	II
44.2	Examination of Deborah Ng and Mr. Smith; Utah DEQ Solid and Hazardous Waste Control Board; Hearing on TOCDF Permit Modification; Transcript of Proceedings	19-Mar-97	Ng and Smith	II
45	Fact Sheet - EPA Special Report on Endocrine Disruption	01-Feb-97	U.S. Environmental Protection Agency	II
46	Excerpts from the Journals of Gary Millar	09-Sep-96	Gary Millar(???)	II

List of Petitioner's Exhibits (Case No. 9708-06159)

Exhibit Number	*Title*	*Date of Document*	*Author*	*Volume No.*
47	Examination of Mr. Timothy Thomas;; Utah DEQ Solid and Hazardous Waste Control Board; Hearing on TOCDF Permit Modification; Transcript of Proceedings	20-Mar-97	Timothy Thomas	II
48	Annual Status Report on the Disposal of Chemical Weapons and Materiel for Fiscal Year 1997 .	30-Sep-97	Department of Defense	II
49	Deposition of Robert Bruce Perry (CWWG, et al. v. U.S. Army, et al.; Case No. 96-CV-0425C; TOCDF)	16-Jul-96	Robert Bruce Perry	II
50	Review of Acute Human-Toxicity Estimates for Selected Chemical Warfare Agents	01-Jan-97	National Research Council	II
51	Long-term Health Effects Associated with Sub-Clinical Exposure to GB and Mustard	18-Jul-96	Dennis M. Perrotta, PhD, CIC, Chair	II
52	105th Congress Report - Gulf War Veteran's Illnesses: VA, DOD Continue to Resist Strong Evidence Linking Toxic Causes to Chronic Health Effects	07-Nov-97	Committee on Government Reform and Oversight (House of Representatives)	II
53	Chemical Weapons DOD Does Not Have a Strategy to Address Low-Level Exposures	01-Sep-98	US General Accounting Office	II
54	Toxicological Profile for 2,3,7,8-Tetrachloridibenzo-p-Dioxin	01-Jun-89	Syracuse Research Corporation for ATSDR (U.S. Public Health Service) and EPA.	II
55	Drinking Water Criteria Document for 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (Final Draft; EPA 600/X-84-194-1)	01-Mar-85	U.S. Enviornmental Protection Agency, Environmental Criteria and Assessment Office	II
56	"Remedial Activities at Uncontrolled Hazardous Wste Sites in the Zone of Regions VI, VII, VIII." Possibly from the "Final Times Beach Site Multimedia Risk Assessment - Volume I"	28-Mar-95	U.S. Environmental Protection Agency	II
57	Review of Systemization of Tooele Chemical Agent Disposal Facility	01-Mar-96	National Research Council	II
58	Interim Status Assessment for the Chemical Demilitarization Program	15-Apr-96	Department of Defense	II

List of Petitioner's Exhibits (Case No. 9708-06159)

Exhibit Number	*Title*	*Date of Document*	*Author*	*Volume No.*
59	Deposition of Robert Bruce Perry	16-Jul-96	Robert Bruce Perry	II
60	"Information Paper" regarding dioxin emissions from the DUN	21-May-96	LTC John Ontiveros	II
61	EG&G Memo - Discontinuing op. Of BRA at the Tooele Facility	28-Jul-98	Tom Kurkjy & Debbie Sweeting	II
62	Table prepared by the Utah Division of Solid and Hazardous Waste - compiling data concerning the enormous off-site waste disposal needs of the Tooele Facility - based on data from 8/96 through 3/98		Utah DEQ	II
63	Pilot testing of Neutralization/Biotreatment of Mustard Agent at Aberdeen Proving Ground, Maryland - Final Environmental Impact Statement	01-Jul-98	PMCD	II
64	Excerpts from the testimony of Army expert Gary Boyd	29-Jul-96	Gary Boyd	II
65	Public Health Assessment for US Army Umatilla Depot Activity - Public Health Service Agency for Toxic Substance and Disease Registry	30-Sep-97	HHS	II
66	Attachment A, Appendix 3 - PAS Carbon Filter Unit and Emission tot he Carbon filters Permit Conditions	28-Dec-98	Oregon Department of Environmental Quality	II
67	Appendix 3 - Commission Response - February 7, 1997	07-Feb-97	II	
68	Agenda Environmental Quality Commission Meeting (EQC) January 29, 1999	01-Jan-99	Environmental Quality Commission	II
69	Request for Contested Case Hearing and Other Relief	14-Dec-98	Stuart Sugarman	II
70	Umatilla Army Depot Request for Contested Case Hearing	04-Feb-99	Langdon Marsh	II
71	Comments on EQC Order Clarifying Permit Decision	15-Mar-99	Stuart Sugarman, Richard Condit	II
71.1	Risk Assessment of the Pollution Abatement Filter System for the Umatilla Chemical Agent Disposal Facility	01-Sep-98	Mitretek Technical Report	II

List of Petitioner's Exhibits (Case No. 9708-06159)

Exhibit Number	*Title*	*Date of Document*	*Author*	*Volume No.*
72	Supplement to March 15, 1999 Comments	18-Mar-99	Sugarman & Condit	II
72.1	Department of Defense's Status Assessment for the Chemical Demilitarization Program	01-Jan-97	II	
73	Petitioner's Attorney's Affidavit Supporting Memorandum Opposing Supplemental Motion for Summary Judgment	12-Apr-99	Stuart Sugarman	II
74	Affidavit of Dr. Lisa P. Brenner & Dr. Thomas Stibolt with "Analyis of Kristina Iisa's Report Concerning the Emission of Dioxin and the Use of PAS Carbon Filters"	12-Apr-99	Dr. Lisa P. Brenner & Dr. Thomas Stibolt	II
74.1	Appendix 1 - Iisa Report References With Quotes from the References (attached to Exhibit #74)	12-Apr-99	Dr. Lisa P. Brenner & Dr. Thomas Stibolt	II
74.2	Appendix II to Exhibit 74 - Summary of the events found in the record	12-Apr-99	Dr. Lisa P. Brenner & Dr. Thomas Stibolt	II
74.3	Appendix III to Exhibit 74 - Copies of the References from Kristina Iisa's Dioxin Report to the EQC	12-Apr-99	Dr. Lisa P. Brenner & Dr. Thomas Stibolt	II
74.301	A New Theory of Dioxin Formation in Municipal Solid Waste Combustion	01-Nov-86	Roger D. Griffin	II
74.302	Effect of Sulfur Dioxide on the Formation Mechanism of Polychlorinated Dibenzodioxin and Dibenzofuran in Municipal Waste Combustors	01-Jun-92	Brian K. Gullett	II
74.303	Combustion Dioxin Supression in Municipal Solid Waste Incineration with Sulphur Additives	01-Oct-92	Ralf L. Lindbauer, Friedrich Wurst and Theodor Prey	II
74.304	Effect of Sulfur in Reducing PCDD/PCDF Formation	11-May-98	K. Raghunathan and Brian K. Gullett	II
74.305	Dioxin Reduction by Sulfur Component Addition	01-Jan-96	Hiroshi Ogawa, Norihiko Orita, Mitsuhiro Horaguchi, Takumi Suzuki, Mitsuhiro Okada and Shirzuo Yasuda	II

List of Petitioner's Exhibits (Case No. 9708-06159)

Exhibit Number	*Title*	*Date of Document*	*Author*	*Volume No.*
74.306	Dioxin Emissions from Full Scale Hazardous Waste Combustion Units Handling Variable Chlorine Feed Compositions	11-May-98	J.D. Wilson, C.N. Park and D.I. Townsend	II
74.307	Effects of Facility Contamination on Dioxin Emissions	01-May-96	K. Raghunathan	II
74.308	Dioxin Emissions from Full Scale Hazardous Waste Combustion Units Handling Variable Chlorine Feed Compositions	11-May-98	J.D. Wilson, C.N. Park and D.I. Townsend	II
74.309	The Relationship Between Chlorine in Waste Streams and Dioxin Emissions from Waste Combustor Stacks (CRTD 36)	20-Oct-95	H. Gregor Rigo, A.J. Chandler, and W.S. Lanier	II
74.31	Evaluation of Carbon Injection for Controlling PCDD/PCDF Emissions at WTI's Commercial Hazardous Waste Incineration Facility	11-May-98	Douglas R. Roeck, Alfred Sigg	II
74.311	Mechanisms for Formation and Options for Control of Emissions of PCDD'S/PCDF'S from Incineration	11-May-98	D.I. Townsend, J.D. Wilson and C.N. Park	II
74.312	Dioxin/Furan Formation and Control in Waste Combustors	01-May-96	K. Raghunathan and Brian K. Gullett	II
74.313	Formation of Polychlorinated Dibenzofurans by Chlorination and de Novo Reactions with FeCl3 in Petroleum Refining Processes	03-Mar-93	Adrian Beard, K.P. Nalkwadi and F.W. Karasek	II
74.314	PCDD and PCDF Formation From Hydrocarbon Combustion in the Presence of Hydrogen Chloride	01-Jul-92	R. De Fre and T. Rymen	II
74.315	Mechanisms of Formation and Destruction of Polychlorinated Dibenzo-p-dioxins and Dibenzofurans in Heterogeneous Systems	01-Jun-95	Ruud Addink and K. Olie	II
74.316	Prevention of PCDD Formation in MSW Incinerator by Inhibition of Catalytic Activity of Fly Ash Produced	01-Jul-89	Naikadi K.P. and F.W. Karasek	II
74.317	Reduction of Dioxins by Combustion Control and Prevention of Reformation (Control of the Denovo Reaction)	01-May-96	William Prescott	II

List of Petitioner's Exhibits (Case No. 9708-06159)

Exhibit Number	Title	Date of Document	Author	Volume No.
74.318	Effects of Copper Contamination on Dioxin Emissions from CFC Incineration	01-Jan-96	G.W. Lee, J.V. Ryan, R.E. Hall, et al.	II
74.319	Reduction of Dioxins by Combustion Control and Prevention of Reformation (Control of the Denovo Reaction)	01-May-96	William Prescott	II
74.32	Inhibition Effect of Calcium Compound Fed to Furnace on PCDDS/PCDFS from Incineration Plant	11-May-98	S. Matsui, T. Iwasaki and T. Noto	II
74.321	A Survey of Post-Combustion PCDD/PCDF Control Technologies	11-May-96	B. Siret, K. Gilman	II
74.322	Comparison of Dry Sorbent Injection of Sodium Bicarbonate Lime and Carbon and their Control of Dioxins/Furans, Mercury, Chlorides and Sulfur Dioxide	01-May-96	John Maziuk, Jr	II
74.323	Reduction of Dioxin/Furan Emissions from an Incineration Plant by Means of an Activated Carbon Filter	11-May-98	G. Steinhaus and F. Dirks	II
74.324	Catalyst Development for the Destruction of Volatile Organic Compounds in the Flue Gas of Municipal Waste Incinerators	01-May-96	H. Dropsch, J. Stohr and J. Furrer	II
74.325	Rotary Kiln Incinerator at Bayer AG in Germany Sets New Performance Standards for Air Emissions	01-May-96	Dr. Hans Piechura and Dr. Peter K. Zeeb	II

Oregon Department of Environmental Quality

A CHANCE TO COMMENT ON...

INVITATION TO COMMENT ON REQUEST FOR REVOCATION OF PERMITS	Public Notice Date: October 18, 1999 Comments Due: December 17, 1999

UMATILLA CHEMICAL AGENT DISPOSAL FACILITY (UMCDF)
UMATILLA CHEMICAL DEPOT
HERMISTON, OREGON
PERMIT NO. ORQ 000 009 431

For what facility?

This Invitation to Comment is related to the Umatilla Chemical Agent Disposal Facility (UMCDF) currently under construction at the U.S. Army's Umatilla Chemical Depot near Hermiston in Eastern Oregon. The UMCDF is an incineration facility that will be used to destroy the stockpile of chemical warfare agents that have been stored at the Depot since the mid-1960s. The chemical agents at the Umatilla Chemical Depot are stored in munitions and bulk containers and include the lethal nerve agents known as "GB" (Sarin) and "VX," and the blister agent "HD" (commonly known as "mustard").

Who has requested revocation of the UMCDF permits?

In August 1997 a legal challenge to the UMCDF permits was filed in Multnomah County Circuit Court (Case No. 9708-06159) by G.A.S.P. (a local Hermiston organization), the Sierra Club of Oregon, Oregon Wildlife Federation, and 22 individuals (collectively referred to as the "Petitioners"). The Petitioners challenged the validity of the hazardous waste and air permits issued by the Environmental Quality Commission (EQC) and the Department of Environmental Quality (DEQ) ("Agencies") in February, 1997. A final judgment affirming the Agencies' decisions to issue hazardous waste and air permits for UMCDF was entered in June, 1999. (The Petitioners have appealed that decision to the Oregon Court of Appeals. The appeal is currently pending.)

In connection with the Circuit Court case, the EQC and DEQ made a commitment to the Court that a letter written by the Petitioners to the Agencies on December 14, 1998, would be treated as a request for revocation of the permits under applicable regulations.

What is the basis for the revocation request?

The Petitioners contend that there is new information since the issuance of the permits that provides a basis for revocation. The information submitted by the Petitioners consists of 74 "Exhibits" representing approximately 120 individual documents, plus various letters and comments submitted to the Agencies by the Petitioners.

The documents submitted by the Petitioners include, but are not limited to, excerpts from Court proceedings related to the Army's Tooele, Utah chemical agent disposal facility; information related to the toxicity and health effects of chemical agents and emissions from incineration facilities; and information about conducting health risk assessments. The Department has placed copies of the Exhibits and other related documents in the information repositories listed below.

Is there going to be a public hearing?	A regular meeting of the EQC is scheduled for November 18-19, 1999 in Portland, Oregon. The Commission will take oral public testimony beginning at 2:00 p.m. on November 19, but is not expected to reach a decision on the request for revocation until a later meeting. The meeting will be held at the DEQ Headquarters building, Conference Room 3A, 811 S.W. Sixth Ave., Portland, Oregon, 97204. A separate agenda for the EQC meeting is attached.
Where can I find more information?	Please call the Hermiston office of the DEQ if you would like to be provided a list of all the available documents related to this matter. DEQ will place the documents in the following information repositories: DEQ--Hermiston Office 256 E. Hurlburt, Suite 105 Hermiston, OR 97838 (541) 567-8297 Hermiston Public Library 235 E. Gladys Avenue Hermiston, OR 97838 (541) 567-2882 Pendleton Public Library 502 S.W. Dorion Avenue Pendleton, OR 97801 (541) 966-0210 Mid Columbia Library (Kennewick Branch) 1620 S. Union St. Kennewick, WA 99336 (509) 586-3156 or 1-800-572-6251 Portland State University Library 951 SW Hall, Fifth Floor Portland, OR 97204 (503) 725-4617 Umatilla Community Outreach Office 245-B East Main Street Hermiston, OR 97838 (541) 564-9339
Where do I send my comments?	Written comments should be received by the DEQ no later than 5:00 p.m., December 17, 1999. The mailing address is Wayne C. Thomas, DEQ – Hermiston Office, 256 E. Hurlburt, Suite 105, Hermiston, OR 97838. The facsimile number is (541) 567-4741.
What happens next?	The members of the EQC will review the documents submitted by the Petitioners and all comments received during the comment period. The EQC will accept oral testimony on the Petitioners' revocation request at the November meeting. The Department is also reviewing the Petitioners' documents and all comments received during the public comment period. The Department will prepare a staff report with recommendations for the EQC's consideration at its February 2000 meeting. It is expected that the EQC may issue a decision on the request for revocation at or following the February 2000 meeting
Accommodation of disabilities:	Please notify DEQ about any special physical or language accommodations you may need as far in advance of the meeting or hearing as possible. To make these arrangements, contact Sylvia Herrley at 1-800-452-4011 (toll free in Oregon), or at (503) 229-5317. People with hearing impairments may call DEQ's TDD number at (503) 229-6993.

A G E N D A

ENVIRONMENTAL QUALITY COMMISSION MEETING

November 18-19, 1999
DEQ Conference Room 3A
811 S. W. Sixth Avenue
Portland, Oregon

Notes: Because of the uncertain length of time needed for each agenda item, the Commission may deal with any item at any time in the meeting. If a specific time is indicated for an agenda item, an effort will be made to consider that item as close to that time as possible. However, scheduled times may be modified if agreeable with participants. Anyone wishing to listen to the discussion on any item should arrive at the beginning of the meeting to avoid missing the item of interest.

Public Forum: The Commission will break the meeting at approximately 11:30 a.m. for the General Public Forum if there are people signed up to speak. The Public Forum is an opportunity for citizens to speak to the Commission on environmental issues and concerns not a part of the agenda for this meeting. The public comment period has already closed for the Rule Adoption items and, in accordance with ORS 183.335(13), no comments can be presented to the Commission on those agenda items. Individual presentations will be limited to 5 minutes. The Commission may discontinue this forum after a reasonable time if an exceptionally large number of speakers wish to appear.

Thursday, November 18
Beginning at 1:30 p.m.

Work Session: Tax Credit Application Number 5009

A. Approval of Minutes

B. Approval of Tax Credits

Friday, November 19
Beginning at 8:30 a.m.

C. **Informational Item:** Update on the General Air Contaminant Discharge Permits (ACDP)

D. **Action Item:** Appeal of Hearing Order Regarding Assessment of Civil Penalty in the Matter of Cascade General, Inc., Case No. HW-NWR-97-176

E. †Rule Adoption: On-site Sewage Disposal Fees

F. †Rule Adoption: Rules Establishing Review and Acceptance Criteria for New or Innovative Technologies and Materials for Application in the On-site Program

G. Action Item: Reopen the Permit at the Umatilla Chemical Agent Disposal Facility (UMCDF) for Modifications with Respect to the Inclusion of the Carbon Filter System as Part of the Pollution Abatement System

H. Commissioners' Reports

I. Director's Report

2:00 p.m. - Public Comment: UMCDF Permit Revocation Request Dated December 14, 1998 from GASP, et al only

†Hearings have already been held on the Rule Adoption items and the public comment period has closed. In accordance with ORS 183.335(13), no comments can be presented by any party to either the Commission or the Department on these items at any time during this meeting.

The Commission will honor outgoing Chair, Carol Whipple before the meeting on November 18.

The Commission will have lunch at 12:00 noon on November 19. No Commission business will be discussed.

The Commission has set aside February 10-11, 2000, for their next meeting. The location has not been established.

Copies of staff reports for individual agenda items are available by contacting the Director's Office of the Department of Environmental Quality, 811 S. W. Sixth Avenue, Portland, Oregon 97204, telephone 229-5301, or toll-free 1-800-452-4011. Please specify the agenda item letter when requesting.

If special physical, language or other accommodations are needed for this meeting, please advise the Director's Office, (503)229-5301 (voice)/(503)229-6993 (TTY) as soon as possible but at least 48 hours in advance of the meeting.

October 15, 1999

ATTACHMENT E

(DEQ Item No. 99-2201)

"Comments of G.A.S.P., Sierra Club, Oregon Wildlife Federation, et al., In Support Of Their Request To Suspend And Revoke Permits For The Umatilla Chemical Demilitarization Facility"

(Comment C-5, without attachments)
(See Attachment G for list of exhibits that were attached)

December 17, 1999

"Comments of G.A.S.P., Sierra Club, Oregon Wildlife Federation, et al., In Support Of Their Request To Suspend And Revoke Permits For The Umatilla Chemical Demilitarization Facility"
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99-2201

STATE OF OREGON
DEPARTMENT OF ENVIRONMENTAL QUALITY
RECEIVED
DEC 20 1999
HERMISTON OFFICE

COMMENTS OF

G.A.S.P., SIERRA CLUB, OREGON WILDLIFE FEDERATION, KARYN JONES, SUSAN JONES, HEATHER BILLY, DEBORAH BURNS, JANICE H. LOHMAN, LEANDRA PHILLIPS, MERLE C. JONES, CINDY BEATTY, ANDREA E. STINE, DOROTHY IRISH, MARY BLOOM, ROBERT J. PALZER, JANET NAGY, LaDONNA KING, JOHN SPOMER, CHRISTINE CLARK, STUART DICK, GAIL HORNING, DAVID BURNS, PIUS A. HORNING, KARLA STUCK, and MELANIE BELTANE

IN SUPPORT OF THEIR REQUEST TO
SUSPEND AND REVOKE PERMITS FOR
THE UMATILLA CHEMICAL DEMILITARIZATION FACILITY

Submitted by

Richard E. Condit
P.O. Box 77001
Washington, D.C. 20013-8001
202-955-6968 ext. 4

Stuart A. Sugarman
3430 S.E. Belmont #101
Portland, OR 97214
503-234-2694

dated: December 17, 1999

I. INTRODUCTION

The Commentors have requested that the Oregon Department of Environmental Quality (DEQ) and Oregon Environmental Quality Commission (EQC) (jointly referred to as DEQ/EQC or Agencies) suspend and revoke the permits issued for the Umatilla Chemical Demilitarization Facility (UMCDF). These comments respond to a DEQ Chance to Comment Notice published on or about October 18, 1999. The Notice established an oral public comment session on November 19, 1999, and a written comment deadline of December 17, 1999. The Commentors participated in the November 19th meeting and provided prior written and oral comments regarding the pollution abatement system carbon filter units allegedly planned for UMCDF.

In support of their request for revocation of the UMCDF permits, Commentors will rely, in part, on the extensive record already before the Agencies. This record includes the following:

(1) References to the administrative record (AR) created during the permitting process.

(2) The oral and written comments provided to the Agencies regarding the pollution abatement system carbon filter units.

(3) The record of new evidence that was presented initially to the Circuit Court. This material has been expertly organized and catalogued by DEQ staff in a two volume set identified as Documentation Related to Case No. 9708-06159 (Aug. 1997 - June 1999). This two volume set contains pleadings and briefs

filed with the Circuit Court, Circuit Court decisions, and a full set of exhibits number 1 through 74. The Commentors will rely on this documentation.

(4) The Commentors letter to the EQC dated December 14, 1998 and the documents included in that submission will also be relied upon to support the Commentors request for revocation.

(5) The Comments and supporting documentation provided by Oregon CPR and air modeling summary provided by Dr. Halstead Harrison.

A. How did we get here?

The issues presented in these comments and comments presented throughout this year are a culmination of the new evidence and issues that the Commentors have been trying desperately to have a court or agency promptly address. During the first phase of litigation of the UMCDF permits before the Circuit Court, counsel for the EQC/DEQ sought to dismiss the evidence the Commentors sought to introduce because it had not been previously presented to the agencies. For example, counsel for the agencies argued on one issue that "[e]vidence of stack releases at Tooele . . . might be relevant to a future decision to modify or revoke the permits . . . EQC/DEQ Brief (98-1287) to Circuit Court at 22 (Sept. 30, 1998). This same brief made similar points on a variety of issues. Id. at 18-26. Overall, the effort by the agencies in court appeared to the Commentors to merely be a tactic designed to delay assessment of the issues being raised.

In an effort to obtain immediate review of these important issues by the EQC/DEQ the Commentors submitted a detailed letter on December 14, 1998 seeking to halt construction at

UMCDF and obtain a contested case hearing on the important issues being raised. At least eighteen exhibits were submitted with the letter along with a promise to provide additional evidence once the Agencies advised the Commentors of a process for consideration of their concerns. Further, the Commentors sought a hearing within forty-five days in order to quickly assess and make decisions on the issues and evidence being raised.

The Circuit Court was inclined to agree that arguably "new" facts should be considered by the agencies before receiving court review. On June 1, 1999, the Circuit Court issued a Final Judgment that concluded the first phase of the permit litigation. In its Opinion and Order Denying Supplemental Petitions and for Final Judgment (Final Order) the Court memorialized the agencies' agreement to evaluate the Commentors December 14, 1998 letter as presenting requests for revocation and/or reconsideration of the UMCDF permits based upon new evidence. Final Order (99-0942) at 4-5.

Over one year later, the Commentors are submitting their written comments on the issues meriting revocation of the UMCDF permits without the benefit of a contested case process. A contested case process would have benefited the agencies and all the parties as it could have helped put to rest many difficult issues. If the agencies had provided a contested case process, the record now being made on the critical issues discussed herein would overwhelmingly favor revocation of the UMCDF permits. Given the deadly serious nature of the chemical warfare agent disposal process and the risks of serious injury and death to workers and nearby residents, the Commentors strongly believe that the agencies' refusal to provide a contested case process is a gross denial of their right to due process.

B. Persons effected

Many members of Commentor organizations and individual Commentors live, work, and/or recreate in close proximity to UMCDF. See, Exhibits 1-22.[1] Many of the Commentors live or work in the area designated as the Immediate Response Zone (IRZ). Many also consume foods grown in or near the IRZ. See, e.g., Exhibits 1, 3-8, 13, 16, 18, 20, 21. There is little doubt the Commentors have reason to be gravely concerned about all aspects of UMCDF.

II. SUMMARY OF LEGAL STANDARDS

The Commentors are seeking revocation of the current permits that authorize the Army to construct, test, and operate incinerators at UMCDF. A permit shall be terminated if the permittees either: (1) fail in the application or during the permit issuance process to disclose fully all relevant facts or misrepresent any relevant facts; or (2) the permitted activity is determined to be a danger to human health or the environment that cannot be regulated to acceptable levels. 40 C.F.R. § 270.43. As these issues are presently before the EQC, the Commentors will consider their request for revocation to be denied if the EQC fails to provide a decision within sixty (60) days (by February 15, 2000). OAR 340-106-0005(1)(b).

In addition, as the information being offered by the Commentors implicates the very statutory requirements that were supposed to be satisfied in order to permit UMCDF in the first place. Federal standards, which must be adopted and followed by Oregon, provide the following standards regarding public health protection in the permitting process.

In order for the State of Oregon or EPA to approve permits authorizing construction of an incinerator facility for the purposes of treating, storing, and disposing of toxic and hazardous wastes and their byproducts, it must be sure that the facility can be operated so that it will adequately protect public health and the environment. 42 U.S.C. 6925(c); 40 C.F.R. § 270.32(b); In the Matter of Ecolotec, Inc., RCRA Appeal No. 87-14 (Remand Order 12/14/88). The EPA has made it clear that hazardous waste permitting decisions are solely focused on protection of public health and the environment.

> Section 3005(c) [42 U.S.C. § 6925(c)] provides that each RCRA permit issued under section 3005 shall contain such terms as the Administrator [or the State] deems necessary to protect human health and the environment. The Congressional intent underlying this amendment is to authorize the Agency to impose permit conditions beyond those mandated by the regulations, such as new or better technologies or other requirements. S. Rep. No. 284, 98th Cong., 1st Sess. 31 (1983). The purpose is to upgrade facility requirements in order to protect human health and the environment. The Agency believes the authority to issue permits containing conditions deemed necessary to protect human health and the environment must encompass the authority to deny permits where necessary to afford such protection.

50 Fed. Reg. 28,723 (July 15, 1985) (emphasis in original). Thus, in Ecolotec the EPA Administrator reasoned that "[m]ere technical compliance with the existing location, design, and operational standards is not ... sufficient to justify permit issuance if human health and the environment cannot be adequately protected." Ecolotec, at 8.

Most significantly, what is referred to as EPA's omnibus authority is reflected in Part 270. As explained in Ecolotec, EPA's omnibus authority is used to ensure that public health is adequately protected when evaluating hazardous waste permits. The regulation states:

---

[1] Commentors' Exhibits 1 - 74 are documents already in the possession of the Agencies. These are the documents previously referenced that have been cataloged by DEQ staff in a two-volume set. Any new exhibits submitted in support of these comments will begin with number 75.

270.32 Establishing permit conditions.

(a) In addition to conditions required in all permits (§ 270.30), the Director shall establish conditions, as required on a case-by-case basis, in permits under 270.50 (duration of permits), 270.33(a) (schedules of compliance), 270.31 (monitoring), and for EPA issued permits only, 270.33(b) (alternate schedules of compliance) and 270.3 (considerations under Federal law).

(b)(1) Each RCRA permit shall include permit conditions necessary to achieve compliance with the Act and regulations, including each of the applicable requirements specified in Parts 264 and 266 through 268 of this chapter. In satisfying this provision, the Administrator may incorporate applicable requirements of Parts 264 and 266 through 268 of this chapter directly into the permit or establish other permit conditions that are based on these parts.

(2) Each permit issued under section 3005 of this act shall contain terms and conditions as the Administrator or State Director determines necessary to protect human health and the environment.

(c) For a State issued permit, an applicable requirement is a State statutory or regulatory requirement which takes effect prior to final administrative disposition of a permit. For a permit issued by EPA, an applicable requirement is a statutory or regulatory requirement (including any interim final regulation) which takes effect prior to the issuance of the permit (except as provided in § 124.86(c) for RCRA permits being processed under Subparts E or F of Part 124). Section 124.14 (reopening of comment period) provides a means for reopening EPA permit proceedings at the discretion of the Director where new requirements become effective during the permitting process and are of sufficient magnitude to make additional proceedings desirable. For State and EPA administered programs, an applicable requirement is also any requirement which takes effect prior to the modification or revocation and reissuance of a permit, to the extent allowed in § 270.41.

(d) New or reissued permits, and to the extent allowed under § 270.41, modified or revoked and reissued permits, shall incorporate each of the applicable requirements referenced in this section and in 40 CFR 270.31.

(e) Incorporation. All permit conditions shall be incorporated either expressly or by reference. If incorporated by reference, a specific citation to the applicable regulations or requirements must be given in the permit.

40 C.F.R. § 270.32. Subsection 270.32(b)(2) is considered the omnibus provision because it provides broad authority for EPA or a state to do what is necessary to protect public health.

One recent EPA decision described Agency's omnibus authority as follows.

> Under the omnibus clause, if the operation of a facility would have an adverse impact on the health or environment of the surrounding community, the Agency would be required to include permit terms or conditions that would ensure that such impacts do not occur. Moreover, if the nature of the facility and its proximity to neighboring populations would make it impossible to craft a set of permit terms that would protect the health and environment of such populations, the Agency would have the authority to deny the permit. See In re Marine Shale Processors, Inc., RCRA Appeal No. 94-12, at 48, n.64 (EAB, Mar. 17, 1995) ("[T]he Agency has traditionally read [section 3005(c)(3)] as authorizing denials of permits where the Agency can craft no set of permit conditions or terms that will ensure protection of human health and the environment."). In that event, the facility would have to shut down entirely.

In Re Chemical Waste Management of Indiana, Inc., RCRA Appeal Nos. 95-2 & 95-3, 1995 WL 395962, *6 (EPA 1995).

The Oregon Legislature has explicitly mandated that protection of public health, safety, and the environment is the paramount purpose of the State's hazardous waste law.

> (b) ... the Legislative Assembly declares that it is the purpose of [the hazardous waste law] to:
>
> (A) Protect the public health and safety and environment of Oregon to the **maximum extent possible.**

ORS § 466.010(1)(a)(b)(A) (emphasis added). Both the DEQ and EQC are directed to enforce and carry out the provisions of the State's hazardous waste law. ORS §§ 466.015 and 466.025.

The Legislature has given some specific direction to the DEQ/EQC regarding the manner in which the Agencies implement the hazardous waste law. For example, Oregon law requires the following:

> Before issuing a permit for a new facility designed to dispose of or treat hazardous waste or PCB, the commission must find, on the basis of information submitted by the applicant, the department or any other interested party, that the proposed facility meets the following criteria:

(1) The proposed facility location:
(a) Is suitable for the type and amount of hazardous waste or PCB intended for treatment or disposal at the facility;

(b) Provides the maximum protection possible to the public health and safety and environment of Oregon from release of the hazardous waste or PCB stored, treated or disposed of at the facility; and

(c) Is situated sufficient distance from urban growth boundaries, as defined in ORS 197.295, to protect the public health and safety, accessible by transportation routes that minimize the threat to the public health and safety and to the environment and sufficient distance from parks, wilderness and recreation areas to prevent adverse impacts on the public use and enjoyment of those areas.

(2) Subject to any applicable standards adopted under ORS 466.035, the design of the proposed facility:

(a) Allows for treatment or disposal of the range of hazardous waste or PCB as required by the commission; and

(b) Significantly adds to:

(A) The range of hazardous waste or PCB handled at a treatment or disposal facility currently permitted under ORS 466.005 to 466.385; or

(B) The type of technology employed at a treatment or disposal facility currently permitted under ORS 466.005 to 466.385.

(3) The proposed facility uses the best available technology for treating or disposing of hazardous waste or PCB as determined by the department or the United States Environmental Protection Agency.

(4) The need for the facility is demonstrated by:

(a) Lack of adequate current treatment or disposal capacity in Oregon, Washington, Idaho and Alaska to handle hazardous waste or PCB generated by Oregon companies;

(b) A finding that operation of the proposed facility would result in a higher level of protection of the public health and safety or environment; or

(c) Significantly lower treatment or disposal costs to Oregon companies.

(5) The proposed hazardous waste or PCB treatment or disposal facility has no major adverse effect on either:

(a) Public health and safety; or
(b) Environment of adjacent lands.

ORS 466.055. Many of these standards go beyond or supplement EPA requirements.

Oregon regulations provide additional guidance regarding the application of the best available technology standard to the proposed UMCDF incinerator.

> The facility shall use the best technology as determined by the Department for treatment and disposal of hazardous waste and PCB. The facility shall use the highest and best practicable treatment and/or control as determined by the Department to protect public health and safety and the environment.

OAR 340-120-010(2)(c). See, also, OAR 340-120-001(1). If a permit applicant cannot demonstrate that these criteria will be met, then the permit must be denied.

In addition to the best technology requirements, the DEQ/EQC must also ensure that UMCDF meets the General Facility Standards established by state and federal law or regulations. 40 C.F.R. Part 264, Subparts A - H. Similarly, the Agencies must ensure that UMCDF meets specific requirements for hazardous waste incinerators. 40 C.F.R. Part 264, Subpart O.

One of the most critical EPA authored requirements mandates that the UMCDF incinerator "shall be designed, constructed, maintained, and operated to minimize the possibility of a fire, explosion, or any unplanned sudden or nonsudden discharge of hazardous waste or hazardous waste constituents to air, soil, groundwater, or surface water which could threaten the environment or human health." 40 C.F.R. § 264.31. The most important words in this requirement are: "could threaten the environment or human health." This phrase means

that the DEQ/EQC have a duty to prevent injury to the environment or human health by denying authorization to operate or sufficiently limiting such operations to ensure protection.

With these standards firmly in mind the Commentors turn to the facts supporting revocation of the UMCDF permits.

III. OVERVIEW OF FACTS THAT REQUIRE THE DEQ/EQC TO FINALLY REJECT THE TECHNICAL AND NON-TECHNICAL STATEMENTS OFFERED BY THE ARMY TO EXPLAIN THE LIMITATIONS AND FAILURES OF THE INCINERATION TECHNOLOGY

Commentors have seen throughout the permitting and construction process involving UMCDF how the Army has charmed, lobbied, bombarded with technical information, and cajoled state and local officials on a variety of issues. For example, consider the Army's recent discussion regarding the dunnage incinerator (DUN) for UMCDF. Although, the Commission and DEQ staff exhibited skepticism about the Army's decision to consider a different treatment method for dunnage, there were no hard questions asked. One important issue that should addressed concerning the DUN is when did the Army first encounter serious design and/or operation problems with the DUN? This question is important because the Commentors have seen evidence indicating that the Army and its contractors have known for quite sometime that the DUN was not a viable piece of the baseline incineration system. See, e.g., Affidavit of Gary E. Harris (Harris Afft. or Exhibit 75) ¶¶ 53-54, 60, 115; Exhibits 23, 49. Further, Commentors believe the totality of facts and circumstances surrounding the baseline program will show that the DUN was not viable long before the UMCDF permits were approved. The Army's new found concern for cost is simply a ruse to justify its desire to now officially eliminate the DUN.

Why couldn't the cost or other issues concerning the DUN have been raised prior to permit approval? Because such an admission would have raised further doubts about the baseline incineration system and delayed the acquisition of permits. Once the permits are in hand, the Army feels free to add modification after modification until the facility is nothing like the one permitted. The documentation for permit modifications at TOCDF now totals 18,000 pages.

The deception involving the DUN and the others issues described herein makes a mockery of the initial permitting process, including risk assessment, technology assessment, and public participation. It is important to investigate these issues because the change in the Army's baseline program may change the Agencies' assessment of the technology, human health impacts, and/or environmental impacts. The Commentors urge the Agencies to check all modification requests against when issues or problems were first known to the Army. Commentors believe there is a pattern emerging concerning important issues the Army was aware of during the permitting process, but failed to inform the Agencies of in order to ensure initial receipt of a permit. The important issues that come to mind and make the point raised here include: toxicity of the agents; viability of the DUN; viability of the brine reduction area (BRA); solidification or gelling of agents in stored munitions; agent stack releases; worker exposures to agent; and the viability of the pollution abatement system carbon filter units. Each of these issues has evolved with significant new[2] information since the permits were granted. This means that the EQC approved a significantly different facility on paper, than might be tested and operated in the future. Consequently, the Agencies have failed to meet their statutory and regulatory obligations to fully assess UMCDF as best available technology

and have failed to properly assess the risks posed by the facility. This problem is primarily a creation of the Army, but must be sternly addressed by the Agencies.

A. Despite repeated denials, the Army has released nerve agents from TOCDF into the environment.

Another Army myth is that there have been no confirmed releases of nerve agents from the stack at TOCDF. There have been many stack alarms, but according to Army officials these incidents do not result in the confirmation of agent release. See, e.g., Testimony of TOCDF Project Manager Tim Thomas, Exhibit 43 at 2-3. Even in the absence of a stack alarm agent may escape into the environment. See, Exhibits 31, 32, 34 (regarding the March 30, 1998 overfeed of agent GB into the Metal Parts Furnace at TOCDF). Interestingly, during the federal court trial regarding TOCDF in June 1999 the Army failed to produce evidence from stack DAAMS tubes to prove that agent had not been detected in the stack on March 30, 1998.

The Commentors have obtained a copy of an internal EG&G document that sheds further light on the Army's stack release charade. The memo, in part, evaluates the uses of DAAMS tubes to confirm the presence of agent during an ACAMS alarm. The authors of the memo specifically evaluated one incident where agent was not confirmed through the DAAMS analysis, but should have been confirmed had the proper analysis been confirmed. The memo provides the following analysis of one report involving an ACAMS alarm and a DAAMS analysis.

> The conclusion is made that because there was not enough agent on the DAAMS tube to calculate an 8 hour TWA [time weighted average] above the LOQ [limit of quantification], that the ACAMS was a false positive. This is an improper conclusion

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[2] That is, new to regulators and the public.

> . . . For confirmation of the ACAMS, the DAAMS tube needed only contain a mass of 0.060 ng [nanograms]. The mass of agent on the two tubes was 0.93 ng on one and 1.48 ng on the other. This is well over the needed mass to confirm the ACAMS.[3]

The memo concludes by recommending the review of all reports that used DAAMS data in the decision making process.[4] It remains to be seen if the recommendation will be followed and how many agent releases from the stack and elsewhere will be "newly" confirmed for TOCDF.

This information is important for risk calculations for workers and the public. It is also important for assessing the Army's agent monitoring, emergency preparedness, and contingency planning capabilities. At this stage of construction at UMCDF, the uncertainty that exists regarding these critical issues requires suspension of the permits followed by revocation. The Army has only itself to blame for any delay that such a prudent action would cause.

B. Despite repeated denials, the Army has exposed TOCDF workers to nerve agent.

Another Army word game that directly impacts public health involves the determination of worker "exposure" to chemical warfare agents. Instead of following a common sense approach which would indicate that a worker is exposed when s/he comes in contact with agents, the Army requires a blood test indicating a certain level of cholinesterase depression in order to confirm an exposure.

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[3] Exhibit 76: EG&G Interoffice Correspondence from Sam Guello and Fred Burton to Mike Rowe. Jack Maddox, and James Colburn dated October 15, 1999 at 2.

[4] Id. at 3.

A recent event at TOCDF indicates that workers have clearly been exposed to agents during operations. An internal EG&G memo describes an incident where readings on the skin of exposed workers exceeded four (4) TWA. See, letter with attachments from Jackson P. Maddox (EG&G) to Army Contracting Officer Janice Wards dated August 6, 1999 (Exhibit 77).

C. At TOCDF the Army rigged the trial burns to ensure permitting.

It appears that the Army was able to manipulate the trial burn process at TOCDF in order to avoid being tested in ways that might result in failure. The testing methods also appear to have avoided testing actual conditions that are repeatedly experienced during operations. For example, ton containers were sawed in half to ensure an efficient burn. Harris Afft. ¶¶ 8-9. Ton containers with solidified agents were rejected during the trial burn process. Harris Afft. ¶¶ 42-45.

Moreover, there was a pattern of rejecting the gelled or hard to burn munitions during trial and mini-burn activities at TOCDF. This is documented in a recently obtained internal Army document. See, Issues and Directed Actions with Fact Sheet, 6 December 1999 (Exhibit 78) at 2, 4, 8. This document also indicates that the Army has been aware of the gelling/solidification problem for some time and recognizes that the condition of the agents in the munitions effects the waste analysis. Exhibit 78 at 4-5.

The compromise of the TOCDF trial burns renders the data from those burns virtually useless for calculation of emissions and risks at UMCDF. The trial burn manipulation also demonstrates gross weaknesses in the incineration system, which should have been clearly identified during the permitting process.

D. At TOCDF the Army manipulated the permit modification process in order to avoid public scrutiny and input.

As noted earlier, the Army has used the permit modification process to create the "real" permit for TOCDF and UMCDF. This manipulation violates the letter and spirit of the laws and regulations that govern the permit evaluation process. Gary Harris notes several instances of such manipulation in his affidavit. Harris Afft. ¶¶ 20, 35, 66-72, 111-112. Similar abuses of the permitting process are evident in the carbon filter and DUN replacement issues being raised at UMCDF.

IV. FACTS REQUIRING A DECISION TO SUSPEND AND THEN REVOKE THE ARMY'S PERMIT TO CONSTRUCT, TEST, AND OPERATE A CHEMICAL WARFARE AGENT INCINERATION FACILITY

A. Inadequate emergency preparedness and community protection

Worker Incident: September 15, 1999

Existing procedures for dealing with the type of incident which occurred on September 15, 1999 at the UMCDF were ignored by PMCD and Raytheon Demilitarization Corporation (RDC) in an attempt to mitigate any image or other problems which may have resulted in the information concerning this event getting into the public arena.

PMCD and Raytheon did not notify the Depot Commander of the incident until between 28 and 30 minutes after the occurrence, knowingly violating agreements surrounding such events.

PMCD and Raytheon made the unilateral determination that the incident was not a chemical event knowingly violating agreements surrounding such events.

PMCD and Raytheon failed to provide adequate medical attention to impacted workers for more than two hours after the incident occurred, knowingly violating procedures surrounding such events.

PMCD and Raytheon knowingly falsely represented their handling of the incident in a public hearing on November 1, 1999.

Basis of Comments

Appropriate procedures were not followed to determine the type of event which took place on September 15, 1999.

Standard Operating Procedure

The Memorandum of Agreement (MOU) signed January 4, 1999 between the Deputy Chief of Staff for Chemical and Biological Matters and the Program Manager for Chemical Demilitarization states, "[w]here the installation is a SBCCOM Chemical Depot the Commander will execute the Installation and Chemical Activity functions described below." The Umatilla Chemical Depot is a SBCCOM Chemical Depot. The MOU states that the AMC Commander, in this instance, Lt. Col. Woloszyn shall,

1) "Determine if any abnormal situation warrants characterization as a chemical event."

2) "Program, budget and provide for coordinated security, emergency response, ... medical support, ...from installation assets." (emphasis added).

3) "Serve as the Initial Response Force Commander/Federal On-Scene Coordinator and direct all installation and tenant resources for response, recovery, and remediation during all simulated or actual chemical events."

Incident Facts

According to the UMCD/RDC document "Fact Finding Mission - UMCDF Industrial Release (September 15, 1999), presented at the public meeting on November 1, 1999 they state:

a) RDC: "The (RDC) Deputy Project Manager, in discussion with Safety and Construction Management, concluded that the incident was not related to chemical agent from K-Block." ." (Violates MOU)

UMCD: " It was clear from the beginning that this was not a chemical event." (Violates MOU);

b) RDC: "The initial assessment of employee symptoms was made at the construction site infirmary by EMT/Paramedics." (emphasis added) (Violates MOU);

c) UMCD: " Initial notification confirmed this was a construction site vs. a chemical weapons incident. Therefore, normal CAIRA response plan actions were not taken." (Violates MOU). Note: The Depot Commander is required to determine if the incident is a chemical event, and if so, is required to provide the Initial Response Force. In this case the Commander was not notified until after the determination was made by unauthorized personal

(PMCD/RDC). To date the cause of the worker illness has yet to be determined and thus, the root cause should still consider chemical agents in their investigation. Outcomes could determine chemical agent as the cause, in which case the PMCD/RDC determination to exclude the Commander from responding would violate MOU.

According to the RECORD transcribed at the November 1, 1999 public meeting:

a) Mr. Bluestein (RDC) stated, " It was deemed to be an industrial incident, and it was felt, again, lessons learned, it was felt that we could handle it ourselves and it wasn't to the point that we needed extra help." (Violates MOU);

b) Lt. Col. Woloszyn stated, "The initial immediate response was slow. Actually, it was two hours." ." (Violates MOU);

c) Lt. Col. Woloszyn stated, "In this situation, there were 30 workers inside one room inside one building. The people in the EOC looked at that, analyzed that, and the leadership came to a decision that is could not have been chemical agents." (Record Transcript from Nov. 1, 1999 public meeting at 65) Note: This is more than 30 minutes after PMCD/RDC already made the determination, had sent workers to the hospital and were attempting to control the situation from the construction site. (Violates MOU).

d) In response to DEQ question, " When was the EOC first notified that the incident had occurred?") Lt. Col. Woloszyn stated, The first notification, I believe, came at 11:30." (Violates MOU). (Public Record at 67);

e) In response to DEQ question, " Who was in command? Who was making decisions?"

RDC's Mr. Bluestein stated, "At that time (11:30) my deputy and as well as the construction manager were working with the safety manager and making decisions on the spot." (Violates MOU). (Public Meeting Record at 69).

PMCD/RDC failed to provide adequate medical attention to stricken workers and knowingly falsely represented their handling of the medical attention provided immediately after the incident at the November 1, 1999 public meeting.

a) According to the RECORD transcribed at the November 1, 1999 public meeting:

RDC's Mr. Bluestein: "We did have a couple of employees who were seriously injured, at least indicated they were serious, Those were treated first. The balance were then treated." (at 6).

RDC's Mr. Bluestein: "...in the period of about 11:05 to around 12:00 as we triaged the system, we discovered 34 people that were experiencing symptoms."

Lt. Col. Woloszyn, in response to the question, "But in this case, your clinic was not part of the process?" Stated, "That's correct." (at 42)

Mr. Bluestein, in response to the question, "How come it took two hours for workers to go from the site to Hermiston hospital?' , stated, "The EMT's took care of two that were I'm going to use the word more seriously injured than the other two. And then they went to the triage and worked their way down." (at 46)

According to the following individuals' presentations at that same meeting, the following statements were given:

Mr. Brian Zazzo: "I'm one of the workers, and I was refused medical care. I wasn't triaged on this job. I was told to sit in the shade on the side of the trailer. I asked continually from an hour after the incident and I was told the people that were up there did not have the

authority to have me transported. This was not just a learning process. This was a process to keep us from having medical attention.

There was no triage going. The millwrights were giving first aid to one of the people that was injured, not anybody from Raytheon. And the safety personnel just flat refused us medical care. And I have documented this, and have witnesses to this fact."

Mr. Zazzo continued, "We were kept on the job against our will. We were refused transportation to the hospital or medical care."

Mr. Tony Kimball: "I'm an injured worker. They sent us to the trailer, and then they sent us up there, and I sat there for an hour and a half, and Brian is sitting there looking at me saying, 'He needs to go to the hospital now.'"

"No. He needs some fresh air. We'll just let him get some fresh air," said RDC Management.

Kimball continued, "For an hour and a half after -- when we first left the trailer -- we sat there and were denied, completely denied, medical attention.

Conclusion

Based on the facts as presented it is the commentors position that RDC and PMCD have, in an attempt to mitigate any image or other problems which may have resulted in the information concerning this event getting into the public arena, violated their own procedures, put workers at undue risk and lied about their response during the incident.

Furthermore, it is the contention of Commentors that PMCD and Raytheon

Chemical Demilitarization Corporation have shown by their actions in this instance their inability and unwillingness to operate the proposed facility in compliance with the provisions of ORS 466.005 to 466.385 and 466.890 or any condition imposed on the Permittee by the Commission.

B. Failure to consider the human health and environmental risks associated with operation of pollution abatement system carbon filter units

The carbon filter unit has been permitted and is anticipated by the EQC to be installed and operated at UMCDF. The EQC, in its revised Findings and Conclusions regarding the UMCDF permit, determined that the carbon filter unit provided an additional measure of safety for the public.

However, despite the information provided in the permit application for UMCDF and the public comments taken on the draft permit, it now turns out that the Army does not even have a design in place for the PAS-CF unit. The National Research Council (NRC) confirmed this fact in the following statement. "Final designs for the carbon filter systems for the Umatilla or Anniston sites had not been presented to the committee at the time this report was completed." Carbon Filtration for Reducing Emissions from Chemical Agent Incineration (NRC 1999) at 31. The NRC's revelation strongly indicates that the Army did not have a final design in place when it submitted its original permit application and later revisions. Under these circumstances the permit application was not complete and the EQC had no authority to issue the permit. OAR 340-105-0010(3)(a) and (b).

The EQC and the public have been misled about the carbon filter unit. Considering that the EQC had no authority to issue the permit for UMCDF, the Commentors request that the EQC immediately revoke the permit.

Moreover, without a design in place the Commission could not properly evaluate the operating conditions, malfunctions, upsets, and risks that could be encountered by installing and operating the PAS-CF unit. Both statute and regulation require the DEQ and EQC to set permit conditions necessary to protect public health and the environment. ORS § 466.055(5); 40 C.F.R. § 270.32(b). It is clear from available data that there are significant risks associated with the operation of a carbon filter unit.

Yet, despite prior concerns raised by the Commentors, the EQC and DEQ have failed to assess what negative impacts may result from the addition of a carbon filter unit. This is particularly troubling considering that construction of UMCDF is more than fifty percent complete.

The NRC report, presented to the Commission on August 18, 1999, makes clear that there are significant risks to consider including, carbon fire, accumulation and release of chemical warfare agents and other dangerous chemicals (i.e., dioxin, PCBs, etc.) from a carbon filter unit, and the subsequent treatment and disposal of contaminated carbon filters. NRC 1999 at 9). The estimated risk to workers alone due to upsets of a PAS-CF unit are significant (3.3 x E-05 or 33 per million). NRC 1999 at 42. The estimated risk to workers alone exceeds the Environmental Protection Agency's 10 per million risk standard for hazardous waste facilities.

As noted in previous comments to the DEQ, the Army has been aware of the potential risks of adding a PAS-CF unit. The summary of information provided below reflects the

Army's knowledge of some of the risks that may be associated with the operation of a carbon filter unit.

"Since the Army's initial assessment, additional risk assessment tools have been developed to assist in the characterization of baseline system performance, both with and without the proposed PAS filter system. Preliminary assessments using these tools indicate that the addition of the PAS filter system may not contribute to any measurable reduction in risk and may actually be the source of new risk to both workers and to the public." Department of Defense; Interim Status Assessment of the Chemical Stockpile Disposal Program: April, 1996.

"Two areas where cost reductions have been identified in developing the December 1996 cost estimate are associated with the filter system for the Pollution Abatement System (PAS) and optimizing operations. The Program Manager has completed a value engineering study that modified the design and found reductions in capital and operating costs." (Statement before the House National Security Committee of the House of Representatives by Mr. Gil Decker, Assistant Secretary Army/Research Development and Acquisition).

A risk assessment performed for the Army by Mitretek acknowledges a large percent increase in the frequency of some accident events (from 168% to 385% more likely) due to addition of the PFS carbon filters. Mitretek at 4-13 (Table 4-8). Moreover, the addition of PFS carbon filters presents new accident scenarios "not present in the baseline QRA [Quantitative Risk Assessment]." Mitretek at 4-14 to 4-18. The addition of PFS carbon filters also presents "a 13 percent increase in worker fatality risk for the UMCDF." Mitretek

RA at 4-30. Finally, the Mitretek PAFS Risk Assessment acknowledges that significant uncertainties in the QRA process have not been "treated", "including uncertainty in the parameters affecting the downwind transport of agent and in the dose/response behavior of the population." Mitretek at 4-35. See, Mitretek Systems, Inc. "Risk Assessment of the Pollution Abatement Filter System for the Umatilla Chemical Agent Disposal Facility" (Draft September 1998). The prior analysis as well as the following pages of the Mitretek assessment were previously offered into the record: cover - vii; 1-1 to 1-2; 3-2 to 3-7; 4-7 to 4-18; 4-30 to 4-36. These pages directly address PAS carbon filter issues as well as other issues related to the overall risk of the baseline incineration system.

It is important to point out that the analyses performed regarding the possible risks of a carbon filter unit were performed, as the NRC noted, "by comparing results for alternative designs." NRC 1999 at 41. Such results are not an accurate assessment of what the risks might be at UMCDF because the design of the PAS-CF unit is still undetermined. While the Army and NRC might feel they are at liberty to speculate about the risks of a system of uncertain design, the DEQ and EQC who are assigned by law to protect public health and the environment cannot take such liberties. The ability of the Agencies to perform their mandated duties to protect public health and the environment has been thwarted by the Army's deception or confusion regarding the design and operation of the PAS-CF unit, and possibly other important systems (i.e., the dunnage incinerator).

C. Failure to consider and assess the real toxicity of chemical warfare agents

Before reviewing the latest toxicity information it is important to understand the process by which the existing exposure limits were derived. Air concentrations for

occupational limits were calculated, based on data demonstrated herein to have been tied directly to acute exposure effects. A safety factor for workers was applied to these levels. A further safety factor was then applied for civilians, taking into consideration populations that could be more susceptible to chemical agent effects that others. However, regardless of the safety factors applied, if the data upon which these exposure limits are calculated is invalid, it follows that the resultant "safe" exposure standards are also invalid.

The National Research Council's Review of Acute Human-Toxicity Estimates for Selected Chemical Warfare Agents (NRC Toxicity Review - Exhibit 50) offers important information not previously considered by the Agencies. Commentors offer this document to establish that the EQC was mislead concerning a critical aspect of the permitting process (i.e., the likely toxicity of CW agents). Such information is critical to assessing the best available technology (BAT), and establishing emissions standards/limits, as well as determining appropriate emergency procedures. The EQC has not reviewed and considered this information. In sum, the NRC Toxicity Report states in part:

> The U.S. Army's Chemical Defense Equipment Process Action Team (CDEPAT) recently conducted an extensive review of the scientific basis for toxicity estimates in use by the Army for several chemical-warfare (CW) agents: GA, GB, GD, GF, VX, and HD. Following a detailed analysis of the toxicity of these agents and using contemporary methods of analysis, CDEPAT concluded that many of the human-toxicity estimates in use would not protect the soldier adequately (CDEPAT 1994). Recalculations of the potencies of several of the CW agents are greater than previously determined. As a result, lower exposure levels of CW are expected to elicit adverse effects.

NRC Toxicity Review at 17 (emphasis added). Thus, the Army has known that the toxicity data concerning the referenced CW agents was incorrect since as early as 1994. Two years before this permit was issued. Yet, the NRC Toxicity

Report was not issued until December 1997, and only became publicly known sometime after that date.

The report also makes the following statement regarding individual sensitivity to CW agents:

> The U.S. Army's original purpose for developing human-toxicity estimates for CW agents was to enable it to predict the number of casualties that would occur during an offensive action in which the goal was to kill or incapacitate a certain fraction of the enemy forces (for example, killing or incapacitating a minimum of 50% of the least-sensitive (most-resistant) individuals). Such an approach would actually result in more than half of the exposed individuals dying (the bonus effect), because a certain percentage of those exposed would be expected to be more susceptible than the least-sensitive individual.

NRC Toxicity Report at 1 (emphasis added). Thus, the sensitivity of individuals to nerve agent is a critically important factor when considering accidents and emissions involving CW agents. The EQC/DEQ did not complete such an analysis. Thus, the actions of the Agencies approving the UMCDF permits are inconsistent with statutory requirements. See, ORS 466.010(1)(b)(A); 466.055(5).

The new agent toxicity information creates serious questions and severely undermines the validity of the following:

* the Army's Time Weighted Average (TWA) "safe" exposure levels for workers;
* the General Population Limits (GPL) for "safe" exposure levels;
* the adequacy of the monitoring systems deployed within the CSDP;
* the Allowable Stack Concentrations (ASC) currently used within the CSDP;
* the Army's CSDP Environmental Impact Statements;
* the Army's Quantitative and Human Health Risk Assessments; and, the adequacy of the Chemical Stockpile Emergency Preparedness Program (CSEPP).

See, e.g., Exhibits 40, 41.

D. Failure to consider and assess the human health and environmental impacts of low level (non-lethal) exposures to nerve agents

Data from the Gulf War has not been explored in the Human Health Risk Assessment (HHRA). Addendum to Risk Assessment at 5. One of the lessons taught by the Gulf War is that low-level agent exposure alone or in combination with other chemicals can generate a range of disturbing health effects. A July, 1996 report requested by the DOD stated that "[i]t appears that a single exposure ... to a very small amount of GB will produce observable acute signs and/or symptoms." Environment Committee- Armed Forces Epidemiological Board, "Long-term Health Effects Associated with Sub-clinical Exposures to GB and Mustard," July 18, 1996 (Exhibit 51). This document responds in part to the EQC's/DEQ's position in court that the effects of low-level impacts from agents were addressed in an addendum to the risk assessment. See AR 2377 (CD1, Folder 10B, Addendum p. 5.) This statement is misleading as the term addressed suggests the issue was considered substantively. This is not the case. The Addendum states that "[a]t the time the PreRA [pre-trial burn risk assessment] was conducted, additional data on Gulf War veterans was not available." Id. This statement ignores information that was available through the Army.

The report goes on to note:

> There are no No Observable Effects Levels (NOELS) established with any degree of confidence for any of the chemical agents. These NOELS would be useful for answering questions related to DESERT STORM, but also for establishing workplace and general population exposure limits for demilitarization efforts.

Exhibit 51 at 6 (emphasis added). This means that exposure to low-levels of agent should be assumed to have some adverse effect. Yet, neither the EQC/DEQ nor their contractor took this into consideration when evaluating BAT, emissions, and accidents involving chemical warfare agents.

Another important low-level agent effects survey was conducted by a committee of the U.S. Congress: Gulf War Veterans Illnesses: VA, DOD Continue to Resist Strong Evidence Linking Toxic Causes to Chronic Health Effects by the Committee on Government Reform and Oversight (Exhibit 52). This report provides further rebuttal to the EQC's/DEQ's arguments in court, and supports the Commentors contention that low-levels (i.e., non-lethal concentrations) of agents must be fully evaluated for potential long term impacts. The report specifically states as part of its findings that "[e]xposures to low levels of chemical warfare agents and other toxins can cause delayed, chronic health effects." Exhibit 52, Findings in Brief (p.6). The information and conclusions of the report establish that the Commentors were correct to be concerned about low-level agent impacts and demonstrates that the Agencies and their contractor clearly erred when they refused to fully assess this issue.

Next is Exhibit 53: Chemical Weapons: DOD Does Not Have a Strategy to Address Low-Level Exposures by the U.S. General Accounting Office (GAO) (September 1998). This report notes that "[p]ast research indicates that low-level exposures to some chemical warfare agents may result in adverse short-term performance and long-term health effects." Exhibit 53, GAO Report at 3. This confirms Petitioners' earlier analysis that the Army has information indicating that low-level impacts were critical to evaluate. It is uncertain whether the Army provided and the EQC/DEQ evaluated the "[p]ast research" referred to by the GAO.

The GAO report makes several important findings, which include:

*Past research indicates that low-level exposures to some chemical warfare agents may result in adverse short term performance and long term health effects.

*Past research by DOD and others indicates that single and repeated low-level exposures to some chemical warfare agents can result in adverse psychological, physiological, behavioral, and performance effects . . . The research, however, does not fully address the effects of low level exposures to a wide variety of agents, either in isolation or combination with other agents and battlefield contaminants; chronic effects; reliability and validity of animal human extrapolation models; the operational implications of the measured adverse impacts; and delayed performance and health effects.

*Research on animals and humans conducted by DOD and others has identified some adverse psychological, physiological, behavioral and performance effects of low-level exposure to some chemical warfare agents. . . . At low doses, nerve agents [and related pesticides] produce a wide range of effects on the central nervous system, beginning with anxiety and emotional instability. Psychological effects in humans from nerve agent VX on skin have been noted earlier than physical effects (e.g. nausea and vomiting) or appeared in the absence of physical effects. The psychological effects were characterized by difficulty in sustaining attention and slowing of intellectual and motor processes. Doses considerably below the LD50 can degrade performance and alter behavior. . . .Moreover, the detrimental effects of exposure to single doses of nerve agents may be prolonged.

*In the 1980's, the Air Force conducted research on the bioeffects of single and repeated exposures to low levels of the nerve agent soman . . . . The Air Force found that the nerve agent degraded performance on specific behavior tasks in the absence of obvious

physical deficits in primates. . . . The research examples reveal that sub-lethal exposures of an agent can have a variety of effects (depending on the species, exposure parameters, time and combination of exposures) and produce measurable, adverse effects on physiology and behavior (both motor and cognitive performance). (GAO at 3-12.)

*We noted that, as early as the 1950s, studies demonstrated that repeated oral and subcutaneous exposures to neurotoxic organophosphates produced delayed neurotoxic effects in rats and mice. In addition, German personnel who were exposed to nerve agents during World War II displayed signs and symptoms of neurological problems even 5 to 10 years after their last exposure. Long term abnormal neurological and psychiatric symptoms, as well as disturbed brain wave patterns, have also been seen in workers exposed to sarin in manufacturing plants. The same abnormal brain wave disturbances were produced experimentally in non-human primates by exposing them to low doses of sarin. Delayed, chronic neurotoxic effects have also been seen in animal experiments after the administration of organophosphate. In other experiments, animals given a low dosage of the nerve agent sarin for 10 days showed no signs of immediate illness but developed delayed chronic neurotoxicity after 2 weeks. (GAO at 16-17.)

*Regarding the 2010 Study, we disagree with DOD's statement that there may not be medical effects for low-level chemical agents. Rather our work shows that low-level exposure can have medical effects that cannot only result in casualties, but also disrupt [military] operations. (GAO at 23.)

Careful analysis of low level agent impacts is critical to understanding the risks posed by the UMCDF incinerator because as TOCDF has demonstrated low levels of agent will be

released throughout life of incineration activities. The failure to perform this analysis requires revocation and re-analysis of the permits for UMCDF.

E. The analysis of human health and environmental risks posed by dioxin and dioxin-like compounds relied upon by the EQC/DEQ is flawed and seriously underestimates the risks of these dangerous chemicals

Perhaps the most troubling aspect of the HHRA relied upon by the EQC is its refusal to consider the non-cancer health effects from expected exposures to PCBs, dioxin, dioxin-like chemicals, and the sulfur analogs of dioxins and furans. The risk assessment contractor attempted to justify the failure to recognize non-cancer health impacts from dioxin and related chemicals in the following passage.

> EPA does not endorse using RfDs [reference doses] to assess the noncancer effects posed by dioxin. Rather, the margin or exposure approach has been recommended ... If the facility-specific exposures are a small fraction (i.e., 1% to 3%) of the background exposures, [level of contamination that already exists] then the facility is assumed to pose negligible noncancer risks ... Rough calculations for this scenario were performed for the subsistence farmer scenario located at the fence line at UMCDF. This scenario resulted in a dose of .03 picogram per kilogram per day (pg/km/day), which is within the 1% to 3% range. Therefore ... noncancer effects from potential dioxin emissions do not exceed EPA's benchmark.

Risk Assessment Addendum at 5.[5] This explanation, which was not specifically adopted by the EQC, must be rejected as completely contrary to public health protection principles and inconsistent with Oregon's BAT requirement.

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[5] It is interesting to note that EPA used a reference dose for dioxin identical to the 1 pg/km/day value established by ATSDR in a recent risk assessment for a dioxin incinerator in Times Beach, Missouri. Apparently, EPA does not strictly prohibit use of a RfD for calculation of dioxin non-cancer risks.

What the quoted passage attempts to avoid is the stark reality that residents of Oregon, and most of the rest of the United States, already have too much dioxin in their bodies. EPA's Dioxin Health Assessment Study concludes that an appropriate RfD for non-cancer effects from dioxin exposure would be 10 to 100 times less than the current national exposure levels for dioxin (1 to 3 pg/km/day).[6],[7] Relying, for the moment on EPA's assessment, this would place the dioxin RfD in the range between .01 and .03 pg/km/day.

The "rough" calculation for the subsistence farmer provided in the addendum to the risk assessment reached .03 pg/km/day, the upper end of the RfD. If proper adjustments were made to consider a breast-feeding infant or developing fetus, the .03 RfD would be easily exceeded. Therefore, the EQC has failed to adequately protect these sensitive sub-populations. See, 42 U.S.C. § 6925(c); Ecolotec; ORS §§ 466.010(1)(b), 466.055(5).

Moreover, in light of the serious accumulation of dioxin in the environment and the low threshold for non-cancer effects, the EQC should have taken the position that the best available technology is one that produces no dioxin or dioxin-like chemical emissions. Oregon's prudent BAT requirement, which is more stringent than EPA's approach, dictates that the EQC take full account of the dioxin emergency and reassess the technologies that may be used alone or in combination with others at UMCDF in order to avoid further damage to human health and the environment.

In sum, the excuse that there is no RfD (i.e., safe dose) for dioxin non-cancer effects is so misleading that it could be considered scientific fraud. See, Exhibits 39, 40. The fact that we are all already over the limit for what might be considered a safe dose of dioxin exposure

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[6] EPA Health Assessment for TCDD and Related Compounds, Chapter 9, Draft, May 2, 1994, at 51.

[7] A picogram (pg) is a trillionth of a gram.

is the obvious reason why EPA chose not to provide a RfD. This reality clearly counsels against permitting sources like the proposed UMCDF incinerator that will emit more dioxin into the environment.

These and other inadequacies of the assessment of risks posed by UMCDF are well described and documented in the Commentors' Exhibits. See, Exhibit 27, Affidavit of Lisa Brenner and Tom Stibolt; Exhibit 28, Affidavit of Trygve Steen; Exhibit 29, Affidavit of J.R. Wilkinson at ¶ ¶ 8 – 16; Exhibit 74, April 12, 1999 Affidavit of Lisa Brenner and Tom Stibolt. These affidavits describe the failings of the previous EQC/DEQ process. In particular these affidavits support Petitioners' well founded concerns that the EQC/DEQ failed to: (i) thoroughly and properly assess the impacts of the Army's proposed incineration facility; (ii) fully evaluate alternative technologies; (iii) consider impacts of incineration on sensitive populations (i.e., children, elderly, persons with illness); (iv) assess the current environmental burdens of the area; and (v)compare the risks of storage, storage after reconfiguration, alternative technologies and incineration.

Such significant flaws are errors demonstrating that the Agencies failed to completely fulfill their obligation to protect public health and the environment to the maximum extent possible by ensuring that the disposal process chosen would not have a major adverse effect. Moreover, aside from the flaws in the risk assessment process, it is clear that the DEQ/EQC did not undertake an effort to answer the question: will the incineration system proposed by the Army cause a major adverse effect on public health or the environment.

F. **Non-incineration alternatives must be considered by the EQC/DEQ and implemented at UMCDF in order to comply with the statutory mandate to ensure use of best available technology and that there will be no major adverse effect on public health and safety or the environment of adjacent lands**

Department of Defense Assembled Chemical Weapons
Assessment Program (ACWA)

On September 30, 1996 P.L. 104-208 became law. In significant part, P.L. 104-208 provides:

> $40,000,000 shall only be available for the conduct of a pilot program to identify and demonstrate not less than two alternatives to the baseline incineration process for the demilitarization of assembled chemical munitions: Provided, That the Under Secretary of Defense for Acquisition and Technology shall, not later than December 1, 1996, designate a program manager who is not, nor has been, in direct or immediate control of the baseline reverse assembly incineration demilitarization program [i.e. PMCD] to carry out the pilot.
>
> P.L. 104-208 also provides:
>
> That no funds may be obligated for the construction of a baseline incineration facility at the Lexington Blue Grass Army Depot or the Pueblo Deport Activity until 180 days after the Secretary of Defense has submitted to the Congressional defense committees a report detailing the effectiveness of each alternative chemical munitions demilitarization technology identified and demonstrated under the pilot program and its ability to meet the applicable safety and environmental requirements.

Both the Lexington and Pueblo sites contain explosively-configured chemical weapons. The Lexington site includes 51,740 GB M55 rockets.

The ACWA program is looked at alternative technologies that can be used to retrofit TOCDF/ANCDF/UMCDF. The ACWA program "involves a three-phased approach, evaluation criteria development, technology assessment, and demonstration of not less than two technologies." ACWA has completed the evaluation criteria development and technology

assessment phases as follows: a) evaluation criteria development completed by December 1997; b) technology assessment phase completed on July 29, 1998. ACWA evaluated three technologies that claimed they could destroy all of the waste streams, including the explosives and propellants.

On September 30, 1999, ACWA submitted its Supplemental Report to Congress (Exhibit 79). That report documented two technologies capable of fully treating all munitions and agents (General Atomics Neutralization/SCWO) and munitions containing mustard agent only (Parsons/Allied Signal Neutralization/Biotreatment). A copy of the full ACWA report is available on the ACWA web site and will be forwarded under separate cover.

Both ACWA demonstrated technologies would provide substantial benefits for the disposal of the Umatilla stockpile from both human health and environmental perspectives. Both technologies are superior to incineration. Significantly, the General Atomics technology was designed to be directly retrofitted into the baseline incineration configuration with minimal disruption.

Alternative Technology Program (Maryland and Indiana)

As a result of a Congressional mandate to do so, PMCD is building an alternative technology facility in Aberdeen, Maryland to dispose of the chemical weapons stockpiled there. See, Exhibit 63. This alternative technology facility is full-scale and uses a neutralization process that involves mixing the mustard agent with hot water. The resultant sludge is then composted, or "biotreated." After the composting, the "waste" is sent to a sewer plant, not a hazardous waste incinerator. The neutralization-based process was selected as the preferred alternative technology to the incineration process. The State of Maryland has

issued a permit for the facility. See, Letter from Richard W. Collins to Col. Robert J. Spidel dated February 22, 1999 (Exhibit 80).

Similarly, PMCD is in the process of building an alternative technology treatment facility at Newport, Indiana because Congress directed them to consider it. The technology used at Newport involves neutralization by mixing VX with a solution of sodium hydroxide in water near the boiling point. After neutralization, the waste generated would be treated at an on-site Supercritical Water Oxidation (SCWO) facility. After the SCWO process, the liquid "waste" would be sent to a sewer plant.

V. CONCLUSION AND RELIEF REQUESTED

The evidence presented by the Commentors herein demands prompt action by the EQC to suspend construction at UMCDF and revoke the Army's permits. The Army's baseline incineration technology is a flawed and failed technology that has been kept alive, not on its merits, but by the unjustifiable commitment of vast amounts of taxpayer dollars. The resources and influence of the Army and its contractors have been overwhelming for most state agencies and local governments. However, those governmental entities, now fully informed, can no longer justify failures to take firm action to get control of the chemical warfare agent disposal process.

It is time for the EQC to mandate a course correction. The baseline incineration technology (whatever form it may take) must be rejected in favor of new and more protective technologies. Such a course change is morally correct and required by federal and state law.

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ATTACHMENT F

(DEQ Item No. 99-2186)

"Comments on the Request for Revocation of Permits"
Umatilla Chemical Agent Disposal Facility
Submitted by
Oregon Clearinghouse for Pollution Reduction

(Comments C-3, C-3A, and C-3B, without additional attachments)
(See Attachment G for list of documents that were attached)

December 16, 1999

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OrCPR

The Oregon Clearinghouse for Pollution Reduction

Protecting public health and the environment from toxic substances that disrupt natural systems including improper use, manufacture, transport, storage, release and disposal.

FILE

99-2186

Wayne Thomas, Umatilla Program Manager
Oregon DEQ, Hermiston Office
256 Hurlburt, Suite 105
Hermiston, OR 97838

December 16, 1999

RE: Comments on the Request for Revocation of Permits
Umatilla Chemical Agent Disposal Facility
Permit # ORQ000009431

Enclosed are two separate comments. The first is an abstract provided to us by Dr. Halstead Harrison of his findings from running his air dispersion model against Umatilla Army Base meteorological data. We had hoped that he would complete his report on this exercise so that it could be included in the Chance to Comment on the Request for Revocation of permits, but the written report on the results was not completed in time.

Dr. Harrison's abstract contains important conclusions, and we urge you to follow up by commissioning a full report from him as well as arranging DEQ and public presentations of his results. This is the type of excellent, independent academic work that should characterize data used by DEQ in its decision making process.

The other submission includes the comments from Oregon CPR along with its attachments. We feel that both these submissions, in addition to all the new information submitted since the original permits were granted, support reconsidering the ill advised permit to incinerate chemical weapons at the Umatilla army base. We encourage you to revoke the permit and require advanced technology for disposal of the chemical weapons.

Regards,

Lisa P Brenner

Lisa P. Brenner, President

STATE OF OREGON
DEPARTMENT OF ENVIRONMENTAL QUALITY
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HERMISTON OFFICE

3816 NE Glisan Portland, OR 97232 Telephone: 239-0402 Fax: 235-8029

FILE

99-2187 C

Air-Quality Dispersion Modeling in Complex Terrain near the Umatilla Chemical Agent Disposal Facility, Hermiston, Oregon.

Halstead Harrison
University of Washington
Seattle, WA 98195
<harrison@atmos.washington.edu>

December 15, 1999

Abstract:

Meteorological data collected since 1994 with a 30 meter tower at the Umatilla Chemical Demilitarization Facility now under construction near Hermiston, Oregon, indicate a remarkable 42% of 41,617 total hours with stable air. These occur mostly at night, and maximize in winter, but are present in all seasons.

A consequence of this stability will be many episodes with reduced efficiency for the dispersion of chemical tracers emitted by the facility. Simulations with a time-dependent, Lagrangian-Puff air-quality dispersion model suggest infrequent plume "hits" in the neighboring communities of Hermiston, Umatilla, Plymouth, Irrigon, and Boardman, but at concentrations several hundred fold higher than annual averages. Attention should therefore be paid to non-linear effects on the health of the exposed populations and, especially, to off-design emissions during the very frequent conditions with stable air.

STATE OF OREGON
DEPARTMENT OF ENVIRONMENTAL QUALITY
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99-2188

Comments on the Request for Revocation of Permits
Umatilla Chemical Agent Disposal Facility
Permit # ORQ000009431

Provided by Lisa P Brenner, PhD and Thomas B. Stibolt MD
Oregon Clearinghouse for Pollution Reduction

INTRODUCTION

A Flawed Public Process

This November DEQ held several stakeholder meetings at which a brochure was passed out titled: "Oregon Department of Environmental Quality: Mission, Vision, Values, Strategies and Goals, July 1999." In the brochure under "Value, Excellence and Integrity," is the statement: "We make decisions based on facts and science."

It is ironic, then that since the beginning of the permit process for the Umatilla Chemical Weapons Disposal facility DEQ has encouraged but then ignored public presentations of fact and science. This one way street has become an exercise in futility.

The November 1999 DEQ Carbon Filter report to the EQC by Sue Oliver is a disheartening continuation of the agency's failure to objectively "make decisions based on facts and science." The report, and its acceptance by the EQC without comment, was the latest act in the judicially arranged review of the EQC's original decision to permit incineration of chemical weapons based on issues surrounding the role of carbon filters.

To volunteers who are involved on behalf of public interest concerns and who have not received a penny in compensation for many months of work over many long years, DEQ's unwillingness to accept good arguments at face value, to pursue important concerns that have been raised both locally and at other chemical weapon depot sites, and to continue using sources such as E&E that have close ties and major funding from the U.S. Military which the DEQ then calls "independent" is extremely disheartening.

Included as Attachment 1 is E&E's web information showing Department of Defense contracts totaling over 50 million awarded in 1999. E&E's July 31 fiscal 1999 year report lists 63.3 million in total revenue. The large majority of E&E's business comes from DOD and EPA. Reasonable persons would not hire them as an independent source to review Army submissions. But DEQ relied on E&E for its risk assessment and for continuing consulting. (DEQ did not provide Oregon CPR a copy of their contract with and payments to E&E as requested.)

Vitiating important evidence

In addition to our previously submitted critique of Kristiina Iisa's Carbon Filter Report (the rebuttal by E&E is discussed here), we submitted testimony regarding carbon filters in September of 1999. We, as well as other commentators, faulted the current incinerator designs as not including carbon injection. Kristiina Iisa cited carbon injection as being "used extensively in Europe," Nonetheless, Sue Oliver claimed in her report that the permitted incinerator would include all components mentioned in the *Journal of Hazardous Materials* article, "Overview of municipal waste incineration industry in west Europe (based on the German experience."

Carbon injection is not, in fact, a component of the Umatilla incinerator, and we point out yet again that our September testimony specifically mentioned carbon injection as a component of modern incineration systems as mentioned in that 1996 article. It is extremely frustrating to have DEQ sidestep to avoid a discussion of European incinerators which use carbon bed filters only as a "polishing" finishing touch, while the same incinerators rely on carbon injection for major dioxin removal.

This particular point, and the referenced article is terribly important because it calls into question the NRC claim that European incinerators use carbon bed filters as a major component of their PAS. In a deposition taken in the Arkansas court case contesting their proposed chemical weapons incinerator, Marty Hopkins, current Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Maryland, states (Questioned by Richard Condit. See Attachment 2):

> A. Well, most recently the National Research Council conducted an evaluation of the Army's evaluation of the Anniston and Umatilla PFS risk assessment. In that report they identified approximately 20 other industrial or industrial incinerator applications, including hazardous waste incinerators, that applied carbon filter technology.
> Q. Are any of those facilities regulated and located in the United States?
> A. I believe most of them are in Europe. All of them may be in Europe. I'd have to go back and check.
> Q. So are you aware as you sit here today of any hazardous waste incinerator in the United States of America subject to United States or state laws that has a carbon filter unit like the one that you've been discussing here today?
> A. No, sir.

When important evidence is submitted and vitiated, no sound decisions can result.

Demonizing

Sue Oliver describes our critique of the Iisa Carbon Filter Report, "Exhibit 74": "The critique contains extensive and serious allegations about 'whether the report authored by Kristiina Iisa...is a deliberate attempt to mislead the reader." Why did she leave out the rest of the sentence, which was: "...or instead, simply poor writing on the part on an individual who is unskilled in or inexperienced with scientific inquiry and reporting techniques."? Frankly, Kristiina Iisa was an inexperienced Assistant Professor who had few publications and left the University environment two months after submitting her report. It is our bet that the latter explanation is the most likely, although we also expect that she may also have been "helped" by the army.

In light of all this, it is laughable that the E&E authors continue to describe Kristiina Iisa as "Professor Iisa". Outside of the classroom only tenured, full professors are officially identified as "Professor".

We are tired of DEQ's lumping commentators into the same pool and characterizing us or hiring someone to characterize us in unflattering terms as this selective quoting indicates. For example, EQC minutes characterize Dr. Stibolt's comments (at the carbon filter EQC work session) as on behalf of "the petitioners." Oregon CPR is not a petitioner. Dr. Stibolt's comments (as he stated at the time) were on behalf of Oregon CPR and the greater environmental community, that has been discouraged by DEQ's failure to act on their previous comments. Inviting community participation and then belittling those who particpate is a petty strategy

Not pursuing important information

As a part of that testimony we also urged DEQ to obtain important depositions produced as a component of the ongoing court case relating to the Utah chemical weapons incinerator as soon as they were available. We know that the depositions were available well before the November report to the EQC. We know what DEQ could have learned about carbon filter and dioxin emissions from those depositions and could have, but did not include them in their report.

For example, here are brief samples from one deposition concerning the decision to not include carbon filters at Utah, in the words of the contractor's former chief permit coordinator. The first excerpt documents known problems with the use of carbon bed filters:

> 51. PMCD wanted to avoid schedule delays from what would otherwise be legally required permit modifications and engaged in illegal conduct to avoid such delays. One example was the PAFS (Carbon Stack Filter) PMCD wanted EG&G to convince the state that the PAFS was not required and would not work. My engineers were used, and spent a lot of time to show why it was not needed. The flyash that was visible on cars and other surfaces at TOCDF that is emitted from the stack would have plugged the carbon stack filter. Use of the carbon stack filter would have complicated the delicate balance among the pressures that must be maintained throughout the incineration and HVAC systems, increasing the likelihood that an incinerator will go positive. Use of the carbon stack filter would have reduced combustion air, combustion air turbulence and oxidizing air. Use of the carbon stack filter would have required a class 3 permit modification with resulting substantial schedule delays.
>
> 54. We were told not to take the DUN out of the permit as that would bring up questions about how to handle the waste streams including the carbon filters with agent, and we had no answers. This would lead to permit delays, so my department (environmental) was to proceed as though the incinerator worked. My objections again brought verbal reprimands.
>
> 86. One possible alternative explanation for the agent break through in the first and second carbon filter banks during the first day of agent operations was that the shock from OD had caused the charcoal in the filters to settle in a manner that left cracks between the charcoal and the frame through which agent could bypass the charcoal.
>
> This explosive vibration from OBOD on the charcoal had been discussed in engineering meetings with EG&G. We also discussed this pressure wave hitting the mustard munitions stored in the open was adding to the "leakers". Mr._____, PMCD instructed EG&G to rotate the charcoal back into banks two and three, but keep using it.

And a brief sample from the same source relating to known problems with emissions sampling at the Utah incinerator that renders data presented by both Iisa and E&E about dioxin emissions erroneous.

> 105. Mr. _____, DEQ, was concerned about down drafts on the common stack during the trial burns. He was concerned about a frequently observed phenomenon of down drafts both outside and inside the stack causing dilution of air samples from combustion gases. As a result DEQ instructed that the sampling cord be moved lower in the stack to reduce this problem. However, the ACAMS sampling port or ports used during operations have not been relocated.
>
> 106. Because of cyclonic flows of the exhaust gases from the various incinerators that feed into the large common stack and because of the size of the common stack, it happens that the exhaust gas streams from each of the four incinerators do not intermix with each other but maintain separate paths

while going through the stack. This phenomenon not only allows for down drafts into the voids in the stack but also creates sampling voids in which sampling probes could be placed which would sample only ambient air and not combustion gas.

108. Because of the cyclonic flow phenomenon in the common stack EG&G Engineers concluded there was a need to monitor at each incinerator duct. This cyclonic flow and non intermixing incinerator plumes with resulting voids in the stack could explain how a duct alarm might not be accompanied by a stack alarm.

109. The Army will never allow stack ACAMS validation testing because they know incineration does not destroy agent--My opinion.

Another deposition taken in the Arkansas court case contesting their proposed chemical weapons incinerator includes statements by Marty Hopkins, current Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Maryland. These quotes document the Army's reasons for not testing carbon bed filters at JACADS or at Tooele, Utah, including money and difficult questions asked by Utah's Department of Environmental Quality. The quotes also give a sample of the process used in developing PMCD risk assessments for the sites:

In my current -- prior to my current position as the associate state project manager, I was working as an engineer with the what's known as the operations branch or operations team at PMCD. I was largely responsible for a number of special projects, one of which was the risk assessment of the PAS filter system.(p2)

Q. Now, what year, Mr. Hopkins, was the Army considering testing the carbon filter units at the Utah facility?
A. I want to say 1995.
Q. And I wasn't clear. You said that -- in your testimony that JACADS was already in operation. Is that the reason why JACADS was not using it -- used as a test site?
A. Yes, it was believed that there would be less of an impact to the overall program by retrofitting a system at Tooele than at JACADS.
Q. In other words, the Army didn't want to stop the JACADS operation in order to test the carbon filter unit on JACADS; is that correct?
A. That's correct.

Q. You mentioned in discussing the potential testing of the carbon filter units in Utah that there were -- that the life cycle costs were significantly higher, that's what my notes have; is that correct?
A. Yes, sir.
Q. Can you tell us what you're talking about when you're referring to life cycle costs please?
A. The life cycle costs refers to the cost to build, install and operate carbon filters at all of the baseline facilities. During the Army's preliminary assessment or -- and report to Congress, the life cycle costs for adding carbon filters -- adding and operating carbon filters at all of the sites with the exception of JACADS, we were looking at the scenario of putting them on all of the -- what are known as the CONUS sites, the continental United States sights. The cost estimate was approximately 260 million dollars. After we began the contracting process at Tooele and began to get actual cost information in from the contractors, **it became apparent that our original estimates had been low and that the life cycle cost across -- across the entire program would be somewhere in the range of 600 million dollars.**
Q. And is that a reason -- well, let me ask it this way. What -- what action did the Army take or what steps did the Army take following that -- coming to that conclusion that it was a 600 million dollar life cycle cost to add to the continental U.S. facilities?
A. Well, we went back and we reassessed some of the conclusions from the -- from the preliminary assessments. The preliminary assessments or the conclusions and the recommendation to the Congress on the preliminary assessment was that it paralleled with testing the units at -- at Tooele, testing the prototype units at Tooele. Because it was felt that the largest risk to the community was continued risk of storage, we would go ahead and in parallel install the full scale systems at the follow-on sites, Anniston, Umatilla, Pine Bluff, in anticipation that the Tooele test would indicate that the carbon filters were beneficial. We did not -- the reason

we went in parallel with that is we did not want to have to wait for the -- we wanted to minimize the time it would take to get the PFS up and operational at the follow-on sites following the testing at Tooele. Now, what the Army did is we went back and that original decision in part was based on the fact of a certain capital investment that would be required on the part of the Army at the follow-on sites in advance of the Tooele test results. When we went back and we reassessed the cost increase, that capital -- that capital cost investment at the follow-on sites that would be required prior to the -- to obtaining the Tooele test results were several hundred million dollars higher than -- than had been originally estimated when the decision was made to perform prototype testing and -- and -- excuse me, to perform prototype testing and install the full scale system in parallel. Based on that, with that new information, the Army determined that it would -- it would be more cost effective for the Army and also that we could probably obtain the same sort of test results sooner by going with a -- with a program of modeling and simulation and performing the risk assessment as opposed to the prototype tests.

Q. So cost was a significant consideration in determining whether or not to build and test full scale carbon filter units at the Utah facility; is that correct?

A. Well, they would have been prototype.

Q. Prototype, I'm sorry.

A. Yes. Cost was one consideration, yes.

Q. All right. **Now, what type of modeling and simulation work did the Army do in lieu of building these prototype facilities at -- at Tooele?**

A. Okay.

Q. And all I'm interested in for the moment is a list, not a detailed description of the activities, but just what's the list of activities that the Army engaged in to do this modeling and simulation?

A. The Army performed some laboratory scale testing of -- of carbon absorption in the laboratory. Based on those results, a computer model was generated to simulate carbon performance. Those results added to -- were used to update the baseline health risk assessment, quantitative risk assessment, to determine potential impacts of the PFS.

Q. So this simulation was simply an assessment of how the carbon would handle the agent and other contaminants? Is that a fair way to characterize it?

A. It was -- we estimated what the -- the model predicted, excuse me, what the removal efficiency --projected removal efficiency of the carbon would be for those compounds, yes, sir.

Q. And about what year or date, if you know, was this deduction or calculation about the removal efficiency done or created? When did you have that information?

A. 1995, '96 timeframe.

Q. All right. **Now, you also indicated that there were some concerns raised by the Utah regulators regarding the addition of carbon filters to the facility there; is that correct?**

A. Yes, sir.

Q. All right. Let me show you what has been marked and admitted into evidence as Petitioners' Exhibit Number 6. I'd ask that you take a look at it for a few moments and tell me if you're familiar with it please?

A. Yes, sir, I've seen this.

Q. What is that document as you understand it, sir?

A. This document was the State's response to -- the State of Utah's response to the Army's submission of a class three permit modification request to install the prototype units at Tooele.

Q. As I understand it looking at Petitioners' Exhibit 6, **the State of Utah raises about 19 different points or questions regarding the addition of carbon filter units to the Tooele facility;** is that correct?

A. Yes, sir. We were in the initial stages of discussion and negotiation with the state.

Q. Was there an Army response prepared to that document?

A. Yes, I believe there was.

Q. All right. And did it review each of those points, the 19 points?

A. No, sir. **Approximately a month later, the Army rescinded -- for the reasons I've stated before, made the decision to go with modeling and simulation and issued a letter to the State of Utah requesting to withdraw the permit application.**

Q. So just to make sure I understand then, the sequence of events is that the State raises those questions that we just mentioned, and the Army considers it, but the Army's response is to withdraw the request to modify the permit. Is that a fair characterization?

A. Yes, sir. The -- a number of the questions that were raised by the state were things that we were hoping to determine, to utilize the test itself, the prototype test, to determine the answers to. And based on some of the concerns raised by the state, again, that added to the -- to the feeling that modeling and simulation could give us a way to determine some of the results without actual testing at Tooele.

Yet again we urge DEQ to obtain complete copies of all depositions in the Utah and Arkansas cases and read them. We wonder why Utah regulators found the courage to ask the Army hard questions about carbon filter technology and our DEQ does not?

DEQ's Blanket Acceptance of E&E's Rebuttal of our critique of the Iisa Carbon Filter Report

The DEQ report contains a blanket acceptance of the E&E rebuttal of our critique of Kristiina Iisa's Carbon Filter Report. Had they submitted resumes from the E&E authors showing extensive publications and academic recognition in the field of incineration control, we might have had some understanding of DEQ's deference. However, the E&E authors were not presented as academic experts, and we expect that they are not. No credentials of the E&E authors were presented and we are puzzled by what authority they include subjective judgments. Our search of Elsevier publications for articles in the field of incineration by the E&E authors came up with nothing, and we have not seen their names on any scientific publications in the field.

Examining their writing, we conclude that the rebuttal is not a fair examination of our points. An ethical, academic writer would not participate in the tricks of logicused by E&E to obscure our valid points. Their techniques frankly have no credible explanation, nor does DEQ's wholehearted swallowing of the rebuttal.

For example, the E&E authors state:

"The suggestion that the EQC was not aware of Dr. Iisa's involvement is highly unlikely, as she presented the report to the EQC. As discussed below, her report was technically accurate and would not be any more accurate were it also signed by Dr. Frederick or any other professors."

First, our original critique stated concerns that the EQC was unaware, not of Dr. Iisa's involvement, but of the fact that Dr. Frederick was NOT involved, as when we quoted the EQC Chair's stating "And my conclusion in this regard is directed substantially by the results of the two professors from Oregon State University and the testimony provided at the last commission meeting by Professor Iisa..." We were clear in our presentation. Why would E&E substitute Iisa for Frederick and misrepresent a very important point that we made? Would you buy a used car from these authors?

Next, E&E's statement that Dr. Frederick's signature wouldn't make the report any more accurate is an attempt to reduce our concern to the ridiculous by equating the preparation of an independent scholarly report by a full professor and department head with a simple signature. Why didn't DEQ or E&E get a statement from Dr. Frederick validating the report and saying that he would have written the same report? We expect it was because of the points made by our

critique, that Dr. Ilsa's report was that of an inexperienced academic, not the kind of scholarly report that a full professor would produce, or certify as accurate.

Their comments about scholarly writing also reveal a profound failure to properly represent what any educated person understands. They state that "authors do not directly quote their sources to avoid accusations of plagiarism. The opposite is more true. The real issue is inaccurate quoting and inappropriate paraphrasing. Having made this statement, the E&E authors then go on to later include a long, direct quote from the difficult to obtain, industry study that was the subject of our complaint about not using direct quotes. (p7) Their own quote is an example of the same use of citations in scholarly writing that we claim is standard practice. Clearly here they have included an example of correct citation practice while simultaneously claiming that the practice is inappropriate. They conclude that not using direct quotes "does not affect the accuracy of these references." Our main concern was and still is that the lack of quotes from difficult to obtain references prohibits critical examination by the reader, which is a basic element of scientific inquiry.

The E&E authors also dismiss our placing some studies in the context of the political, regulatory arena by stating, in part that "The fact that the authors of these reports work for companies that operate incinerators does not in any way invalidate the results of these studies. These studies are technically accurate, and no contradictory studies are available form other sources." They give no further arguments or references to support these broad assertions. Again, we have to wonder, with what experience and authority do these authors speak.

There is a large and growing body of literature demonstrating that politics and corporate sponsorship affects the reliability of scientific studies. Most recently in the medical field in which we have most experience, Problems in the Design and Reporting of Trials of Antifungal Agents Encountered During Meta-analysis by Helle Krogh Johansen and Peter C. Gøtzsche was published in the Journal of the American Medical Association (1999;282:1752-1759) with an excellent accompanying editorial, "Fair Conduct and Fair Reporting of Clinical Trials" by Drummond Rennie, JAMA editor. (1999;282:1766-1768) which gives a clear example of a growing problem.

No more casting pearls to the swine

E&E and DEQ are apparently counting on readers being overwhelmed by the difficulty in sorting through E&E's references to us, having forgotten our presentation, and not taking the time to verify their statements. If DEQ would like to hire Oregon CPR as a consultant to rebut the E&E rebuttal at the same rate that they hired E&E, we would do a line by line rebuttal. But we are disheartened by DEQ's failure to utilize our previous hard work, to seek accuracy and facts in this extremely important case. In this submission, we include only enough information to demonstrate the extremely disappointing lack of balance and scientific objectivity in E&E's rebuttal in hopes that someone will bring DEQ to task for not following its stated value of making decisions based on "facts and science."

A BRIEF CRITIQUE OF THE REBUTTAL OF THE CRITIQUE OF THE CARBON FILTER REPORT

What's the point?

The E&E rebuttal does not states its purpose, limit itself to our stated purpose, or include the bulk of our substantive testimony refuting the assertions in the Iisa Carbon Filter Report. Puzzled at the scope of the rebuttal, we asked for a copy of DEQ's directions to E&E in preparing our response. The August 20 DEQ memo to E&E provided to us includes the statement, "Please review the Affidavit, and supporting documents, and provide us a Technical Memorandum concerning the validity of the statements and claims that are made in the Affidavit." The memo also mentions an earlier telephone conversation, where we have to assume the purpose of the rebuttal was frankly discussed.

We have to ask: Why didn't DEQ utilize its own professional staff to evaluate our assertions? Were they as unwilling as Dr. Frederick? Is DEQ issuing permits with perfunctory reviews?

Out of focus

The E&E rebuttal is a one sided dismissal of not only our critique but also a defense of Iisa's claims using recent EPA and NRC publications. However, our introduction, Focus of Our Analysis, made it clear that we would not include any information outside of the references used by Kristina Iisa:

> "The following critique brings no outside information to the Iisa Report other than the content of the references therein. The critique attempts to deconstruct Iisa's knowing manipulation of the data by using the report's own sources, looked at in their entirety. Additionally, this critique points out fallacies and tactics used to distract and mislead the reader of the report."

The main point of our affidavit was to make it clear that Dr. Iisa's report did not appropriately state the uncertainty and contrary conclusions that exists in the literature which she references. This remains an issue, despite the EQC's apparent comfort with assurances from DEQ and E&E.

Lack of recent information used to discredit us

We directed the reader or our critique to the Pat Costner critique for a technical rebuttal, including additional information known at the time. We did not bring in new information, because that was not the purpose of the report, yet E&E discredits our effort with the inappropriate statement that, "Drs. Brenner and Stibolt seem unaware of these more recent technical documents." Let us respond with the appropriate comment that the E&E authors apparently failed to note our reference to the Pat Costner report or respond to its new evidence while they inappropriately included new test data from the Utah incinerator but failed to include data from the Utah trial depositions indicating problems with incinerator performance, or Utah incident reports.

We also respond with the observation that the EPA report cited by E&E chose to include only four of Dr. Iisa's references out of their forty non-EPA references. The E&E authors can't have it both ways. If they choose EPA as their authority, then EPA did not find the majority of Iisa's references compelling.

An inauspicious beginning

E&E starts their rebuttal with four quotes from an EPA 1988 Peer Review Draft side by side with quotes from the Iisa Carbon Filter Report, claiming that: **"Although the EPA document does not directly address the merits of carbon filtration or other emission control technologies or specifically discuss the potential for dioxin formation during chemical agent combustion**, as can be seen from the above it supports the majority of Professor Iisa's conclusions." Only two of the quotes actually support the "parallel" Iisa statements included by E&E in its comparison, and even these statements do not represent her most important conclusions. None of the quotes answer the "Although" phrase included by E&E at the beginning of their sentence, which does include the main questions put, not to EPA, but to Jim Frederick, by the EQC. Any reasonable person would question such an opening to the E&E rebuttal.

Under "On the relationship between chlorine feed and dioxin/furan emissions," the second EPA quote states: "Obviously, no D/Fs could be formed without the presence of chlorine." There you have it! No chlorine = no dioxin. E&E provides EPA refutation of Iisa's statement listed in parallel that "... Factors other than the chlorine content have a greater impact on the formation of dioxins and it is impossible to predict dioxin concentrations solely based on the chlorine content of the feed."

The third comparison, "On design technology for preventing dioxin production," E&E quotes Iisa's conclusion, "Hence the incineration technology is not nearly as crucial as the design of the pollution abatement system for formation of dioxin..." The EPA quote only discusses that "...even in systems achieving good combustion ...D/F reformation may occur...downstream." The citation makes no comparison between the relative importance of incineration technology and pollution abatement systems to the absolute production of D/F.

In the case of their last comparison, "On design elements of a pollution abatement system for controlling dioxin emissions," they feature a quote from the Iisa report that we had no complaint with. They should have left "well enough alone" because the similarity between EPA and Iisa's quotes is not even close. She states that "below 250°C the net rates of dioxin formation are negligible. The minimization of the exposure to these temperatures is one of the most efficient methods of preventing dioxin formation." They then quote EPA's example of temperatures of 170-185°F for "low D/F emissions." Astoundingly, they have asked us to equate Iisa's value of 250°C to EPA's value of 170 to 185°F which is 77 to 85°C. **These are significantly different values!**

The EPA is not an independent academic source

If the EQC had wanted advice from EPA they wouldn't have gone to the head of the Chemical Engineering Department at OSU to prepare a report with the latest scientific information. Subsequent to the draft document included with the E&E report, EPA produced and promulgated a MACT rule for Medical Waste Incinerators and a MACT rule for Hazardous Waste Incinerators. The Medical Waste Incinerator rule has been subsequently struck down through a court challenge by the Sierra Club, which has also sued EPA over its Hazardous Waste MACT Rule with a predicted similar prognosis for success in court.

All of these rules are, as we stated in our critique, a highly politicized process that has little to do with state of the art science, which was what the Carbon Filter Report was to summarize..

Beating a dead horse

To utterly and completely make our point, here are even more recent quotes that directly apply to the question that the EQC asked about the relationship of chlorine to dioxin production. The quotes come from EPA's Response to Comments to the Proposed HWC MACT Rule. We include commentator statements that yet again show how politicized the rule making process is. Note that the EPA acknowledges an exception for incinerators not feeding chorine, as well as the narrow definition of their mandate. (Misspellings come directly from EPA's web site.)

Grossman Consulting Comment: "EPA's reconsideration of industry data for preparation of this NODA constitutes nothing less than the clearest form of "junk-science" imaginable. We strongly urge the agency to step back away from their predetermined conclusions. Return to the law and quality science. Continued failure to analyze the available data in a scientifically sound manner is an embarrassment to both the agency and the industry. We need sound rules and limits based on scientific principles designed to protect human health and the environment, not the politically motivated, predetermined approach used to date. Gossman Consulting, Inc. continues to support sound regulation based on congressional intent and scientific principals. Regulations developed to satisfy political agendas does not best serve human health and the environment."

Sierra Club Comment: We do not support the unproven theory that suggests that chlorine input is not well correlated to dioxin output. It is too obvious that dioxin output requires chlorine input, and that there is available peer-reviewed scientific evidence to support that such correlations are present in hazardous waste combustors as a fundamental concern in evaluating how to reduce dioxin emissions.

British Petroleum Comment: *"Feed streams at BP Chemicals Lima plant do not contain the major precursors of concern in the proposed regulation. These streams principally come from distillation operations, with no chlorine use in the unit processes. As such, these streams contain deminimis concentrations of chlorine, particulate, mercury, and metals. Our Lima plant has historic stream composition data to support this conclusion."*

EPA Response to Commentors: "Response: CAA §112 does not provide us with the outright authority to promulgate regulations that prohibit the combustion of chlorine-containing wastes."

*" • **Potentially low risk on-site incinerators which burn relatively "clean" wastes (referred to by the commenters as needing more relaxed standards) may be exempt based on classification under the new comparable fuels exemption, or get waivers from metals or chlorine emissions testing and operating requirements other than feedrate limits based on low waste metals and/or chlorine levels. Additionally, even if these exemptions are not appropriate, it of course will be all the more easy for these facilities to meet the MACT floor standards because they are low HAP emitting facilities."***

(We include as Attachment 3, these excerpts in their context from comments and EPA's responses to comments.

There's lots of sulfur in hell as well as in dioxin reduction

E&E's page 4, 1st paragraph, claims that our critique "misquotes or misrepresents the references such that they are portrayed as stating the opposite of their actual conclusions." This extremely strong accusation is presented in the answer to the first question, in which we actually agreed that four of her references supported her assertions. Although this section does not contain the

most important questions posed by the EQC, the above accusation is so egregious that we take the time to work through the intricacies of a complicated reference and our attempt to present it.

The E&E authors quote us as saying that "Iisa seriously misquotes several references". They leave off our qualifier, which is: "Iisa seriously misquotes several references **when she equates the effects of sulfur operating alone and sulfur operating in the presence of coal.**" They turn a highly qualified introductory statement into a blanket accusation. This is not ethical.

The E&E authors follow their accusation by analyzing Iisa's reference #2, quoting what they claim to be the article's conclusion "...the conclusion of the reference is that 'the apparent lack of PCDD and PCDF in the emissions from coal-fired combustors may be due to the relatively high concentrations of SO2.'" However this quote from Reference 2 is actually **taken from the abstract**, not the conclusion of article itself, which does, as we pointed out, focus on the relationship between copper and sulfur. The authors are making the point in the abstract that the **reduced** PCDF/PCDD is due to the **high concentration** of SO_2, not the mere presence of SO_2. The **actual** conclusion of the article on page 1943 states:

> "Formation of PCDD between 300 and 500 ºC under simulated MWC conditions is **dependent upon a catalyst (e.g. CuO)** that produces Cl_2, the primary chlorinating agent of the aromatic structures, reaching a maximum at 400 ºC. While gas-phase SO_2 has little apparent effect upon the production of PCDD, the presence of S as an upstream reaction product, $CuSO_4$, results in minor (less than 1 order of magnitude) reduction of the overall PCDD production mechanism. Although $CuSO_4$ also catalytically forms Cl_2, the temperature of maximum Cl_2 production shifts upward to ~500 ºC. However, the decreased ability of the $CuSO_4$ catalyst to produce PCDD is not necessarily linked to the production of Cl_2. Rather the 2 order of magnitude difference in PCDD production between CuO and $CuSO_4$ catalysts in the presence of chlorophenol precursors suggests a second catalytic role of Cu species – the $CuSO_4$ appears to have lower activity than CuO in a biaryl synthesis reaction. **Additional understanding of the PCDD and PCDF formation mechanism is necessary before apparently lower levels of PCDD and PCDF in coal-fired utility boilers can be definitively attributed to $CuSO_4$ formation alone.**"

Our statement about reference 2 was that it "finds the role of copper as a catalyst negates the effects of sulfur." Another way of stating this is that as the amount of copper increases the effect of sulfur diminishes, and overall the article concludes that it is the relationship between copper and sulfur that appears to determine PCDD formation.

We included the following quote from reference 2, "Addition of SO2 to these "baseline' synthesis conditions appears to have little, if any, effect on the production of PCDD at all three temperatures, 300, 400, and 500'C." The E&E rebuttal comments about this quote were,"...however, in some cases dioxin concentrations were below detectable levels in these tests even before the addition of sulfur, and the standard deviation in these results is large. These uncertainties were noted in the text of the paper and did not affect the conclusion." We have quoted the REAL conclusions of the article here, they do not contradict our critique's statements. Why did the E&E authors confuse an abstract with a conclusion?

In our review of this article we neither, as the E&E authors claim, misquoted or misrepresented reference 2. We simply pointed out that this reference does not support Iisa's statement that *"Thus the sulfur in the mustard gas will behave in exactly the same manner as sulfur dioxide*

added to the incinerators in the tests or sulfur in coal and the results are applicable to combustion of mustard in the incinerators."

The E&E sulfur discussion continues to incorrectly state that "it remains true that all tests of sulfur as a waste feed additive resulted in the significant inhibition of dioxin formation under most conditions". In fact, the references show that the effect can be quite small under a number of scenarios. They also state that "the potential physical processes by which sulfur inhibits dioxin formation have been identified, namely, that sulfur may reduce chlorine gas (necessary for dioxin formation) to hydrogen chloride". Not a very convincing statement, it is further refuted in Iisa's reference 2 on page 1942, fifth paragraph "In the declining temperature flue gas environment, it follows then that the apparently minimal amounts of PCDD and PCDF detected in coal-fired combustors is not attributable to depletion of the Cl_2 chlorinating agent through direct homogeneous reaction with SO_2.".

The real world is considerably more complicated then Iisa presented it to be, or that the E&E authors believe when they say "There is no reason to believe that sulfur mustard would behave in a significantly different manner than coal..." They conclude"... nor is any such reason stated in the affidavit.". We encourage the reader to read page 9 of our affidavit, where we do state reasons quite clearly.

S...LIME, waste of time attack

The E&E document wins the prize for confusing the reader with more errors of statement than Iisa's report and our rebuttal combined. Their tendency was to couple acknowledgement of the validity of our observations with attack statements which may or may not have been related to or important points in our critique; embedded in a writing style that requires a careful reading of the Iisa report, our critique, and the references themselves in order to sort out fact from fiction.

Although the main importance of Reference 20 was really to support the importance of carbon injection, the article researches adding both Calcium Carbonate and Lime to the carbon as it is injected. Our critique correctly pointed out Dr. Iisa's error in citing the reference, where she states that "limestone" was used. The E&E authors could have chided us for picking at a not very important error of Iisa's and of having confused lime with limestone and stopped there.

However they compound the irrelevancy of the issue and collective errors by claiming that "The affidavit incorrectly states that Reference 20 refers only to $CaCO_3$, and not limestone. In fact, $CaCO_3$ is chemical shorthand for calcium carbonate, which is a technical term for limestone." The article, in fact used only the term Calcium Carbonate, which is indeed a major but not the sole component of limestone. Limestone contains magnesium, carbon and other impurities. The reference cited used calcium carbonate, which was likely obtained from limestone but purified before use. There is indeed a difference.

A more serious mistake on the part of the E&E authors is their statement on p7, paragraph two that:

"As documented in several references and described by Professor Iisa, measurable dioxin formation in combustion facilities does not occur in the incineration process itself, but rather downstream, under conditions that may be similar to those described in this reference."

Now this is a really major mistake on the part of the authors! How could they discuss the temperature ranges under which dioxin forms without realizing that the temperature at which the incinerator operates determines whether dioxins will form in the incinerator. Of course dioxins production can occur in the incineration process. Their statement indicates such a profound lack of understanding of incineration that this sentence alone calls for the whole rebuttal to be tossed in the waste basket.

Wouldn't it have been wonderful to have had a real academic expert in hazardous waste incineration write the very first report, and to have saved all of us this scrabbling over meaning, relevancy, and accountability?

Putting Carbon Filters to Bed

The E&E authors defend Iisa's statement, "The efficiency of activated carbon filters is unsurpassed by other method," which we pointed out was "notable" because the one reference that she uses refers to experiments with "three small incinerators.

"It is common scientific practice to study technologies first at the bench scale, and subsequently at pilot scale prior to implementation at full scale. Use of these data aids understanding of complex processes and furthers the body of knowledge about subjects of concern and helps prevent capital expenditures for full-scale facilities only to find critical design flaws."

Exactly! We brought up the basis for Iisa's recommendation of carbon bed filters so that the EQC wouldn't commit Oregon to being the FIRST facility to try a prototype carbon filter bed on a very dangerous chemical weapons incinerator. How the E&E authors thought that their statement would "support" Iisa's conclusions is a puzzle.

E&E quotes Iisa's reference 21 several times, first claiming that "This article indicates that each of the methods is effective in removing dioxin to required levels, and compares the capital and operating costs for each." It would have been very useful for the E&E authors to have included a quote here to support their statement that "each of the methods is effective in removing dioxin to required levels," because we can't find that statement in the article. The article does conclude with, "In summary, **considering the technical benefits and costs** we believe that the most favorable solutions, overall, are the wet dediox process, followed by the Flugstrom and the SCR."

Let's get this article straight. It considers not just costs as E&E claims, but **technical benefits**. It does not include carbon bed filters in its recommendations. Period. In addition, our critique quoted in full the article's statements about carbon bed filters, which included their technical analysis. the E&E authors write that:

"This article indicates that each of the methods is effective in removing dioxin to required levels, and compares the capital and operating costs for each. Static carbon beds were reported in this reference to be the most expensive option evaluated, but cost should not be confused with their efficiency in removing dioxin from the waste stream."

Oops, no one confused cost with efficiency. E&E left out the article's consideration of technical benefits (and we still can't find that sentence in the article about how effective carbon bed filters are.) And then, in a later paragraph on p12, the E&E authors, correctly this time, characterize reference 21: "As stated earlier, although this article is focused on comparing these technologies in terms of their **effectiveness and cost** ..."

E&E repeatedly appeals to their own authority to cover for Iisa's failure to convey all the information about carbon bed filters actually included in her references. They suggest that "Question 4a does not ask Professor Iisa to provide detailed list of the drawbacks associated with design elements, but rather asks her to list the essential design elements. She should not be faulted for failing to outline all of the possible pitfalls." One wonders, if Dr. Iisa doesn't outline the pitfalls, who will? What were these questions intended for if not to educate the EQC about the viability of carbon bed filters. Two paragraphs later, however, they claim that "Professor Iisa addresses the drawbacks of several post-combustion treatment methods." She either did or she didn't.

Then, again using their authority only, the E&E authors state that "the design elements and drawbacks of this system are not relevant for the UMCDF..." Several times they refer the reader to the permit application and subsequent permit modifications. These statements go well beyond a rebuttal of our critique. They go beyond, but do not explain their comments. Kristiina Iisa was provided with the permit application and chose not to cite it in her report. By what authority do the E&E authors speak?

Under the discussion of Question 5, Design of the carbon filters and best available control technology, our critique points out:

"Iisa repeatedly used carbon filters throughout her document as the 'magic bullet' that would eliminate all dioxin that one would normally find in incinerator operations. Having done so, there was a large burden of proof on her to demonstrate the consistent reliability of this control method. But she did not marshal a single substantial reference to support her assertion. In fact, she did not include the disadvantages listed in her reference (21) of cost and engineering problems, nor that carbon beds are not a recommended technology..."

The E&E authors suggest that she did not reference her answer to this question because she had used her references in the previous question. They attempt then to confuse "the merits of using activated carbon as an adsorbant as part of the PAS" with the desirability of using carbon bed filters. Authors who see no difference between limestone and calcium carbonate might also not see the difference between carbon injection and carbon bed filters.

Aloha

In conclusion, let us reiterate our disheartened stepping away from any belief that ODEQ is actually seeking objective information presented to them with only a presentation of facts and science in mind. How have our comments about the Iisa report been handled by DEQ and E&E? We weren't thanked for providing an unpaid public service. The veracity of our good points were not acknowledged. Our stumblings over technical terms were not stretched to find the valid points that underlay our efforts. Instead we have been treated to a not very clever "roast" by hired consultants with unknown credentials and at best sloppy writing. This hardly seems to be making decisions based on "fact and science".

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ATTACHMENT G

TABLE OF COMMENTS AND EXHIBITS

Comments received during the "Request for Revocation" comment period

October 18 through December 17, 1999

(See also Attachment E for Comment C-5 and Attachment F for Comment C-3)

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ATTACHMENT G

Comments received during the "request for revocation" comment period (October 18-December 17, 1999)

EXHIBIT/ COMMENT NO.[1]	DOCUMENT TITLE (IF APPLICABLE)	DATE OF DOCUMENT	AUTHOR/ COMMENTER	ADMIN RECORD NO.	NOTES AND CITATIONS TO DOCUMENT[2]
C-1	Letter, transmitted via e-mail	10/21/99	Bill Fujii, Oregon Water Resources Department	99-2273	Mr. Fujii offers the Department assistance in review of any water right issues related to UMCDF.
C-2	Facsimile Transmission (one page)	12/17/99	Nathan and Allison Butz, and Andrew Butz	99-2193	The Commenters express their support for the revocation of the UMCDF permits.
C-3	Letter transmitting comments	12/16/99	Lisa Brenner, President Oregon Clearinghouse for Pollution Reduction (OCPR)	99-2186	Dr. Brenner transmits an abstract of the findings of Dr. Halstead Harrison concerning an atmospheric dispersion model, and transmits the comments of the OCPR (see Comments C-3A through C-3E, below). **(This document is included in its entirety in Attachment F.)**
C-3A	Abstract of "Air-Quality Dispersion Modeling in Complex Terrain near the Umatilla Chemical Agent	12/15/99	Dr. Halstead Harrison University of Washington	99-2187	Comment C-3A is an abstract summarizing Dr. Harrison's findings using an air quality dispersion model that "suggest[ed] infrequent plume 'hits' in the neighboring communities...but at concentrations

[1] The comments from G.A.S.P. et al., included "Exhibits" with numbering that continued from previous legal briefs. Because these Exhibits were not actually part of the August 1997 lawsuit or revocation request, the Exhibit number has been preceded by a "C" to indicate that the Exhibit was received in the context of a comment period.

[2] No. **98-1247**: "Request for Contested Case Hearing and Other Relief," letter dated December 14, 1998 (Included as Attachment A)
No. **98-1275**: "Petitioners' Memorandum Supporting Cross Motion for Summary Judgment," August 20, 1998 (Case No. 9708-06159)
No. **98-1285**: "Petitioners' Additional Documentary Evidence," November 10, 1998 (Case No. 9708-06159)
No. **99-0704**: "Petitioners' Opposition to Respondents' Supplemental Motion for Summary Judgment," April 12, 1999 (Case No. 9708-06159)
No. **99-2201**: "Comments of G.A.S.P., et al., in Support of Their Request to Suspend and Revoke Permits for [UMCDF]," December 17, 1999 (Included in Attachment E)

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	Disposal Facility"				several hundred fold higher than annual averages." (A full copy of the report was received January 11, 2000.) Item No. **99-2186** cites Dr. Harrison's findings and urges the Department to "follow up by commissioning a full report from him as well as arranging DEQ and public presentations of his results." **(This document is included in its entirety in Attachment F.)**
C-3B	"Comments on the Request for Revocation of Permits"	12/16/99	Lisa P. Brenner, Ph.D. and Thomas B. Stibolt, M.D. Oregon Clearinghouse for Pollution Reduction (OCPR)	99-2188	Comment C-3B focuses primarily on responding to the Department's November, 1999, staff report related to the carbon filter systems. **(This document is included in its entirety in Attachment F.)**
C-3C	"Information from Ecology and Environment's Web Site" (labeled as "Attachment 1")	12/99	Ecology and Environment	99-2189	Comment C-3C (Attachment 1 to Comment C-3B) is information from Ecology and Environment's website concerning corporate acquisitions, recently awarded contracts, and financial statements.
C-3D	"Deposition of Martin Hopkins In the Matter of United States Department of the Army Pine Bluff Arsenal"	9/21/99	Martin Hopkins	99-2190	Comment C-3D (Attachment 2 to Comment C-3B) is a copy of the Testimony (including Examination and cross-examination) of Mr. Martin Hopkins during a hearing before the Arkansas Pollution Control & Ecology Commission related to the Pine

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EXHIBIT/ COMMENT NO. [1]	DOCUMENT TITLE (IF APPLICABLE)	DATE OF DOCUMENT	AUTHOR/ COMMENTER	ADMIN RECORD NO.	NOTES AND CITATIONS TO DOCUMENT [2]
	(labeled as "Attachment 2")				Bluff Arsenal Chemical Agent Disposal Facility. Mr. Hopkins was questioned concerning his work related to carbon filters when he was an engineer with the Operations Team of the Army Program Manager for Chemical Demilitarization.
C3-E	"Selected Excerpts from the EPA Response to Comments to the Proposed HWC MACT Rule, Volume 1 Standards, Taken from the EPA web site" (labeled as "Attachment 3")	Undated	EPA	99-2191	Comment C3E (Attachment 3 to Comment C3-B) is described as an excerpt of EPA's response to Comments to the Proposed Hazardous Waste Combustor Maximum Achievable Control Technology. OCPR cites this excerpt when discussing the relationship of chlorine to dioxin production.
C-4	(Transmittal letter)	12/18/99	Richard E. Condit, Esq. and Stuart Sugarman, Counsel for the Commentors (G.A.S.P., et al.)	99-2200	Comment C-4 is a transmittal letter of Comment C-5 and related Exhibits C-75 through C-80.
C-5	"Comments of G.A.S.P., et al., In Support Of Their Request To Suspend And Revoke Permits For The Umatilla Chemical Demilitarization Facility"	12/17/99	Submitted by: Richard E. Condit, Esq. and Stuart Sugarman, Counsel for the Commentors (G.A.S.P., et al.)	99-2201	**(This document is included in its entirety in Attachment E.)**
C-75	Affidavit of Gary E. Harris	12/16/99	Gary E. Harris	99-2202	Exhibit C-75 is an Affidavit from Mr. Gary E. Harris, a former employer of EG&G who worked at

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Comments received during the "request for revocation" comment period (October 18-December 17, 1999)

EXHIBIT/ COMMENT NO.[1]	DOCUMENT TITLE (IF APPLICABLE)	DATE OF DOCUMENT	AUTHOR/ COMMENTER	ADMIN RECORD NO.	NOTES AND CITATIONS TO DOCUMENT[2]
					TOCDF until 1996. Mr. Harris was formerly EG&G's "Permits Coordinator" and states that he "supervised Environmental Engineers, Permitting Technicians and other technical and non-technical staff" and that he "was involved in preparation of emergency and contingency plans as well as permitting, compliance, and trial burn testing. Mr. Harris explains the purpose of his affidavit "is to inform Oregon officials of the serious problems I witnessed regarding the permitting, testing, and operation of the TOCDF. Mr. Harris' Affidavit contains 128 individual allegations related to: Agent Monitoring; Emissions/Releases; Lessons Learned Program; Munitions Storage, Handling & Tracking; Permit Modifications; Permit Violations; Questionable Procedures; Risk Assessments; System Inadequacies/Failures; Trial Burns; Waste Characterization, Handling & Tracking; and Worker Exposures. (The Affidavit submitted as Exhibit C-75 was arranged numerically. Later publication of the Affidavit by the Chemical Weapons Working Group provided the subject area listings given above.) Item No. **99-2201** (pp. 10, 14, and 15) cites Exhibit C-75 in relation to issues surrounding the Dunnage Incinerator, Trial Burns, and the Permit Modification process.

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EXHIBIT/ COMMENT NO.[1]	DOCUMENT TITLE (IF APPLICABLE)	DATE OF DOCUMENT	AUTHOR/ COMMENTER	ADMIN RECORD NO.	NOTES AND CITATIONS TO DOCUMENT[2]
C-76	Memorandum: "DAAMS Analysis and UOR #99-06-04-A1"	10/15/99	Sam Guello and Fred Burton (EG&G)	99-2203	Exhibit C-76 is an internal EG&G (the Army's contractor at the Tooele facility) memorandum related to the use of the Depot Area Agent Monitoring System (DAAMS). Item No. **99-2201** (pp. 12-13) cites Exhibit C-76 to support their contention that it is an "Army myth" that there have been "no confirmed releases of nerve agents from the stack at TOCDF."
C-77	Letter from EG&G to the Department of the Army related to a confirmed agent reading in the Toxic Maintenance Area at the Tooele facility	8/6/99	Jackson Maddox, EG&G	99-2204	Exhibit C-77 is a letter from EG&G's "Deputy General Manager—Risk Management" to the "Administrative Contracting Officer" of the Department of the Army's Industrial Operations Command. The letter transmits a report ("Occurrence Report No. 99-05-26-A1") related to a confirmed agent reading in the Toxic Maintenance Area at the Tooele facility and the exposure of workers to the agent. [Cited in Item No. **99-2201** as an indication that "workers have clearly been exposed to agents during operations."]
C-78	"Issue and Directed Actions with Fact Sheet" (Issue # 95-104)	12/6/99	Unknown (from Army's "Programmatic Lessons Learned" Program)	99-2205	Exhibit C-78 is a document titled "Issue and Directed Actions with Fact Sheet" related to the "Agent Quantification System Tank Problems Requiring Repeat Draining of Rockets." Item No. **99-2201** (p. 14) cites Exhibit C-78 to support the Petitioners' contention that the "the

ATTACHMENT G

Comments received during the "request for revocation" comment period (October 18-December 17, 1999)

EXHIBIT/ COMMENT NO.[1]	DOCUMENT TITLE (IF APPLICABLE)	DATE OF DOCUMENT	AUTHOR/ COMMENTER	ADMIN RECORD NO.	NOTES AND CITATIONS TO DOCUMENT[2]
					Army was able to manipulate the trial burn process at TOCDF in order to avoid being tested in ways that might result in failure."
C-79	"Assembled Chemical Weapons Assessment Program, Supplemental Report to Congress"	9/30/99	Department of Defense	99-2206	Exhibit C-79 is a partial copy of a "Supplemental Report to Congress" from the Department of Defense. Item No. **99-2201** (pp. 34-35) cites Exhibit C-79 to support the contention that "both ACWA demonstrated technologies would provide substantial benefits for the disposal of the Umatilla stockpile from both human health and environmental perspectives."
C-80	Letter	2/22/99	Richard W. Collins Director, Waste Management Administration, Maryland Department of the Environment	99-2207	Exhibit C-80 is a letter from the Maryland Department of the Environment to the Commander of the Aberdeen Proving Ground approving a modification to the "Controlled Hazardous Substances Permit" to include the Aberdeen Chemical Agent Disposal Facility (which will use neutralization to destroy the mustard agent stockpile stored at Aberdeen). Item No. **99-2201** (pp. 35-36) cites Exhibit C-80 to support the use of an alternative treatment technology for the Umatilla stockpile.

ATTACHMENT H

TABLE OF COMMENTS AND EXHIBITS

"Exhibit 74" Documents Reviewed During the 1999 Comment Period
Related to the Use of the UMCDF Pollution Abatement System Carbon Filter System

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"Exhibit 74" Documents Reviewed During the 1999 Comment Period Related to the Use of the UMCDF Pollution Abatement System Carbon Filter System (See also "EQC Clarifying Order" from March, 1999, and Department Staff Report from November, 1999)

EXHIBIT NO.	TITLE	DATE	AUTHOR (IF APPLICABLE)	NOTES AND CITATIONS TO DOCUMENT[1][2]
74	Affidavit of Dr. Lisa P. Brenner & Dr. Thomas Stibolt with "Analysis of Kristina Iisa's Report Concerning the Emission of Dioxin and the Use of PAS Carbon Filters"	4/12/99	Dr. Lisa P. Brenner & Dr. Thomas Stibolt	DEQ Item Nos. **99-0704** (p. 15), Item No. **99-2186**, and Item No. **99-2201** cite this Exhibit and its various attachments. (Previously reviewed.)
74.1	Appendix 1 - Iisa Report References With Quotes from the References (attached to Exhibit #74)	4/12/99	Dr. Lisa P. Brenner & Dr. Thomas Stibolt	(Previously reviewed.)
74.2	Appendix II to Exhibit 74 - Summary of the events found in the record	4/12/99	Dr. Lisa P. Brenner & Dr. Thomas Stibolt	(Previously reviewed.)
74.3	Appendix III to Exhibit 74 - Copies of the References from Kristina Iisa's Dioxin Report to the EQC	4/12/99	Dr. Lisa P. Brenner & Dr. Thomas Stibolt	(Previously reviewed.)
74.301	A New Theory of Dioxin Formation in Municipal Solid Waste Combustion	11/1/86	Roger D. Griffin	Reference 1 to Exhibit 74. From Chemosphere, Volume 15, Nos. -9-12, pp. 1987-1990, 1986 (date of 11/1/86 is approximated).

[1] The DEQ Chemical Demilitarization Program maintains a database of documents related to the Umatilla Chemical Agent Disposal Facility. Most documents are assigned a record number for tracking purposes. Individual "Exhibits" submitted during the course of G.A.S.P., et al., *v.* EQC, et al., (Case No. 9708-06159, Oregon Circuit Court) were not assigned record numbers at the time of submittal—only the document the Exhibit was attached to was assigned a number. Some Exhibits do have Administrative Record Numbers because the document had been previously received.

[2] No. **99-0704**: "Petitioners' Opposition to Respondents' Supplemental Motion for Summary Judgment," April 12, 1999 (Case No. 9708-06159)
No. **99-2186**: "Comments of the Oregon Clearinghouse for Pollution Reduction," December 15, 1999 (listed in Attachment G)
No. **99-2201**: "Comments of G.A.S.P., et al., in Support of Their Request to Suspend and Revoke Permits for [UMCDF]," December 17, 1999 (Included in Attachment E)

ATTACHMENT H

"Exhibit 74" Documents Reviewed During the 1999 Comment Period Related to the Use of the UMCDF Pollution Abatement System Carbon Filter System (See also "EQC Clarifying Order" from March, 1999, and Department Staff Report from November, 1999)

EXHIBIT NO.	TITLE	DATE	AUTHOR (IF APPLICABLE)	NOTES AND CITATIONS TO DOCUMENT[12]
74.302	Effect of Sulfur Dioxide on the Formation Mechanism of Polychlorinated Dibenzodioxin and Dibenzofuran in Municipal Waste Combustors	6/1/92	Brian K. Gullett	Reference 2 to Exhibit 74. From Environmental Science Technology, Vol. 26, No. 10, pp. 1938-1943, 1992 (date of 6/1/92 is approximated).
74.303	Combustion Dioxin Suppression in Municipal Solid Waste Incineration with Sulphur Additives	10/1/92	Ralf L. Lindbauer, Friedrich Wurst and Theodor Prey	Reference 3 to Exhibit 74. From Chemosphere, Volume 25, Nos. 7-10, pp. 1409-1414, 1992 (date of 10/1/92 is approximated).
74.304	Effect of Sulfur in Reducing PCDD/PCDF Formation	5/11/98	K. Raghunathan and Brian K. Gullett	Reference 4 to Exhibit 74. From the Proceedings of the International Conference on Incineration and Thermal Treatment Technologies, pp. 225-230, May 11, 1998.
74.305	Dioxin Reduction by Sulfur Component Addition	1/1/96	Hiroshi Ogawa, Norihiko Orita, Mitsuhiro Horaguchi, Takumi Suzuki, Mitsuhiro Okada and Shirzuo Yasuda	Reference 5 to Exhibit 74. From Chemosphere, Volume 32, No. 1, pp. 151-157, 1996 (date of 1/1/96 is approximate).
74.306	Dioxin Emissions from Full Scale Hazardous Waste Combustion Units Handling Variable Chlorine Feed Compositions	5/11/98	J.D. Wilson, C.N. Park and D.I. Townsend	Reference 6 from Exhibit 74 (also Reference 8). From the Proceedings of the International Conference on Incineration and Thermal Treatment Technologies, pp. 387-391, May 11, 1998.
74.307	Effects of Facility Contamination on Dioxin Emissions	5/1/96	K. Raghunathan	Reference 7 to Exhibit 74. From the Proceedings of the International Conference on Incineration and Thermal Treatment Technologies, pp. 681-683, May, 1996.

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"Exhibit 74" Documents Reviewed During the 1999 Comment Period Related to the Use of the UMCDF Pollution Abatement System Carbon Filter System (See also "EQC Clarifying Order" from March, 1999, and Department Staff Report from November, 1999)

EXHIBIT NO.	TITLE	DATE	AUTHOR (IF APPLICABLE)	NOTES AND CITATIONS TO DOCUMENT[12]
74.308	Dioxin Emissions from Full Scale Hazardous Waste Combustion Units Handling Variable Chlorine Feed Compositions	5/11/98	J.D. Wilson, C.N. Park and D.I. Townsend	Reference 8 from Exhibit 74 (also Reference 6). From the Proceedings of the International Conference on Incineration and Thermal Treatment Technologies, pp. 387-391, May 11, 1998.
74.309	The Relationship Between Chlorine in Waste Streams and Dioxin Emissions from Waste Combustor Stacks (CRTD 36)	10/20/95	H. Gregor Rigo, A.J. Chandler, and W.S. Lanier	Reference 9 to Exhibit 74. This Exhibit provides only a copy of a web page with ordering information from the ASME International Publications Catalog. The document is 716 pages long.
74.31	Evaluation of Carbon Injection for Controlling PCDD/PCDF Emissions at WTI's Commercial Hazardous Waste Incineration Facility	5/11/98	Douglas R. Roeck, Alfred Sigg	Reference 10 to Exhibit 74. From the Proceedings of the International Conference on Incineration and Thermal Treatment Technologies, pp. 393-396, May 11, 1998.
74.311	Mechanisms for Formation and Options for Control of Emissions of PCDD'S/PCDF'S from Incineration	5/11/98	D.I. Townsend, J.D. Wilson and C.N. Park	Reference 11 to Exhibit 74. From the Proceedings of the International Conference on Incineration and Thermal Treatment Technologies, pp. 331-335, May 11, 1998.
74.312	Dioxin/Furan Formation and Control in Waste Combustors	5/1/96	K. Raghunathan and Brian K. Gullett	Reference 12 to Exhibit 74. From the Proceedings of the International Conference on Incineration and Thermal Treatment Technologies, pp. 685-688, May, 1996.
74.313	Formation of Polychlorinated Dibenzofurans by Chlorination and de Novo Reactions with FeCl3 in Petroleum Refining Processes	3/3/93	Adrian Beard, K.P. Nalkwadi and F.W. Karasek	Reference 13 to Exhibit 74. From Environmental Science Technology, Vol. 27, No. 8, pp. 1505-1511, 1993 (date of 3/3/93 is approximated).
74.314	PCDD and PCDF Formation From Hydrocarbon Combustion in the Presence of Hydrogen Chloride	7/1/92	R. De Fre and T. Rymen	Reference 14 to Exhibit 74. From Chemosphere, Vol. 19 Nos. 1-6, pp. 331-336, 1989 (date of 7/1/92 is approximated).

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"Exhibit 74" Documents Reviewed During the 1999 Comment Period Related to the Use of the UMCDF Pollution Abatement System Carbon Filter System (See also "EQC Clarifying Order" from March, 1999, and Department Staff Report from November, 1999)

EXHIBIT NO.	TITLE	DATE	AUTHOR (IF APPLICABLE)	NOTES AND CITATIONS TO DOCUMENT[12]
74.315	Mechanisms of Formation and Destruction of Polychlorinated Dibenzo-p-dioxins and Dibenzofurans in Heterogeneous Systems	6/1/95	Ruud Addink and K. Olie	Reference 15 to Exhibit 74. From Environmental Science & Technology, pp. 1425-1435, Volume 29, No. 6, 1995 (date of 6/1/95 is approximated).
74.316	Prevention of PCDD Formation in MSW Incinerator by Inhibition of Catalytic Activity of Fly Ash Produced	7/1/89	Naikadi K.P. and F.W. Karasek	Reference 16 to Exhibit 74. From Chemosphere, Volume 19, Nos. 1-6, pp. 229-304, 1989 (date of 7/1/89 is approximated).
74.317	Reduction of Dioxins by Combustion Control and Prevention of Reformation (Control of the Denovo Reaction)	5/1/96	William Prescott	Reference 17 to Exhibit 74 (also Reference 19). From the Proceedings of the International Conference on Incineration and Thermal Treatment Technologies, pp. 617-619, May, 1996.
74.318	Effects of Copper Contamination on Dioxin Emissions from CFC Incineration	1/1/96	G.W. Lee, J.V. Ryan, R.E. Hall, et al.	Reference 18 to Exhibit 74. From Combustion Science and Technology, 1996. Petitioners point out that they were unable to locate this reference. DEQ located Combustion Science and Technology via "Chemweb." This document was not located in any of the titles listed for the issues from 1996-1998.
74.319	Reduction of Dioxins by Combustion Control and Prevention of Reformation (Control of the Denovo Reaction)	5/1/96	William Prescott	Reference 19 to Exhibit 74 (also Reference 17). From the Proceedings of the International Conference on Incineration and Thermal Treatment Technologies, pp. 617-619, May, 1996.
74.32	Inhibition Effect of Calcium Compound Fed to Furnace on PCDDS/PCDFS from Incineration Plant	5/11/98	S. Matsui, T. Iwasaki and T. Noto	Reference 20 to Exhibit 74. From the Proceedings of the International Conference on Incineration and Thermal Treatment Technologies, pp. 381-385, May 11, 1998.

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"Exhibit 74" Documents Reviewed During the 1999 Comment Period Related to the Use of the UMCDF Pollution Abatement System Carbon Filter System (See also "EQC Clarifying Order" from March, 1999, and Department Staff Report from November, 1999)

EXHIBIT NO.	TITLE	DATE	AUTHOR (IF APPLICABLE)	NOTES AND CITATIONS TO DOCUMENT[12]
74.321	A Survey of Post-Combustion PCDD/PCDF Control Technologies	5/11/96	B. Siret, K. Gilman	Reference 21 to Exhibit 74. From the Proceedings of the International Conference on Incineration and Thermal Treatment Technologies, pp. 583-586, May, 1996.
74.322	Comparison of Dry Sorbent Injection of Sodium Bicarbonate Lime and Carbon and their Control of Dioxins/Furans, Mercury, Chlorides and Sulfur Dioxide	5/1/96	John Maziuk, Jr	Reference 22 to Exhibit 74. From the Proceedings of the International Conference on Incineration and Thermal Treatment Technologies, pp. 595-602, May, 1996.
74.323	Reduction of Dioxin/Furan Emissions from an Incineration Plant by Means of an Activated Carbon Filter	5/11/98	G. Steinhaus and F. Dirks	Reference 20 to Exhibit 74. From the Proceedings of the International Conference on Incineration and Thermal Treatment Technologies, pp. 273-275, May 11, 1998.
74.324	Catalyst Development for the Destruction of Volatile Organic Compounds in the Flue Gas of Municipal Waste Incinerators	5/1/96	H. Dropsch, J. Stohr and J. Furrer	Reference 24 to Exhibit 74. From the Proceedings of the International Conference on Incineration and Thermal Treatment Technologies, pp. 613-616, May, 1996.
74.325	Rotary Kiln Incinerator at Bayer AG in Germany Sets New Performance Standards for Air Emissions	5/1/96	Dr. Hans Piechura and Dr. Peter K. Zeeb	Reference 25 to Exhibit 74. From the Proceedings of the International Conference on Incineration and Thermal Treatment Technologies, pp. 603-607, May, 1996.

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"Exhibit 74" Documents Reviewed During the 1999 Comment Period
Related to the Use of the UMCDF Pollution Abatement System Carbon Filter System
(See also "EQC Clarifying Order" from March, 1999, and Department Staff Report from November, 1999)

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TABLE OF COMMENTS AND EXHIBITS

Documents Related to the Use of the
UMCDF Pollution Abatement System Carbon Filter System

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Documents Related to the Use of the UMCDF Pollution Abatement System Carbon Filter System (See also "EQC Clarifying Order" from March, 1999, and Department Staff Report from November, 1999)

EXHIBIT NO.	TITLE	DATE OF DOCUMENT	AUTHOR	ADMIN RECORD NO.[1]	NOTES AND CITATIONS TO DOCUMENT[2]
57	Review of Systemization of Tooele Chemical Agent Disposal Facility	3/1/96	National Research Council	98-1355	Exhibit 57 is an excerpt of the full document, which was received in the Hermiston office in July, 1996. Item No. **98-1285** (p. 6) cites this Exhibit in relation to the UMCDF carbon filter system. Also cited in Item No. **98-1247** and Item No. **99-0704.**
58	Interim Status Assessment for the Chemical Demilitarization Program	4/15/96	Department of Defense	1856	Exhibit 58 is a two-page excerpt of a discussion of the carbon filter study undertaken in response to NRC recommendations. Item No. **98-1285** (p. 6) cites this Exhibit in relation to the UMCDF carbon filter system. Also cited in Item No. **98-1247** and Item No. **99-0704.**

[1] The DEQ Chemical Demilitarization Program maintains a database of documents related to the Umatilla Chemical Agent Disposal Facility. Most documents are assigned a record number for tracking purposes. Individual "Exhibits" submitted during the course of G.A.S.P., et al., *v.* EQC, et al., (Case No. 9708-06159, Oregon Circuit Court) were not assigned record numbers at the time of submittal—only the document the Exhibit was attached to was assigned a number. Some Exhibits do have Administrative Record Numbers because the document had been previously received.

[2] No. **98-1247**: "Request for Contested Case Hearing and Other Relief," letter dated December 14, 1998 (Included as Attachment A)
No. **98-1419**: "Petitioners' Motion for Relief from an Order of Court," December 28, 1998 (Case No. 9708-06159)
No. **98-1285**: "Petitioners' Additional Documentary Evidence," November 10, 1998 (Case No. 9708-06159)
No. **99-0704**: "Petitioners' Opposition to Respondents' Supplemental Motion for Summary Judgment," April 12, 1999 (Case No. 9708-06159)
No. **99-1752**: "Petitioners' Reply to Opposition to Motion for Relief," January 19, 1999 (Case No. 9708-06159)

ATTACHMENT I

Documents Related to the Use of the UMCDF Pollution Abatement System Carbon Filter System (See also "EQC Clarifying Order" from March, 1999, and Department Staff Report from November, 1999)

EXHIBIT NO.	TITLE	DATE OF DOCUMENT	AUTHOR	ADMIN RECORD NO.[1]	NOTES AND CITATIONS TO DOCUMENT[2]
66	Attachment A, Appendix 3 - PAS Carbon Filter Unit and Emission to the Carbon Filters--Permit Conditions	12/28/96	Oregon Department of Environmental Quality	40	An excerpt from the February, 1997 "Findings and Conclusions of the Commission" related to the UMCDF permits. Item No. **98-1419** (p. 2) cites this Exhibit in relation to the UMCDF carbon filter system.
67	Appendix 3 - Commission Response - February 7, 1997	2/7/97	Environmental Quality Commission	40	An excerpt from the February, 1997 "Findings and Conclusions of the Commission" related to the UMCDF permits. Item No. **98-1419** (p. 2) cites this Exhibit in relation to the UMCDF carbon filter system.
68	Agenda Environmental Quality Commission Meeting (EQC) January 29, 1999	1/1/99	Environmental Quality Commission	99-0546	Item No. **99-1752** (p. 3) cites this Exhibit in relation to the UMCDF carbon filter system.
71	Comments on EQC Order Clarifying Permit Decision	3/15/99	Stuart Sugarman & Richard Condit	99-0402	Item No. **99-0704** (p. 15) cites this Exhibit in relation to the UMCDF carbon filter system. Also cited in Item No. **99-0704.**
71.1	Risk Assessment of the Pollution Abatement Filter System for the Umatilla Chemical Agent Disposal Facility	9/1/98	Mitretek Technical Report	99-0066	Item No. **99-0704** (p. 15) cites this Exhibit in relation to the UMCDF carbon filter system.

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Documents Related to the Use of the UMCDF Pollution Abatement System Carbon Filter System (See also "EQC Clarifying Order" from March, 1999, and Department Staff Report from November, 1999)

EXHIBIT NO.	TITLE	DATE OF DOCUMENT	AUTHOR	ADMIN RECORD NO.[1]	NOTES AND CITATIONS TO DOCUMENT[2]
72	Supplement to March 15, 1999 Comments	3/18/99	Stuart Sugarman & Richard Condit	99-0426	Item No. **99-0704** (p. 15) cites this Exhibit in relation to the UMCDF carbon filter system. Also cited in Item No. **99-0704**.
72.1	Department of Defense's Status Assessment for the Chemical Demilitarization Program	1/1/97	Department of Defense	99-0426	Item No. **99-0704** (p. 15) cites this Exhibit in relation to the UMCDF carbon filter system.
73	Petitioner's Attorney's Affidavit Supporting Memorandum Opposing Supplemental Motion for Summary Judgment	4/12/99	Stuart Sugarman	No Record Number assigned	Item No. **99-0704** (p. 15) cites this Exhibit in relation to the UMCDF carbon filter system. Also cited in Item No. **99-0704**.

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Documents Related to the Use of the UMCDF Pollution Abatement System Carbon Filter System
(See also "EQC Clarifying Order" from March, 1999, and Department Staff Report from November, 1999)

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ATTACHMENT J

TABLE OF COMMENTS AND EXHIBITS

Documents related to dioxin issues, including toxicity, noncancer effects, and EPA's use of a "reference dose" for dioxin noncancer effects.

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ATTACHMENT J

Documents related to dioxin issues, including toxicity, noncancer effects, and EPA's use of a "reference dose" for dioxin noncancer effects

EXHIBIT NO.	TITLE	DATE OF DOCUMENT	AUTHOR	ADMIN RECORD NO.[1]	NOTES AND CITATIONS TO DOCUMENT[2]
35	Health Assessment Document for 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD) and Related Compounds Volume III of III (External Review Draft)	8/1/94	U.S. Environmental Protection Agency	1573	Exhibit 35 is a nine-page excerpt from a three volume "external review draft." This document was included in the original administrative record used for the UMCDF permit decision. Item No. **98-1275** (p. 41, lines 11-17) cites this Exhibit as supporting the Petitioner's contention that "most adult persons in the U.S. are already exposed to dioxin doses higher than' EPA's and ATSDR's RfD of 1 pg/kg/day without additional dioxin exposure from sources such as TOCDF and UMCDF."
38	Final Screening Risk Assessment Resource Conservation and Recovery Act Part B Pine Bluff Chemical Agent Disposal Facility	10/8/97	United States Army Center for Health Promotion and Preventive Medicine	No Record Number Assigned	This exhibit is a single page (page 3-11) from the Pine Bluff risk assessment. The excerpted page contains a discussion of how the infant breast milk pathway was calculated in the Pine Bluff HRA. Item No. **98-1275** (p. 43, lines 0-2) cites this Exhibit as supporting the Petitioner's contention that there is a dioxin "non-cancer reference dose" in use for infants.

[1] The DEQ Chemical Demilitarization Program maintains a database of documents related to the Umatilla Chemical Agent Disposal Facility. Most documents are assigned a record number for tracking purposes. Individual "Exhibits" submitted during the course of G.A.S.P., et al., *v.* EQC, et al., (Case No. 9708-06159, Oregon Circuit Court) were not assigned record numbers at the time of submittal—only the document the Exhibit was attached to was assigned a number. Some Exhibits do have Administrative Record Numbers because the document had been previously received.

[2] No. **98-1247**: "Request for Contested Case Hearing and Other Relief," letter dated December 14, 1998 (Included as Attachment A)
No. **98-1275**: "Petitioners' Memorandum Supporting Cross Motion for Summary Judgment," August 20, 1998 (Case No. 9708-06159)
No. **98-1285**: "Petitioners' Additional Documentary Evidence," November 10, 1998 (Case No. 9708-06159)
No. **99-0704**: "Petitioners' Opposition to Respondents' Supplemental Motion for Summary Judgment," April 12, 1999 (Case No. 9708-06159)
No. **99-2201**: "Comments of G.A.S.P., et al., in Support of Their Request to Suspend and Revoke Permits for [UMCDF]," December 17, 1999 (Included in Attachment E)

ATTACHMENT J

Documents related to dioxin issues, including toxicity, noncancer effects, and EPA's use of a "reference dose" for dioxin noncancer effects

EXHIBIT NO.	TITLE	DATE OF DOCUMENT	AUTHOR	ADMIN RECORD NO.[1]	NOTES AND CITATIONS TO DOCUMENT[2]
39	Affidavit of Dr. Peter deFur	7/31/98	Dr. Peter deFur	No Record Number Assigned	Dr. deFur's Affidavit discusses the issues surrounding the cancer and non-cancer effects of dioxins. The Affidavit indicates that there is an Attachment (Curriculum Vitae of Dr. deFur), but the Attachment was not included with the Exhibit. Dr. deFur reviewed the TOCDF Health Risk Assessment and states his belief that the TOCDF Health Risk Assessment is "not complete without adding the non-cancer risks from dioxin exposure to all target groups or individuals, and especially to fetuses, infants and young children..." Dr. deFur also states he has reviewed Exhibit 32 (TOCDF MPF incident report) and Exhibit 34 (Holmes' deposition related to the incident), and provides his opinion on how the risk assessment process should account for similar incidents. Item No. **98-1275** (p. 44, lines 11-23; p. 45, lines 0-24 , p. 55, Lines 13-15) cites this Exhibit when explaining how dioxins and PCBs act upon an organism, the toxic effects associated with exposures to dioxins, and the endocrine-disrupting effects of dioxins, furans, and PCBs. Item No. **99-2201** (p. 32) also cites Exhibit 39 to support the statement that "...the excuse that there is no RfD (i.e., safe dose) for dioxin non-cancer effects is so misleading that it could be considered scientific fraud."

ATTACHMENT J

Documents related to dioxin issues, including toxicity, noncancer effects, and EPA's use of a "reference dose" for dioxin noncancer effects

EXHIBIT NO.	TITLE	DATE OF DOCUMENT	AUTHOR	ADMIN RECORD NO.[1]	NOTES AND CITATIONS TO DOCUMENT[2]
40.1	Public Health Effects of Chemical Weapons Incineration	3/1/98	Richard Clapp, Ph.D.	No record number assigned	Dr. Clapp (Center for Environmental Studies, John P. Snow Institute, Boston, Massachusetts) discusses the toxicity and health effects of dioxins and dioxin-like compounds and states his belief that the Health Risk Assessments undertaken for the chemical agent incineration facilities are "inadequate and incomplete" because the failure to account for dioxin and dioxin-like compounds. Cited in Item No. **99-2201** (p. 32). See Exhibit 40.
40.3	Critique of Chemical Weapons Incineration Risk Assessment	3/1/98	Peter deFur, Ph.D.	No record number assigned	Dr. deFur (Affiliate Associate Professor of Environmental Studies at the Center for Environmental Studies at Virginia Commonwealth University and Adjunct Senior Scientist, Environmental Defense Fund) discusses the issues surrounding the cancer and non-cancer effects of dioxins. Dr. deFur reviewed the TOCDF Health Risk Assessment and states his belief that the TOCDF Health Risk Assessment is "not complete without adding the non-cancer risks from dioxin exposure to all target groups or individuals, and especially to fetuses, infants and young children..." Cited in Item No. **99-2201** (p. 32). See Exhibit 40.
40.6	Synthetic Chemicals as Endocrine Disruptors	3/1/98	Peter deFur, Ph.D., and Carolyn Raffensperger, M.A., J.D.	No record number assigned	Dr. deFur (Affiliate Associate Professor of Environmental Studies at the Center for Environmental Studies at Virginia Commonwealth University and Adjunct Senior Scientist, Environmental Defense Fund) and Ms. Raffensperger (Director, Science and Environmental Health Network) describe the endocrine system and the effects of chemicals known as endocrine disruptors, and the pathways through which human exposure occurs.

ATTACHMENT J

Documents related to dioxin issues, including toxicity, noncancer effects, and EPA's use of a "reference dose" for dioxin noncancer effects

EXHIBIT NO.	TITLE	DATE OF DOCUMENT	AUTHOR	ADMIN RECORD NO.[1]	NOTES AND CITATIONS TO DOCUMENT[2]
					The authors urge individuals to take action to reduce exposures, and also state that "to act responsibly and with precaution in light of the known effects of endocrine disruption in animals and humans and the uncertainty of the extent of human exposure, the Army must shut down the existing [chemical weapons] incinerators and choose alternative technologies with no toxic emissions." Cited in Item No. **99-2201** (p. 32). See Exhibit 40.
45	Fact Sheet - EPA Special Report on Endocrine Disruption	2/1/97	U.S. Environmental Protection Agency	No Record Number assigned	The fact sheet discusses EPA's findings as of February 1997 concerning the effects of endocrine disrupters on human health and the environment. (There is also a reference to the EPA's "Special Report on Endocrine Disruption," but the report was not included with this Exhibit). Item No. **98-1275** (p. 55, lines 5-7) cites a quotation from this fact sheet describing the effects of endocrine-disrupting agents.
54	Toxicological Profile for 2,3,7,8-Tetrachloridibenzo-p-Dioxin	6/1/89	Syracuse Research Corporation for ATSDR (U.S. Public Health Service) and EPA.	No Record Number assigned	Exhibit 54 includes two pages from "Section 9" of this document. Item No. **98-1285** (p. 5) cites this Exhibit to support the Petitioner's assertion that EPA has a "reference dose" for determining the non-cancer effects of dioxin exposure. Item No. **98-1247** (p. 7) also cites this Exhibit to support the Petitioner's assertion that there is a "reference dose" for dioxins. Also cited in Item No. **99-0704** (p. 11).

ATTACHMENT J

Documents related to dioxin issues, including toxicity, noncancer effects, and EPA's use of a "reference dose" for dioxin noncancer effects

EXHIBIT NO.	TITLE	DATE OF DOCUMENT	AUTHOR	ADMIN RECORD NO.[1]	NOTES AND CITATIONS TO DOCUMENT[2]
55	Drinking Water Criteria Document for 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (Final Draft, EPA 600/X-84-194-1)	3/1/85	U.S. Environmental Protection Agency, Environmental Criteria and Assessment Office	No Record Number assigned	This Exhibit is a two-page excerpt from a document of unknown total length. The Document cover page is stamped with "Draft: Do Not Cite of Quote." The excerpted sections are related to "sensitive sub-populations" and "carcinogenic risks." Item No. **98-1285** (p. 5) cites this Exhibit to support the Petitioner's assertion that EPA has a "reference dose" for dioxins. Item No. **98-1247** (p.5) also cites this Exhibit as providing "further support that the Agencies erred in failing to consider the 1 pg/kg/day non-cancer standard..." Also cited in Item No. **99-0704** (p. 11).
56	"Remedial Activities at Uncontrolled Hazardous Waste Sites in the Zone of Regions VI, VII, VIII." (from the "Final Times Beach Site Multimedia Risk Assessment - Volume I")	3/28/95	U.S. Environmental Protection Agency	No Record Number assigned	This is a one-page excerpt ("Table 5-2" from page 5-8) from a document of unknown total length. The Table in the Exhibit shows the "Toxicity Values for Chemicals of Potential Concern--Noncancer Effects." Item No. **98-1285** (p. 6) cites this Exhibit to support the Petitioner's assertion that EPA has a "reference dose" for dioxins. Item No. **98-1247** (p.5) also cites this Exhibit as establishing "that EPA currently uses a non-cancer reference dose for reproductive impacts of dioxin." Also cited in Item No. **99-0704** (p. 11).

ATTACHMENT J

Documents related to dioxin issues, including toxicity, noncancer effects, and EPA's use of a "reference dose" for dioxin noncancer effects

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ATTACHMENT K

TABLE OF COMMENTS AND EXHIBITS

Documents related to the acute toxicity and/or the chronic health effects of nerve and blister agents

and additional documents listed below:

TITLE OF DOCUMENT	PAGE
"Background Document on Gulf War-Related Research," *by* Syracuse Research Corporation *for* U.S. Department of Health and Human Services Centers for Disease Control and Prevention, February, 1999.	K-7
"Management Actions Needed to Answer Basic Research Questions," Government Accounting Office, January, 2000.	K-41
Letter to the Utah Citizens Advisory Commission from Centers for Disease Control and Prevention (date unknown).	K-73
"Review of [National Research Council's] Review of Acute Human-Toxicity Estimates for Selected Chemical Warfare Agents," Memorandum from Ecology and Environment to Oregon Department of Environmental Quality, September 11, 1998.	K-77
Letter to the Centers for Disease Control and Prevention from U.S. Army Program Manager for Chemical Demilitarization (date unknown).	K-79
Letter to the U.S. Army Program Manager for Chemical Demilitarization from Centers for Disease Control and Prevention, October 7, 1998.	K-81
Letter to the Alabama Department of Environmental Management from the U.S. Army Program Manager for Chemical Demilitarization, October 16, 1998.	K-83
Media Advisory and Question and Answer sheet about the "NRC Review of Acute Human-Toxicity Estimates for Selected Chemical Warfare Agents," U.S. Army, October 8, 1998.	K-87

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Documents related to the acute toxicity and/or the chronic health effects of nerve and blister agents

EXHIBIT NO.	TITLE	DATE OF DOCUMENT	AUTHOR	ADMIN RECORD NO.[1]	NOTES AND CITATIONS TO DOCUMENT[2]
40	Public Health and Chemical Weapons Incineration	3/1/98	Kentucky Environmental Foundation	No record number assigned	The Kentucky Environmental Foundation (KEF) was founded in 1990, by a local grassroots group, Common Ground. KEF's mission is "to further the cause of safe disposal of chemical weapons and environmental democracy by improving public access to information, coalition building, fostering cooperation between government and citizens, and encouraging grassroots participation in the decision-making process." (From the website of the Chemical Weapons Working Group) Exhibit 40 is a collection of papers by various scientists arguing against the use of incineration for stockpile disposal. See Exhibits 40.1 through 40.5 for a description of each paper. Item No. **98-1275** (p. 46, lines 0-7) cites this Exhibit (which includes 40.1 through 40.5) as supporting the Petitioner's contention that "studies of non-lethal agent exposures and chemicals containing ingredients similar to agent demonstrate that impacts to brain function and behavior may be likely." Also cited in Item No. **99-2201** (p. 32).

[1] The DEQ Chemical Demilitarization Program maintains a database of documents related to the Umatilla Chemical Agent Disposal Facility. Most documents are assigned a record number for tracking purposes. Individual "Exhibits" submitted during the course of G.A.S.P., et al., *v.* EQC, et al., (Case No. 9708-06159, Oregon Circuit Court) were not assigned record numbers at the time of submittal—only the document the Exhibit was attached to was assigned a number. Some Exhibits do have Administrative Record Numbers because the document had been previously received.

[2] No. **98-1247:** "Request for Contested Case Hearing and Other Relief," letter dated December 14, 1998 (Included as Attachment A)
No. **98-1275**: "Petitioners' Memorandum Supporting Cross Motion for Summary Judgment," August 20, 1998 (Case No. 9708-06159)
No. **98-1285**: "Petitioners' Additional Documentary Evidence," November 10, 1998 (Case No. 9708-06159)
No. **99-0704**: "Petitioners' Opposition to Respondents' Supplemental Motion for Summary Judgment," April 12, 1999 (Case No. 9708-06159)
No. **99-1751**: "First Supplemental Petition for Review," April 5, 1999 (Case No. 9708-06159)
No. **99-2201**: "Comments of G.A.S.P., et al., in Support of Their Request to Suspend and Revoke Permits for [UMCDF]," December 17, 1999 (Included in Attachment E)

ATTACHMENT K

Documents related to the acute toxicity and/or the chronic health effects of nerve and blister agents

EXHIBIT NO.	TITLE	DATE OF DOCUMENT	AUTHOR	ADMIN RECORD NO.[1]	NOTES AND CITATIONS TO DOCUMENT[2]
40.2	Toxic Exposures and Chronic Illnesses	3/1/98	Howard Urnovitz, Ph.D.	No record number assigned	Dr. Urnovitz (Scientific Director, Chronic Illness Research Foundation, Berkeley, California) discusses the implications of various research projects related to chronic illnesses and Gulf War Syndrome that indicate exposures to a combination of chemical compounds can have synergistic and additive effects. Dr. Urnovitz states that "there are several closed-loop disposal technologies available that have no toxic emissions and have proven out effective." Cited in Item No. **99-2201** (p. 32). Part of Exhibit 40.
40.4	Toxicology of Chemical Agents	3/1/98	Robert Ginsburg, Ph.D.	No record number assigned	Dr. Ginsburg (Research Director, Midwest Center for Labor Research, Chicago) reviewed the literature on the toxicity of the agents GB and VX. He found that "evaluation of the potential effects from exposure to low levels of these chemicals is difficult because of complications arising from the chemicals' extremely high acute toxicity." Dr. Ginsburg recommends further testing of sub-acute exposure effects because "despite the limitations in testing, long-term consequences from low-level exposure to nerve agents as well as commercial organophosphate pesticides have been demonstrated." Cited in Item No. **99-2201** (p. 32). Part of Exhibit 40.

ATTACHMENT K

Documents related to the acute toxicity and/or the chronic health effects of nerve and blister agents

EXHIBIT NO.	TITLE	DATE OF DOCUMENT	AUTHOR	ADMIN RECORD NO.[1]	NOTES AND CITATIONS TO DOCUMENT[2]
40.5	Health Effects of Low-level Exposure to Nerve Agent	3/1/98	Jerry Buccafusco, Ph.D.	No record number assigned	Dr. Buccafusco (Professor of Pharmacology and Toxicology, Medical College of Georgia and Director, Neuropharmacology Laboratory, Department of Veterans Affairs Medical Center, Augusta, Georgia) discusses the research conducted by the Medical College. The research found that chronic low-level exposure to an organophosphorus agent "produced a subtle but reproducible memory impairment." Cited in Item No. **99-2201** (p. 32). Part of Exhibit 40.
41	Nerve gas danger underestimated, study says	7/29/98	James Long, The Oregonian	No Record Number Assigned	This Exhibit is a news article from the Oregonian concerning the NRC "Acute Human Toxicity" Report. Item No. **98-1275** (p. 47, lines 3-5) cites this Exhibit as supporting the Petitioner's contention that "chemical warfare agents are even more dangerous than originally thought." (See Exhibit 50.)
50	Review of Acute Human-Toxicity Estimates for Selected Chemical Warfare Agents	1/1/97	National Research Council	98-0727	This Exhibit is an excerpt of the NRC Report (approximately 22 pages out of 90). This document was received in Hermiston in September, 1998. Item No. **98-1275** (p. 47, lines 5-9) cites this Exhibit as supporting the Petitioner's contention that "chemical warfare agents are even more dangerous than originally thought." Item No. **98-1285** (pp. 2-3) states that "Petitioners offer this document to establish that the EQC was misled concerning a critical aspect of the permitting process(i.e., the likely toxicity of CW Agents)." Also cited in Item No. **98-1247** (pp. 5-6); Item No. **99-0704** (p. 8); Item No. **99-1751** (p. 4); and **99-2201** (pp. 24-27).

ATTACHMENT K

Documents related to the acute toxicity and/or the chronic health effects of nerve and blister agents

EXHIBIT NO.	TITLE	DATE OF DOCUMENT	AUTHOR	ADMIN RECORD NO.[1]	NOTES AND CITATIONS TO DOCUMENT[2]
51	Long-term Health Effects Associated with Sub-Clinical Exposure to GB and Mustard	7/18/96	Dennis M. Perrotta, Ph.D., CIC, Chair	2479	This is an excerpt of a review conducted by the "Environment Committee" of the "Armed Forces Epidemiological Board." It appears to have been printed on August 18, 1998 from a website (http://www.gulflink.oed.mil/agent.html). This document was originally received by the DEQ in April, 1997. The document was prepared at the request of the Assistant Secretary of Defense (Health Affairs) to conduct a literature review and to critique and comment on the question "Are there observable long-term health effects associated with exposure to Sarin (GB) and mustard at concentrations below that needed to cause acute signs, symptoms, or injury?". Item No. **98-1275** (p. 54, lines 1-4) cites this Exhibit as supporting the Petitioner's contention that "low level agent exposure alone or in combination with other chemicals can generate a range of disturbing health effects." Item No. **98-1285** (pp. 3-4) cites this Exhibit to counter the EQC/DEQ statements that there was insufficient information available concerning the "Gulf War Syndrome" to incorporate into the Pre-Trial Burn Health Risk Assessment. Also cited in Item Nos. **98-1247** (p. 6); **99-0704** (p. 9); and **99-2201** (pp. 27-28).

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Documents related to the acute toxicity and/or the chronic health effects of nerve and blister agents

EXHIBIT NO.	TITLE	DATE OF DOCUMENT	AUTHOR	ADMIN RECORD NO.[1]	NOTES AND CITATIONS TO DOCUMENT[2]
52	105th Congress Report - Gulf War Veteran's Illnesses: VA, DOD Continue to Resist Strong Evidence Linking Toxic Causes to Chronic Health Effects	11/7/97	Committee on Government Reform and Oversight (House of Representatives)	No Record Number Assigned	This Exhibit is a partial copy of a report in response to requests by Gulf War veterans. The Department obtained a full copy of the document. Item No. **98-1275** (p. 54, lines 3-5) cites this Exhibit as supporting the Petitioner's contention that "low level agent exposure alone or in combination with other chemicals can generate a range of disturbing health effects." Also cited in Item No. **98-1285** (pp. 4-5); Item No. **98-1247** (p. 6); Item No. **99-0704** (p. 10); and in Item No. **99-2201** (p. 28).
53	Chemical Weapons: DOD Does Not Have a Strategy to Address Low-Level Exposures	9/1/98	US General Accounting Office	No Record Number Assigned	This is a complete copy of a report by the GAO that concluded the Department of Defense "does not have an integrated strategy to address low-level exposures to chemical warfare agents." Item No. **98-1285** (p. 5) cites this Exhibit and questions whether the research referenced in the Report was reviewed by the Department. Also cited in Item No. **98-1247** (p. 7); Item No. **99-0704** (p. 10); and in **99-2201** (pp. 28-31).

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Documents related to the acute toxicity and/or the chronic health effects of nerve and blister agents

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Background Document on Gulf War-Related Research
for
The Health Impact of Chemical Exposures During the Gulf War: A Research Planning Conference

February 28 - March 2, 1999
Atlanta, Georgia

Sponsored by
Centers for Disease Control and Prevention
in coordination with
the Office of Public Health and Science (Department of Health and Human Services),
the National Institutes of Health, and
the Agency for Toxic Substances and Disease Registry

Document Prepared by:
Peter McClure, Ph.D., D.A.B.T.
William Richards, Ph.D.
Lisa Ingerman, Ph.D., D.A.B.T.
Fernando Llados, Ph.D.
Michael Neal, Ph.D.
Environmental Science Center
Syracuse Research Corporation
6225 Running Ridge Road
North Syracuse, NY 13212-2510

Submitted to:
U.S. Department of Health and Human Services
Centers for Disease Control and Prevention
National Center for Environmental Health
Division of Environmental Hazards and Health Effects
Veteran's Health Activity Working Group
4770 Buford Highway, NE
Atlanta, GA 30341-3724
Project Officer: Phillip M. Talboy
Technical Monitor: Drue H. Barrett, Ph.D.

File Contains Data for PostScript Printers Only

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List of Acronyms and Abbreviations

ANG	Air National Guard
ATSDR	Agency for Toxic Substances and Disease Registry
CARC	Chemical Agent Resistant Coating
CCEP	Comprehensive Clinical Evaluation Program
CDC	Centers for Disease Control and Prevention
CIA	Central Intelligence Agency
DHHS	Department of Health and Human Services
DoD	Department of Defense
DSB	Defense Science Board
DU	Depleted Uranium
DVA	Department of Veterans' Affairs
EMG	electromyography
FDA	Food and Drug Administration
GAO	Government Accounting Office
ICD-9	International Classification of Diseases, Ninth Revision
IOM	Institute of Medicine
MCS	Multiple Chemical Sensitivity
MMPI	Minnesota Multiphasic Personality Inventory
NIH	National Institutes of Health
PAC	Presidential Advisory Committee on Gulf War Veterans' Illnesses
PAH	Polycyclic Aromatic Hydrocarbon
PGHR	Persian Gulf Health Registry
PGVCB	Persian Gulf Veterans Coordinating Board
PL	Public Law
PSOB	Presidential Special Oversight Board
RR	rate ratio or relative risk
RWG	Research Working Group
SIU	Special Investigation Unit on Gulf War Illness
SMR	Standardized Mortality Ratios
U.K.	United Kingdom
U.S.	United States
USAEHA	U.S. Army Environmental Hygiene Agency
VA	Veterans' Administration
VOC	Volatile Organic Compound

EXECUTIVE SUMMARY

The purpose of this document is to provide background information to participants in the upcoming conference, *The Health Impact of Chemical Exposures During the Gulf War: A Research Planning Conference*, sponsored by the Centers for Disease Control and Prevention in coordination with the Office of Public Health and Science (Department of Health and Human Services), the National Institutes of Health, and the Agency for Toxic Substances and Disease Registry. In response to U.S. House of Representatives Report 105-205, the conference is to be held on February 28-March 2, 1999 in Atlanta, Georgia for the purpose of obtaining broad public input into the development of a multi-year research plan investigating the relationships of chemical exposures to illnesses among Gulf War veterans.

The 697,000 men and women of U.S. military services who served in the Gulf region in 1990 and 1991 were exposed to a wide array of known and potential hazards to health including blowing dust and sand particles, smoke from oil well fires, petroleum fuels and their combustion products, possible exposure to chemical warfare nerve agents and biological warfare agents, pyridostigmine bromide pills to protect against organophosphate nerve agents, insecticides, vaccinations, infectious diseases, depleted uranium, and psychological and physiological stress. Quantitative data for exposure of soldiers to most of these agents during Gulf deployment, however, are not available. Appendix A of this document gives an account of events related to health concerns of Gulf War veterans. Appendix B discusses what is known concerning exposures and potential health consequences of the most likely health risk factors associated with the Gulf War experience.

Gulf War veterans registered in the U.S. Department of Defense's Comprehensive Clinical Evaluation Program, the U.S. Department of Veterans' Affairs Persian Gulf Health Registry, and the United Kingdom Ministry of Defence Medical Assessment Programme show an array of health symptoms and a distribution of disease diagnoses involving a wide variety of organ systems. In these programs, clinicians were unable to assign a standard diagnostic disease category to about 20-30% of participants other than *symptoms, signs and ill-defined conditions*. Three diagnostic disease categories (*psychological conditions, musculoskeletal diseases*, and *symptoms, signs and ill-defined conditions*) represented more than 50% of the primary diagnoses. The overall symptom pattern for Gulf War veterans in the clinical programs has been noted to be consistent with experiences of U.S. veterans of previous wars.

Various review panels and groups have evaluated information regarding illnesses among Gulf War veterans within the past 4-5 years. Appendix A summarizes recommendations from many of these review panels. Given the broad range of illnesses and health symptoms noted among Gulf War veterans and the lack of exposure data, these groups generally have concurred that no single cause of the multiple illnesses could be established. These groups have made several recommendations for research including: 1) epidemiological research to compare prevalence rates of illnesses in Gulf War veterans with appropriate control populations; 2) in-depth neurophysiological, neuropsychological, and psychological evaluations comparing symptomatic

and asymptomatic Gulf War veterans; 3) research on health effects from specific risk factors such as stress, pesticides, depleted uranium, pyridostigmine bromide, and low-level exposure to chemical warfare nerve agents; 4) research on health effects from mixtures of chemicals (e.g., pesticides, pyridostigmine bromide, and chemical warfare nerve agents) alone and in combination with other risk factors; 5) epidemiological research on the health status of U.S. troops known to be in the vicinity of an Iraqi weapons storage site, near Khamisiyah, Iraq, in March 1991 when low-level exposure to sarin and cyclosarin may have occurred compared with troops outside of the area; and 6) research into the causes, methods of prevention, and methods of treatment for musculoskeletal conditions and stress-related disorders.

The U.S.-government sponsored research projects which are coordinated by the Research Working Group of the Persian Gulf Veterans Coordinating Board address a wide spectrum of basic and applied topics related to illnesses among Gulf War veterans. Appendix C describes and evaluates selected published studies related to health concerns of Gulf War veterans. Appendix D contains descriptions of ongoing research projects related to: 1) multiple symptom disorders; 2) genetic differences in susceptibility to chemicals; 3) health effects from mixtures of chemicals and other risk factors; 4) treatment of chronic multiple symptom disorders in Gulf War veterans; 5) health effects from low-level, subclinical exposures to chemical warfare nerve agents; 6) health effects from pyridostigmine bromide; 7) assessment and definition of Gulf War illnesses; 8) prevalence of illnesses and associations between chemical exposures and illnesses in Gulf War veterans; and 9) health effects from depleted uranium exposure.

Published epidemiological studies of mortality rates, rates of hospitalizations, and rates of birth defects after the Gulf War have not found consistent, statistically significant differences between active-duty U.S. military personnel who were deployed to the Gulf War compared with active-duty personnel who were not deployed to the Gulf, except for a higher rate of mortality from unintentional injuries (such as automobile accidents). Further epidemiological research efforts are ongoing to track mortality, hospitalization, and reproductive outcome among groups of Gulf-deployed veterans and non-deployed veterans of the same era.

In contrast to the hospitalization and mortality studies, numerous epidemiological studies of self-reported health symptoms consistently have found statistically significantly higher rates of self-reported symptoms in groups of Gulf-deployed compared with non-deployed veterans and provide evidence that there may be an increased frequency of chronic, multi-systemic conditions of ill health among groups of Gulf War veterans. The array of reported symptoms are, in general, difficult to diagnose into a disease category. The most frequently reported symptoms are similar to the most frequently reported symptoms among veterans diagnosed as having *symptoms, signs and ill-defined conditions* in the previously discussed clinical programs (fatigue, headache, memory problems, sleep disturbances, skin rash, joint or muscle pain, and shortness of breath) and appear to overlap with several of the symptoms in other symptom-based disorders including chronic fatigue syndrome, fibromyalgia, and multiple chemical sensitivity. Using a mathematical technique called factor analysis to examine associations among symptoms reported in groups of Gulf War veterans, one group of investigators proposed that there might be unique health

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disorders among Gulf War veterans, whereas two other groups of investigators reported finding no evidence of a unique disorder among Gulf War veterans when control groups were included in the analysis.

The lack of exposure data makes it difficult, if not impossible, to know the cause of many of the illnesses among Gulf War veterans. In attempts to obtain clues to possible causes, however, several epidemiological studies are looking for associations between self-reported symptoms and self-reported Gulf War experiences and exposures. To date, a few published studies, mostly of a small scale, have reported some associations between self-reported symptoms and particular risk factors (e.g., receiving multiple vaccinations, exposure to pesticides or debris from Scud missiles), but results are not consistent across studies. Several planned and ongoing research projects are similarly designed to look for possible associations between health symptoms and self-reported exposure to risk factors, including the large-scale Veterans' Administration (VA) National Health Survey. Other ongoing projects are taking a different approach to searching for etiological clues by comparing hospitalization rates, self-reported symptoms, and/or clinical measurements of neurophysiological and neuropsychological variables in various groups of veterans known to be at different geographical locations in March 1991 when low-level exposure to nerve agents may have occurred near the Iraqi weapon storage site near Khamisiyah.

Several hypotheses concerning the cause of difficult-to-diagnose illnesses among some Gulf War veterans remain plausible: some investigators hypothesize physiological changes that are stress-induced; some hypothesize causative relationships to low-level exposure to neurotoxic chemicals; and others hypothesize causative interactions between stress and low-level exposure to mixtures of chemicals. Limited suggestive evidence from a few published animal studies has led some to suggest that delayed neurological effects may occur from short-term exposure to mixtures of anti-cholinesterase agents that may have additive or synergistic effects. To date, the relevance of these animal studies to possible chronic neurological impairment in Gulf War veterans is uncertain for several reasons including the high exposure levels to which the animals were exposed and other potential differences between mixtures to which the animals were exposed and mixtures that may have been experienced by soldiers in the Gulf region. Short-term, high-level exposure to certain carbamate and organophosphate nerve agents is known to produce delayed neurological effects in animals and humans, but the occurrence of delayed effects from short-term, low-level exposure to these types of chemicals (an exposure scenario presumed to be relevant to the Gulf War experience of some veterans) is uncertain. Ongoing research projects at several institutions are evaluating possible delayed effects on neuropathological, neurobehavioral, and immunological variables in several animal species exposed to low-levels of various mixtures of cholinesterase-inhibiting chemicals (e.g., sarin, insecticides, and pyridostigmine), alone and in combination with other risk factors such as stress and vaccinations.

Ongoing basic research projects at several institutions are examining hypotheses related to the biochemical and/or genetic basis for differences among individuals in susceptibility to neurotoxic, cholinesterase-inhibiting chemicals such as organophosphate chemical warfare nerve agents (e.g., sarin) and carbamate anti-nerve-agent drugs (e.g., pyridostigmine bromide). Results from these

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projects may lead to new methods to identify individuals at greater risk for neurological effects from cholinesterase-inhibiting chemicals or new prophylactic methods against neurological effects from chemical warfare nerve agents.

Several studies have evaluated neurophysiological and neuropsychological variables in small groups of symptomatic Gulf War veterans, but, in general, have not found obvious or consistent changes. Some of the studies, however, have found subtle changes in several variables in some of the examined patients. Ongoing research projects at numerous institutions are examining a wide range of clinical and laboratory physiological variables in attempts to identify objective diagnostic variables that may be consistently affected in Gulf War veterans experiencing multiple chronic symptoms. Endpoints being evaluated include: brain activation patterns determined with magnetic resonance imaging; nerve firing rate of the peroneal nerve; quantitative electroencephalographic pattern analysis; changes in neurohormonal levels in response to different stressors; cerebral spinal fluid levels of neurotransmitters; pain threshold measurements; esophageal smooth muscle motility; viral infections; immune function; and various physiological responses (e.g., blood pressure, heart rate, eyeblink) to acute physical, chemical, or cognitive challenges. In general, it is believed that this body of research may lead to a better basis for proposing new methods of diagnosis and treatment for Gulf War veterans with multiple unexplained chronic symptoms including fatigue, headache, muscle and joint pain, and chemical sensitivities.

In response to the wide diversity of illnesses and symptoms experienced by Gulf War veterans and the uncertainty of their cause, several reviewers have noted that treatment should proceed on an individual basis. Treatment is best addressed when objective clinical measures of distinct illness can be made, but, in the absence of such measures, multidisciplinary treatment of symptoms may be effective (involving medical evaluations, exercise programs, various therapy programs, and counseling). The U.S. Department of Defense has a Specialized Care Program using such an approach for Gulf War veterans with persistent, non-specific symptoms, and, in collaboration with the Department of Veterans' Affairs, has established a 2-year, multiple-site, control trial of cognitive behavioral therapy, aerobic exercise programs, and usual and customary care for such patients. Two other ongoing treatment trials are based on limited evidence suggesting that some Gulf War veterans with non-specific, chronic symptoms may be infected with microorganisms that are difficult to detect. These are double-blind clinical trials of long-term antibiotic treatment, one with symptomatic patients with positive findings for mycoplasma infection and the other with symptomatic patients with bacterial remnants in their urine.

During the upcoming two-and-a-half day conference, participants from various disciplines will meet several times in Workgroups with the goal of discussing and recommending further research in one of four focus areas related to illnesses among Gulf War veterans:
1) Pathophysiology, Etiology, and Mechanisms of Action; 2) Assessment and Diagnosis;
3) Treatment; and 4) Prevention. Final reports and recommendations from each Workgroup will be presented to the conference at large prior to adjournment.

1. Purpose of the Conference

The current conference, *The Health Impact of Chemical Exposures During the Gulf War: A Research Planning Conference,* is convened, under the support specified by House Report 105-205[1], to obtain broad public input into the development of a multi-year research plan investigating relationships of chemical exposures to illnesses among Gulf War veterans (Eisenberg, 1998).

House Report 105-205 provided funding to the Office of the Secretary, Department of Health and Human Services (DHHS) to support research in the areas of:

- "multiple chemical sensitivity";
- "genetic differences in the ability to metabolize environmental agents commonly encountered during the Persian Gulf";
- "how multiple exposures of chemicals interact to exert their toxicity on an organism"; and
- "treatment protocols which are being developed in the public and private sectors for illnesses resulting from chemical and other environmental exposures" (Eisenberg, 1998).

The plan is to be developed without duplicating existing research efforts contained within the research plans of the Research Working Group (RWG) of the Persian Gulf Veterans Coordinating Board (PGVCB) (Eisenberg, 1998).

2. The Gulf War: Overview

Shortly after Iraqi armed forces invaded Kuwait on August 2, 1990, Coalition troops (i.e., troops from the United States [U.S.], United Kingdom [U.K.], Canada, France, Saudi Arabia, Egypt, Syria and other countries) began deployment in Operation Desert Shield. Within two months, 200,000 U.S. troops had been added to those already in the Gulf area. Beginning on January 16, 1991, air attacks against the Iraqi army opened the phase of operations known as Operation Desert Storm (IOM, 1996b). The first oil well fires were started in Kuwait by the Iraqis on January 20, 1991 and the majority of oil well fires had been started by February 19, 1991 (Spektor, 1998; DoD, 1998c; PAC, 1996b). By February, 1991, more than 500,000 U.S. troops were in the field facing the Iraqi armed forces. Operation Desert Storm ended after a brief ground war from February 24 to February 28. U.S. troops were removed quickly from the area, and by June, 1991, fewer than 50,000 U.S. troops remained. A total of approximately 697,000 U.S. military men and women served in Operations Desert Shield and Desert Storm in 1990 and 1991 (Joseph et al., 1997). During the war, deaths among U.S. troops were restricted to 148 combat deaths and 145 deaths due to disease or unintentional injuries; only 467 additional individuals among U.S. troops sustained injuries (PAC, 1996b). It was well known that Iraq had chemical and biological warfare capabilities, but several review panels have concluded that there is no convincing evidence that Iraq used chemical or biological warfare agents against U.S. troops (DSB, 1994; NIH, 1994a,b; IOM, 1996b; PAC, 1996a,b; 1997; see Appendix A: *Account of Events Related to Health Concerns of Gulf War Veterans*). The Department of Defense (DoD)

[1] House Report 105-205 accompanied the 1998 U.S. House of Representatives Appropriations Bill for the Departments of Labor, Health and Human Services, and Education and Related Agencies.

released information in June 1996 that, in March 1991, U.S. forces demolished Iraqi weapon-storage sites in the Khamisiyah region. After the demolition, the sites were determined to have contained chemical warfare agents (e.g., the nerve agents, sarin and cyclosarin), thus indicating the possibility that certain U.S. troops may have been exposed for short periods of time to low levels of nerve agents (see Appendix B: *Exposure to Chemicals During the Gulf War*).

Upon return from the Gulf War, some U.S. veterans reported an array of general symptoms of ill health including fatigue, skin rash, headache, muscle and joint pain, memory disturbance, concentration difficulties and memory loss, shortness of breath, sleep disturbances, and diarrhea. Health concerns among some veterans still persist in 1999.

Various review panels have concluded that no single cause has been established for these symptoms of ill health (DSB, 1994; NIH, 1994a,b; IOM, 1996b; PAC, 1996a,b; 1997; U.S. Senate, 1998), but several potential explanations have been proposed including: possible exposure to low levels of chemical or biological warfare agents; use of pyridostigmine bromide pills to protect against chemical warfare nerve agents; exposure to airborne sand particles and/or oil-well fire smoke; exposure to mixtures of pesticides, insect repellents, and other chemicals; anthrax and botulinum toxoid vaccines; infectious diseases; depleted uranium; and physiological and psychological stress (see Appendix B: *Exposure to Chemicals During the Gulf War* for more details).

3. Illnesses Among Gulf War Veterans

The Department of Veterans' Affairs Persian Gulf Health Registry and the Department of Defense Comprehensive Clinical Evaluation Program

Health registries for U.S. Gulf War veterans were established in 1992 by the Department of Veterans' Affairs (DVA), the Persian Gulf Health Registry (PGHR), and in 1994 by the DoD, the Comprehensive Clinical Evaluation Program (CCEP). These programs were established to gather information from veterans regarding their wartime exposures and health histories and to offer veterans the opportunity to have comprehensive physical and laboratory examinations of their health. Veterans who choose to participate are clinically examined (including laboratory analysis of blood and urine samples) and administered a questionnaire regarding medical and family history, symptoms, recent debilitating illnesses, and self-perceived wartime exposures to specific risk factors (e.g., combat and specific chemicals) (Joseph et al., 1997; PGVCB, 1995).

Participation in these health registries is voluntary. The registries provide useful information to describe the health status of participants, but general prevalence rates of illnesses among Gulf War veterans cannot be assessed because participants are self-selected and do not constitute a representative sample of all U.S. soldiers who served in the Gulf region. Furthermore, no control group is available for comparison of rates of illness.

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Table 1 cites the frequencies of diagnoses and the most frequent symptoms recorded for 20,000 participants in the CCEP registry through April 1, 1996 (DoD, 1996; Joseph et al., 1997). The diagnostic categories are based on the *International Classification of Diseases, Ninth Revision. Clinical Modification* (ICD-9) established by the U.S. Department of Health and Human Services (DHHS, 1998).

Table 1. Frequencies of symptoms and diagnoses for 20,000 Gulf War veterans participating in the DoD Comprehensive Clinical Evaluation Program (CCEP - through April 1, 1996). Adapted from DoD, 1996 (symptoms) and Joseph et al., 1997 (diagnoses).

Self-reported Symptoms (13 most frequent symptoms; 10% of participants had no complaints)	Chief Complaint (%)	Any Complaint (%)
Joint pain	11	49
Fatigue	10	47
Headache	7	39
Memory loss	4	34
Sleep disturbance	2	32
Skin rash	7	31
Difficulty concentrating	<1	27
Depression	1	23
Muscle pain	1	21
Diarrhea	2	18
Dyspnea (shortness of breath)	3	18
Abdominal/gastrointestinal pain	3	17
Hair loss	<1	12
Diagnostic Category	**Primary Diagnosis**	**Secondary Diagnosis**
Disease of musculoskeletal system & connective tissue	18.6	29.5
Mental disorders	18.3	17.9
Symptoms, signs, ill-defined conditions	17.8	32.6
Respiratory system diseases	6.8	10.8
Skin and subcutaneous tissue diseases	6.3	13.7
Digestive system diseases	6.2	14.1
Nervous system & sense organ diseases	5.8	12.3
Infectious and parasitic diseases	2.6	6.4
Circulatory system diseases	2.2	5.9
Endocrine, nutritional & metabolic diseases & immunity disorders	2.1	6.1
Genitourinary diseases	1.3	4.2
Injury and poisoning	0.8	2.4
Neoplasms	0.8	2.1
Blood & blood-forming organ diseases	0.6	2.6
Congenital anomalies: conditions originating in perinatal period	0.2	0.9

Table 2 lists the ten most frequent self-reported symptoms and the distribution of diagnoses for 52,835 participants in the DVA PGHR, as of August 1997, showing similar frequencies of symptoms and diagnoses as those in the DoD CCEP (DVA, 1998a).

A more recent combined analysis of data in both the DoD and DVA registries through December 1997 (DVA, 1997 as cited in U.S. Senate, 1998) indicated that the frequencies of diagnoses were similar to the CCEP analysis by Joseph et al. (1997). Both registries indicate that there is concern among veterans regarding their health: 85,000 U.S. Gulf War veterans participated in the two clinical programs through 1997 (DVA, 1997 as cited in U.S. Senate, 1998).

Table 2. Frequencies of self-reported symptoms and diagnoses in 52,835 participants in the DVA Persian Gulf Health Registry (PGHR). Data as of August, 1997. Source: DVA, 1998a.

Symptoms	Number	Percent
Fatigue	10,847	20.5
Skin rash	9,719	18.4
Headache	9,525	18.0
Muscle, joint pain	8,871	16.8
Loss of memory and other general symptoms	7,406	14.0
Shortness of breath	4,190	7.9
Sleep disturbances	3,111	5.9
Diarrhea and other gastrointestinal symptoms	2,416	4.6
Other symptoms involving skin and integumentary tissue	1,916	3.6
Chest pain	1,847	3.5
No complaint	6,496	12.3
Diagnostic Category	**Number**	**Percent**
No medical diagnosis	13,998	26.5
Musculoskeletal and connective tissue	13,299	25.2
Mental disorders	7,995	15.1
Respiratory system	7,540	14.3
Skin & subcutaneous tissue	7,144	13.5
Digestive system	6,028	11.4
Nervous system	4,398	8.3
Circulatory system	3,747	7.1
Infectious diseases	3,715	7.0
Injury and poisoning	2,485	4.7
Genitourinary system	1,774	3.4
Neoplasm	232	0.4

In 1993, the British Ministry of Defence established a clinical assessment program, the Medical Assessment Programme, for British Gulf War veterans that is similar to the DVA PGVHR and the DoD CCEP (Coker, 1996). Among the approximately 51,000 British troops who were deployed to the Gulf region, 1,026 registered in this program by June 1996, and 608 completed the program. Coker (1996) reported on an analysis of information for 284 of the veterans who completed the program. Although from a much smaller study population, the frequencies of

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symptoms and diagnoses among the examined British Gulf War veterans (see Table 3) show some similarities to the results in Tables 1 and 2.

Table 3. Frequencies of Symptoms and Diagnoses for 284 participants in the British Ministry of Defence Medical Assessment Programme. Adapted from Coker, 1996.

Symptom	Subjects reporting symptom (%)
Tiredness	55%
Muscle & joint pain	35%
Irritability	29%
Sleep disturbance	24%
Short-term memory loss	22%
Breathlessness	21%
Skin problems	16%
Tingling in limbs	11%
Principal Diagnostic Category (using ICD-9)	**Frequency**
Psychological conditions	35%
Signs, symptoms, and ill-defined conditions & chronic fatigue syndrome	15%
Respiratory system	9%
Skin and subcutaneous tissue	8%
Digestive system	7%
Nervous system	6%
Musculoskeletal system & connective tissue	6%
Circulatory system	3%
Genitourinary system	2%
Infectious diseases	1%
Endocrine	1%
Neoplasms	1%

The frequencies and types of symptoms and diagnoses of illnesses in participants in these clinical programs show that:

- common health problems involve a wide variety of organ systems including the musculoskeletal, gastrointestinal, respiratory, and nervous systems;
- a significant proportion of participants (20-30%) reported common symptoms (e.g., fatigue, headache, nervousness, heartburn, insomnia) that were without a clear physiologic or psychologic basis. Clinicians were not able to assign a standard diagnosis to these patients other than *symptoms, signs and ill-defined conditions*, and
- three diagnostic categories (psychological conditions, musculoskeletal diseases, and symptoms, signs and ill-defined conditions) represented more than 50% of the primary diagnoses.

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The most frequent symptoms reported as a chief complaint by the 3,558 DoD CCEP participants who were assigned to the diagnostic category, *symptoms, signs, ill-defined conditions,* were: fatigue (20%), headache (9.2%), memory problems (6.3%), sleep disturbances (4.7%), skin rash (4.4%), joint pain (4.2%), and shortness of breath (1.8%) (Joseph et al., 1997). Twenty-six percent (914/3558) of these participants reported multiple symptoms without designating a chief complaint.

Hyams et al. (1996) noted that symptom patterns for Gulf War veterans are consistent with the experiences of U.S. veterans of previous wars. Reviewing English-language articles and books of war-related illnesses associated with the Civil War, World Wars I and II, the Korean Conflict, and the Vietnam War, Hyams recognized two general categories of war-related illnesses that were diagnosed after each of these wars: 1) psychological illnesses [2] ; and 2) physiological illnesses[3]. The physiological illnesses were primarily defined by self-reported, chronic (i.e., long-lasting) symptoms including fatigue, shortness of breath, headache, sleep disturbances, impaired concentration, and forgetfulness. Hyams noted that these symptoms are non-specific and are frequently found in all adult populations, as well as among persons with illnesses associated with psychological stress, and that, in each of these wars, the onset of these illnesses was preceded by a high frequency of diarrhea. Hyams concluded that "poorly understood war syndromes" have recurred since the U.S. Civil War, that no single disease or underlying cause that is unrelated to psychological stress is apparent from his review, and that the relationships between chronic, non-specific symptoms and physiological and psychological illness need to be better understood.

Because of the limitations of the information from the health registry programs[4], the DVA is conducting a three-phase National Health Survey of Gulf War veterans to obtain estimates of nationally representative prevalences of symptoms and other medical conditions among all U.S. Gulf War veterans, (DVA research project # 2; RWG, 1998, 1999). Phase 1 involved mailing a questionnaire to 30,000 randomly selected U.S. veterans (15,000 Gulf War veterans and 15,000 veterans who served during the period of the Gulf War, but were not deployed to the Gulf region). Phase 2 interviewed, by telephone, a sample of 8,000 non-respondents, and validated (through records review) self-reported data for randomly selected respondents (2,000 deployed and 2,000 non-deployed). Phase 3 involves comprehensive clinical examination of the 4,000 respondents (and their families) selected in Phase 2. Analysis of collected data is not available to date.

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[2] Given various names through the years from *nostalgia* in the Civil War, through *shell shock* in WWI, and *battle fatigue* in WWII and Korea, to *post-traumatic stress disorder* after the Vietnam and Gulf Wars.

[3] *Da Costa syndrome* (irritable heart) after the Civil War, *Effort syndrome* during and after WWI and II, *Agent Orange exposure* after Vietnam, and *Gulf War syndrome*.

[4] For example, participants are not a random sample of all Gulf War veterans and there is no control group to compare prevalences.

Conclusions and Research Recommendations from Review Panels

Four panels of experts have evaluated available data from the DoD and DVA health registries and other sources of information regarding illnesses among Gulf War veterans: the *Defense Science Board Task Force on Persian Gulf War Health Effects* (DSB, 1994); the *National Institutes of Health Technology Assessment Workshop Panel* (NIH, 1994a,b); the *Institute of Medicine Committee to Review the Health Consequences of Service During the Persian Gulf War* (IOM, 1996b); and the *Presidential Advisory Committee on Gulf War Veterans' Illnesses* (PAC, 1996a,b; 1997). Appendix A of this document provides an historical account of the establishment of these and other panels reviewing various aspects of illnesses among Gulf War veterans and also summarizes panel recommendations. Each of the panels concluded that there was no evidence consistent with the existence of a unique disease among Gulf War veterans (DSB, 1994; NIH, 1994a,b; IOM, 1996b; PAC, 1996a,b, 1997).

The panels considered a number of suggested causes of illnesses among Gulf War veterans including combat- and deployment-related stress, chemical and biological warfare agents, vaccines, pesticides, pyridostigmine bromide, infectious diseases, depleted uranium, smoke from oil-well fires, petroleum products, and exposures to mixtures of chemicals specific to the Gulf War experience (see Appendix B: *Exposure to Chemicals During the Gulf War* for further discussion of potential Gulf War health risk factors). Given the broad range of illnesses noted among Gulf War veterans and the incomplete exposure data that were available, each of the panels concluded that no single cause of the multiple illnesses could be established (DSB, 1994; NIH, 1994a,b; IOM, 1996b; PAC, 1996a,b, 1997). The Presidential Advisory Committee on Gulf War Veterans' Illnesses made three further conclusions that: 1) it was unlikely that the reported illnesses were caused by exposure to any of the previously mentioned physical risk factors; 2) stress was likely to be an important contributing risk factor; and 3) research should be pursued in areas of uncertainty, such as the long-term effects of low-level exposure to chemical warfare agents and the synergistic effects of exposure to pyridostigmine bromide and other risk factors (PAC, 1996a,b, 1997; Lashof and Cassells, 1998).

The Presidential Advisory Committee further recommended that, "To ensure credibility and thoroughness, further investigation of possible chemical or biological warfare agent exposures during the Gulf War should be conducted by a group independent of DoD." (PAC, 1996b, 1997). In response to this recommendation, President Clinton created the Special Oversight Board for Department of Defense Investigations of Gulf War Chemical and Biological Incidents "to provide advice and recommendations based on review of DoD investigations into possible detections of, and exposures to, chemical or biological weapons agents and environmental and other factors that may have contributed to Gulf War Illnesses" (PSOB, 1998). This group held its first public hearing in November, 1998.

In response to another recommendation from the Presidential Advisory Committee (PAC, 1997), the DVA contracted the Institute of Medicine of the National Academy of Sciences to conduct a periodic review of scientific evidence regarding associations between illnesses and Gulf War

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service. To carry out this review, the Institute of Medicine Committee on Health Effects Associated with Exposures During the Gulf War was formed in 1998 and held its first meeting in January 1999 (IOM, 1998a).

Initial research recommendations from the review panels included:

- epidemiological research to compare prevalence rates of illnesses in Gulf War veterans with appropriate control populations;
- research to examine groups of symptomatic Gulf War veterans more closely with neuropsychological and psychological tests; and
- research on specific risk factors such as stress, pesticides, depleted uranium, and Leishmaniasis (DSB, 1994; NIH, 1994a,b; IOM, 1996b; PAC, 1996a).

More recent research recommendations include:

- research into the long-term effects of low-level exposure to chemical warfare agents, alone and in combination with exposure to other Gulf War health risk factors including stress, pesticides and pyridostigmine bromide;
- epidemiological research on groups of U.S. troops known to be in the vicinity of Khamisiyah when low-level exposure to nerve agents may have occurred;
- research emphasis should include investigations of the causes, methods of prevention, and methods of treatment of musculoskeletal conditions and stress-related disorders (PAC, 1996b, 1997).

The Institute of Medicine established the Committee on Measuring Health Status of Persian Gulf Veterans in 1998 to identify important research questions regarding Gulf War illnesses and develop research designs and methods to address the questions (IOM, 1998b). The committee held a workshop in May 1998 (IOM, 1998c), but the committee's findings and recommendations are not yet available.

Overviews of research results and ongoing research on illnesses among Gulf War veterans are presented in sections 5 and 6 and Appendices C and D of this document.

4. Overview: U.S. Government-Supported Research on Gulf War Illnesses

In response to Public Law 102-585, President Clinton, in August, 1993, named the Secretary of Veterans Affairs to coordinate executive branch-funded research on the health consequences of the Gulf War. The Persian Gulf Veterans Coordinating Board (PGVCB) was formed in January, 1994 to coordinate interagency efforts in research, clinical care, disability compensation, resource allocation, and information dissemination. The Secretaries of the DoD, the DVA, and the DHHS chair the PGVCB. The RWG was established to assess the state and direction of research, identifying gaps in factual knowledge and conceptual understanding, identify testable hypotheses, recommend research directions for participating agencies, review research concepts as they are developed, and collect and disseminate scientifically peer-reviewed information (RWG, 1998).

In the 1994-1997 period, the RWG coordinated U.S.-government-sponsorship of 121 research projects pertaining to illnesses in Gulf War veterans (RWG, 1998). New projects were funded in 1998.

As reported in the March 1998 RWG Annual Report to Congress, 39 of the 121 projects were completed through February, 1998. Total funding for research on Gulf War illnesses in the DoD, DVA, and the DHHS (in millions of dollars) was $7.1 in 1994, $17.3 in 1995, $18.8 in 1996, $34.2 in 1997, and $37.9 (projected) in 1998 for a total of $115 million to date (RWG, 1998).

In 1995 and 1996, the RWG established six focus areas of research:

- Symptoms/General Health
- Brain and Nervous System
- Reproductive Health
- Pyridostigmine Bromide
- Environmental Toxicology
- Leishmaniasis.

In response to the 1996 DoD announcement that U.S. troops demolished an Iraqi weapons bunker at Khamisiyah in March of 1991 and that certain troops may have experienced low-level exposure to nerve gas, the RWG (1998) added two additional focus areas related to possible health effects from low-level exposures to chemical weapons agents:

- epidemiological research on health outcomes in troops potentially exposed to sarin at Khamisiyah: and
- research on potential health effects from low-level, sub-clinical exposures to chemical warfare nerve agents, alone and in combination with exposure to other agents.

Ongoing, U.S. Government-funded research projects related to Gulf War illnesses and of interest to the focus of the current research-planning conference are briefly described in Appendix D and include:

- seven projects related to multiple symptom illnesses such as *multiple chemical sensitivity* and chronic fatigue syndrome;
- six projects (two human studies and four animal studies) related to *genetic differences in susceptibility to chemicals or stress*;
- thirteen projects (all animal studies) related to *toxic effects from mixtures of chemicals and other risk factors* (e.g., effects of sarin, pyridostigmine bromide and DEET, alone or in combination, on neurobehavior and immune function in rats);
- four projects related to *treatment of Gulf War symptoms* (two clinical trials of antibiotic treatment, one clinical trial examining cognitive behavioral therapy and aerobic exercise; and one animal study examining behaviorally-active drugs to modify behavior in mice);
- eight projects (three epidemiological studies and five animal studies) related to *toxicity of low-level, subclinical exposures to chemical warfare agents* (all but one project is related to exposure to nerve agents; the other examines possible DNA effects from nitrogen mustard);

- six projects (one human controlled-exposure study and five animal studies) related to *toxicity of pyridostigmine bromide*;
- and numerous clinical and epidemiological studies related to *assessment and definition of Gulf War illnesses* and quantification of *disease prevalence and associations between chemical exposures and disease*.

5. Gulf War Illnesses: Research Results and Ongoing Research

This section discusses results from research related to illnesses in Gulf War veterans and relationships of the results to ongoing research projects. Included in the discussion are results from mortality and hospitalization studies, studies of self-reported symptoms in Gulf War-deployed and non-deployed veterans, studies of neurophysiological and neuropsychological variables in symptomatic Gulf War veterans, studies of health effects from mixtures of chemicals used in the Gulf War and other risk factors, studies of genetic differences in susceptibility to environmental agents, studies of multiple chemical sensitivity in Gulf War veterans, and studies of treatment of Gulf War veterans with non-specific chronic symptoms of ill health. Appendix C: *Research on Gulf War Illnesses: Description and Evaluation of Selected Studies* and Appendix D: *Ongoing Research Related to Illnesses Among Gulf War Veterans* provide additional details.

Mortality and Hospitalization Studies

Large-scale studies are available comparing the following in active-duty U.S. military personnel who served in the Gulf War with active-duty personnel who did not serve in the Gulf:

- rates of mortality (Writer et al., 1996; Kang and Bullman, 1996, 1997);
- rates of general hospitalizations (Gray et al., 1996);
- rates of hospitalizations for unexplained illnesses (Knoke and Gray, 1998);
- rates of hospitalization for testicular cancer (Knoke et al., 1998); and
- rates of general birth defects and a specific birth defect, Goldenhar syndrome (Cowan et al., 1997; Aranata et al., 1997).

The mortality rate studies found no differences between Gulf War-deployed and non-deployed personnel, except for a higher rate of mortality from unintentional injuries (i.e., accidents, in particular motor vehicle accidents) in deployed personnel (Writer et al., 1996; Kang and Bullman, 1996, 1997). The hospitalization studies, which focused on discharge rates from U.S. military hospitals, found no consistent evidence for increased hospitalizations in Gulf War-deployed personnel (Gray et al., 1996; Knoke and Gray, 1998; Knoke et al., 1998). The studies of children of deployed-personnel born in U.S. military hospitals found no statistically significant increase in

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general birth defects or in Goldenhar syndrome[5] compared with children born to non-deployed personnel (Cowan et al., 1997; Aranata et al., 1997).[6]

Whereas these large-scale studies have not found evidence for increased incidence of grave illness among Gulf War veterans, they have several limitations including: not studying personnel who separated from the military; not studying geographically or exposure-defined subgroups; not examining non-military hospitalizations; and not examining outpatient treatment of illness (see Appendix C for more discussion). These studies, thus, do not negate the fact that Gulf War veterans have experienced, and still are experiencing, real illnesses, as demonstrated by the DVA and DoD clinical experiences. Discussion of the strengths and limitations of the published mortality, hospitalization, and reproductive-outcome studies are available in the literature (Doyle et al., 1997; Haley, 1998a,b; Kang and Bullman, 1998; Gray et al., 1998; Cowan et al., 1998). With respect to the possibility that reproductive outcomes (e.g., increased risk for fetal deaths, birth defects, miscarriages, medical termination of pregnancy, and infertility) might be influenced by Gulf War service, there are several on-going controlled epidemiological studies that were designed with these limitations in mind, but for which data are not yet available (see Doyle et al., 1997; RWG, 1997, 1998, 1999; Cowan et al., 1998).

Studies of Self-reported Symptoms in Gulf War-Deployed and Non-deployed Veterans

Results from several studies are available comparing self-reported health symptoms and medical conditions in groups of Gulf War deployed and non-deployed veterans (CDC, 1995; Fukuda et al., 1998; Iowa Persian Gulf Study Group, 1997; Stretch et al., 1995; Pierce, 1997; Canadian Department of National Defence, 1998; Unwin et al., 1999; Ismail et al., 1999; Proctor et al., 1998). These studies have found consistently higher rates of self-reported symptoms in deployed compared with non-deployed veterans; short descriptions of results follow. Results from these studies should be evaluated with the generally accepted understanding that self-reported symptoms are subject to individual and group biases ("recall biases") that can distort the magnitude of differences between groups. (More study details are included in Appendix C)

The CDC (1995) compared rates of self-reported health symptoms that persisted for more than six months among Gulf War deployed and non-deployed, active-duty personnel in Air Force units

[5] Goldenhar syndrome is a prenatal developmental disorder that leads to abnormal ear and facial structures; anecdotal reports in the popular press in 1995 suggested that there might be an excess of this birth defect among children of Gulf War veterans (Aranata et al., 1997).

[6] In addition to these studies of active-duty personnel, early news-media reports that there was an apparent cluster of birth defects in Gulf-deployed Mississippi National Guard units were not supported by a subsequent examination of the frequencies of birth defects, low-birth weight, or premature births in 54 of 55 children born to 52 veterans in these units compared to U.S. national rates, but the small sample size in this study does not allow a definitive conclusion that applies to all Gulf War veterans (Penman et al., 1996).

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from Pennsylvania and Florida and found that the prevalence of each of thirteen symptoms[7] was significantly greater in deployed personnel compared with non-deployed personnel. Individuals in a sample of this study population were defined either as "cases" with chronic multiple symptoms or "noncases" based on their survey responses[8] and evaluated further in physical examinations, laboratory tests of blood, stool and urine samples, and serological examinations (Fukuda et al., 1998). Fukuda et al. (1998) reported that: 1) "cases" with chronic multiple symptoms were more frequent in the deployed group compared with the non-deployed group; 2) no findings in the physical, laboratory or serological tests were predictive of case definition[9]; and 3) no significant associations were found between having chronic multiple symptoms and several surrogate measures of exposure (e.g., date of deployment, season of deployment, occupational activity during war).

The Iowa Persian Gulf Study Group (1997) found significantly higher prevalence of similar self-reported symptoms indicative of several syndromes or disorders[10] in a group of Gulf War-deployed personnel from Iowa who served in U.S. regular military, National Guard, or reserve units compared with a similar group of non-deployed military personnel from Iowa. Stretch et al. (1995; 1996a,b) also found significantly higher percentages of self-reported physical health symptoms in Gulf-deployed veterans from Hawaii and Pennsylvania compared with non-deployed veterans, and noted that this difference was not explained by several demographic variables (e.g., age, rank, marital status) other than deployment.

In a study of female U.S. veterans, Pierce (1997) reported that self-reported frequencies of occurrence of general health symptoms[11] were higher in deployed versus non-deployed veterans, but the differences were not statistically significant. However, self-reported frequencies of occurrence of other symptoms[12] (lumps or cysts in breasts, abnormal Pap smear, headache) were statistically significantly higher, four years after the war, in deployed veterans than in non-deployed veterans, and a significantly greater percentage of deployed veterans (24%) met the

[7] For example: fatigue, joint pain, nasal congestion, diarrhea, joint stiffness, unrefreshing sleep.

[8] A case was defined as reporting one or more chronic symptom from at least two of three categories: fatigue, mood-cognition and musculoskeletal.

[9] Fukuda et al. (1998) reported that "mean values of a few routine blood tests differed among cases and noncases, but the differences were marginal and clinically unimportant". They noted that a more detailed summary of blood and urine data was available by request.

[10] For example: depression, posttraumatic stress disorder, chronic fatigue, cognitive dysfunction, asthma, and fibromyalgia.

[11] Rash, cough, depression, unintentional weight loss, insomnia and memory problems.

[12] Pierce (1997) termed these symptoms *gender specific*.

requirement for combat-related posttraumatic stress disorder (PTSD) than non-deployed veterans (15%) (Pierce, 1997).

In a study of self-reported health symptoms in Canadian Gulf War veterans compared with non-Gulf-deployed Canadian veterans, Gulf-deployed veterans reported higher prevalences of symptoms of chronic fatigue, cognitive dysfunction, multiple chemical sensitivity, major depression, post-traumatic stress disorder, anxiety, fibromyalgia and respiratory diseases (bronchitis and asthma together), as well as higher numbers of children with birth defects (before, during, and after the Gulf War) (Canadian Department of National Defence, 1998).

Investigators at the Boston Environmental Hazards Center found significantly higher percentages of veterans who reported health symptoms[13] in Gulf-deployed groups from New England (n= 186) and New Orleans (n = 66) compared with a group of U.S. veterans (n = 48) who were deployed to Germany during the Gulf War period (Proctor et al., 1998). Statistical analysis of symptom scores (that were based on self-reported frequency of occurrence of the symptoms) and self-reported military-experience exposures found significant associations between specific symptoms[14] and exposures to pesticides, debris from Scud missiles, chemical or biological warfare agents, and smoke from tent heaters.

In a survey study of U.K. veterans, significantly higher percentages of Gulf-deployed veterans reported numerous health symptoms[15] compared with non-deployed veterans from the same era or veterans deployed to Bosnia (Unwin et al., 1999). Most of these differences persisted after statistical adjustment for possible confounders and diagnosed psychological disorders. Statistical associations between self-reported symptoms and self-reported exposures to numerous health risk factors[16] were examined in each of the studied groups, after defining individuals with multiple

[13] Skin rashes, stomach cramps or excessive gas, joint pains, headaches, difficulties learning new material, inability to fall asleep, and frequent periods of anxiety or nervousness.

[14] The analysis excluded 12 subjects in the Gulf-deployed groups who were diagnosed with current PTSD. Statistically significant associations included those between: 1) self-reported exposure to pesticides and musculoskeletal or neurological symptoms; 2) self-reported exposure to debris from Scud missiles and musculoskeletal, neurological, neuropsychological or psychological symptoms; 3) self-reported exposure to chemical or biological warfare agents and musculoskeletal, neurological, neuropsychological, and psychological symptoms; and 4) self-reported exposure to smoke from tent heaters and cardiac, neurological, and pulmonary symptoms.

[15] For example, fatigue, sleep disturbances, irritability, headaches, loss of concentration, joint stiffness or pain, tingling in fingers and arms, chest pain, and night sweats

[16] For example, smoke from oil-well fires, use of personal pesticides, use of pyridostigmine bromide, belief of exposure to chemical attack, multiple routine vaccinations, or vaccinations for biological warfare agents.

symptoms[17] as "cases" and others as "noncases". In all three groups of veterans, statistically significant associations were found between reporting multiple symptoms and reporting exposure to numerous agents, including nerve gas, exhaust from heaters or generators, and pyridostigmine bromide. A weak, although statistically significant, association between reporting multiple symptoms and reporting receiving multiple vaccinations was found in the Gulf-deployed U.K. veterans, but not in the Bosnia U.K. veterans (Unwin et al., 1999). In a companion study, Ismail et al. (1999) used a mathematical technique, two-step factor analysis, to examine if the self-reported symptoms represented a unique Gulf War disorder. Using this technique, a three-factor structure was identified among the Gulf-deployed veterans; the "factors" were labeled mood, respiratory system and peripheral nervous system based on their defining symptoms. Ismail et al. (1999) reported that this three-factor structure also reasonably fit the Bosnia-deployed veterans and the non-deployed, Gulf War-era veterans, and concluded that their findings do not support a unique Gulf War syndrome.

Other studies also looked for relationships between self-reported health symptoms and measures of stress or self-reported exposures to specific health risks such as combat, poisonous gas or occupational exposure to petroleum products (Stretch et al., 1996a,b; Baker et al., 1997; Wolfe et al., 1998). Relationships between war-related stress and physical symptoms of ill-health were found (Stretch et al., 1996a,b; Baker et al., 1997), but these studies do not indicate the strength of the relationship and do not exclude possible relationships between symptoms and other risk factors. One study found that, in a group of Gulf-deployed U.S. veterans, self-reported exposure to poisonous gas was related to higher symptom reporting (Wolfe et al., 1998).

Based on the results of several psychological tests, Stretch et al. (1996a,b) reported that, in addition to more frequently reporting health symptoms, deployed veterans from Hawaii and Pennsylvania exhibited more stress than non-deployed veterans. In a study of 188 Gulf War veterans, half of whom were patients at the Cincinnati Veterans' Administration Medical Center, Baker et al. (1997) found that the 24 Gulf War veterans in this group with PTSD had statistically significantly greater combat exposure and reported more symptoms than others in the group. Wolfe et al. (1998) found that, in a study of 2,119 Gulf-deployed troops who returned to the U.S. through Fort Devens, veterans who reported having been exposed to poison gas were more likely to report health symptoms (such as aches/pains, lack of energy, etc.), even after excluding from the analysis those subjects with presumptive PTSD, and that deployed veterans with combat exposure or occupational exposure to motor vehicles (i.e., petroleum products) were not more likely to report health symptoms.

As discussed earlier, an on-going large-scale project, the VA National Health Survey, is designed to estimate and compare the prevalence of various symptoms, medical conditions, and unexplained illnesses in Gulf War-deployed and non-deployed U.S. veterans and look for relationships between exposure to specific risk factors and frequencies of health symptoms (DVA

[17] Following the convention of Fukuda et al. (1998), a case was defined as reporting one or more chronic symptom from at least two of three categories: fatigue, mood-cognition and musculoskeletal.

research project #2, RWG, 1998, 1999). Data from this project are not currently available. Other on-going large-scale projects for which data are not yet available include:

- a University of Oregon study comparing health survey responses and clinically evaluated neuropsychological and neurophysiological variables in: subjects from U.S. troops located within a 50-km radius of Khamisiyah in March, 1991; subjects from other U.S. Desert Storm and Desert Shield troops; subjects from other U.S. troops that were not deployed to the Gulf region; and civilians with a documented history of exposure to organophosphate insecticides (DoD research project #63; RWG, 1998, 1999); and
- an Institute of Medicine/Medical Follow-up Agency study comparing hospitalization rates and mortality rates during a 5-year post-Gulf War period in: subjects directly involved in the March 1991 Khamisiyah demolition, subjects from two battalions located within a 50-km radius of the Khamisiyah demolition site during March, 1991; subjects from Gulf War battalions never located within a 50-km radius of Khamisiyah; and subjects from non-deployed U.S. troops (DoD research project #69; RWG, 1998, 1999).

Neurophysiological and Neuropsychological Evaluations of Symptomatic Gulf War Veterans

Several studies have carried out neurophysiological and neuropsychological evaluations of small groups of symptomatic Gulf War veterans (Jamal et al., 1996; Amato et al., 1997; Goldstein et al., 1996; Axelrod and Milner, 1997; Haley et al., 1997a,b; Haley and Kurt, 1997). In general, these studies have not found obvious and consistent changes in objective measures of numerous neurophysiological or neuropsychological variables; however, some of the studies have found subtle changes in several variables in some of the examined patients. Several hypotheses concerning the cause or physiological basis of difficult-to-diagnose chronic illnesses among some Gulf War veterans remain plausible; some investigators hypothesize relationships to stress (e.g., Goldstein et al., 1996; Amato et al. 1997), whereas other investigators hypothesize relationships to low-level chemical exposure (Haley and Kurt, 1997).

In an evaluation of neuromuscular function[18], Jamal et al. (1996) found statistically significant changes in two variables of nerve conduction velocity[19] and one variable of cold sensation in fourteen symptomatic[20] British Gulf War veterans compared with ten healthy civilians, but noted that the clinical relevance of these findings was unknown.

[18] The evaluation included a physical examination of reflexes, muscle power, and response to stimulation (e.g., pin prick), nerve conduction velocity tests, electromyographic analysis of muscles, and quantitation of sensory thresholds to heat and vibration. 14 subjects (12 men and 2 women) were randomly selected by Jamal et al. from a list, compiled by a voluntary organization, of 40 U.K. veterans who complained of unexplained illness after the Gulf War.

[19] Among 19 nerve conduction and electrophysiological variables that were measured.

[20] These veterans reported musculoskeletal symptoms including fatigue, weakness, numbness and spontaneous sensations of heat or cold.

In evaluations of neuromuscular function and muscular structure[21] in 20 Gulf War veterans who complained of severe and debilitating muscle fatigue, weakness, or pain, Amato et al. (1997) reported that the only abnormalities[22] found were "mildly increased" levels of serum creatinine kinase or non-specific histological changes in biopsied muscle tissue in 8/20 of the patients. Amato et al. (1997) did not believe these changes to be clinically significant or indicative of a specific neuromuscular disorder.

Axelrod and Milner (1997) administered 36 neuropsychological tests to a group of 44 self-selected U.S. Gulf War veterans[23] and found that average performances for the group only showed slight, but statistically significant, impairments, relative to normal values, in two of six tests of finger dexterity and in three of twelve tests of executive functioning[24].

Goldstein et al. (1996) compared performance by 21 symptomatic Gulf War veterans and 38 healthy civilian volunteers in a battery of neuropsychological tests[25], and reported that no statistically significant differences were found between the two groups on scores in fourteen tests of cognitive processes (i.e., attention and memory). No statistically significant difference was found between the Gulf War veterans and the control group in a cognitive impairment index[26], when adjustment for psychological distress was made (Goldstein et al., 1996).

Using a mathematical technique, principal factor analysis, to identify associations among symptoms reported by a group of 249 Gulf War veterans, Haley et al. (1997a) identified and named six possible syndromes and studied subjects with the three syndromes showing the strongest associations among symptoms: *impaired cognition* (associated with: attention,

[21] The evaluation included physical examination, determinations of serum creatine kinase and erythrocyte sedimentation rate, thyroid function tests, nerve conduction velocity tests, repetitive nerve stimulation tests, electromyographical analysis of several muscle groups, and microscopic examination of biopsied muscle tissue.

[22] Amato et al. (1997) noted that the frequencies of abnormalities which they observed in their group of 20 patients were less than that seen in other larger studies in which patients were referred for in-depth evaluation of muscle pain.

[23] This group of veterans reported experiencing joint pain (65%), skin rashes (57%), fatigue (57%), sleep disturbances (50%), shortness of breath (41%), and cognitive difficulties (39%).

[24] The three executive function tests with lower scores involved color naming and word naming. The other executive functioning tests administered included Trail Making tests, card-sorting tests, oral word association tests, and a test of semantic fluency.

[25] Included were tests of attention, memory, psychomotor function, and problem solving.

[26] The impairment index was based on the number of tests performed by a subject in which the score was below one standard deviation of the mean of the control group.

memory, and reasoning problems; insomnia; depression; daytime sleepiness; and headaches), *confusion-ataxia* (associated with: thinking problems; disorientation; balance disturbances; vertigo; and impotence), and *arthro-myo-neuropathy* (associated with: joint and muscle pain; muscle fatigue; difficulty lifting; and extremity paresthesias). In 23 symptomatic "cases" with these syndromes and 20 controls[27], Haley (1997b) examined performance in a battery of neuropsychological tests, auditory and vestibular function variables, brain stem auditory evoked potentials, somatosensory and visual evoked potentials, clinical motor and reflex functions, brain images, and numerous blood cytological and biochemical variables (see Appendix C for more details on administered tests and results). The following statistically significant differences between cases and controls were found: 6/22 cases showed weakness of the lower extremities compared with 1/20 controls; mean scores on composite indices of neuropsychological dysfunction were higher in cases than controls; and 4/23 cases versus 0/20 controls showed abnormal spontaneous nystagmus (rhythmic movement of the eyeball). In addition, mean values of several auditory and vestibular function variables[28] and several variables associated with evoked potentials[29] were significantly different (in the direction of impairment) in cases compared with controls.

The clinical significance of these differences is uncertain. Six neurologists, who were blinded to the identity of the subjects, reviewed the findings on each individual and concluded that "the clinical and laboratory findings were nonspecific and not sufficient to diagnose any known syndrome in any subgroup of the subjects." Haley et al. (1997b) speculated that the observed statistically significant differences between cases and controls in several objective measures of neurophysiological and audiovestibular variables may have a relationship with "sublethal exposures to cholinesterase-inhibiting chemicals", and noted that additional research is necessary, including examining the same, and additional, endpoints (e.g., neuromuscular and nerve conduction velocity variables) in a greater number of subjects (cases and controls).

Haley and Kurt (1997) hypothesized that the three previously discussed factor analysis-derived syndromes may represent variants of organophosphate-induced delayed peripheral neuropathy due to exposure to mixtures of anti-cholinesterase agents (e.g., chemical warfare nerve agents, pesticides, insect repellent, and/or pyridostigmine bromide). In support of this hypothesis, several statistically significant associations were found between self-reported exposures to anti-cholinesterase agents and the syndromes (e.g., wearing of pet flea and tick collars and *impaired cognition*; adverse reactions to pyridostigmine bromide and *confusion-ataxia* or *arthro-myo-*

[27] Cases included 5 subjects with *impaired cognition*, 5 with *arthro-myo-neuropathy*, and 13 with *confusion-ataxia*. Controls, matched for age, sex, and educational level, included 10 deployed asymptomatic veterans and 10 non-deployed veterans. See Appendix C for more details.

[28] For example, increased interocular asymmetry in response to rotation.

[29] For example, increased latency of the lumbar-to-cerebral peaks on the posterior tibial somatosensory evoked potential.

neuropathy. See Appendix C for more details.) Landrigan (1997) has noted that the hypothesis put forth by Haley and colleagues is important and deserves serious investigation, but limitations[30] in the studies conducted to date "substantially weaken the authors' strong conclusions."

Several ongoing research projects are making efforts to identify specific physical or laboratory neurological variables that may be consistently affected in Gulf War veterans who are experiencing multiple chronic symptoms such as fatigue, headaches, and difficulty concentrating.

- At the University of Texas Southwestern Medical Center (DoD research project #65; RWG, 1998, 1999), a battery of clinical and laboratory tests are being developed to assess neurological variables that may be differentially affected in subjects with unexplained, multiple chronic symptoms compared with healthy subjects (e.g., regional cerebral blood flow before and after challenge with a carbamate cholinesterase inhibitor, nerve firing rate of peroneal nerve, quantitative electroencephalographic pattern analysis, and blood levels of serum butyrylcholinesterase). This group is also developing a plan to conduct another health and exposure survey of randomly selected national samples of deployed and non-deployed Gulf War-era veterans.

- At Georgetown University (DoD research project #31; RWG, 1998, 1999), several physiological variables (pain threshold, esophageal smooth muscle motility) and biochemical variables (changes in neurohormonal levels in response to different stressors, cerebral spinal fluid levels of neurotransmitters) are being examined in groups of ill Gulf-deployed veterans compared with groups of civilians experiencing similar multiple chronic symptoms and groups of healthy subjects.

- At Boston University, brain activation patterns (determined with magnetic resonance imaging) will be examined in groups of ill and healthy Gulf War-deployed U.S. veterans, a group of Germany-deployed veterans of the Gulf War era, and a group of ill, non-Gulf War deployed veterans (DHHS research project #5; RWG, 1999). Brain activation patterns will be assessed in subjects challenged with a test of working memory, a brain function thought to be affected in various disorders such as chronic fatigue syndrome, multiple chemical sensitivity, and post-traumatic stress disorder. This project will also administer neuropsychological tests to two groups of Danish veterans. One group was deployed to the Persian Gulf region in 1991 after the ground war ceased, and the other was not deployed to the Gulf.

[30] Landrigan (1997) noted that the studies are focused on a single battalion of naval construction workers whose Gulf War experiences may not be representative of most Gulf War veterans; that only 41% of the battalion participated in the examinations raising the possibility of selection bias; that most information collected on illnesses was self-reported - detailed clinical and neuropsychological examinations were performed on only 23 symptomatic veterans representing less than 4% of the battalion; that motor nerve conduction velocity tests to confirm organophosphate-induced delayed peripheral neuropathy were made on only 5 veterans; and that exposure information was entirely self-reported.

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Studies of Neurological Effects from Mixtures of Chemicals and other Risk Factors

As discussed in the previous section, there is limited suggestive evidence for the hypothesis that some Gulf War veterans with chronic, non-specific symptoms may be experiencing neurological dysfunction due to low-level exposures to mixtures of anti-cholinesterase agents that might have additive or synergistic effects (Haley et al., 1997a,b; Haley and Kurt, 1997).

Suggestive evidence of additive or synergistic effects among anti-cholinesterase agents is provided by three animal studies of acute (i.e., short-term) exposure: one with hens exposed to the anti-nerve agent, pyridostigmine bromide, the insect repellent, DEET, and the insecticide, permethrin, alone and in various combinations with each other (Abou-Donia et al., 1996a)[31]; another with hens exposed to pyridostigmine bromide, DEET, and the insecticide, chlorpyrifos, alone and in combination[32] (Abou-Donia et al., 1996b); and a third with rats given single doses of pyridostigmine bromide, DEET, and permethrin, alone and in various combinations[33] (McCain et al., 1997). The rat study found a significant increase in lethality when all three compounds were given compared with expected additive values based on lethality from exposure to the individual compounds; these findings suggest that the compounds interacted in a synergistic (greater than additive) manner (McCain et al., 1997). In the hen studies, individual compounds were administered at exposure levels that produced mild signs of neurological effects (e.g., transient leg weakness or diarrhea) and no, or minimal, microscopic changes in spinal cords or sciatic nerves (Abou-Donia et al., 1996a,b). Co-exposure to various combinations of two of the compounds produced signs of greater neurotoxicity (e.g., gait disturbances, tremors) and mild to moderate microscopic changes in the spinal cord and sciatic nerve of some of the hens; co-exposure to all three compounds produced marked neurotoxic signs and mild to severe changes in spinal cords and sciatic nerves (Abou-Donia et al., 1996a,b). Although the design of the hen studies does not allow definitive conclusions about synergistic interactions, the results suggest that additive effects occurred. The physiological or biochemical basis of these interactions is not

[31] Hens were exposed 5 days/week for 2 months to oral doses of 5 mg/kg-day pyridostigmine bromide, subcutaneous doses of 500 mg/kg-day DEET, and subcutaneous doses of 50 mg/kg-day permethrin, alone, in binary combination, or all three together. Although the individual doses of these compounds did not produce marked neurotoxic effects in the hens, they were higher than doses experienced by Gulf War soldiers; for example, the prescribed dose of pyridostigmine bromide of 30 mg per 8 hours corresponds to about 1.3 mg/kg-day for a 70-kg subject.

[32] Hens were exposed 5 days/week for 2 months to oral doses of 5 mg/kg-day pyridostigmine bromide, subcutaneous doses of 500 mg/kg-day DEET, and subcutaneous doses of 10 mg/kg-day chlorpyrifos, alone, in binary combination, or all three together.

[33] Rats were exposed to several oral doses of each compound alone to determine acute oral lethal dose-response relationships. Interaction studies were then conducted examining lethality that occurred when low-level exposure to two of the compounds was constant and the dosages of the third compound were varied.

understood, but Abou-Donia et al. (1996a,b) hypothesized that competition among the compounds for esterases in the liver and plasma may lead to impaired breakdown and subsequent increased concentrations in nervous tissues[34].

The relevance of these animal studies to possible chronic neurological impairment in Gulf War veterans is uncertain due to the high exposure levels to which the animals were exposed[35], differences in routes of administration, potential physiological differences between humans and the studied animals, and other potential differences between mixtures to which the animals were exposed and mixtures that may have been experienced by Gulf War veterans (e.g., use of insecticides and insect repellents may have been low in the winter of 1991 when the use of pyridostigmine bromide occurred).

Acute exposure to some cholinesterase-inhibiting agents, such as certain organophosphate and carbamate insecticides, at exposure levels that produce acute symptoms of poisoning[36] is documented to produce different types of delayed or chronic neurological effects including persistent performance deficits on neuropsychological tests (Rosenstock et al., 1991; Ecobichon, 1994a,b; Steenland et al., 1994). Recent studies of subjects who experienced acute sarin poisoning in the Tokyo, Japan subway incident provide additional evidence that persistent subtle neurological deficits or changes may occur following acute high-level poisoning from cholinesterase-inhibiting chemicals (Murata et al., 1997; Yokoyama et al., 1998a,b). However, there are fewer data concerning persistent or long-term neurological effects from acute low-level exposures to cholinesterase inhibiting agents. Mice exposed to air concentrations of the organophosphate nerve agent, sarin, that did not produce obvious acute signs or symptoms of neurological damage[37] developed signs of peripheral neuropathy after exposure ceased, suggesting that obvious acute symptoms may not be a requirement for later developing neurological effects (Husain et al., 1993). Another study measured impairment in spatial learning in rats throughout a 21-day period following a 14-day treatment period with a potent organophosphate cholinesterase inhibitor at a dose that did not produce obvious signs of neurotoxicity (Prendergast et al., 1997).[38]

[34] Buchholz et al. (1997) reported that co-exposure of rats to pyridostigmine bromide and permethrin caused a 30% decrease in nervous tissue doses of permethrin compared with permethrin exposure alone, and concluded that their results do not support Abou-Donia's proposed mechanism.

[35] McCain et al. (1997) noted that to achieve the lowest doses used in the rat study, a person weighing 70 kg would have to simultaneously ingest 107 30-mg pyridostigmine bromide tablets, 23 six-ounce aerosol cans of 0.5% permethrin, and 6.6 two-ounce tubes of 33% DEET.

[36] Acute symptoms can include increased secretions, tremors, and mental confusion due to stimulation of cholinergic nerves in the central and peripheral nervous system.

[37] 5 mg/m^3, 20 minutes/day for 10 days.

[38] Rats were given subcutaneous injections of 0, 50, 250, or 500 µg diisopropylfluorophosphate/kg per day for 14 days (Prendergast et al., 1997). Diisopropylfluorophosphate is a potent organophosphate

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In contrast, a recent study found no symptoms of neurological effects in a group of rescue workers, one year after they were involved in a sarin incident in Matsumoto, Japan without experiencing acute symptoms of neurological effects (Nakajima et al., 1997).

Animal studies have indicated that physically-induced stress may disrupt the blood-brain barrier (Sharma et al., 1991; Friedman et al., 1996), thus leading to the hypothesis that war-related stress may have facilitated increased nervous system concentrations of pyridostigmine bromide and caused adverse acute neurological reactions that would not have occurred under non-stress conditions. In support of this hypothesis, Friedman et al. (1996) reported that, after mice were subjected to a stress-inducing forced-swim protocol, the dose of pyridostigmine bromide that was required to inhibit brain acetyl cholinesterase activity by 50% was reduced to less than 0.01 of the usual dose under non-stress conditions. Friedman et al. (1996) suggested that this hypothesis may partially explain the findings that acute symptoms of central nervous system dysfunction[39] were reported by more than 23% of 213 soldiers who took pyridostigmine under wartime conditions and were surveyed within 24 hours, whereas in a double-blind, placebo-controlled study under non-stressed conditions, about 8% of subjects given the same dose of pyridostigmine bromide reported similar acute symptoms. Whether or not stress-induced acute effects on the blood-brain barrier are related to subtle neurological changes observed in some Gulf War veterans with chronic non-specific symptoms of ill health remains unknown.

Numerous animal studies relevant to interactions between various neurotoxic Gulf War chemicals and other risk factors (such as stress and botulinum toxoid vaccination) are in progress or are being prepared for publication.[40] Given the extensiveness of this research effort, it appears that

inhibitor of acetylcholine esterase. The highest dose produced obvious signs of neurotoxicity (slowed movement, ataxia) that were not observed at the lower doses; at the two lower doses, subtle changes in behavior were noted during treatment. In rats from the two lower dose groups, cognitive function was assessed in a test of spatial learning at several intervals up to 21 days after treatment ceased; performance was impaired in rats treated with 250 µg/kg, but not in 50-µg/kg rats.

[39] Headaches, insomnia, drowsiness, nervousness, difficulties in focusing attention.

[40] These projects include: an examination of neurobehavioral variables in rats exposed to jet fuel vapor alone and in various combinations with insect repellent (DEET), pyridostigmine bromide, and periodic electric shock to induce stress (DoD research project #2; RWG, 1999); evaluation of neurobehavior and immune function variables in rats exposed to pyridostigmine bromide, permethrin, and DEET, alone or in combination (DoD research project #37; RWG, 1999); examination of possible delayed neurobehavioral and neuropathological effects in rats or monkeys following exposure to various cholinesterase inhibiting chemicals, alone or in various combinations or in combination with the administration of botulinum toxoid (DoD research projects # 54 and 61; RWG, 1999); examination of possible delayed respiratory and nervous system effects in guinea pigs and marmosets exposed to low-levels of sarin, with or without pretreatment with pyridostigmine (DoD research project #55; RWG, 1999); examination of possible delayed effects on neuromuscular and sensory systems in mice and hens exposed to low levels of sarin alone or in combination with pyridostigmine bromide (DoD research project #56; RWG,

additional animal studies currently are not needed, at least until research results from the ongoing studies can be evaluated.

Genetic Differences in Susceptibility to Environmental Agents

The Gulf War experience with and the clinical trials of the use of pyridostigmine bromide at the recommended dosage rate of 30 mg per 8 hours indicate that variable percentages of individuals experience acute symptoms of acetylcholinesterase inhibition including eye pain and headache, dizziness, runny nose, tightness in the chest, nausea, and/or abdominal cramps (Taylor, 1996; Keeler et al., 1991; Friedman et al., 1996). Keeler et al. (1991) reported that, during wartime use at this dose, the incidence of such "side effects" was around 1% and that about 0.1% of subjects experienced sufficiently severe effects to discontinue its use. Friedman et al. (1996) reported that in double-blind clinical trials with 35 healthy volunteers about 8% experienced acute symptoms of central nervous system dysfunction (e.g., headaches, insomnia, drowsiness, nervousness) and that, in studies with 213 soldiers under war-time conditions, similar symptoms were reported by about 24% of the subjects. In another report of the same study of 213 soldiers, Sharabi et al. (1991) noted that most individuals who experienced symptoms reported them as mild, but small percentages (3-10%) of subjects reported symptoms to be severe.

The underlying physiological, biochemical and/or genetic basis of why some individuals experience "side effects" from this pyridostigmine dosage rate is not understood and could vary from individual to individual. One hypothesis that is receiving some research attention is that differences among individuals in the level or the genotype of the blood serum enzyme, butyrylcholinesterase, may be responsible, at least in part, for differences among individuals in susceptibility to acute effects from nerve agents that inhibit cholinesterases. Butyrylcholinesterase is thought to provide a normal protective mechanism whereby nerve agents, including pyridostigmine and organophosphate nerve agents, are "scavenged" and detoxified by chemical interaction with the enzyme. In support of this hypothesis, Loewenstein-Lichtenstein et al. (1995) reported that an Israeli soldier, who had experienced severe acute symptoms after taking pyridostigmine during the Gulf War, was found to have an 'atypical' butyrylcholinesterase that had a low potential to interact with pyridostigmine. Other support comes from animal experiments showing that the intravenous administration of acetylcholinesterase from fetal bovine serum or butyrylcholinesterase from human serum allows animals to survive, without toxic effects or neurobehavioral deficits, short-term exposures to a variety of organophosphate nerve agents at levels well above those that are normally lethal (see Wolfe et al., 1992).

It is unknown if individuals who have low levels of serum butyrylcholinesterase or who have 'atypical' butyrylcholinesterase will experience, after acute exposure to pyridostigmine or other nerve agents, delayed neurological impairments that are not experienced by others with normal

1999); and examination of effects of low-level sarin, physical exercise, and pyridostigmine bromide on neurobehavioral, neurobiochemical, and neurophysiological variables in mice (DoD research project #62; RWG, 1999).

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levels of typical butyrylcholinesterase. An ongoing exploratory research program at the University of Nebraska Medical Center (DoD research project #60, RWG, 1999) is comparing serum levels and genotypes of butyrylcholinesterase in healthy Gulf War veterans and Gulf War veterans who report chronic symptoms of ill health to determine if there are correlations between butyrylcholinesterase levels or genotype and generic chronic health symptoms associated with Gulf War service. A related ongoing project at the East Orange VA Medical Center is comparing neurobehavioral, physiological and biochemical responses to pyridostigmine, alone or in combination with physically-induced stress, in two strains of rats that differ in inherent serum levels of butyrylcholinesterase (DVA research project #49; RWG, 1999). This project is also examining if the amount of pyridostigmine that reaches the brain is different in the two strains of rats under conditions of repeated physically-induced stress compared with non-stress conditions.

In another ongoing exploratory program (DoD research project #51; RWG, 1999), a group at the Hebrew University of Jerusalem is genetically engineering mice to overexpress various types of cholinesterases in nervous tissue in an effort to understand genetic differences in susceptibility to nerve agents and to identify particular cholinesterase genotypes with the greatest potential to protect against acute toxicity from organophosphate nerve agents. In addition, this group is examining DNA from human subjects who display hypersensitivity to anti-cholinesterase agents, such as pyridostigmine, organophosphate insecticides, and organophosphate warfare nerve agents, in search of particular gene sequences that may correlate with hypersensitivity.

Multiple Chemical Sensitivity in Gulf War Veterans

Multiple chemical sensitivity is a hard-to-characterize disorder occurring in a subset of the general population in which individuals typically report a wide array of recurrent symptoms of ill health in response to very low concentrations of chemicals in the environment. Symptoms reported include fatigue, depression, headaches, gastrointestinal problems, muscle and joint pain, irritability, and memory and concentration difficulties (Miller, 1994). The biomedical community has not agreed on a case definition for this disorder due to several difficulties including the unreliability of self-reported symptoms linking illness to chemical exposure, the diversity of reported symptoms and their overlap with other illness such as chronic fatigue syndrome, post-traumatic stress disorder, and fibromyalgia, and the lack of a widely agreed upon diagnostic physical finding or test (Sorg et al., 1998; Bell et al., 1998a). The disorder has been proposed to occur following either long-term, low-level exposure or short-term, high-level exposure to chemicals. The underlying physiological basis of the disorder is not known, but several psychological, immunological, and biochemical mechanisms have been proposed (Miller, 1992, 1994; Buchwald and Garrity, 1994; Sorg, 1998; Bell et al., 1998a).

Fiedler et al. (1996) hypothesized that exposure to one or a combination of environmental agents during Gulf War service may be a contributing factor to health complaints in veterans with unexplained illnesses and that there may be a higher than expected prevalence of chronic fatigue syndrome and multiple chemical sensitivities among Gulf War veterans. Leading to this hypothesis was the observation that the most frequently reported symptoms among Gulf War

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veterans with unexplained or undiagnosed illnesses in the DoD and DVA clinical programs[41] overlap with several of the required symptoms in the Center For Disease Control and Prevention's definition of chronic fatigue syndrome (fatigue, muscle/joint pain, headaches, and loss of memory; Fukuda et al., 1994), and are common in patients with multiple chemical sensitivities (Buchwald and Garrity, 1994).

A considerable prevalence of self-reported fatiguing illness and chemical sensitivities was found in a preliminary study that administered a questionnaire to a group of 432 Gulf War veterans who registered in the DVA Persian Gulf Health Registry; 203 previously listed fatigue as a medical complaint and 228 did not (Fiedler et al., 1996). Among those who initially reported fatigue and responded to the questionnaire: 89% reported that the fatiguing illness began in 1991 or 1992; 7% reported adopting three or more avoidance behaviors based on chemical sensitivities[42]; and 33% and 20% considered themselves especially sensitive to car exhaust and perfume, respectively. Among respondents who did not initially report fatigue, 63% reported developing fatiguing illness and 30% considered themselves sensitive to certain chemicals with 19% sensitive to car exhaust and 11% to perfume. A more extensive survey of 2800 registrants in the DVA Persian Gulf Health Registry is being conducted by this research group (DVA research project #5A; RWG, 1999). Ongoing analyses of these data (which include self-reported environmental exposures to chemicals) are examining potential associations among symptoms to define one or more case definitions of Gulf War unexplained illnesses and potential associations between environmental risk factors and symptoms.

In a small-scale telephone survey study, a statistically significant increased percentage of subjects who considered themselves especially sensitive to certain chemicals was found in ill Gulf-deployed veterans (12/14 subjects or 86%) compared with healthy Gulf-deployed veterans (3/10 or 30%), but not in ill non-deployed veterans (4/7 or 57%) compared with healthy non-deployed veterans (3/10 or 30%) (Bell et al. 1998b).

Although these studies (Fiedler et al., 1996; Bell et al., 1998b) suggest that chronic fatigue and chemical sensitivities are present among Gulf War veterans, they do not quantify the prevalence of these conditions among all Gulf War veterans because either the studied subjects do not represent a suitably large random sample of U.S. Gulf War veterans (both studies) or a control (non-deployed) group is not included. The importance of a control group to assess whether there is an increased prevalence of chemical sensitivities among Gulf War veterans is emphasized by results of past questionnaire studies of self-reported chemical sensitivity in other groups of people[43]

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[41] Fatigue, headache, memory problems, sleep disturbances, skin rash, joint pain, and shortness of breath.

[42] For example, following a special diet, wearing special clothes, taking special precautions in selecting home furnishings because of chemical sensitivities.

[43] Including college students, a rural population, office workers, and elderly WWII veterans.

showing that approximately 30% of subjects responded positively when questioned if they have chemical sensitivity and that only about 4-6% report chemical sensitivities severe enough to prompt drastic changes in their lifestyle (see Bell et al., 1998a,b). Although a larger scale study with a suitable questionnaire given to larger numbers of subjects representing random samples of all Gulf War veterans and non-deployed veterans from the same era may provide better information concerning prevalence of multiple chemical sensitivity, the lack of understanding of the neuropsychological and physiological basis of the condition itself may represent a more important problem to address with more research.

Research efforts to better understand physiological and neuropsychological characteristics in veterans reporting chronic fatigue and chemical sensitivities are ongoing at the East Orange, Tucson, and Boston VA Medical Centers, at Georgetown University (in collaboration with the Washington VA Medical Center), and at the University of Medicine and Dentistry of New Jersey. In general, it is believed that this research may lead to a better basis for proposing new methods of diagnosis and treatment of Gulf War veterans with unexplained chronic symptoms including chemical sensitivity.

- At the East Orange Center, healthy veterans and veterans with chronic fatigue and/or chemical sensitivities have received comprehensive medical evaluations[44] and the results are being compared with civilians with chronic fatigue syndrome and/or chemical sensitivities (DVA research project #5B; RWG, 1999). A related research project is ongoing in which the effects[45] of short-term exposure to 5 ppm diesel exhaust and aerobic exercise are being compared in healthy veterans and veterans with chronic fatigue syndrome and/or chemical sensitivities (DVA research project #5C; RWG, 1998, 1999).
- At the Tucson Center, several physiological and neuropsychological variables[46] will be measured in several groups of veterans following repeated exposure to controlled concentrations of jet fuel vapor or air (DVA research project #48; RWG, 1999). Subjects will include groups of ill Gulf War veterans with or without chemical sensitivity, healthy Gulf War veterans without chemical sensitivity, and healthy, non-deployed veterans of the Gulf War era.
- At the Boston Center, in-depth neuropsychological evaluations that will diagnose multiple chemical sensitivity, chronic fatigue syndrome, post-traumatic stress disorder, and other related disorders have been given to groups of treatment-seeking Gulf War veterans and

[44] Included were evaluations for viral infections and immune dysfunction, tests of neuropsychological variables, and tests of physiological responses to physical and cognitive challenges.

[45] Endpoints evaluated include self-reported symptoms, physiological responses such as heart rate and blood pressure, and performance in tests of cognitive ability.

[46] Endpoints will include blood pressure, heart rate, eyeblink and performance in tests of cognitive ability.

non-deployed veterans and groups of non-treatment seeking veterans (DoD research project #32; RWG, 1999). Analysis of collected data for over 300 subjects is ongoing and expected to have the potential to reveal differences between treatment-seeking deployed and non-deployed Gulf War-era veterans. A short questionnaire to identify multiple chemical sensitivity also has been developed (DoD research project #52; RWG, 1999). This will be used to compare prevalence of chemical sensitivities in female and male members of a cohort of Gulf War veterans and explore risk factors for the development of this condition.

- At Georgetown University (in collaboration with the Washington VA Center), physiologic and biochemical variables[47] have been measured in Gulf War veterans with unexplained chronic symptoms, in civilian patients with chronic fatigue syndrome or fibromyalgia, and in healthy controls (DoD research project #31; RWG, 1999).
- At the University of Medicine and Dentistry of New Jersey, the persistence of self-reported symptoms over time will be evaluated in a group of Gulf War veterans (DHHS research project #6; RWG, 1999). In addition, working definitions for multiple symptom illnesses, such as chronic fatigue syndrome and multiple chemical sensitivity, will be compared with alternative definitions as descriptors of unexplained illnesses in Gulf War veterans.

Treatment of Gulf War Veterans with Non-specific Chronic Symptoms of Ill Health

The DoD's Gulf War Health Center has a *Specialized Care Program* for people with persistent, non-specific symptoms associated with Gulf War service (Engel et al., 1998). This program is a 3-week outpatient treatment program involving three multidisciplinary teams of caregivers: a medical team, a physical team, and a psychosocial team. The program involves medical evaluations, exercise programs, therapy programs (e.g., physical, occupational, and recreational), and counseling. Patients are referred to this program after being evaluated in the DoD's Comprehensive Clinical Evaluation Program. A meta-analysis of studies of these types of programs for patients with chronic pain suggests they are useful in improving pain and mood, facilitating returning to work, and decreasing utilization of health care systems (Flor et al., 1992).

The DVA and DoD have established a 2-year, multiple-site, randomized control trial (starting in 1999 and ending in 2001) to compare treatment methods for U.S. Gulf War veterans who have unexplained chronic symptoms of pain, fatigue, and/or cognitive difficulties (DVA/DoD research project # 1D & 1V; RWG, 1999). Patients will be Gulf War veterans who are chronically experiencing at least two of the following self-reported symptoms: 1) fatigue that limits work, recreational, or social activity; 2) musculoskeletal pain in two or more body regions; and 3)

[47] Variables include qualitative measures of general health symptoms, quantitative measures of pain and muscle motility, heart rate variability, levels of neurohormones in response to stress, and levels of neurotransmitters in cerebral spinal fluid.

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difficulties in memory, concentration, or attention. The program will evaluate 339 randomly assigned patients in each of four treatment groups[48]: 1) "usual and customary care" (the control group); 2) cognitive behavioral therapy[49] plus usual and customary care; 3) aerobic exercise plus usual and customary care; and 4) cognitive behavioral therapy, plus aerobic exercise, and usual and customary care. Treatment will be in a group format and will last for 3 months (one hourly session per week for 12 weeks). Patients will be evaluated for physical function before and immediately after the end of treatment and at 6 and 12 months after start of treatment.

Limited research has investigated the possibility that some veterans with non-specific chronic symptoms may be infected with microorganisms that are difficult to detect and that treatment with antibiotics may be useful in alleviating symptoms (Nicolson and Nicolson, 1996; Nicolson et al., 1998; Nicolson, 1998; Hyman; 1996; See Appendix C for study details). Nicolson and Nicolson (1996) reported that mycoplasma gene sequences were detected in blood leukocytes from 14 subjects in a group of 30 Gulf War veterans with chronic symptoms similar to those associated with chronic fatigue syndrome and that 11/14 of these subjects recovered after multiple treatment cycles of antibiotics (doxycycline or ciprofloxacin). Nicolson et al. (1998) also reported that mycoplasma gene sequences were detected in blood leukocytes of 76 subjects in a group of 170 subjects comprised of Gulf War veterans with chronic-fatigue-syndrome-like symptoms and their immediate family members. Among 73 mycoplasma-positive subjects who received two to six 6-week cycles of antibiotic therapy (doxycycline, ciprofloxacin or azithromycin), 58 were reported to have recovered. Hyman (1996) reported detecting streptococcal bacteria remnants in urine of about ten Gulf War veterans who had chronic-fatigue-syndrome/fibromyalgia-like symptoms (and their immediate family members); treatment with antibiotics was reported to improve the health of the subjects initially, but most relapsed. Limitations of these studies include the lack of blind testing of the specimens, the lack of appropriate control groups, and the lack of investigation of a possible placebo effect (i.e., the lack of blinding of the subjects).

Further research is ongoing regarding the antibiotic treatment of Gulf War veterans with non-specific, chronic symptoms such as fatigue, difficulty concentrating, joint and muscle pain, and headache. The DVA has recently established a multiple-site, 30-month, double-blind clinical trial of antibiotic treatment of symptomatic patients with positive findings for mycoplasma infection (DVA research project # 55; RWG, 1999). The trial (to be conducted between 1999 and 2001) will identify 450 Gulf War veterans who are experiencing at least two of three chronic symptoms (fatigue, musculoskeletal pain, and neurocognitive dysfunction) and who are mycoplasma-positive. Subjects will be randomly assigned to 12-month treatments with either 300 mg

[48] A total of 1356 patients.

[49] Cognitive Behavioral Therapy is a set of techniques that are based on psychological principles of behavioral conditioning (e.g., positive and negative reinforcement) and observational learning and are administered, with active patient participation, by a clinician trained in behavioral medicine. These techniques have been used in the treatment of physical problems such as low back pain, headaches, fibromyalgia (muscle pain), chronic fatigue, asthma, and arthritis (RWG, 1999).

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doxycycline per day or placebo. Patients will be seen monthly during the medication phase and at 18 months. Physical function will be evaluated before treatment starts, and at 3, 6, 9, 12 and 18 months. Patients will also complete questionnaires designed to provide measures of pain, fatigue, and neurocognitive dysfunction.

Another project, funded by the DoD and conducted by the Louisiana Medical Foundation, involves blinded and placebo-controlled clinical trials of antibiotic treatment of patients who are experiencing chronic non-specific symptoms and who show bacterial remnants in their urine (DoD research project # 67; RWG, 1998; 1999). This trial is expected to be completed in 1999.

6. Concluding Remarks

During the upcoming two-and-a-half day conference, participants from various disciplines will meet several times in workgroups with the goal of discussing and recommending research in one of four focus areas related to illnesses among Gulf War veterans:

- Workgroup 1: Pathophysiology, Etiology, and Mechanisms of Action;
- Workgroup 2: Assessment/Diagnosis;
- Workgroup 3: Treatment; and
- Workgroup 4: Prevention.

A central question to be addressed by Workgroup 1 is: What are the most plausible etiological hypotheses concerning 1) diagnosed diseases and 2) unexplained multiple-symptom illnesses noted among Gulf War veterans? Associated questions include: Are ongoing research projects addressing the most plausible of these hypotheses? If not, which additional plausible hypotheses should be addressed? Are there research methods or approaches that need to be developed, or that are available and not being used? The Gulf War experience has created interest in the health effects of particular chemical agents, such as depleted uranium, organophosphate chemical warfare nerve agents, carbamate prophylatic agents against organophosphate nerve agents, vaccines, and organophosphate pesticides. This interest leads to additional questions within the focus of Workgroup 1. Should additional research resources be applied to better understand exposure-response relationships for, mechanisms of actions of, individual susceptibility to, and/or biomarkers of exposure to specific chemical agents or classes of agents associated with the Gulf War experience? Are current research efforts to examine potential interactions among "Gulf war mixtures" of chemicals and other health risk factors of sufficient scope and design? What alternative research approaches could be taken to decrease the uncertainty that will exist in any future attempts to extrapolate results from the animal "mixtures" experiments to expected human exposure scenarios? Should such research efforts be made?

Results from several epidemiological studies concur that Gulf War veterans more frequently report multiple symptoms of ill health than non-deployed veterans of the same era and that there may be an increased frequency of chronic, multi-systemic conditions of ill health among groups of Gulf War veterans. The array of reported symptoms are, in general, difficult to diagnose into a disease category. The most frequently reported chronic symptoms among Gulf War veterans with

unexplained or undiagnosed illnesses in the DoD and DVA clinical programs (fatigue, headache, memory problems, sleep disturbances, skin rash, joint pain, and shortness of breath) and in epidemiology studies appear to overlap with several of the symptoms in other symptom-based disorders including chronic fatigue syndrome, fibromyalgia, and multiple chemical sensitivity. Using factor analysis to examine associations among self-reported symptoms in different sets of Gulf War veterans, one group of investigators proposed that there might be unique disorders among Gulf War veterans (Haley et al., 1997a,b; Haley and Kurt, 1997), whereas other groups concluded that evidence for a unique Gulf War syndrome was not found when control groups were included in the analysis (Fukuda et al., 1998; Ismail et al., 1999). These results are within the focus of Workgroup 2 and lead to several questions related to the goal of recommending research on the assessment and diagnosis of illnesses among Gulf War veterans. Are ongoing efforts to assess the prevalence of these and other illnesses among Gulf war veterans of sufficient scope and design? What are the best or optimal research approaches and methods to apply to the question of whether or not there are unique health conditions among Gulf War veterans? (i.e., are there Gulf War syndromes?) Are ongoing projects using these approaches and methods to address the issues of assessing and diagnosing illnesses among Gulf War veterans? Are there particular clinical and/or research methods or approaches that need further development or validation before they can be used to assess or diagnose illnesses among Gulf War veterans? Which of these methods or approaches hold the greatest promise in increasing the efficiency and accuracy of assessing and diagnosing illnesses among Gulf War veterans or veterans of future wars?

In response to the wide diversity of illnesses and symptoms experienced by Gulf War veterans and the uncertainty of their cause, several reviewers (Engel et al., 1998; Joseph et al., 1998; Lashof and Cassells, 1998) have noted that treatment should proceed on an individual basis and is best addressed when objective clinical measures of distinct illness can be made and that, in the absence of such measures, multidisciplinary treatment of symptoms may be effective. Questions of relevance to the focus of Workgroup 3 include: What are likely to be the most appropriate treatment and/or rehabilitation approaches for 1) veterans with the most frequently diagnosed categories of diseases and 2) veterans with unexplained multiple-symptom illnesses? Are ongoing clinical trials of treatment options (e.g., antibiotic treatment trials and multidisciplinary treatment trials) of appropriate scope, size, and design? Are there other potentially useful treatment approaches or methods that need more basic research before development? Is there a need to educate physicians concerning options in treating Gulf War veterans with illnesses? Are there sufficient health care opportunities for Gulf War veterans?

Joseph et al. (1988) have noted that the DoD has recognized recommendations from various scientific review panels and government agency groups of the need for improved health surveillance programs for military personnel before, during, and after deployment to combat situations, in order to decrease uncertainties regarding chronic, post-deployment health consequences. Components of the surveillance programs include enhancing capabilities of identifying individuals with health risks, conducting standardized health assessments before and after deployment, assessing and documenting exposures to hazardous substances through

environmental monitoring and/or biomonitoring, and monitoring health status of personnel after deployment (Joseph et al., 1988). Questions related to the focus of Workgroup 4, Prevention, include: How can health surveillance programs for U.S. military personnel be improved to decrease uncertainties about post-deployment health consequences? What types of health risk communication and education programs will be useful to prevent or minimize exposure to the most likely chemical and biological health hazards in future conflicts? What techniques or methods of environmental monitoring or biomonitoring are likely to be most useful in helping to prevent or minimize exposure to chemical or biological agents in future conflicts? Which of these require further research and development? What prophylactic methods are available against the most likely chemical and biological health hazards to be encountered in future conflicts? Which of these require further research and development?

Workgroups will meet for discussion and deliberation during four sessions of 2- to 3-hour duration. Final reports and recommendations from each Workgroup will be presented to the conference at large prior to adjournment.

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Appendix B: Exposure to Chemicals During the Gulf War

Chemical Warfare Agents

At the time of the Gulf War, the Iraqi forces had an experimental chemical weapons program and also had chemical munitions available for use in the field. United Nations Special Commission investigations indicated that chemical agents in the Iraqi chemical weapons program included sulfur mustard (a blistering agent), sarin, and VX (IOM, 1996b). Iraq was also assumed to have available the nerve agents, cyclosarin, soman, and tabun (CIA, 1997). The Iraqi's possession of munitions with nerve agents was well known. For example, in 1992, a U.K. newspaper, the Independent, reported that a United Nations demolition team announced they would destroy 400 sarin-filled, 122 mm rockets that were located at a large Iraqi weapons storage bunker, at Khamisiyah 25 miles north of Basra (Independent, 1992). It was reported that the bunker was damaged due to earlier Allied bombing raids and that it was necessary to blow up the rockets at the site because they were leaking.

In 1994, the U.S. Senate Committee on Banking, Housing, and Urban Affairs issued a report expressing the belief that there was "reliable evidence that U.S. forces were exposed to chemical and possibly biological agents" (U.S. Senate, 1994a). However, the 1994 National Institute of Health Technology Assessment Workshop report indicated that evidence of exposure to chemical warfare agents was controversial and drew no conclusions (NIH, 1994a,b). The Defense Science Board concluded that there was "no scientific or medical evidence" to indicate that U.S. troops in Kuwait or Saudi Arabia were exposed to chemical or biological warfare agents (DSB, 1994). In 1996, the Institute of Medicine (IOM, 1996b) indicated that there was no credible evidence that chemical weapons were used by Iraq in the Gulf War, noted that serious concerns persisted among veterans and some investigators that significant exposure to chemical agents may have occurred in non-combat situations, and pointed out that their committee had not had the opportunity to review evidence that troops may have been exposed to chemical agents during destruction of an Iraqi munitions bunker in March, 1991.

In response to inquiries from the Presidential Advisory Committee on Gulf War Veterans' Illnesses, the DoD announced in June 1996 that: chemical warfare agents had been known to be present at Iraqi weapons-storage sites at Khamisiyah, Iraq; that some of these sites were demolished by U.S. troops in March, 1991; and that troops in the vicinity may have experienced low-level exposure to chemical warfare nerve agents during the demolition events (PAC, 1996b; CIA, 1997; DoD, 1997a). The CIA (1997) acknowledged, based on information from United Nations Special Commission inspectors, that chemical warfare agents (sarin and cyclosarin) were likely present in at least two U.S. demolition events at Iraqi ammunition storage sites in the Khamisiyah area: one (Bunker 73) on March 4, 1991 and the other ("the pit") on March 10, 1991 (DoD, 1997a). DoD (1997a) noted that there was evidence that another demolition event occurred at "the pit" on March 12, 1991. In addition, chemical weapons storage sites at Muhammadiyat, and Al Muthanna, Iraq (northwest of Baghdad) were destroyed by Allied

bombing at the beginning of the Gulf War creating a potential risk of exposure for troops located 400-500 km south of the sites (RWG, 1997).

Because air monitoring data are not available for these events, models were developed, based on the limited amount of data available concerning the amount of nerve agent that may have existed at the Khamisiyah sites, to calculate estimates of ground level concentrations of nerve agents (sarin/cyclosarin) as a function of distance and direction away from detonation sites for the March 4 and 10, 1991 events (PAC, 1996b; CIA and DoD, 1997). Modeling results, as of October, 1996, indicated that exposure levels in the explosion plume within 25 kilometers of the demolition site may have been sufficient to cause runny nose, tightness in the chest and dimness of vision (CIA and DoD, 1997), but the U.S. Army Medical Corps reported to the PAC (1996b) that signs and symptoms characteristic of exposure to nerve agents such as sarin and soman were not seen by medical personnel during the Gulf War (PAC, 1996b), and no reports of distinct acute neurological poisonings during the March 1991 Khamisiyah demolitions were located. Efforts to decrease the uncertainty in the modeling efforts are ongoing (CIA and DoD, 1997). The PAC (1996b) concluded that evidence of chemical warfare agent release at Khamisiyah "is overwhelming" and that "low-level exposure to troops within a 50-km radius should be presumed while efforts to develop more precise measures of exposure and more detailed knowledge of the demolition activities continue."

Beginning in August 1996, DoD notified approximately 20,000 individuals (those expected to have been within a 50-km radius of the Khamisiyah demolition sites) that they could have been exposed to low-levels of chemical warfare agents (DoD, 1997a; PAC, 1997). Surveys were mailed to these individuals concerning health symptoms that they recollected experiencing; the CIA and DoD (1997) reported that 7,400 responses were received and that 99 percent of responses indicated "no physical effects that could be correlated with exposure to sarin". The PAC (1997) recommended that DoD should contact all individuals within a 300-mile radius of the Khamisiyah "pit", notifying them if they are, or are not, expected to have been under the plume of the Khamisiyah demolition events.

The DoD has publicly released case narratives of investigations of numerous events of possible chemical warfare agent exposures during the Gulf War period. These include:

- Czech and French detections of nerve gas and blister agents in January 1991 in the vicinities of Hafar al Batin and King Khalid Military City (DoD, 1998a),
- chemical-agent detections by a Fox vehicle in an ammunition supply point in an orchard southwest of Kuwait City in February 1991 (DoD, 1997b),
- reports of loud-noise, SCUD missile impacts, and "noxious" cloud events in the Al Jubayl, Saudi Arabia region on several dates between January and March, 1991 (DoD, 1997c),
- several instances of suspected chemical warfare use during combat to retake Kuwaiti Air Base in Al Jaber in February, 1991 (DoD, 1997d),
- multiple (18) chemical-alarm alerts reported by the 11th Marines over a 42-day period between January 17 and February 27, 1991 (DoD, 1998b),

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- reports of chemical weapon (mustard) storage at the Iraqi An Naisiriyah Southwest ammunition storage point, a site at which U.S. carried out demolition operations in March and April 1991(DoD, 1998c), and
- development of skin burns on a U.S. Army Sergeant after performing reconnaissance in an Iraqi bunker in March, 1991 (DoD, 1997e).

DoD investigators reached conclusions (noted as interim) regarding the possibility of exposure during these events that ranged from "definitely not" (Al Jubayl events; Al Jaber Air Base) to "likely" (Army Sergeant with mustard agent burns). Several events were assigned an "unlikely" assessment (11th Marine events; An Naisiriyah ammunition storage point; Fox detections in orchard). No narrative assigned the "definite" category of exposure assessment. The PAC (1997) recommended that an entity other than the DoD should provide oversight of investigations about possible chemical warfare agent exposures. The Presidential Special Oversight Board has been established to accomplish such a role (PSOB, 1998).

The PAC (1996a, 1997) noted that chemical-warfare-agent detectors used by the U.S. during the Gulf War period (e.g., M8A1 chemical agent alarms, Fox vehicles with MM-1 mass spectrometers, and other detectors) could detect nerve gas agents only at concentrations that would cause acute lethal or near-lethal poisonings and not at low levels that might have subclinical health significance. The principal battlefield detector (M8A1) could not detect mustard agent and was so non-specific in its detection that it was often ignored during the war. The PAC (1997) recommended that DoD support the development of new detectors for "low-level, subclinical exposures" to chemical warfare agents.

After review of information, data, and modeling calculations available for Khamisiyah and other sites, as well as DoD's case narratives and information papers on the potential exposure of troops to chemical agents, the Senate's Special Investigation Unit concluded that there was insufficient evidence to prove or disprove that there was an actual low-level exposure of any troops to chemical weapon nerve agents or that any of the health effects some veterans are experiencing were caused by such exposure (U.S. Senate, 1998).

Pyridostigmine Bromide

Pyridostigmine is an anti-nerve agent (a carbamate molecule) that binds reversibly at sites of the important nerve enzymes (cholinesterases) that are irreversibly bound by organophosphate nerve agents such as sarin. At suitable dosage levels, the binding of carbamates or organophosphates to cholinesterases causes an overstimulation of cholinergic nerves in the peripheral and central nervous systems. Pyridostigmine is expected to provide protection against severe acute organophosphate poisoning when given before exposure to organophosphate agents, based on results from animal experiments showing that pyridostigmine pretreatment coupled with post-exposure treatment with atropine and pralidoxime chloride increased survival after exposure to lethal concentrations of the nerve agent, soman (Harris et al., 1984; Dirnhuber et al., 1979). The reversible binding of pyridostigmine is thought to temporarily protect the enzymes from

permanent damage that can be caused by irreversibly binding organophosphate nerve agents (Glikson et al., 1991; Taylor, 1996).

Prior to the Gulf War, the U.S. Food and Drug Administration (FDA) had approved the use of this drug for the treatment of myasthenia gravis, an autoimmune disease characterized by muscle weakness, but had not approved its repeated use as a pretreatment, protective therapy against organophosphate nerve agents in healthy subjects (U.S. Senate, 1994b). FDA regulations require obtaining an informed consent agreement from any individual who might use such an "investigational new drug". In 1990, the DoD requested that FDA waive its informed consent requirement for pyridostigmine, and, in January 1991, the FDA Commissioner agreed to waive informed consent due to the lack of an alternative satisfactory therapy against organophosphate nerve agents and the infeasibility of obtaining informed consent agreements under combat conditions (Annas, 1992; U.S. Senate, 1994b).

Although results from animal studies indicate that pretreatment with pyridostigmine is effective at decreasing lethality from certain organophosphate nerve agents (Dirnhuber et al., 1979; Harris et al., 1984), excessive doses of pyridostigmine are expected to cause some of the same acute toxic effects that are produced by organophosphate nerve agents due to stimulation of peripheral cholinergic nerves (Taylor, 1996). Studies with rhesus monkeys, however, showed that exposure to pyridostigmine at exposure levels that produced 70-80% inhibition of blood cholinesterase did not significantly affect performance in neurobehavioral tests, whereas exposure to the organophosphate agent, soman, at levels that produced similar blood cholinesterase inhibition, produced severe behavioral toxicity (Blick et al., 1994). These results suggest that the potency of pyridostigmine to affect the central nervous system is much less than the potency of organophosphate nerve agents. Recent results from rodent studies indicate that pyridostigmine pretreatment may not be equally effective at protecting against the lethality of all organophosphate nerve agents. Koplovitz et al. (1992) reported that pretreatment of mice or guinea pigs with pyridostigmine increased the efficacy of treatment with atropine and pralidoxime chloride after exposure to the organophosphate nerve agent, tabun, but with exposure to other organophosphate agents (sarin and VX), the efficacy of atropine and pralidoxime chloride treatment was decreased by pyridostigmine pretreatment.

DoD reported that all U.S. troops were supplied with pyridostigmine bromide pills, and that approximately 250,000 personnel took at least some pyridostigmine during the Gulf War (PAC, 1996b). During the Gulf War, pyridostigmine was to be used at the commanding officer's judgement and was to be self-administered by individuals in 30-mg doses three times daily (U.S. Senate, 1998). At the recommended dosage levels, acute, transient "side effects" from pyridostigmine appear to be mild in most individuals who report experiencing them. Reports from U.S. medical personnel providing care to 41,650 U.S. soldiers who took the recommended dosage for 1 to 7 days in January 1991 indicated that about 50% experienced gastrointestinal symptoms, 5-30% experienced urinary urgency and frequency, <5% experienced headaches, runny nose or tingling of the extremities, 1% (483 soldiers) required clinical visitation, and <1% (28 soldiers) had to discontinue use due to severe acute reactions (Keeler et al., 1991).

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There is evidence that stress may enhance the acute adverse effects from pyridostigmine treatment. Symptoms of central nervous system dysfunction (e.g., headaches, insomnia, drowsiness, nervousness, difficulties in focusing attention) were reported by about 24% of 213 soldiers who took pyridostigmine under wartime conditions and were surveyed within 24 hours, whereas in a double-blind, placebo-controlled study under non-stressed conditions, about 8% of subjects given the same dose of pyridostigmine bromide reported similar symptoms (Friedman et al., 1996). Friedman et al. (1996) hypothesized that stress may disrupt the blood-brain barrier in some manner, allowing greater quantities of pyridostigmine to enter the brain compared with quantities that enter under non-stress conditions.

At dosage levels used for organophosphate nerve agent protection, limited testing has suggested that the short-term use of pyridostigmine may not have delayed or chronic neurological effects. As noted above, pyridostigmine has been used widely for decades in the treatment of the autoimmune disease, myasthenia gravis. The muscle weakness and fatigue associated with this disease is due to an autoimmune reaction with the acetyl choline receptor in neuromuscular nerve junctions (Drachman, 1994; Taylor, 1996). In these diseased subjects, the ability of pyridostigmine to reversibly inhibit acetylcholinesterases is thought to sufficiently increase endogenous concentrations of acetyl choline so that the abnormally low numbers of functional acetyl choline receptors are stimulated and muscle function is improved. No reports were found of chronic neurological or psychological effects in myasthenia gravis patients chronically treated with pyridostigmine bromide. Animal studies have reported changes in structure, ultrastructure and electrophysiological properties of neuromuscular synapses after repeated exposures to carbamates similar in structure and activity to pyridostigmine (Engel et al., 1973; Hudson et al., 1978; Tiedt et al., 1978), but a double-blind, placebo-controlled study found no evidence for adverse effects in extensive tests of neuromuscular function in 35 healthy human volunteers who took 30 mg pyridostigmine bromide, three times a day for up to 8 days (Glikson et al., 1991). In a study of 4 human volunteers who took 30 mg pyridostigmine bromide every 8 hours for 3 days, Borland (1985) reported that no drug-induced changes in electrical activity of the brain were detected and that acute reversible changes were noted in tests of visual motor coordination. The motor coordination changes were noted as minimal.

Biological Warfare Agents

At the time of the Gulf War, the Iraqi forces had experimental biological weapons programs and also had biological munitions available for use in the field. United Nations Special Commission investigations indicated that biological agents in the Iraqi biological-weapons program included botulinum toxin, anthrax, aflatoxin, ricin, mycotoxins, hemorrhagic conjunctivitis virus, rotavirus, and wheat cover smut (IOM, 1996b). During the Gulf War, biological warfare agent field detectors were relatively primitive and could not be relied upon to accurately detect exposure in a timely fashion. U.S. Army hospital admission records identified one admission for anthrax, a disease indigenous to the Gulf region (PAC, 1996b; U.S. Senate, 1998).

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Recent review panels (U.S. Senate, 1998; PAC, 1996b, 1997) have concluded that biological warfare agents were not likely used during the Gulf War because: there is no evidence to date from intelligence agencies that indicates their use; there were no verified detections of anthrax or botulinum toxin during the war; and examination of Iraqi soil samples and enzyme assays by U.S. laboratories did not find evidence of the presence of biological warfare agents.

As discussed previously, the Presidential Advisory Committee further recommended that, "To ensure credibility and thoroughness, further investigation of possible chemical or biological warfare agent exposures during the Gulf War should be conducted by a group independent of DoD." (PAC, 1996b, 1997). The Presidential Special Oversight Board has been established to accomplish such a role (PSOB, 1998).

Infectious Diseases

Many infectious diseases are prevalent in southwest Asia including, but not limited to, agents that cause diarrhea, leishmaniasis, sandfly fever, and malaria. DoD medical personnel monitored troops for the preceding diseases as well as for dengue fever, Sindbis, West Nile fever, Rift Valley fever, and Congo-Crimean hemorrhagic fever, and took measures to prevent illness from endemic diseases (Hyams et al., 1995; PAC, 1996b).

During the Gulf War, infectious diseases were not a significant problem; diarrhea was the most commonly reported condition. Occurrence of diarrhea was 4% per week early in the deployment and declined to <0.5% per week after controls on food sources were imposed (Hyams et al., 1995). Although sand fly fever had been a concern, no cases were found during the war (Hyams et al., 1995). Seven individuals with malaria were diagnosed, one individual had West Nile fever, and one death occurred from meningococcal meningitis (Hyams et al., 1995).

A small number of cases of leishmaniasis (a chronic disease transmitted, like sand fly fever, by the bite of the sand fly) has been diagnosed among U.S. Gulf War veterans: 12 cases of viscerotropic leishmaniasis and 19 cases of cutaneous leishmaniasis (PGVCB, 1995). Most of these cases have displayed objective signs of the chronic disease: elevated temperatures, lymphadenopathy, and hepatosplenomegaly (Magill et al., 1993). The PAC (1996b) arrived at the conclusion that it is unlikely that infectious diseases endemic to the Gulf are responsible for long-term health effects most frequently reported by Gulf War veterans.

Infections by mycoplasma species, microsporidia, and streptococcal bacteria have been hypothesized as possible explanations for illnesses noted in some Gulf War veterans. Nicolson and Nicolson (1996) reported that mycoplasma gene sequences were detected in blood leukocytes from 14 subjects in a group of 30 Gulf War veterans with chronic symptoms similar to those associated with chronic fatigue syndrome and that 11/14 of these subjects recovered after multiple treatment cycles of antibiotics (doxycycline or ciprofloxacin). Nicolson et al. (1998) also reported that mycoplasma gene sequences were detected in blood leukocytes of 76 subjects in a group of 170 subjects comprised of Gulf War veterans with chronic-fatigue-syndrome-like symptoms and

their immediate family members. Among 73 mycoplasma-positive subjects who received two to six 6-week cycles of antibiotic therapy (doxycycline, ciprofloxacin or azithromycin), 58 were reported to have recovered. Hyman (1996) reported the detection of streptococcal bacteria remnants in urine of about ten Gulf War veterans who had chronic-fatigue-syndrome/fibromyalgia-like symptoms (and their immediate family members); treatment with antibiotics was reported to improve the health of the subjects initially, but most relapsed. An initial DVA report of finding microsporidia in stool specimens of some Gulf War veterans was not confirmed with subsequent examinations of stool and gastrointestinal biopsy material (PAC, 1996b) or in CDC examinations of stool specimens from Gulf War veterans in Air Force units from Pennsylvania and Florida (Fukuda et al., 1998). In 1996, the PAC (1996b) expressed the belief that it was unlikely that these three infectious agents "are responsible for widespread disease among Gulf war veterans or their families."

Immunizations

Seven vaccines (polio, diphtheria-tetanus, adenovirus 4 and 7, meningococcus A, CYW135, influenza, and measles-rubella) are administered to U.S. Army recruits during basic training, and others are administered upon deployment to high risk areas (hepatitis A and B, yellow fever, Japanese encephalitis, plague, rabies, and cholera) (IOM, 1996b). DoD reported to the PAC (1996b) that approximately 150,000 Gulf deployed personnel received at least one anthrax vaccination and about 8,000 personnel received at least one dose of botulinum toxoid vaccine, but adequate records to document which troops received the anthrax and botulinum toxoid vaccines were not available.

The anthrax vaccine, licensed by FDA since 1970, produces injection site reactions (e.g., swelling, tenderness) in about 6% of recipients (IOM, 1996b). The botulinum toxoid vaccine, which has been assigned an "investigational" status by the FDA and has been used as an investigational vaccine to protect high-risk laboratory workers, consists of five types of toxins (from *Clostridium botulinum*) that are converted to a "toxoid" status by reaction with formalin (IOM, 1996b). Annas (1992) has noted that the use of the vaccine in laboratory workers was discontinued in the mid-1970s before sufficient data on safety and efficacy had been collected for licensing purposes. The experience of the U.S. Army Medical Research Institute of Infectious Diseases with the botulinum toxoid vaccine indicates that transient reactions include pain, redness, and swelling at the injection site in about 10% of recipients, and headache, myalgia, fever, and malaise in about 3% (IOM, 1996b). Given the possibility that Iraq might use botulinum toxin as a biological weapon, the DoD had requested, in 1990, that FDA waive informed consent requirements for the use of a botulinum toxoid vaccine; this request was granted by the FDA in 1991 noting that obtaining informed consent agreements was not feasible under combat conditions (U.S. Senate, 1994b). Annas (1992) reported that the DoD sent a letter to the FDA noting that, during the Gulf War, the military command decided to administer the botulinum toxoid vaccine on a voluntary basis.

Depleted Uranium (DU)

DU, a byproduct of uranium refinement, is a very dense material that is used to increase the penetration capability of antitank munitions and as a protective shield on tanks against enemy fire (DoD, 1998d). The major toxicity of acute exposure to DU is from its chemical properties, rather than its radioactive properties, but there is uncertainty regarding toxicity from long-term exposure (IOM, 1996b). DU, which has about half the radioactivity of natural uranium, was first used in combat during the Gulf War, during which U.S. troops fired approximately 285 tons of DU munitions. Many U.S. troops handled munitions containing DU, but significant exposure with handling is not expected since the DU is encased in a protective shell (IOM, 1996b). Radiation exposure from intact DU munitions and armor is minimal and within accepted standards of health safety (GAO, 1993; IOM, 1996b).

During the Gulf War, friendly fire incidents wounded 35 U.S. soldiers of whom 22 were suspected to have retained DU fragments. Thirty-three of these wounded soldiers are undergoing a DVA-sponsored medical surveillance program at the Baltimore VA Medical Center. After 3 years, 15 of the 33 soldiers had detectable shrapnel. To date, the follow-up studies have found no evidence for neurological, renal, genotoxic, or immunological effects, but uranium excretion has been noted to be elevated in those known to have retained shrapnel (Keogh, 1995; Joseph et al., 1998). A report of the findings of this surveillance program is in preparation and will likely be available in 1999 (DVA, 1999).

The PAC (1996b) and the GAO (1993) noted that DoD had appropriate procedures for protecting personnel who worked with DU contaminated vehicles during the Gulf War but, apparently, few U.S. service personnel were adequately trained in these procedures. Activities of the 144th Service and Supply Company in fighting fires, recovering vehicles, and cleaning 29 tanks damaged by DU munitions may have led to DU exposure of 27 soldiers. Results of testing 12 of these soldiers were negative and the remaining 15 chose not to be tested (IOM, 1996b). Another two dozen soldiers from the 24th Infantry Division have reported that they were unknowingly exposed to DU-contaminated debris in the course of vehicle recovery and maintenance operations (PAC, 1996b). Additionally, troops may have inhaled particles containing DU while working near a fire at the Doha-Kuwait armored vehicle depot, or while climbing onto allied or enemy vehicles that had been hit by munitions containing DU (U.S. Senate, 1998).

DoD (1998d) classified possible DU exposures during the Gulf War into three levels:

- Level I represents immediate and direct exposures of soldiers in or near combat vehicles at the times these vehicles were struck by DU penetrators or who entered vehicles immediately after they were struck by DU munitions. These soldiers could have been struck by DU fragments, inhaled DU aerosols, ingested DU residues, or had DU particles land on open wounds, burns, or other breaks in their skin.
- Level II represents a lower level of exposure for soldiers and a small number of DoD civilian employees who worked in and around wrecked vehicles containing DU fragments and particles. These people may have inhaled DU residues resuspended during their

activities, transferred DU from hand to mouth, or spread contamination on their clothing. This Level includes soldiers who were involved in cleaning up DU residues that remained after a motor pool fire in which DU munitions detonated and burned.

- Level III represents people who received short-term and very low exposures and included individuals who entered DU-containing Iraqi equipment, troops downwind from burning Iraqi or U.S. equipment struck by DU rounds, or personnel downwind from burning DU ammunition.

DoD (1998d) identified thirteen exposure events during the Gulf War period - two classified as Level I, seven as Level II, and four as Level III. Health risk assessments are being prepared for all thirteen events. The risk assessments will describe the activities of the participants, specify the sources of potential DU exposure, and estimate the dose from inhalation, ingestion, and wound contamination as appropriate for each exposure (DoD, 1998d).

In 1998, the DoD and DVA expanded a medical follow-up program conducted by the Baltimore VA Medical Center to evaluate the remaining veterans who received the largest DU exposures during the Gulf War, those involved in Level I and II exposure events. The evaluations will include a medical examination, determination of uranium levels in the urine, and completion of a detailed DU exposure questionnaire (Roskier, 1998; DVA, 1998b).

Pesticides

The DoD reported that pesticides shipped to the Gulf region for use during the war included 45,770 pounds of malathion, 8,410 pounds of chlorpyrifos, 1,858 pounds of D-phenothrin, 903 pounds of methomyl, and 539 pounds of lindane (IOM, 1996b). Pyrethrin, dichlorovos (DDVP), carbaryl, propoxur, and diazinon were also available but in amounts less than 330 pounds each (IOM, 1996b). All pesticides shipped were approved by EPA or FDA for general use in the United States at the time of the war (PAC, 1996b). It is not known how much of this inventory of pesticides was actually used or what troop exposures may have resulted (IOM, 1996b).

The use of pesticides in the Gulf was reported to have followed strict guidelines. They were used only after arthropod surveys that identified individual pests and estimated arthropod prevalence. Distribution of pesticides was prohibited unless approved by the local commander. Distribution or use for other than personal purposes was restricted to trained or certified personnel or contractors (IOM, 1996b).

DoD reported that about 2.2 spray-cans of permethrin and 2 tubes of DEET (33%) for each U.S. service member were shipped to the Gulf (PAC, 1996b). Some troops were reported to have both applied the insect repellents DEET on their skin and permethrin on their clothing between August and October, 1990, the peak occurrence of arthropods (IOM, 1996b). In addition, some service personnel chose to wear animal flea collars for protection from insects, although DoD discouraged this practice (U.S. Senate, 1998).

Smoke from Oil Well Fires

Near the end of the Gulf War in February, 1991, the Iraqi troops set more than 1,000 Kuwati oil wells and refineries on fire (Spektor, 1998). The burning wells were located in eastern Kuwait, with the majority to the south of Kuwait City. Smoke plumes rose and combined in a "superplume" that could be seen for hundreds of kilometers and sometimes even partially blocked out the sun (U.S. Senate, 1998).

Systematic environmental monitoring did not begin until May 1991, so limited exposure data are available for the period when most U.S. troops were in the Gulf area (Spektor, 1998, USAEHA, 1994). The U.S. Army's Environmental Hygiene Agency (USAEHA) carried out the largest monitoring effort, collecting nearly 4,000 ambient air and soil samples between May and December, 1991 (USAEHA, 1994).

Air monitoring data from the USAEHA and other U.S. and international agencies indicated that air levels of nitrogen oxides, carbon monoxide, sulfur dioxide, hydrogen sulfide, other pollutant gases, and polycyclic aromatic hydrocarbons (PAHs) were lower than anticipated and did not exceed levels seen in urban air in a typical U.S. industrial city (USAEHA, 1994; Spektor, 1998). A health risk assessment conducted by the USAEHA (1994) based on the air monitoring data for volatile organic compounds, particulate heavy metals, and PAHs predicted an excess risk for cancer of three cases per million persons exposed. Risks for non-cancer health effects were estimated by a hazard index approach comparing estimated exposure levels during the fires to U.S. EPA reference exposure levels expected to be without adverse health effects (an index greater than 1 indicates increased risk for general populations including sensitive individuals): hazard indices ranged from 0.6 to 2.0 in Saudi Arabia and 2.0 to 5.0 in Kuwait (USAEHA, 1994). Inhalation of volatile organic chemicals, particularly benzene, contributed to over 99 percent of the non-cancer health risk at all monitoring sites. The USAEHA (1994) noted that the EPA reference exposure levels each have at least 10-fold margins of safety incorporated in their derivation and that hazard indices in the range of 1 to 10 should not present "an unreasonable health risk, particularly for short-term exposures", noting that DoD personnel were exposed to the smoke for a minimum of about a month to a maximum of about 9 months.

Etzel and Ashley (1994) found elevated concentrations of several volatile organic compounds (VOCs) in blood samples collected from 40 American firefighters working in the Kuwait oilfields in October, 1991 compared with blood levels in a random sample of 114 U.S. residents. The measured VOCs (benzene, toluene, xylene, and styrene) are components of smoke from oil well fires; blood levels in firefighters were about two times average levels in the reference group. Concentrations of these VOCs were not elevated, however, in blood collected in May 1991 from 14 U.S. personnel who worked in Kuwait City compared with reference levels.

Analyses of biologic samples from deployed troops, local inhabitants, and autopsy cases have not indicated a risk for health effects from atmospheric pollution caused by the fires (Coombe and Drysdale, 1993; Mullick, 1996). No cases of illness with symptoms resembling the most prevalent

symptoms reported by U.S. Gulf War veterans in the DoD and DVA health registries have been found in a group of 110 oil-well firefighters who worked daily at Kuwati wells in 1991 for 28-day periods without breathing-protection equipment or in other oil-well firefighters with years of experience (Friedman, 1994, 1996).

One study reported an increase in frequency of sister-chromatid exchange in blood cells collected from soldiers who were deployed from Germany to the Persian Gulf to participate in monitoring of the Kuwait oil-well fires between June and September, 1991 (after combat had ceased), but the cause of this apparent increase could not be determined (McDiarmid et al., 1995). Sister chromatid exchanges have been used as an indicator of exposure to a number of environmental mutagenic agents, including polycyclic aromatic hydrocarbons (PAHs). PAHs and other mutagenic agents are present in smoke from oil-well fires and from other fires as well. A further study of a subset of these soldiers measured levels of three biomarkers for exposure to PAHs (two measures of PAH-DNA adducts in blood cells and urinary levels of 1-hydroxypyrene-glucuronide, a metabolite of PAHs) before deployment to the Gulf, during deployment in Kuwait (after 8 weeks of duty), and 4 weeks after returning to Germany (Poirer et al., 1998). Levels of PAH biomarkers were lowest during deployment in Kuwait, suggesting that this group of soldiers were not exposed to elevated levels of PAHs while deployed in Kuwait.

Petroleum Products and Other Chemicals

The fuel used most widely during the Gulf War for both vehicles and equipment was Jet A-1, a kerosene-based aviation fuel. Of the 1.8 billion gallons of fuel used during the Gulf War, roughly 75 percent was jet fuel (mostly Jet A-1), 24 percent was diesel fuel, and 1 percent was gasoline. The gasoline was commercial leaded gasoline (PAC, 1996b). About 145,000 gallons of gasoline were used per day for eight months starting in August, 1990 (IOM, 1996b). Besides use in vehicles and machine engines, petroleum products were used to burn human waste and trash and as a fuel in stoves (U.S. Senate, 1998). Diesel fuel was used in large amounts to suppress dust, with one reported case involving 30,000 gallons used on roads daily. Troops living in tents near the roads, and particularly truck drivers who carried out the spraying, complained of nausea from breathing the resulting fumes (PAC, 1996b).

When fuels were used for heaters, cooking stoves, and portable generators, the fumes and exhaust produced by these fuels, particularly when used in unventilated tents, would have exposed some service members to benzene, toluene, xylene, ethyl benzene, and combustion products including carbon monoxide, sulfur dioxide, nitrogen dioxide, particulates; lead, and other pollutants (PAC, 1996b; U.S. Senate, 1998; IOM, 1996b). Air and limited blood monitoring found no evidence of elevated exposure to volatile organic compounds (PAC, 1996b). A recent study simulated Gulf War exposures to aerosols from unvented heaters in tents and found elevated concentrations of particulate matter, nitrogen oxides and carbon monoxide (Cheng, 1998). Fuel type, heater type, and air exchange rate were important factors in determining air concentrations in the tent. Cheng (1998) noted that information from this study will be used to calculate respiratory doses that may

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have been experienced by troops residing in heated tents during the Gulf War and to calculate estimates of health risks from this type of exposure.

Chemical Agent Resistant Coating (CARC) paint, which releases a compound (toluene diisocyanate) that can adversely affect the lungs, was applied to vehicles and equipment before shipment to the Gulf area or at a port in Dhahran (U.S. Senate, 1998). Accidental exposure to a chemical decontaminant agent containing propylene and ethylene glycols reportedly caused rashes in a group of soldiers (U.S. Senate, 1998).

The Desert Environment

In the initial months of the deployment, troops were exposed to summer daytime temperatures that reached as high as 130 degrees Fahrenheit. In August and September, the mean high temperatures were approximately 100 degrees Fahrenheit with very intense solar heat and low humidity. Preventive medicine efforts resulted in very few heat casualties (U.S. Senate, 1998; Joseph et al., 1998). In surveillance data on 40,000 Marines, less than three cases of heat injury requiring aid station treatment occurred weekly per 1,000 people (U.S. Senate, 1998). Sand flies were present, as evidenced by a few cases of leishmaniasis (IOM, 1996b).

High levels of airborne particulates were detected at several monitoring sites in the Gulf theater and sample analysis indicated that, frequently, the particulates were predominately sand (USAEHA,1994). Korenyi-Both et al. (1992, 1997) theorized that acute respiratory problems experienced by U.S. troops in Al Eskan village between January and March, 1991 were caused as a result of immunosuppression from inhalation of airborne fine sand particulates along with organic pathogenic components; it was further theorized that the acute event may have induced a later-developing state of immunodeficiency that may be related to symptoms of ill health reported by Gulf War veterans. Studies to test this hypothesis were not located.

Psychological and Physical Stressors

The stresses of the Gulf War experience, some of which were unique, included sudden mobilization for military service in a hot, sandy, and foreign desert; exposures to the largest, most dramatic oil well and refinery fires in history, which spilled smoke and oil over a vast area; and potential exposure to chemical and biological warfare agents. Stresses reported by a group of over 2,000 Gulf War veterans as they returned home included nearly 300 events they considered stressful beyond the traditional combat experiences. The reported stress-related events were grouped into the following categories (U.S. Senate, 1998):

- Combat and mission stressors such as actual threat to life from missiles (e.g., friendly fire incidents) or direct exposure to another's death or injury as part of a combat mission.
- Non-combat war-zone stressors such as a unit member seriously injured or killed in a non-mission accident.

- Domestic stressors such as divorce or long separation from or illness of family members and loved ones.
- Anticipation of war/combat activities related to missile attack alerts or fear of attack by chemical or biological agents.
- Physical attributes of the war zone such as severe climate or environmental conditions, long tours of duty, physical limitations and dangers from wearing chemical protective gear in a desert environment, or uncertainty about the war's duration.
- Intra-unit stress related to personal conflicts in a unit, leadership failure or problems, or harassment.

Stress from personal and family concerns likely played a more prominent role in the Gulf War than in other wars, because it involved a greater number of married personnel and parents. In the Vietnam War, 16% of those deployed were married with children, whereas 60% of service members and reservists in the Gulf War were married with dependents, including approximately 32,000 single parents who had to make arrangements for their children during the deployment (U.S. Senate, 1998).

General Exposures of Military Service

In the military environment, personnel are required to perform multiple combat and non-combat activities that may involve potentially hazardous exposures, some of which may be similar to those in the civilian workplace. In addition, however, military personnel who participate in combat and combat support operations are exposed to inherent hazards that are associated with the operation of weapons systems and the battlefield environment. Common exposures to risk factors in the combat environment include propellants from ammunition; combustion products from vehicles; solvents; chemical warfare agents; noise, vibration, and non-ionizing radiation from communications and radar tracking equipment and laser target designators; blast impact, acoustical energy, airborne toxicants, extremes in barometric pressure, oxygen deficiency, and whole-body vibration from operation of tanks, aircraft, and submarines; biological hazards; extremes in temperature, humidity, and weather; and psychological stressors related to fear and isolation. Since a large proportion of the Gulf War veterans were members of the reserves or National Guard and also had non-military jobs, their civilian occupational exposures are potential confounders in the evaluation of their health problems (Joseph et al., 1998).

Hyams et al. (1996) noted that the clinical findings for Gulf War veterans are consistent with the experiences of U.S. veterans of previous wars. Reviewing U.S. clinical reports of war-related illnesses associated with the Civil War, World Wars I and II, the Korean Conflict, and the Vietnam War, Hyams recognized two general categories of war-related illnesses that were diagnosed after each of these wars:
1) psychological illnesses, given various names through the years from *nostalgia* in the Civil War, through *shell shock* in WWI, and *battle fatigue* in WWII and Korea, to *post-traumatic stress disorder* after the Vietnam and Gulf Wars; and

2) physiological illnesses, including *Da Costa* syndrome (irritable heart) after the Civil War, *Effort syndrome* during and after WWI and II, *Agent Orange exposure* after Vietnam, and *Gulf War syndrome*.

The physiological illnesses were primarily defined by self-reported, chronic symptoms including fatigue, shortness of breath, headache, sleep disturbances, impaired concentration, and forgetfulness. Hyams noted that these symproms are non-specific and are frequently found in all adult populations, as well as among persons with illnesses associated with psychological stress, and that, in each of these wars, the onset of these illnesses was preceded by a high frequency of diarrhea. Hyams concluded that "poorly understood war syndromes" have recurred since the U.S. Civil War, that no single disease or underlying cause that is unrelated to psychological stress is apparent from reviewing the available clinical reports, and that the relationships between chronic, non-specific symptoms and physiological and psychological illness need to be better understood.

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United States General Accounting Office

GAO

Report to the Chairman, Subcommittee on National Security, Veterans' Affairs and International Relations, Committee on Governmental Reform, House of Representatives

January 2000

GULF WAR ILLNESSES

Management Actions Needed to Answer Basic Research Questions





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GAO/NSIAD-00-32

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United States General Accounting Office
Washington, D.C. 20548

National Security and
International Affairs Division

B-282454

January 6, 2000

The Honorable Christopher Shays
Chairman, Subcommittee on National Security,
Veterans' Affairs, and International Relations
Committee on Government Reform
House of Representatives

Dear Mr. Chairman:

Many of the approximately 700,000 veterans of the Persian Gulf War have complained of illnesses since the war's end in 1991, and over 10 percent have sought and completed health examinations through the Department of Veterans' Affairs or Defense. Some fear they are suffering from chronic disabling conditions because of wartime exposures to one or more agents with known or suspected health effects. In response to these concerns, the government has funded research, investigation, and information activities through agencies such as the Departments of Veterans' Affairs, Defense, and Health and Human Services, which are represented on the Persian Gulf Veterans' Coordinating Board, the body that coordinates the federal response to Gulf War veterans' illnesses.

As requested, we identified expenditures on these efforts and evaluated their results. Specifically, our objectives were to describe

- the amount of money that these three departments spent on research and investigation of Gulf War veterans' illnesses and health concerns in fiscal years 1997 and 1998, including current and projected spending by the Office of the Special Assistant to the Deputy Secretary of Defense for Gulf War Illnesses;
- the productivity of this research spending, including the extent to which the Coordinating Board has determined that federal research objectives have been satisfied, and the extent to which the research has resulted in peer-reviewed publications and the identification of the causes or successful treatments for Gulf War veterans' illnesses;
- the extent of coordination between the Research Working Group of the Coordinating Board and the Office of the Special Assistant for Gulf War Illnesses; and
- the Office of the Special Assistant for Gulf War Illnesses' contract management.

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Results in Brief

During fiscal years 1997-98, the Departments of Defense, Veterans' Affairs and Health and Human Services spent more than $121 million on research and investigation of Gulf War veterans' illnesses, with DOD spending more than $112 million of that total. These funds supported a growing catalog of research and investigatory efforts intended to address both veterans' health concerns and their questions about hazards encountered in the conflict. The Office of the Special Assistant to the Deputy Secretary of Defense for Gulf War Illnesses spent the majority of the federal research and investigatory funds we identified, about $65.3 million in fiscal years 1997 and 1998, with another $65.4 million in spending planned for fiscal years 1999 and 2000.

Basic questions about the causes, course of development, and treatments of Gulf War veterans' illnesses remain unanswered. As of November 30, 1999, the Research Working Group of the Persian Gulf Veterans' Coordinating Board had not published an assessment of the extent to which the research program had answered the major questions it identified as research objectives in 1995, and no date had been set to publish such an assessment. By the end of 1998, among the 151 research projects monitored by the Group, 117, or 77 percent, were recorded as ongoing, including 29, or 47 percent, of the 62 that were scheduled for completion by that time. Among those that were not recorded as complete at the end of 1998, about one-third were later completed and the remaining two-thirds had their estimated completion dates extended. Group officials attributed the extensions either to provisions to collect or incorporate additional data or to unanticipated delays, such as difficulty in securing approval to collect data or in locating and recruiting veteran participants. Augmenting the research monitored by the Group, DOD's Office of the Special Assistant to the Deputy Secretary of Defense for Gulf War Illnesses had received 19 of the 20 reports due from its major research contractors by late 1999, with 6 publicly released and the remainder largely in various stages of interagency review. Fourteen reports had remained in draft or review status for a year or longer.

While federally sponsored studies have resulted in some descriptive information concerning veterans' symptoms, many basic questions (such as the numbers of veterans with unexplained symptoms and the course of their illnesses over time) remain. Answers to more complex questions about the potential cause(s) of veterans' unexplained symptoms have been difficult to derive in part because problems in identifying veterans' specific exposures persist. In addition, no working case definition or set of

definitions of illnesses affecting veterans has been endorsed by the Group. Perhaps because analytic epidemiological research depends heavily upon exposure data and/or case definition, completed epidemiological research, which comprises a large portion of the research portfolio, has been less likely than other types to result in peer-reviewed publications and most of these studies have been descriptive. Although the question of causation is unresolved, in the interest of assisting ill veterans, the Department of Veterans' Affairs has begun recruiting patients for trials of antibiotic and exercise-behavioral treatments for a set of veterans' unexplained symptoms.

Although the Office of the Special Assistant for Gulf War Illnesses expends more than half of the federal funds supporting research and investigation into Gulf War veterans' illnesses, its activities are not effectively coordinated with those of the Research Working Group. According to officials from both organizations, the Office of the Special Assistant's activities involve investigations, rather than research, and therefore are not subject to coordination. However, the Group considered some of the Office's activities to involve research and expressed concern about the lack of an external review process. The weak coordination between the Group and the Office increases the potential to miss opportunities to leverage ongoing and completed work by other agencies, and we found a few examples of such problems.

The Office rapidly developed relationships with various contractors to support its mission. However, two of the largest task orders were awarded improperly, and the Office discouraged competition for another task order by specifying a preferred vendor. Because the Office is likely to continue to spend a significant part of its budget on support contracts, it needs to insure that its contracts fully comply with applicable requirements.

We are making recommendations to improve federal efforts to assess and conduct research, coordination between the Office and the Group, and the Office's arrangements with its support contractors.

Background

Several federal agencies and offices have generated and coordinated responses to veterans' complaints of illnesses following the Gulf War. These have included the Departments of Defense (DOD), Health and Human Services (HHS), Veterans' Affairs (VA), and Energy, the Central Intelligence Agency, the Environmental Protection Agency, the National Security Council, and the Office of Management and Budget.

The formation of the Persian Gulf Veterans' Coordinating Board (PGVCB) was announced in early 1994 for the purpose of coordinating federal research and other activities in response to illnesses reported by Gulf War veterans. This body, which is co-chaired by the Secretaries of Defense, Veterans' Affairs, and Health and Human Services, comprises working groups on research, clinical issues, and compensation. The PGVCB Research Working Group (RWG), which has no budgetary authority, does not directly manage or distribute research funds. It describes its responsibilities as (1) assessing the state and direction of research and identifying gaps in factual knowledge and conceptual understanding, (2) identifying testable hypotheses and potential research approaches, (3) reviewing research concepts as they are developed, (4) collecting and disseminating scientifically peer-reviewed information, and (5) insuring that appropriate peer review and oversight are applied to research the government has conducted or sponsored.

Within DOD, initial efforts to respond to Gulf War veterans' complaints were managed by the Assistant Secretary of Defense for Health Affairs. In November 1996, following worsening public relations, management of these efforts was transferred to the newly created Office of the Special Assistant for Gulf War Illnesses (OSAGWI), which became responsible for oversight of DOD's efforts regarding illnesses being experienced by Gulf War veterans. OSAGWI reported directly to the Deputy Secretary of Defense. The Assistant Secretary of Defense for Health Affairs continued to be responsible for managing and coordinating related health programs, while DOD's medical research efforts were managed largely by the Undersecretary of Defense for Acquisition and Technology and the Army Medical Research and Materiel Command. DOD established OSAGWI to restore public confidence in DOD's efforts to deal with Gulf War illnesses issues. OSAGWI has focused its efforts on (1) establishing effective two-way communications with veterans and veterans' groups, (2) investigating and reporting on incidents of possible chemical warfare agent exposures, and (3) applying lessons learned from the Gulf War experience to better protect U.S. servicemembers on a contaminated battlefield.

The efforts of the various federal agencies have been met with skepticism on the part of some veterans. This skepticism was fueled by the delay, until 1996, in acknowledging potential exposures to low levels of nerve agent at a munitions dump in Khamisiyah, Iraq, during postwar demolition activities. Additionally, veterans were upset by DOD's and VA's initial emphasis on stress as a potential explanation for their symptoms.

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Congressional oversight of DOD's and VA's efforts has identified problems in the agencies' clinical monitoring of veterans' conditions and inaccuracies in agency statements about veterans' potential exposures.

Spending on Research and Investigation of Veterans' Illnesses Is Concentrated Within DOD

During fiscal years 1997 and 1998, HHS, DOD, and VA reported total expenditures of at least $121.3 million on research and/or investigation of Gulf War veterans' illnesses.[1] These expenditures included $112.4 million in DOD funds ($65.3 million for OSAGWI and $47.1 million for non-OSAGWI expenditures), $7.2 million for VA, and $1.6 million for HHS.[2] These amounts excluded expenditures on examination and clinical care of ill veterans during this time period.

Because OSAGWI managed the majority of DOD's research and investigation expenditures, it was the single largest component of the federal research and investigatory effort to respond to veterans' concerns. The remainder of DOD's spending was attributed to internal and external, DOD-sponsored research efforts catalogued by the RWG.

[1]The RWC records funds expended by VA, HHS, and DOD based on the year in which they were appropriated. Because these appropriations can be spent over 2 years, RWC data for the most recently reported fiscal year (1998) were not necessarily a complete representation of final spending for that fiscal year. For this reason, fiscal year expenditures, which were provided in December 1998, are likely to have increased during fiscal year 1999.

[2]These figures do not add to $121.3 million because of rounding. The costs for VA studies do not include overhead costs because indirect costs are included under VA's medical care appropriation. Similarly, the majority of HHS' expenditures represent direct costs only. DOD's non-OSAGWI spending does not include overhead costs for intramural studies but does for extramural ones. In addition, the numbers reported for OSAGWI include overhead costs and some spending on veteran outreach.

OSAGWI was established in November 1996, when a staff of 110 and an annual budget of $11.4 million were projected. The Office later grew to a staff of slightly over 200, spending more than $65 million across fiscal years 1997 and 1998, and planning expenditures of $35.9 million in fiscal year 1999 and $29.5 million in fiscal year 2000.[3]

OSAGWI categorizes its spending as research or support. During fiscal years 1997-98, OSAGWI spent $13.3 million, or 20 percent of its expenditures, on instruments it characterized as research contracts and another $47.1 million, or about 73 percent of its expenditures, on instruments it characterized as support contracts. The remaining funds, about 7 percent of OSAGWI spending, covered overhead, travel, conferences, computer equipment, and miscellaneous other expenses. Many of its support costs are difficult to separate from research and investigation expenditures. For example, the objectives of OSAGWI's support contracts ($21 million) with one contractor—BDM International—include obtaining, documenting, and analyzing information potentially related to Gulf War illnesses; documenting the data and analysis in databases and other forms of storage; developing questionnaires and surveys to collect data; rapidly creating data analysis tools to aid in analysis efforts; and developing and producing case studies.

Basic Questions About Causes, Course, and Treatment of Veterans' Illnesses Remain Unanswered

The RWC has not assessed the extent to which the research agenda has satisfied the objectives it identified in 1995. The majority of federal research projects remain ongoing or in review. Problems identifying valid data on veterans' exposures persist, and basic questions, such as how many veterans have unexplained symptoms and whether those who have received care in VA facilities are getting better or worse, remain unanswered.

[3]Although OSACWI officials are seeking the guidance of the Special Oversight Board on DOD Investigations of Chemical and Biological Incidents to determine what portion of its investigation work should continue and how it should draw down the Office, the Office is incorporated in DOD's budget through fiscal 2005, with twice the number of investigations ongoing as have been completed.

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The Extent to Which Research Objectives Have Been Met Has Not Been Assessed

In April 1999, PGVCB officials told us they had not finished assessing the government's progress in answering the 21 major questions that the RWG had identified in 1995. As detailed in appendix I, these research objectives include questions about the prevalence of various health problems and exposures among the veteran population and the way the prevalence differs between Gulf War veterans and "appropriate control populations." With regard to exposure, the research objectives cover Leishmania tropica (a type of parasite), petroleum, petroleum combustion products, specific occupational/environmental hazards, chemical agent, pyridostigmine bromide, and psychophysiological stressors. With regard to veterans' health status, the research objectives cover the prevalence among veterans and appropriate control populations of symptoms, symptom complexes, illnesses, altered immune function or host defense, birth defects, reproductive problems, sexual dysfunction, cancer, pulmonary symptoms, neuropsychological or neurological deficits, psychological symptoms or diagnoses, and mortality. Questions about exposure to low levels of nerve agent were added in 1996, when DOD acknowledged that U.S. troops might have experienced such exposures during postwar demolition activities at Khamisiyah.

The research questions incorporate input from HHS, DOD, and VA but do not formally constrain the research funded by these agencies. Asked to identify which of the 21 research objectives had been satisfied by late 1998, RWG officials wrote, "Answers to some of the research questions contained in the Working Plan have been achieved to a greater degree of satisfaction than others. However, at this time, it is accurate to say that no research question has been answered to the extent that additional research would not be able to shed more light on the question." In late 1998, an RWG official noted that a draft analysis of research results as they relate to these questions was anticipated in late spring or early summer 1999 in preparation for publication of a revised working plan for research on Gulf War Veterans' illnesses, but no deadline had been established for publishing this analysis and no such analysis had been published as of June 1999. While DOD noted that the analysis was in progress, it had not been completed or a deadline established for its publication when DOD and VA submitted their comments on our draft report in August and September 1999, respectively.

Return on Research Investment Accruing Slowly

Spending on research was spread among various projects catalogued by the PGVCB's Research Working Group and an additional set of projects

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sponsored by OSAGWI. While findings from this work are beginning to accumulate, most of it is ongoing or in review.

Research Catalogued by RWG

Although the research portfolio monitored by the RWG includes over 50 projects that began in 1994 or earlier, only 34 of the 151 projects, or 23 percent of those catalogued by the RWG, had been reported complete as of December 1998. This was 53 percent of the 62 that were scheduled for completion by that time. Among the 47 percent of this group that were not complete in December 1998, about one-third were later completed and the remaining two-thirds had their estimated completion dates revised (with extensions varying from a few months to 10 years). RWG officials attributed the extensions either to efforts to collect or incorporate additional data or to unanticipated delays, such as difficulties in securing approval to collect data or problems in locating and recruiting veteran participants.[4] The officials identified four instances in which additional funds had been provided. For example, the Centers for Disease Control's health assessment of Persian Gulf War Veterans from Iowa was extended to 2000 to provide for additional follow-up of the survey sample. Similarly, DOD has committed to fund two projects for the Army's Center for Health Promotion and Preventive Medicine until 2003 and 2006.[5]

[4]For example, some projects experienced delays in approval of their plans by institutional review boards while others experienced difficulty in recruiting subjects. Some survey efforts found that it was more difficult than anticipated to track veterans' whereabouts since the war.

[5]Funding is extended through 2006 for the Kuwait Oil Fires Troop Exposure Assessment Model, a project responding to P.L. 102-190 by characterizing the potential carcinogenic and noncarcinogenic health risks to U.S. military personnel exposed to the environment affected by the oil well fires during and after Operation Desert Storm. Funding is extended through 2003 for the Persian Gulf Veterans Health Tracking System, which is intended to characterize exposures (other than airborne contaminants from oil well fires) experienced by U.S. military personnel during Desert Storm and to assess the potential health risks/consequences of those potential exposures.

By June 1999, PCVCB reported only 1 of the 13 primary research areas, leishmaniasis, had a majority of projects complete (four of seven).[6] In one research area—treatment—no projects had yet been finished.

Among the 23 percent of federal research projects into Gulf War veterans' illnesses that were completed by December 1998, about two-thirds (22 of 34) had resulted in at least one article published in a peer-reviewed journal. (We focused on this outcome because publication in a peer-reviewed journal was suggested as a surrogate marker for research quality in early interviews with RWG officials and because publication in this form insures more widespread access to research findings.) Some of the other completed projects have had findings released in the form of technical reports or summarized in an annual report issued by the RWG. Additional peer-reviewed publications have been issued from projects that are still ongoing.

Research Expenditures Managed by OSAGWI

Five key contractors accounted for about 72 percent of the $13.3 million that OSAGWI attributed to spending on research contracts in fiscal years 1997 and 1998. We reviewed the status of deliverables under their contracts to determine whether they had been received in a timely manner and had been released to the public. We focused on timely provision of deliverables as a basic measure of contractor performance and on release of deliverables as an indicator of effectiveness, since the contracts were often for developing public information and doing so was a major part of OSAGWI's mission. As of December 1999, OSAGWI (or the responsible element at DOD) had received 19, or 95 percent, of the 20 products due from the 5 research contracts. Among those products received, 6 had been released to the public, with the remainder largely in various stages of interagency review when we ended our work in December 1999. Fourteen products had remained in review or draft status for a year or longer. Appendix II contains detailed information on the research contracts we examined, including the contractor, the contract amount, the titles or topics of deliverables, and the deliverables' status (i.e., whether they were due at the time of our review, had been received, and/or released, what

[6]The RWG cataloged the federal research portfolio by primary research topic in March 1998. At that time, there were 121 (instead of the current 151) federally sponsored research projects. Because 30 research projects that began after March 1998 were not categorized by the RWG into primary research topics, our analysis by primary research topic includes only the 121 that had been categorized. See the RWG's report entitled *Annual Report to Congress: Federally Sponsored Research on Gulf War Veterans' Illnesses for 1997*, March 1998.

form they were in at receipt, what was the date of the earliest known receipt, and whether they had been released).

With respect to other products of OSAGWI's spending, including nonresearch spending, by January 1, 1999, OSAGWI had issued 13 case narratives (accounts of particular incidents during the war), 2 environmental exposure reports, and 4 information papers.[7] Work on an additional 26 case investigations was ongoing.[8] As of December 3, 1999, 1 additional case narrative and 3 additional information papers had been issued.

[7]Other accomplishments cited by OSAGWI officials in hearings before the Senior Oversight Panel on DOD Investigation of Chemical and Biological Incidents (held Nov. 19-20, 1998) included visiting five bases, answering 3,000 hotline calls, and responding to 5,000 e-mail inquiries. Additional veterans were contacted via the Office's programs to notify veterans of potential exposures or survey veterans on particular topics.

[8]For a review of OSAGWI's investigatory activities, see *Gulf War Illnesses: Procedural and Reporting Improvements Are Needed in DOD's Investigative Processes* (GAO/NSIAD-99-59, Feb. 26, 1999).

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Problems in Identifying Valid Exposure Data Persist

Absence of agreement or valid data on veterans' wartime exposures has presented formidable obstacles to researchers in developing definitive information about the causes of veterans' illnesses. Although the nearly half of studies that are epidemiological depend to some extent on the use of exposure data, researchers continue to face difficulties in assessing and validating veterans' exposures. These difficulties led us to conclude in our 1997 report that the many epidemiological studies being sponsored would not provide definitive information on the causes of veterans' illnesses.[8] Proceedings of conferences on federally sponsored research also document that researchers are experiencing increasingly difficult problems in soliciting reliable self-reported data on exposures as time from the original events increases.[10] Because of such problems, the likelihood of misclassifying persons who received no exposure as having had some or significant exposure (or vice versa) will increase, reducing the capacity of data analyses to identify associations between exposures and health outcomes. Perhaps as a result, completed research projects classified as epidemiological had a lower rate of publication in peer reviewed journals than other types of federally sponsored research.[11]

To begin to identify the causes of an unexplained illness, epidemiological researchers normally define a set of criteria, known as a case definition, that can be used to separate persons who have the condition from those who do not. This permits researchers to look into differences in their histories to gain insight into what may have caused their illness. However, no such working case definition or set of such definitions that might focus federal research has been endorsed by the Research Working Group. Working case definitions of unexplained illness among veterans that have been proposed by individual researchers have been similar to one another in emphasizing unexplained fatigue, neurocognitive complaints, and

[8]*Gulf War Illnesses: Improved Monitoring of Clinical Progress and Reexamination of Research Emphasis Are Needed* (GAO/NSIAD-97-163, June 23, 1997).

[10]See the RWG, PGVCB, *Proceedings: Conference on Federally Sponsored Gulf War Veterans' Illnesses Research*, June 17-19, 1998 and June 23-25, 1999.

[11]Of the 22 completed research projects classified as epidemiological, 12, or about 55 percent, had resulted in publication of an article in a peer-reviewed journal. By way of comparison, 83 percent (10 of 12) of the completed nonepidemiological projects had results published in such journals. (We include projects originally classified by the RWG as clinical epidemiology as well as those projects classified as epidemiology in this total; after we recommended a shift from epidemiological research in June 1997, the RWG reclassified studies formerly designated clinical epidemiology as clinical research projects).

musculoskeletal complaints, symptoms reported more commonly by Gulf War veterans than by veterans of the same era who were deployed elsewhere (see app. III).

Descriptive Information Concerning Veterans' Symptoms Exists, but Many Basic Questions Remain Unanswered

The government has had some success in cataloging data on the illnesses suffered by Gulf War veterans. DOD and VA registries gather such information, and studies have been funded to collect data on veterans' symptoms. However, owing to the data collection formats used in the registry process and the self-selection of registry participants, the registries are not optimal sources of information regarding the prevalence of various symptom clusters among veterans, making it difficult to know which of the various case definitions or symptom groups deserve closer examination. For example, these registries are unlikely to record sufficient data to determine whether a veteran meets criteria for multiple chemical sensitivity or chronic fatigue syndrome, for which recognized case definitions exist, but not standard diagnostic categories, as represented by international disease classification codes. Some federally sponsored research, notably VA's National Health Survey, might be able to clarify this issue, but descriptive data from the survey remained unpublished at the close of our review.

Although some progress has been made in cataloging veterans' illnesses, the results generally describe only what illnesses a veteran was suffering from at a particular point in time. As a result of this and the limitations of the DOD and VA registries, several basic descriptive questions remain unanswered. For example, the Special Investigative Unit of the Senate Veterans' Affairs Committee and others have identified such open questions as the following:

- How many of those veterans who have been examined have unexplained illnesses or symptoms?
- How many of those veterans are also receiving compensation for that condition?
- How many are receiving health care?
- What treatments have they received?
- Are those who have received care in VA facilities getting better or worse?

Some data that might be helpful in answering such questions are being collected, but an analysis of these data was not available at the close of our review. An HHS-sponsored project, which began in 1997, is assessing the

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persistence and stability of veterans' symptoms over time. This study is planned to end in 2000. In addition, VA and DOD are recruiting patients for cooperative trials of antibiotic and exercise-behavioral treatments for a broad set of veterans' unexplained symptoms. However, perhaps because there is little understanding of the physical causes underlying veterans' symptoms, VA and DOD officials note that the treatments to be used in these trials are expected only to ameliorate symptoms, not to eliminate them.

RWG and OSAGWI Activities Not Effectively Coordinated

OSAGWI's activities have not been effectively coordinated with those of the RWG in order to maximize the efficient use of resources. We found conflicting information about the nature of OSAGWI's work and whether it should be coordinated. Specifically, RWG and OSAGWI officials told us that OSAGWI's activities involve investigations, not research, and therefore are not subject to coordination. However, in an August 1997 letter to OSAGWI, the RWG raised questions about the methodologies of three OSAGWI-sponsored studies and expressed concern over the lack of any external review process for these studies and for OSAGWI's research efforts in general. OSAGWI pursued these studies, but it has not published their findings. The lack of effective coordination between the RWG and OSAGWI increases the potential to miss opportunities to leverage ongoing and completed work by other agencies.

Other examples illustrate the need for better coordination. For example, in January 1998, the National Academy of Science's Institute of Medicine presented a proposal to VA, which was funded under a congressional mandate, to pursue studies at a projected cost of $1.25 million to "comprehensively review, evaluate and summarize the available scientific and medical information regarding the association between exposures during the Persian Gulf War and adverse health effects experienced by Persian Gulf War veterans." However, in 1997, OSAGWI had contracted with RAND at a cost of more than $1.5 million for "the preparation of literature reviews of key possible causal hypotheses of GWI."[12] The Institute's assessments regarding the links between exposures and health outcomes must be based, at least partly, on the review of relevant literature, and RAND's identification of this literature has required, at least, some assumptions regarding potential exposure scenarios. Thus, it should

[12]OSAGWI eventually authorized RAND work valued at $3.2 million.

have been possible to use RAND's ongoing work for the Institute study, and better coordination of these two efforts might have saved both time and money. When we interviewed Institute staff in June 1998, they were generally aware of RAND's plan to perform literature reviews, but they were not familiar with the content of RAND's work, noting that none of it had been released. While RAND did seek approval of a list of scientific peer reviewers for its work from Institute officials, in the absence of coordination mechanisms, these two efforts were pursued independently.

Similarly, at least three reviews of the health effects of depleted uranium have been commissioned within a few years – one by each agency represented on PGVCB. HHS' Agency for Toxic Substances and Disease Registry first released a toxicological profile for uranium in 1989 and issued an updated draft toxicological profile on uranium (including depleted uranium) on October 17, 1997. This draft, prepared by the Research Triangle Institute, incorporated a plain-language public health statement and reflected the Agency's assessment of all relevant toxicological testing and information that had been peer-reviewed. In addition, at OSAGWI's request, RAND performed a review of the scientific literature regarding the health effects of depleted uranium. Finally, IOM will conduct such a review as part of its work for VA. The need for the additional review of depleted uranium by RAND, which was submitted in August 1998, after the Agency had issued its draft, is questionable.

Contracting for OSAGWI Support Services Was Flawed

OSAGWI spent more than $47 million in fiscal years 1997 and 1998 on its support contracts. We reviewed four support agreements, which made up more than 91 percent of OSAGWI's support spending, and found problems with several of the task orders. Specifically, two of the largest task orders were awarded improperly, and OSAGWI discouraged competition on another by naming a preferred vendor.

Improper Task Orders

OSAGWI's support arrangements consisted largely of task orders under multiple-award contracts of other agencies and offices. OSAGWI's largest support arrangement was based on two improper task orders awarded to BDM. OSAGWI officials noted that they were directed to establish the Office with all possible speed and explained that they anticipated relying heavily on contractors for support. As part of addressing this need, an initial task order covering a broad range of services was awarded to BDM under a National Guard Bureau (NGB) multiple-award task order contract for information technology services.

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The BDM task order describes its objectives as including, but not limited to:

"obtaining, documenting, and analyzing information potentially related to Gulf War illnesses; documenting the data and analysis in databases and other forms of storage; establishing a program to reach-out to veterans; developing questionnaires and surveys to collect data; developing maps and other multimedia presentations; plotting and analyzing troop movements and locations; rapidly creating data analysis tools to aid in analysis efforts; developing and producing case studies; preparing documents for storage on GulfLINK; developing recommendations and long range plans; writing papers; and, providing testimony."

The task order also required BDM to provide facilities, furniture, telecommunications, equipment, and services, as needed.

Orders under multiple-award, task-or-delivery-order contracts are required by law to contain a statement of work that "clearly specifies all tasks to be performed or property to be delivered under the order."[13] In our opinion, this language means that a task order must identify with reasonable specificity the task or tasks that a contractor will be expected to perform, rather than merely list categories of services. The task order awarded to BDM, however, was basically a broad menu of services from which OSAGWI could pick and choose as the occasion arose and lacked the degree of specificity required. While we appreciate the exigent circumstances under which this award was made, we do not believe that the award of this broad task order was proper because it did not clearly specify the tasks to be performed. The DOD Inspector General also cited concerns with OSAGWI's task orders to BDM.[14]

When OSAGWI reached its allotted cost ceiling under the NGB contract and the NGB did not increase the contract ceiling, OSAGWI continued the arrangement with BDM through an order under the General Services Administration's Management, Organizational, Business Improvement Services (MOBIS) schedule contract. The MOBIS schedule states that it is intended to support business, management, and organizational improvement through activities such as quality management, benchmarking, reengineering, surveys, strategic planning, and development of leadership and management skills. The General Services

[13]10 U.S.C. § 2304c(c).

[14]See DOD Inspector General, *DOD Use of Multiple Award Task Order Contracts* – Report No. 99-116, Apr. 2, 1999.

Administration's summary of MOBIS services states that such contracts are not intended for independent management or technical studies.

The task order to BDM was outside the scope of the MOBIS contract. The work identified in the task order supports OSAGWI's operational functions and activities and does not fit properly within the scope of the contract. Specifically, the objective of the task order is to support OSAGWI's research and investigation into potential causes of Gulf War veterans' illnesses, rather than, as OSAGWI contends, to support efforts to improve managerial or organizational processes of the type intended for the MOBIS contract. In this regard, the MOBIS scope of work states that the "performance of operational activities" and database planning are not appropriate for purchase under MOBIS. Given the substantial disparity between the purposes of this contract and the BDM task order, we believe that the task order is outside the scope of the MOBIS contract and should not have been awarded under that contract. OSAGWI officials have informed us that this task order will expire in January 2000, but that the need for the type of support services that BDM is providing will continue for an indefinite period.

Competition for Task Order Discouraged

Under multiple award task order contracts, all of the multiple award contractors are to be given a fair opportunity to be considered for the award of any particular task order, typically by submitting proposals in response to agency announcements. Competition is one of the means by which agencies insure they obtain the best value from their contractors. OSAGWI's solicitation for one task order opportunity, however, discouraged competition among the multiple award contractors by naming Systems Research and Applications Corporation (SRA) as the preferred contractor.

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We have testified and reported that naming preferred contractors in task order announcements discourages competition, frequently resulting in just one proposal being received.[15] SRA was the only multiple award contractor that responded to the announcement.[16] OSAGWI has not argued that SRA was uniquely qualified to perform the required work.

Conclusions

During fiscal years 1997-98, the government expended considerable funds on research and investigation into Gulf War veterans' illnesses—about $121 million. More than half of this total was spent by the Office of the Special Assistant for Gulf War Illnesses.

Even though significant funding has been spent on research and investigation of Gulf War veterans' illnesses, most of the research is ongoing and the Research Working Group has not completed an assessment of the extent to which federal research objectives identified in 1995 have been satisfied. While about two-thirds of the 34 completed projects had resulted in peer-reviewed publications, researchers face increasingly difficult problems in identifying valid data on veterans' exposures. Moreover, little is known about how veterans' conditions have changed over time, no working case definitions have been endorsed in order to focus research efforts, and research on treatments has begun only recently. As a result, little knowledge exists concerning the causes, courses, or successful treatments for Gulf War veterans' illnesses. In addition, although the Office of the Special Assistant for Gulf War Illnesses has received most of the material requested of its research contractors, the review process established by the Office can be slow.

Coordination of planned efforts is key to maximizing the government's investment into research on Gulf War veterans' illnesses. However,

[15] *Defense Acquisition: Improved Program Outcomes Are Possible* (GAO/T-NSIAD-98-123, Mar. 18, 1998), and *Acquisition Reform: Multiple Award Contracting at Six Federal Organizations*, (GAO/NSIAD-98-215, Sept. 30, 1998). In response to our testimony, the Office of Management and Budget directed that the Federal Acquisition Regulation be revised to prohibit the naming of preferred contractors in task order announcements. The federal acquisitions regulation was revised to prohibit the designation of preferred awardees effective August 16, 1999.

[16] After the initial award was made to the preferred vendor identified in the announcement, succeeding awards were directed to the same vendor under an exception to the fair opportunity requirement for work that is a "logical follow-on" from prior work. Thus, the anticompetitive effect of directing the initial award was magnified in subsequent awards.

disagreement regarding which activities should be subject to coordination exists. As a result, the Office of the Special Assistant for Gulf War Illnesses, which spends more than half of the federal funds supporting research and investigation, has not effectively coordinated its activities with the Research Working Group.

DOD established the Office of the Special Assistant for Gulf War Illnesses to restore public confidence in DOD's efforts to deal with Gulf War illnesses issues. While officials of the Office of the Special Assistant for Gulf War Illnesses noted that they intended to seek advice on drawing down the office, they planned expenditures of $65.4 million across fiscal years 1999 and 2000, and the Office remains in DOD's budget through fiscal year 2005. Because the Office spends a high percentage of its budget on support contracts, it is important that its contracting procedures comply fully with applicable laws and regulations.

Recommendations

With respect to the health research efforts coordinated by the Research Working Group of the Persian Gulf Veterans' Coordinating Board, we recommend that the Secretaries of Veterans' Affairs, Defense, and Health and Human Services direct the executive director of the Research Working Group to

- establish and achieve a target date within fiscal 2000 for publishing its assessment of progress toward addressing the research objectives it identified in 1995;
- compile data on the number of Gulf War veterans with unexplained illnesses, the progression of their illnesses, the treatments they are receiving, and the success of these treatments (recognizing that application of some working case definitions or categorization scheme may be useful for purposes of such an accounting); and
- effectively coordinate the efforts of the Office of the Special Assistant for Gulf War Illnesses with related activities of DOD, VA, and HHS to prevent duplication and improve the efficiency of resource use.

We also recommend that the Secretary of Defense direct the Office of the Special Assistant for Gulf War Illnesses to replace the task order issued under the MOBIS contract with a proper contracting arrangement as soon as practicable. In addition, the Secretary should direct the Office of the Special Assistant for Gulf War Illnesses that all future support contracts should comply fully with applicable laws and regulations.

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Agency Comments and Our Evaluation

In written comments on a draft of our report, DOD and VA agreed with some of our findings and recommendations but disagreed with others, and CDC generally concurred with our findings and recommendations. DOD provided additional technical comments, which we incorporated as appropriate. Also, CDC requested that we incorporate additional information on two of its sponsored studies, which we did. (App. IV, V, and VI contain the written comments of DOD, VA, and CDC, respectively, and our evaluation of them.)

DOD commented that our report paints a pessimistic picture of the research on Gulf War veterans' health. The Department cited studies that compared the hospitalization in military facilities, the birth outcomes in military facilities, and the mortality of active duty Gulf War veterans to large groups of nondeployed veterans as support for a more optimistic perspective on veterans' health. However, DOD did not cite the most consistent finding of the health research to date; that is, Gulf War veterans seem to exhibit more of some symptoms, such as fatigue, difficulty concentrating, and muscle and joint pain, than do nondeployed veterans.[17] DOD believes that the failure to identify a "unique syndrome" is an optimistic sign of veterans' health overall. We disagree. Even if the symptoms reported more often by Gulf War veterans are not confined to those veterans, DOD needs to explain why Gulf War veterans report these symptoms more frequently. Furthermore, none of the studies DOD cited examined the possible existence of significant differences in the health of Gulf War veterans based on specific exposures to hazardous materials during military service.[18]

[17] Institute of Medicine, *Gulf War Veterans: Measuring Health* (Washington, D.C.: National Academy Press, 1999), p. 2; Iowa Persian Gulf Study Group, "Self-Reported Illness and Health Status Among Gulf War Veterans: A Population-Based Study," *Journal of the American Medical Association*, 227 (3), (1997), pp. 238-245; and K. Fukuda, et al., "Chronic Multisymptom Illness Affecting Air Force Veterans of the Gulf War," *Journal of the American Medical Association*, 380 (11), (1998), pp. 981-88.

[18] One study argued that the Gulf War veterans may have been more fit than those not deployed; thus, the finding of no difference between the two groups might suggest a significant decline in the post-war health of the Gulf War veterans. R. Haley, "Point: Bias From the 'Health Warrior Effect' and Unequal Follow-up in Three Government Studies of Health Effects of the Gulf War," *American Journal of Epidemiology*, 148 (4), (1998), pp. 315-23.

DOD also said that we were incorrect in stating that little is known about how veterans' conditions have changed over time. However, our report is consistent with a September 1999 report of the Institute of Medicine. The report notes that there has been no systematic evaluation of whether or how veterans' health status is changing.[19] Also, in a 1998 report to Congress, the Research Working Group stated that no government research is specifically directed toward understanding the progress of Gulf War veterans' illnesses over time and that research should determine the long-term health of these veterans.[20]

DOD further stated that the effectiveness of government research has been demonstrated in a variety of ways. We agree that the research to date has added to what was known about Gulf War veterans' health shortly after the war. Nevertheless, little information is available on the extent or course of the development of veterans' undiagnosed illnesses, basic information on the prevalence of veterans' symptoms is unavailable, and no research on the treatment of such illnesses has been completed. Although joint commands have revised joint policy on record-keeping, and operational changes have been made to improve environmental monitoring, these changes do not serve as proof of research effectiveness. Rather, they address problems that have challenged Gulf War researchers in interpreting data on veterans' illnesses because they lack accurate and precise information (i.e., duration and doses) on veterans' exposures to hazardous materials.

Both DOD and VA concurred with our recommendation that the Research Working Group set a date in fiscal year 2000 for reporting its progress in addressing the research objectives it identified in 1995. DOD confirmed, as we noted in our draft report, that this report is in progress, but neither agency provided a specific date for its publication.

Regarding our recommendation that steps be completed to compile data on the number of Gulf War veterans with unexplained illnesses, the treatments they were receiving, and the success of these treatments, DOD partially concurred and VA did not concur. Neither agency opposed the collection of information on the number and health status of Gulf War veterans with

[19] Institute of Medicine, *Gulf War Veterans: Measuring Health* (Washington, D.C.: National Academy Press, Sept. 1999), p. 3, 35.

[20] Persian Gulf Veterans' Coordinating Board – Research Working Group, *Annual Report to Congress – 1998* (Washington, D.C.: PGVCB RWG, June 1999), p. 53.

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unexplained illnesses. However, VA stated that it could not implement the recommendation as worded without specific case definitions (that is, criteria to identify distinct illnesses). We agree that some categorization scheme or set of working case definitions would be useful in counting the numbers of veterans that have unexplained illnesses of some type, and we revised our recommendation accordingly.

Although DOD concurred with our recommendation that the Research Working Group coordinate with the Office of the Special Assistant for Gulf War Illnesses on activities related to Gulf War veterans' illnesses, DOD disagreed that its current coordination was weak. It stated that coordination was already occurring and that coordination on Office-sponsored reviews of scientific literature was unnecessary because the reviews were not research. VA did not concur with the recommendation because most of the work of the Office of the Special Assistant involves investigations of specific wartime incidents rather than research.

Regardless of whether the work of the Office is considered research or not, it describes the extent and nature of veterans' possible exposures to hazardous materials. These descriptions are important to researchers trying to identify the health consequences of such exposure. Moreover, the law does not limit the Working Group's coordination efforts to activities that constitute research, however defined. Accordingly, we are now recommending that the Research Work Group effectively coordinate the activities of the Office of the Special Assistant with related activities of DOD, VA, and the Department of Health and Human Services to prevent duplication of effort and optimize the use of resources. We are making this recommendation to prompt these organizations to work more closely on behalf of ill veterans. We believe that greater cooperation, exchange of information, and coordination will help expedite the process and help find solutions the veterans need.

Finally, DOD did not concur with our recommendation to replace an improperly awarded task order as soon as practicable and to comply fully with applicable laws and regulations in future contracting activities. DOD noted that because its Gulf War Illnesses office does not have contracting officers, it relies on the professional judgment of contracting professionals outside that office, who did not object to the office's contract actions. DOD contends that the office complied with all legal requirements in effect at the time.

We note that DOD did not disagree with our conclusion that the task order was improperly awarded. The task order was for support of office operations in developing information related to Gulf War illnesses, even though the underlying contract prohibited its use for the performance of operational activities. The task order was therefore improper and should be terminated, if practicable, as we recommended.

We recognize that the Office of the Special Assistant relies on contracting professionals outside that office to execute its support contracts. Nevertheless, the office is, at a minimum, responsible for determining its requirements for support, a process that in one instance resulted in naming a preferred vendor and in another led to an overly broad statement of work. The effect of these practices is to discourage competition. It is important, therefore, that both requiring agencies, such as the Gulf War Illnesses office, as well as agencies that execute contracts, adhere to the statutes and regulations designed to maximize competition.

Scope and Methodology

To determine how much DOD, HHS, and VA have spent on research and investigation of Gulf War veterans' illnesses and health concerns in fiscal years 1997 and 1998, we reviewed budget documents, contracts, and other relevant documents. We also interviewed RWG members, as well as DOD, HHS, and VA officials managing the respective agencies' budgeting for research, investigation, and clinical care. During our interviews, we inquired about spending levels and the distribution of funds across activities.

The expenditure estimates included in this report are limited to DOD, VA, and HHS. Because we targeted key entities within these agencies on the basis of the public profile of their research and investigatory efforts, the expenditures we identified may exclude related spending by entities that have not been prominently identified with the federal effort. We did not independently assess the estimates provided us by the various agencies and offices apart from determining that they were basically consistent with the contract documents examined.

To determine the status of research efforts and identify research products, we reviewed research and investigatory objectives, reports to Congress, agency documents, and articles appearing in peer-reviewed journals. In addition, we interviewed researchers, PGVCB officials, and officials at the sponsoring agencies. We did not independently assess the appropriateness

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of federal research objectives, nor did we determine how well federally sponsored research had addressed them.

To investigate the extent of coordination between OSAGWI and the RWG, we interviewed members of OSAGWI, the RWG; representatives from DOD, HHS, and VA; and researchers about the process. We reviewed agency documents and the minutes of PGVCB and other meetings and examined research protocols, contracts, and documentation of reviews conducted by sponsoring agencies into research and investigatory activities.

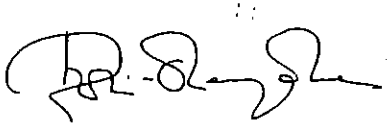
To determine the expenditures and resources OSAGWI had directed toward veterans' health concerns and the way it managed its contracts, we interviewed OSAGWI officials and contracting officers and reviewed contracts, task orders, statements of work, copies of deliverables, and requested any assessments of contractor performance. For efficiency, we limited the review to four support and five research contracts, which accounted for 91 percent and 72 percent of OSAGWI's expenditures in the respective areas.

Our work was conducted from May 1998 through December 1999 in accordance with generally accepted government auditing standards.

As agreed with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from its issue date. At that time, we will send copies of this report to other interested congressional committees and members.

If you have any questions or would like additional information, please contact those listed in appendix VII.

Sincerely yours,



Kwai-Cheung Chan
Director, Special Studies and Evaluations

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Research Objectives Identified by the Research Working Group of the Persian Gulf Veterans' Coordinating Board

1. What is the prevalence of symptoms/illnesses in the Persian Gulf veteran population? How does this prevalence compare to that in an appropriate control group?

2. What was the overall exposure risk of troops to Leishmania tropica?

3. What were the exposure concentrations to various petroleum products, and their combustion products, in typical usage during the Persian Gulf conflict?

4. What was the extent of exposure to specific occupational/environmental hazards known to be common in the Persian Gulf veteran's experience? Was this exposure different from that of an appropriate control group?

5. What were the potential exposures of troops to organophosphate nerve agent and/or sulfur mustard as a result of allied bombing at Muhammadiyat and Al Muthanna, or the demolition of a weapons bunker at Khamisiyah?

6. What was the extent of exposure to chemical agent, other than at Khamisiyah, Iraq, in the Persian Gulf as a function of space and time?

7. What was the prevalence of PB use among Persian Gulf troops?

8. What was the prevalence of various psychophysiological stressors among Persian Gulf veterans? Is the prevalence different from that of an appropriate comparison population?

9. Are Persian Gulf veterans more likely than an appropriate comparison group to experience non-specific symptoms and symptom complexes?

10. Do Persian Gulf veterans have a greater prevalence of altered immune function or host defense when compared with an appropriate control group?

11. Is there a greater prevalence of birth defects in the offspring of Persian Gulf veterans than in an appropriate control population?

12. Have Persian Gulf veterans experienced lower reproductive success than an appropriate control population?

13. Is the prevalence of sexual dysfunction greater among Persian Gulf veterans than among an appropriate comparison population?

14. Do Persian Gulf veterans report more pulmonary symptoms or diagnoses than persons in appropriate control populations?

15. Do Persian Gulf veterans have a smaller baseline lung function in comparison to an appropriate control group? Do Persian Gulf veterans have a greater degree of non-specific airway reactivity in comparison to an appropriate control group?

16. Is there a greater prevalence of organic neuropsychological and neurological deficits in Persian Gulf veterans compared to appropriate control populations?

17. Can short-term, low-level exposures to pyridostigmine bromide, the insect repellant DEET, and the insecticide permethrin, alone or in combination, cause short-term and/or long-term neurological effects?

18. Do Persian Gulf veterans have a significantly higher prevalence of psychological symptoms and/or diagnoses than do members of an appropriate control group?

19. What is the prevalence of leishmaniasis or other infectious diseases in the Persian Gulf veteran population?

20. Do Persian Gulf veterans have a greater risk of developing cancers of any type when compared with an appropriate control population?

21. Are Persian Gulf veterans experiencing a mortality rate that is greater than that of an appropriate control population? Are specific causes of death related to service in the Persian Gulf?

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Reports Received and Released by the Office of the Special Assistant Under Research Contracts Examined by GAO

Contractor	Contract amount	Topics/titles	Due	Received	Form and date of earliest known receipt	Released (as of 12/15/99)
Mitre Corporation[a]	$3,185,000	Iraqi Chemical Warfare Study	Yes	Yes	Classified draft report (4/4/97)[b]	Partial (9/5/97)[c]
RAND	$3,200,000	Oil Fires: A Review of the Scientific Literature as It Pertains to Illnesses of Gulf War Veterans	Yes[d]	Yes	Partial draft (12/97). Draft for agency review (4/16/98).	Yes[e] (11/5/98)
		A Review of Scientific Literature as It Pertains to Gulf War Illnesses, Volume V: Depleted Uranium	Yes[d]	Yes	Draft for agency review (8/4/98).	Yes (4/16/99)
		A Review of the Scientific Literature as It Pertains to Gulf War Illnesses, Volume VI: Chemical and Biological Warfare Agents	Yes[d]	Yes	Draft for agency review (9/1/98).	No
		A Review of the Scientific Literature as It Pertains to Gulf War Illnesses: Volume III: Pyridostigmine Bromide	Yes[d]	Yes	Draft for agency review (6/10/98).	Yes (10/19/99)
		Stress: A Review of the Scientific Literature as It Pertains to Health Problems of Gulf War Veterans	Yes[d]	Yes	Draft for agency review (4/23/98).	Yes (5/19/99)
		Infectious Disease	Yes[d]	Yes[f]	Draft for agency review (2/11/98).	No
		Immunizations	Yes[d]	Yes	Draft for agency review (4/22/99).	No
		Military Uses of Drugs Not Yet Approved by FDA for BW/CW Defense: Lessons from the Gulf War	Yes[d]	Yes	Draft for agency review (4/24/98).	Yes (4/16/99)
		Assessing the Health Effects of Military Deployments: DOD's Activities Following the Gulf War	Yes[d]	Yes	Draft for agency review (9/15/98).	No
		Notes on the history of stress	Yes[d]	No	Not received as of 12/20/99.	No
		Pesticides	Yes[d]	Yes	Draft for agency review (11/3/98).	No
Institute for Defense Analyses	$389,000	Full Dimensional Protection: Military Records and Reports Dimension	Yes	Yes	Draft for agency review (12/10/97) Revised draft (7/28/98).	No[g]

(Continued)

Contractor	Contract amount	Topics/titles	Due	Received	Form and date of earliest known receipt	Released (as of 12/15/99)
		Safe and Timely Disposal in Wartime of Large Quantities of Captured Chemical and Biological Munitions	Yes	Yes	Draft for agency review (11/8/97).	No[a]
		Protecting Against the Uncertain Risks of Exposure to Very Low Concentrations of Chemical Warfare Nerve Agents	Yes	Yes	Draft received 9/99.	No
		[A paper describing planned and possible alternative approaches for improving DOD capabilities to detect chemical agents on the battlefield and archive such data]	Yes	Yes	Report delivered 6/16/97.	No
National Academy of Sciences	$2,703,809[m]	Force Protection: Lessons Learned from the Gulf War	No[l]	No[l]	No final report due before 3/31/00.	
Birch & Davis Associates	$176,500[k]	Birth Defects Among Children of Gulf War Veterans and Potential Nerve Agent Exposure	Yes	Yes	Draft for agency review (8/21/98).	No[i]
		Comprehensive Clinical Evaluation Program Gulf War Studies and Analyses: Report on Findings from a Telephone Survey of Persian Gulf War Veterans Assigned to Demolition Units	Yes	Yes	Draft for agency review (12/1/97).	No
		Toxicity Assessment and Risk Evaluation for Exposure of U.S. Troops to Chemical Agents at Khamisiyah	Yes	Yes	Draft for agency review (5/22/98).	No
		Admissions to Field Hospitals During the Gulf War and Potential Nerve Agent Exposures	Yes	Yes	Draft for agency review (7/16/98).	No
	$9,654,309		20	19		6

(Continued from Previous Page)

[k]Mitre contracted with the Assistant to the Secretary of Defense for Intelligence Oversight, but the Office of the Special Assistant for Gulf War Illnesses (OSAGWI) was directed to provide $3,185,000 to support Mitre's work on the study. Although OSAGWI does not have direct oversight of the effort, the status of the study is shown here in the interest of tracking the products associated with funds provided to OSAGWI.

[l]The Office of the Assistant Secretary of Defense for Intelligence Oversight reported that no final report was available as of July 27, 1998.

[m]A declassified version of chapter 11 of this report was released by OSAGWI on September 5, 1997, in response to a request from the Presidential Advisory Committee on Gulf War Veterans' Illnesses. An official of the Office of the Assistant Secretary of Defense for Intelligence Oversight indicated on December 15, 1999 that he expected the report to be transmitted to the Secretary on or before December 25, 1999 accompanied by a recommendation for release of a substantial portion in unclassified form.

[n]Products of the RAND contract were originally due in September 1997. A December 1997 modification to RAND's agreement with the Department of Defense (DOD) reestablished due dates between December 1997 and January 1998.

[o]In many instances, the deadlines on these products were extended or the Office was slow to provide the official comment necessary for the contractor to issue a final product. OSAGWI also instituted a review process that incorporated comments from various government agencies. This process has required months to apply, and some deliverables spent a year or longer in unreleased or draft form. OSAGWI officials indicated that they initiated the external review process at the urging of the Research Working Group (RWG), but Group officials said that they encouraged an external, university-based review process, not the extensive interagency review OSAGWI adopted.

[p]OSAGWI officials told us that this document was finalized in August 1999 and distributed to the Office of the Secretary in October 1999, but has not been publicly released.

[q]OSAGWI officials told us that this document was finalized in October 1999 and distributed to the Office of the Secretary in November 1999, but has not been publicly released.

[r]The total cost of this contract over the anticipated period of performance, including option years, is expected to be $5,922,305.

[s]None of the report deliverables for this contract, apart from progress and status reports, was due before March 29, 1999, when a draft panel report was expected. A final interim report is due on March 29, 2000, and a final consensus report on September 29, 2000.

[t]Subsidiary products from this contract have been provided and released. The National Academy Press has released the following documents in 1999 as part of a series on Strategies to Protect the Health of Deployed U.S. Forces: (1) *Medical Surveillance, Record Keeping and Risk Reduction*; (2) *Analytical Framework for Assessing Risks* (and *Workshop Proceedings: Strategies to Protect the Health of Deployed U.S. Forces: Assessing Health Risks to Deployed U.S. Forces*); and (3) *Strategies to Protect Deployed U.S. Forces: Force Protection and Contamination*.

[u]The total amount of funds OSAGWI reported as supporting its research contract with Birch & Davis in fiscal years 1997 and 1998. The total cost of delivery order 48 for contract number DASW01-95-D-0026 was $1,684,773, but this order also covered substantial work for DOD/Health Affairs and its Deployment Surveillance Team to validate and analyze data from the Comprehensive Clinical Evaluation Program and other surveillance activities. Cost information is not available by product.

[v]An April 9, 1997, request by Birch & Davis Associates for approval to disseminate and/or publish articles based on analyses conducted under delivery order 48 was formally rescinded by an April 15, 1997, letter that cited a conversation on the subject that led the contractor to understand "that any request to disseminate and/or publish articles under the referenced contract must be done on a 'case by case' basis and must be accompanied by a definite publication plan." In explanation of non-release of one or more of this contractor's products, OSAGWI staff cited dissatisfaction with the deliverables as presented by the contractor in July 1998. However, they provided no written performance reviews for the contractor, explaining that the products were developed under a task order that was part of a contract with the Office of the Assistant Secretary of Defense for Health Affairs, which was presumably responsible for evaluating the contractor's performance.

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Sample Working Case Definitions Describing Symptoms Experienced by Gulf War Veterans

Origin	Date	Inclusion criteria	Exclusion criteria
Sanford[a]	1994	(1) In theater of operations between 8/8/90 and late July 1991 (2) New onset of a symptom complex with the occurrence of at least five of eight minor criteria: fatigue, arthralgia, headache, diarrhea, neuropsychiatric complaints, difficulty sleeping, low-grade fever, and/or weight loss.	Other clinical conditions with similar symptomologies based on thorough evaluation, including history, physical exam and appropriate lab studies.
Haley[b]	1997	The three primary syndromes are impaired cognition (symptoms include distractibility, difficulty remembering, depression, middle and terminal insomnia, fatigue, slurring of speech, confused thought process, and migraine-like headaches); confusion-ataxia (symptoms include problems with thinking and reasoning processes, getting confused, getting disoriented, problems keeping their balance, posttraumatic stress disorder, depression, liver disease, and sexual impotence); and arthro-myo-neuropathy (symptoms include generalized joint and muscle pains, increased difficulty lifting heavy objects, muscle exhaustion after exertion, and tingling or numbness of the hands, arms, feet, and legs).	
CDC[c]	1998	One or more chronic symptoms (present for more than 6 months) from at least two of the following three categories: fatigue, mood and cognition (feeling depressed, difficulty remembering or concentrating, feeling moody, feeling anxious, trouble finding words or difficulty sleeping), and/or musculoskeletal (joint pain, stiffness, or muscle pain).	Other clinical conditions with similar symptomologies based on thorough evaluation, including history, physical exam and appropriate lab studies.
National Health Survey Team[d]	1999	Combination of blurred vision, loss of balance/dizziness, tremors/shaking, and speech difficulty (reported by 27.7 or 2.4 percent of surveyed Gulf-deployed veterans in contrast to 43 or 0.5 percent of surveyed nondeployed veterans).	

[a]Memorandum from Jay P. Sanford, M.D. to MG Ronald Blanck, MC USA, re: Gulf War Syndrome: Proposed Provisional Case Definition, Jan. 27, 1994.

[b]Robert W. Haley et al., "Is There a Gulf War Syndrome? Searching for Syndromes by Factor Analysis of Symptoms," *Journal of the American Medical Association*, vol. 277 (Jan. 15, 1997), pp. 215-222.

[c]Keiji Fukuda et al., "Chronic Multisymptom Illness Affecting Air Force Veterans of the Gulf War," *Journal of the American Medical Association*, vol. 280 (Sep. 16, 1998), pp. 981-988.

[d]National Health Survey Research Team, "Unique Cluster of Symptoms Among Gulf Veterans," in The Research Working Group [of the] Persian Gulf Veterans Coordinating Board, *Conference on Federally Sponsored Gulf War Veterans' Illnesses Research: Program and Abstract Book*, 1999, p. 99.

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Comments From the Department of Defense

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

OFFICE OF THE SECRETARY OF DEFENSE
1000 DEFENSE PENTAGON
WASHINGTON, DC 20301-1000

AUG 19 1999

Mr. Kwai Cheung Chan
Director, Special Studies and Evaluations
National Security and International Affairs Division
General Accounting Office
Washington, D.C. 20548

Dear Mr. Chan:

This is the Department of Defense (DoD) response to the General Accounting Office (GAO) draft report, "GULF WAR ILLNESSES: Management Actions Needed to Answer Basic Research Questions", dated July 16, 1999 (GAO Code 713038/OSD Case 1865).

Federal Gulf War veterans' illnesses research encompasses a wide variety of research approaches (basic research through applied research) spanning a broad spectrum of technical disciplines. The effectiveness of this research has been demonstrated through the refinement of future research direction, progress in the development of clinical treatment efforts, changes in health care operations policy and doctrine to emphasize military force health protection, publications in the technical literature, and the outcomes of peer review. Still, the full impact of Federal Gulf War veterans' illnesses research will not be realized for years.

See comment 1.
See comment 2.

See comment 3.

The GAO paints a pessimistic picture and incorrectly states that "little is known about how veterans conditions have changed over time." Although further research is in progress, a more optimistic perspective on veterans' health has been provided by an extensive descriptive and analytic epidemiological research effort based on clinical evaluations and medical records. Systematic clinical examinations have not identified a unique syndrome or a characteristic organic abnormality among over 100,000 U.S., British, and Canadian Gulf War veterans. Additionally, the mortality rate of Gulf War veterans has been less than half that of the civilian population, and overall deaths due to medical causes have not increased. Moreover, there has been no overall increase in hospitalizations among Gulf war veterans or birth defects among their children.

See comment 4.

See comment 5.

See comment 6.

See comment 7.

See comment 8.

Significantly, the GAO fails to understand that the Office of the Special Assistant for Gulf War Illnesses (OSAGWI) is not responsible for either DoD's medical programs or medical research. OSAGWI's unique charge is to investigate and explain what occurred. OSAGWI's sponsorship of the RAND

See comment 9.

See comment 9.

See comment 10.

See comment 11.

literature reviews was meant to inform, not to conduct research. Since the literature reviews are not research, they do not fall under the Research Working Group (RWG). Consequently, DoD disagrees with GAO's assertion that coordination between the RWG and OSAGWI is weak. The Draft Report does not state exactly what "weak coordination" means, and also does not mention that an OSAGWI representative is a formal member of the RWG and provides input.

DoD agrees with the GAO recommendation that the RWG should publish a more formal assessment of progress toward addressing the research objectives identified in 1995. However, the GAO omits that this update is a work in progress and was ongoing at the time of the GAO audit. The GAO also fails to note the extensive research management, ongoing assessment, and oversight provided by the RWG since identifying research objectives in 1995. It is important to note that the annual reports published by the RWG analyze the Federal Government's portfolio of research on Gulf War veterans' illnesses, highlighting significant research and research-related events and milestones, discussing the management of federal Gulf War veterans' illnesses research programs (including research oversight, peer-review and coordination), and articulating priorities for future research. The GAO also omits the DoD-specific review of the research program by the Armed Services Biomedical Research Evaluation and Management (ASBREM) Committee and by an independent panel of experts during the Technology Area Review and Assessment (TARA). Both these forums have provided oversight and guidance to the DoD biomedical research efforts to date on illnesses among Gulf War veterans. Program management, oversight, and assessment is continuous.

The GAO apparently did not consider ongoing work by the Departments of Defense, Veterans Affairs, and Health and Human Services when making the recommendation to "ensure that steps are completed to compile data on the number of veterans with Gulf War illnesses, the progression of their illnesses, the treatments they are receiving, and the success of their treatments." Gulf War veterans have experienced a wide variety of diagnosed and undiagnosed medical conditions, which span the entire range of medical experience. DoD reiterates the consensus of the scientific community, including prior findings of the Institute of Medicine, that Gulf War veterans' illnesses appear to be a heterogeneous group of disorders, exhibiting widely varying manifestations and not amenable to a single unifying case definition. Therapeutic approaches have been tailored appropriately to each individual veteran's needs. However, the methodology for evaluating health outcomes and treatment efficacy in such a complex situation has not been developed. The task of designing a protocol for acquiring and analyzing longitudinal information to provide an accurate assessment of the health outcomes and treatment results in Gulf War veterans poses a significant challenge. Consequently, last year the Departments of Defense and Veterans Affairs requested that the National Academy of Sciences establish a committee to consider these methodological questions. The final report from the Academy is expected later this month.

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See comment 12.

DoD also disagrees with GAO's criticism of OSAGWI's contracting practices. OSAGWI does not have its own independent contracting officers, but relies upon the professional judgment of government contracting professionals. Contracting officers at GSA FEDSIM, National Guard Bureau, Defense Supply Service – Washington, GSA Kansas City and the National Institute of Health agreed with various OSAGWI contract actions, and raised no objections to them.

Lastly, DoD strongly objects to the wording of Recommendation 3 because it implies that OSAGWI did not obey the law when contracting. As previously stated, federal contracting personnel reviewed the BDM and SRA task orders and raised no objections. OSAGWI's contracts complied with all applicable laws and regulations.

DoD's summary and detailed comments on the Draft Report are set forth in the enclosures.

Sincerely yours,

Bernard Rostker

Enclosures

"GULF WAR ILLNESSES: Management Actions
Needed to Answer Basic Research Questions,"
Dated July 16, 1999
(GAO Code 713038/OSC Case 1865)

DEPARTMENT OF DEFENSE COMMENTS
TO THE GAO RECOMMENDATIONS

RECOMMENDATION 1: The GAO recommended that the Secretaries of Veterans' Affairs, Defense, and Health and Human Services direct the Executive Director of the Persian Gulf Veterans Coordinating Board's Research Working Group (RWG) to ensure that:

- The RWG establishes a date within fiscal 1999 or 2000 for publishing its assessment of progress toward addressing the research objectives it identified in 1995,
- Steps are completed to compile data on the number of veterans with Gulf War illnesses, the progression of their illnesses, the treatments they are receiving, and the success of these treatments;
- The RWG defines research activities and takes necessary steps to ensure any efforts meeting this definition by the Office of the Special Assistant for Gulf War Illnesses (OSAGWI) are subject to coordination. (pp. 16-17/GAO Draft Report)

DOD RESPONSE:

Part 1, Concur: DoD agrees that the RWG publish a more formal assessment of progress towards addressing the research objectives identified in 1995. In fact, this update is a work in progress and was ongoing at the time of the GAO audit. The Department has also performed extensive research management, ongoing assessment, and oversight through the RWG since identifying research objectives in 1995. The annual reports published by the RWG analyze the Federal Government's portfolio of research on Gulf War veterans' illnesses, highlighting significant research and research-related events and milestones, discussing the management of federal Gulf War veterans' illnesses research programs (including research oversight, peer-review and coordination), and articulating priorities for future research.

See comment 10.

Part 2, Partially Concur: While the Department is pursuing the compilation of data, this task is not as basic as the Draft Report implies. The Departments of Defense, Veterans Affairs, and Health and Human Services are currently working together to "ensure that steps are completed to compile data on the number of veterans with Gulf War illnesses, the progression of their illnesses, the treatments they are receiving, and the success of their treatments." However, Gulf War veterans have experienced a wide variety of diagnosed and undiagnosed medical conditions, which span the entire range of medical experience. DoD concurs with the consensus of the scientific community, including prior findings of the Institute of Medicine, that Gulf War veterans' illnesses appear to be a heterogeneous group of disorders, exhibiting widely varying manifestations and not amenable to a single unifying case definition.

See comment 11.

Therapeutic approaches have been tailored appropriately to each individual veteran's needs. To date, the methodology for evaluating health outcomes and treatment efficacy in such a complex situation has not been developed. Consequently, the task of designing a protocol for acquiring and analyzing longitudinal information to provide an accurate assessment of the health outcomes and treatment results in Gulf War veterans poses a significant challenge. Consequently, last year the Departments of Defense and Veterans Affairs requested that the National Academy of Sciences establish a committee to consider these methodological questions. The final report from the Academy is expected later this month.

See comment 11.

Part 3, Concur: While the Department agrees that there should be a close coordination between the two entities on research activities, we believe this is already occurring. It appears that the GAO has misinterpreted OSAGWI's mission, since OSAGWI is not responsible for either DoD's medical programs or medical research. OSAGWI's unique charge is to investigate and explain what occurred. Therefore, OSAGWI's sponsorship of the RAND literature reviews was meant to inform, not to conduct research. Since the literature reviews are not research, they do not fall under the RWG. Consequently, DoD disagrees with GAO's assertion that coordination between the RWG and OSAGWI is weak. The Draft Report does not state exactly what "weak coordination" means, and also does not mention that OSAGWI is a formal active member of the RWG.

See comment 9.

RECOMMENDATION 2: The GAO also recommended that the Secretary of Defense direct the OSAGWI to replace the task order issued under the General Service Administration's Management, Organizational, Business Improvement Services (MOBIS) schedule contract with a proper contracting arrangement as soon as it is practical to do so. (P.17/GAO Draft Report)

DOD RESPONSE:

Not Concur: DoD disagrees with GAO's criticism of OSAGWI's contracting practices. OSAGWI does not have its own independent contracting officers, but relies upon the professional judgment of government contracting professionals. Contracting officers at GSA FEDSIM, National Guard Bureau, Defense Supply Service – Washington, GSA Kansas City and the National Institute of Health agreed with various OSAGWI contract actions, and raised no objections to them.

See comment 12.

RECOMMENDATION 3: The GAO further recommended that the Secretary of Defense direct OSAGWI to ensure that all future support contracts comply fully with applicable laws and regulations. (p. 17/GAO Draft Report).

DOD RESPONSE

Not Concur: DoD strongly disagrees with the wording of this recommendation because it implies that OSAGWI did not obey the law when contracting. OSAGWI's contracting actions complied with the laws and regulations in effect at the time of award. Moreover, numerous federal contracting officials reviewed OSAGWI's various task orders and did not raise any objections.

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GAO Comments

The following is GAO's response to the Department of Defense's (DOD) comments dated August 19, 1999.

1. With respect to the refinement of future research direction, it is important to note that a National Institutes of Health working group assembled in 1994 noted the desirability of identifying one or more case definitions or an evolving case definition to focus research efforts. Our report notes that the Research Working Group had not endorsed one or more case definitions that might focus future research efforts on veterans' unexplained illnesses and that problems with exposure data persist.

2. Our report notes that 8 years after the war, the Department of Veterans' Affairs has just begun to recruit subjects for clinical trials and no treatment research has yet been completed. We have not evaluated the quality of these trials or the selection of treatments to be evaluated.

3. Longitudinal follow-up of mortality, cancer rates, and health status will require many years. However, without accurate and precise exposure data (i.e., duration and dose), the interpretation of morbidity and mortality data from these studies will remain challenging.

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4. The facts and observations in this report are consistent with those of the Institute of Medicine (IOM). The Institute noted in a report issued in mid-September 1999, the month after DOD provided its formal comments, that no one has systematically evaluated whether the health of Gulf War veterans is changing and, if so, how. Similarly, it noted that no one had determined the number of veterans who have symptoms of illnesses that they attribute to service in the Gulf War, or whether the health of these veterans is better than, worse than, or the same as that of veterans who were not deployed to the Gulf War, although some studies have found higher levels of reported symptoms among Gulf War veterans.[1] In addition, RWG, in its annual report to Congress for 1998 stated that, "although several individual research projects...have longitudinal components built into them, no research is specifically directed toward understanding the progress of Gulf War veterans' illnesses over time. The RWG has concluded that to the extent feasible, research approaches need to be applied to determine the long-term health of Gulf War veterans in contrast to the several cross-sectional epidemiological research projects recently completed or still ongoing."[2]

[1]Institute of Medicine. *Gulf War Veterans: Measuring Health.*

[2]Persian Gulf Veterans' Coordinating Board – Research Working Group. *Annual Report to Congress* – 1998.

5. It has been difficult for researchers to progress from descriptive to analytical epidemiology due partly to the absence of accurate and precise data on the factors to which veterans were exposed. None of the research DOD cited compared veterans on the basis of their specific exposure history. Instead, results generally describe the experience of persons who were on active duty in the Gulf War theater (that is, the Persian Gulf, Kuwait, Iraq, Saudi Arabia, the Red Sea, the Gulf of Oman, the Gulf of Aden, the northern portion of the Arabian Sea, Oman, Bahrain, Qatar, or the United Arab Emirates) between August 2, 1990, and June 13, 1991, as compared to those who were on active duty elsewhere during this time frame. As we noted in 1997, one might not find differences between these large and diverse groups even if some veterans have illnesses that are significantly related to specific military exposures. Nonetheless, researchers have documented that these two groups differ in their frequency of reporting various symptoms and, even with poorly defined exposures, some investigators have reported associations between certain exposures and indicators of veterans' post-war health.[3]

[3]See, for example, S. P. Proctor et al., "Health Status of Persian Gulf War Veterans: Self-reported Symptoms, Environmental Exposures, and the Effect of Stress," *International Journal of Epidemiology* 27 (6), 1000-10. Unwin, C. et al. (1999.) Health of U.K. Servicemen Who Served in Persian Gulf War. *Lancet*, 353, 169-178. Haley, R. W., & Kurt, T. L. (1997). Is There a Gulf War Syndrome? *Journal of the American Medical Association*, 277 (3). 215-22 and related articles at 223-37.

6. DOD's comments do not embrace the most consistent finding of the health research to date. As IOM concluded, "There does seem to be a higher prevalence of some symptoms among veterans who served in the Gulf War as compared to nondeployed veterans. The primary symptoms include fatigue, difficulty concentrating, memory loss, skin rash, headache, and muscle and joint pain."[4] Several studies support this conclusion. For example, a study funded by the Centers for Disease Control conducted telephone interviews of a stratified random sample of 3,695 of 29,000 Gulf War-era military personnel listing Iowa as their home of record and found that those deployed to the Gulf War were more likely than those who served elsewhere during the war to report symptoms suggestive of cognitive dysfunction, depression, chronic fatigue, post-traumatic stress disorder, and respiratory illness (asthma and bronchitis).[5] These symptoms appeared to affect the functional activity and daily lives of the Gulf War veterans. Similarly, a CDC study of Air Force personnel found that a multisymptom case definition developed after clinical examination of 158 veterans was, in its severe form, reported several times more frequently by sampled Gulf War veterans than by nondeployed personnel.[6] Mild-to-moderate cases, while more evenly spread, were still well over twice as common in the Gulf War group. Gulf War veterans classified as having mild-to-moderate and severe illness had a significant decrease in functioning and well-being compared with Gulf War veterans who did not fit the criteria for the multisymptom illness. Similar findings were reported in a study of 3000 veterans from New England, a study of 525 women veterans, and a study of 8,000 veterans from the United Kingdom.[7] Moreover, a survey of Canadian veterans found significantly higher rates of self-reported chronic conditions and symptoms of a variety of conditions among Gulf-deployed veterans compared to those serving elsewhere during the Gulf conflict.[8] The conditions reported more frequently by Gulf War

[4]Institute of Medicine (1999). *Gulf War Veterans: Measuring Health*, Washington, D.C.: National Academy Press p. 2.

[5]Iowa Persian Gulf Study Group. (1997). Self-reported Illness and Health Status Among Gulf War Veterans: A Population-Based Study. *Journal of the American Medical Association*, 277 (3). 238-245.

[6]See Fukuda, K. et al. (1998.) Chronic Multisymptom Illness Affecting Air Force Veterans of the Gulf War. *Journal of the American Medical Association*, 280, 981-88. They report that 6.0% of 1155 Gulf War veterans they surveyed reported symptoms that fit their working definition of a severe case of multisymptom illness, while only 0.7% of the 2520 surveyed non-deployed personnel did so. The investigators reported that the univariate association between Gulf War veteran status and fitting the severe case criteria was statistically significant (odds ratio =12.7 with 95% confidence limits between 7.5 and 21.5).

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veterans included problems with bones and joints, allergies, and limitations in activity due to health.

It is common throughout the epidemiological literature to accept a statistically significant difference in the risk of an illness as evidence of association. Even if the symptoms disproportionately reported by Gulf War veterans are not confined to these veterans, their increased frequency among Gulf War veterans needs to be explained. IOM has similarly concluded that, "It appears that veterans who served in the Gulf are more likely than their nondeployed comrades or civilians to experience a set of symptoms that include cognitive, musculoskeletal and energy/fatigue elements. In some cases, the symptoms are severe enough to be totally debilitating. Not all veterans experience the same cluster of symptoms; therefore, assuming a single underlying pathology or single cause for the complaints would not be appropriate."[9]

[8]Wolfe, J. et al. (1998.) Health Symptoms Reported by Persian Gulf War Veterans Two Years After Return. *American Journal of Industrial Medicine*, 33, 104-113. Unwin, C. et al. (1999.) Health of U.K. Servicemen Who Served in Persian Gulf War. *Lancet*, 353, 169-178. Pierce, P. (1997.) Physical and Emotional Health of Gulf War Veteran Women. *Aviation, Space and Environmental Medicine*, 68, 317-21.

[9]Goss Gilroy, Inc. (1998.) *Health Study of Canadian Forces Personnel Involved in the 1991 Conflict in the Persian Gulf*, vol. 1. Ottawa: Goss Gilroy.

[10]Institute of Medicine (1999). *Gulf War Veterans: Measuring Health*. Washington, D.C.: National Academy Press, p. 33.

7. Veterans of the Gulf War differ from the general civilian population with respect to fitness profile and other factors, so it is not surprising that their mortality rate would also differ from the rate for the general civilian population. Research found the mortality rate of Gulf War veterans through September 1993 to be slightly higher than that of veterans of the same era who served elsewhere, with the difference explained largely by greater mortality in motor vehicle accidents.[10] In the published report of the mortality study, the authors speculate that increased mortality in automobile accidents might be attributed to increased risk-taking among war veterans in general, but they note that the reasons for the excess of deaths due to external causes among war veterans are not well understood. The finding was replicated in a follow up study extending the observation period through December 1997.[11]

[10]The odds ratio for this difference was 1.09 with 95% confidence limits between 1.01 and 1.16. See Kang, H.K. & Bullman, T. A. (1996.) Mortality Among U.S. Veterans of the Gulf War. *New England Journal of Medicine*, 335, 1498-1504. See also Haley, R. W., (1998.) "Commentaries: Point: Bias from the 'Healthy Warrior Effect' and Unequal Follow-up in Three Government Studies of Health Effects of the Gulf War." *American Journal of Epidemiology*, 148 (4), pp. 315-338.

[11]The follow-up study found that the excess in deaths attributable to motor vehicle accidents persisted among Gulf War veterans observed through December 1997 (crude rate ratio = 1.32; confidence interval 1.23-1.41), while the risk of disease related deaths did not increase or decrease over time. See Kang, H.A. & Bullman, T. A. (1998). Mortality Among U.S. Veterans of the Gulf War: Update Through December 1997. *Conference on Federally Sponsored Gulf War Veterans' Illnesses Research: Program and Abstract Book*, (June 23-25, 1999). Washington, D.C.: The Research Working Group of the Persian Gulf Veterans' Coordinating Board, p. 28.

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8. DOD does not note the methodological limitations of these studies as their authors do in the respective published reports. As noted by IOM, the studies of hospitalization (Gray et al., 1996; Knoke and Gray, 1998) and adverse birth outcomes (Araneta et al., 1997; Cowen et al., 1997) have been limited to personnel remaining on active duty and to events occurring in military hospitals. Conceivably, those suffering from Gulf War-related symptoms might leave active duty voluntarily or take a medical discharge. Hospitalizations for that group would appear in VA or private sector databases but not in the DOD database. The health or characteristics of active duty personnel could differ from those of personnel who have left active duty or who have been treated in nonmilitary hospitals. Moreover, economic and other non-health related factors are likely to affect use of nonmilitary hospitals and health care services.[12] However, through 1993, studies did not observe an increase in hospitalization among deployed versus nondeployed veterans in the active duty military. Knoke and Gray, analyzing the same database, observed slightly more admissions for symptoms, signs and ill-defined conditions among Gulf-deployed veterans than among veterans deployed elsewhere during the same timeframe. They attributed the difference to admissions for evaluation purposes under the Comprehensive Clinical Evaluation Program, which offered examination and diagnostic services to Gulf War veterans.

9. Whether OSAGWI performs medical research is not relevant to determining whether the Research Working Group should coordinate its activities. We see nothing in the law that would limit the Group's coordinating efforts to activities that constitute research, however defined.

DOD also contends that OSAGWI does not need to coordinate with RWG and that it has coordination mechanisms. However, DOD's assertion that close coordination is already occurring is difficult to reconcile with our finding that duplication has occurred. Federal agencies have commissioned at least three reviews of the health effects of depleted uranium in the last few years, one each by the agencies represented on RWG. In addition, two major efforts to review the health effects of Gulf War veterans' exposures have been pursued more or less independently – one by RAND, under contract to DOD, and another by the National Academy of Sciences, under contract to VA.

[12]Institute of Medicine (1999). *Gulf War Veterans: Measuring Health*, Washington, D.C.: National Academy Press, p. 36.

Minutes of RWG meetings from April 1997 forward indicate that they have been attended by a succession of OSAGWI professional staff, as participants or observers, and we have revised the report to reflect this. Nonetheless, the working relationship between these organizations appears far from seamless. For example, RWG felt it necessary to write to OSAGWI to request a briefing on the literature reviews the office had tasked RAND to conduct. Similarly, in a letter to OSAGWI in April 1997, a VA RWG official expressed concerns about the lack of external review for several of OSAGWI's proposed research efforts.

We understand that OSAGWI is not responsible for DOD's medical research programs. As noted in our report, we deliberately adopted a broad scope, to include both research and investigation of exposure scenarios, to comprehensively examine relevant efforts. In any event, some of OSAGWI's projects (listed in app. II) constitute research not only by the dictionary definition that DOD cites but also by DOD's more restrictive criteria.

Whether these undertakings are regarded as research or some other type of endeavor, our interest was in assessing their productivity. Thus, the key point is that most of the contracted projects are completed, but only a handful had been released.

10. While DOD and others have published various assessments of the research program, none of them have directly addressed the status of the research objectives identified in 1995. We requested this information from RWG officials, orally and in writing, and did not receive it. DOD contends that the effectiveness of these research efforts is not yet fully measureable. However, what is needed is not a final judgment but a simple accounting of where federal efforts stand with respect to answering the basic questions identified in 1995.

11. We have not called for an identification of a single unifying case definition or a summary judgment of treatment efficacy for heterogeneous conditions. However, it would seem reasonable to expect an accounting of the status of veterans' health over time and a description of the types of treatments they have received. DOD suggests that it would be unreasonably difficult to provide such information. We note in the text that some basic questions about veterans' health may be addressed by VA's national health survey. However, at this writing, data from the survey have not yet been published. In mid-September 1999, the National Academy of Sciences Institute of Medicine Committee that VA commissioned to study methodological problems issued a report that describes a method of health

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assessment. The law requires that VA continue this process by reviewing the methods suggested by IOM and pursuing, to the extent feasible, the collection of appropriate data.

12. With respect to the task order issued under the Management, Organizational, Business Improvement Schedule (MOBIS) contract, OSAGWI does not take issue with our conclusion that the order is outside the scope of the contract. For the reasons stated in the report, we continue to believe that the task order was improper. Therefore, the order should be terminated, if practicable, as we recommended and the office should ensure that any subsequent support contract is properly awarded.

We recognize that OSAGWI relies on contracting professionals outside that office to execute its support contracts. However, that does not absolve the office of all responsibility concerning how its contract support is acquired. At a minimum, OSAGWI is responsible for determining and articulating its requirements, a process that in one instance resulted in the naming of a preferred vendor and in another instance led to an overly broad statement of work. The effect of these practices was to discourage competition for over $20 million in awards and therefore to risk inefficient use of funds. It is important that both entities that initiate requests for goods and services (for example, OSAGWI) as well as agencies that execute contracts for these goods and services ensure adherence to the statutes and regulations designed to maximize competition.

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Comments From the Department of Veterans' Affairs

Note: GAO comments supplementing those in the report text appear at the end of this appendix.



DEPARTMENT OF VETERANS AFFAIRS
ASSISTANT SECRETARY FOR PLANNING AND ANALYSIS
WASHINGTON DC 20420

SEP 9 1999

Mr. Kwai-Cheung Chan
Director, Special Studies and Evaluation
National Security and International Affairs Division
U. S. General Accounting Office
441 G Street, NW
Washington, DC 20548

Dear Mr. Chan:

This is in response to your draft report, ***GULF WAR ILLNESSES: Management Actions Needed to Answer Basic Research Questions*** (GAO/NSIAD-99-103). Although we agree with much of the report, we have several concerns regarding portions of GAO's findings, conclusions and recommendations. These concerns preclude us from concurring with recommendations two and three.

See comment 1.

The GAO report notes (pages 6 and 10) that many questions about Gulf War veterans remain unanswered, including the prevalence of diagnosed and undiagnosed illnesses, what treatments have been received, and whether Gulf War veterans who have received care in VA facilities are getting better or worse. While complete answers to these questions are not yet available, the Veterans Health Administration (VHA) has taken considerable effort to address these issues. As we have previously reported, VHA has carried out several activities that provide longitudinal information on the health status of Gulf War veterans. This is, however, a highly complex question, and the answers provided are, admittedly, incomplete. The methodology to obtain valid, definitive answers to the questions GAO poses is not insignificant. To obtain advice on the optimal methods to assess the health status of Gulf War veterans, we contracted with the National Academy of Sciences, Institute of Medicine (IOM). The IOM committee established for this project sponsored a workshop in Washington, D.C. on May 7, 1998, and released its Workshop Summary on August 31, 1998. This summary did not contain any conclusions or recommendations. The committee will publish its final report and recommendations in September 1999.

See comment 2.

In order to acquire more detailed information about veterans' perceptions of their care, we conducted a detailed Gulf War veteran customer satisfaction survey during the past fiscal year. We intend that this will become a longitudinal feedback mechanism to assess current levels of customer satisfaction with VA care, to measure functional health status, and to assess improvements in these areas. In addition to this survey, VHA's Office of Quality and Performance also conducted Gulf War veteran focus groups to assess further the special needs and concerns of these individuals.

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See comment 2.

In further pursuit of identifying the most effective treatment modalities and clinical settings, VA has initiated five clinical demonstration projects at seven VAMCs for case management and multidisciplinary specialized Gulf War clinics. The demonstration projects, which are funded as two-year studies, will support this important effort by using objective outcome measures to assess whether health care and patient satisfaction for Gulf War veterans are improved by multidisciplinary specialized Gulf War clinics or by case management approaches.

See comment 3.

GAO states, "because of the way data on symptoms are recorded in VA and the Department of Defense (DoD) registries, the registries are not good sources of information regarding the prevalence of various symptom clusters among veterans groups." This statement is incorrect. The Registry's inability to determine incidence and prevalence of Gulf War veteran's health problems is unrelated to the manner in which the data are recorded in the database. The Gulf War Health Registries are not adequate for determining the prevalence of symptoms or diagnoses in the Gulf War population because of the self-selected nature of this voluntary health examination program. Although VA's registry is severely limited as a research tool, it has served the purpose for which it was established.

GAO is critical of the coordination between the Persian Gulf Veterans' Coordinating Board's (PGVCB) Research Working Group (RWG) and the Office of the Special Assistant to the Deputy Secretary of Defense for Gulf War Illnesses (OSAGWI). We take issue with this conclusion for a number of reasons. First, it is important to note that the role of the PGVCB is one of communication and coordination of its member agencies' activities; it does not control these activities. Second, OSAGWI is represented on the RWG's parent organization, the PGVCB, along with the Department of Defense Office of Biomedical Research and Office of Health Affairs. Third, the overwhelming majority of OSAGWI's work has been focused on determination of facts concerning specific incidents of the Gulf War as opposed to research. This work would not be subject to overview by the PGVCB.

ments 4-6.

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Additionally, GAO inappropriately illustrates the lack of communication and coordination between the RWG and OSAGWI through two contracts. The OSAGWI contract with the RAND Corporation is for literature reviews on various Gulf War topics; VA's contract with the IOM is for an analysis of the scientific literature to determine whether associations exist between Gulf War exposures and health effects. This example is inappropriate for a number of reasons. First, the published RAND reports are made available to the IOM. In fact the IOM has a copy of the RAND report on depleted uranium and the Department of Health and Human Services (HHS) Agency for Toxic Substances and Disease Registry (ATSDR) report on uranium and will review these documents as appropriate. Second, the RAND reports and the IOM committee's study use different

3. Mr. Kwai-Cheung Chan

methods, have different goals, and are not duplicative. The Presidential Advisory Committee was aware of the RAND work and still recommended that VA contract with the IOM for its study. An IOM committee will provide a comprehensive review, evaluation, and summary of available scientific/medical information regarding the association between exposure during the Gulf War and adverse health effects experienced by Gulf War veterans. This review will include an assessment of biologic plausibility that exposures, or synergistic effects of combinations of exposures, are associated with illnesses Gulf War veterans experienced. The NAS will make recommendations for additional scientific studies to resolve areas of continued scientific uncertainty related to health consequences. Finally, the IOM study is being carried out under legislative mandates provided in both Public Law 105-368 and Public Law 105-277.

See comment 8.

See comment 9.

See comment 10.

While we agree that many questions about Gulf War veterans' symptoms remain unanswered, there is still no evidence that the symptoms reported by veterans constitute a unique disease entity. Consequently, no single case definition is appropriate.

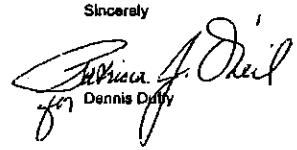
See comment 11.

We concur with recommendation one, that the RWG establish a date in FY 1999 or FY 2000 for publishing its assessment of progress toward addressing the research objectives it identified in 1995. As worded in the draft report, we cannot concur with recommendation two, to complete steps to compile data on the number of veterans with Gulf War illnesses, the progression of their illnesses, the treatments they are receiving, and the success of these treatments. Without clear case definitions the recommendation cannot be implemented as currently worded. GAO should consider revising the recommendation to read, ". . . the number of veterans with unexplained Gulf War illnesses. . . ." This would remove the implied causality associated with the current wording of the recommendation. Finally, we do not concur with recommendation three. As discussed above, the RWG has already provided sufficient information on the scope of activities that it has and continues to coordinate among VA, DoD and HHS.

See comment 12.

Thank you for the opportunity to comment on your draft report.

Sincerely



Dennis Duffy

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GAO Comments

The following is GAO's response to the Department of Veterans' Affairs comments dated September 9, 1999.

1. VA acknowledges that complete answers remain unavailable to the basic questions we identified in this report and in an earlier report (for example, how many veterans have unexplained illnesses and whether ill veterans examined by VA and DOD are better or worse than when they were first seen).[1] A basically satisfactory answer to the question of whether those ill veterans who have registered with VA or DOD are in better or worse health than when first examined involves only a periodic reassessment of their health, which is part of routine medical care.[2] As we stated when we first made such a recommendation 2 years ago, augmenting the data on the progress of ill Gulf War veterans with comparative data would add valuable information. However, at a minimum, it seems desirable to collect descriptive information on how Gulf War veterans' conditions have improved or worsened. In mid-September 1999, IOM issued its report, which recommended a methodology to VA for measuring veterans' health status (a longitudinal follow-up of a cluster sample of Gulf War veterans with several comparison groups). This approach is consistent with our recommendation that VA and DOD select a strategy for answering this question and compile the appropriate data.

2. Many of the efforts VA cites appear worthwhile, but VA does not assert that any of these have answered or would answer the basic questions we have identified about the prevalence of diagnosed and undiagnosed conditions in Gulf War veterans, the treatments they have received, and the course of any unexplained illnesses. The Veterans' Health Administration's (VHA) intention to collect longitudinal data on these veterans' satisfaction with VHA services may provide a useful monitor of veterans' perceptions. Early findings from this work suggest that Gulf War veterans, as a group,

[1]See *Gulf War Illnesses: Improved Monitoring of Clinical Progress and Reexamination of Research Emphasis Are Needed* (GAO/NSIAD-97-163), June 23, 1997.

[2]For example, such an effort has been pursued by one of the VA's Integrated Service Networks. Using a standardized assessment of health-related functioning, the SF-36 from the RAND medical outcomes study, researchers found that the presenting Gulf War veterans scored lower than U.S. norms on all dimensions of health status and that baseline scores were significantly different from 6 month follow-up. See Powell-Cope, G. M. & Roswell, R. (1999). Health Status of Gulf War Veterans in VISN 8. The Research Working Group, Persian Gulf Veterans Coordinating Board. *Conference on Federally Sponsored Gulf War Veterans' Illnesses Research*, Washington, D.C.: PGVCB/RWG, p. 32.

were somewhat less satisfied with VHA services than other veteran groups. VHA's efforts to clarify the reasons for this through the use of focus groups are also appropriate. Similarly, the health services research efforts that VA identifies may help improve service delivery but do not appear suited to developing much longitudinal information because the projects are funded for only 2 years.

3. Among the conclusions the NIH Working Group reached in 1994 was that, "It is important that a more accurate estimate of the symptom prevalence be established." In support of our finding that basic information on the prevalence of various symptom clusters remains unavailable, we note that VA and DOD registries of examined Gulf War veterans also do not provide sufficient data for determining which of various symptom clusters deserve the closest attention. We agree that the registries may be valuable for other purposes and that there are additional reasons that they might be imperfect research tools. While the VA's national health survey has collected much of the symptom data sought by the NIH group, its results remained unpublished at the close of our review.

4. In support of its objection to our criticism of the coordination between the PGVCB RWG and the Office of the Special Assistant, VA notes that the role of the PGVCB is one of communication and coordination of its member agencies' activities; it does not control these activities. For this reason, our draft report noted that PGVCB has no budgetary authority. Nonetheless, part of the function of communication and coordination is to reach agreement on a plan of action to optimize resources while meeting sometimes varied needs for information. We observed that some projects sponsored by agency members of the RWG are duplicative (see our comment 9 in app. IV.)

5. In support of its objection to our criticism of the coordination between the PGVCB's RWG and the Office of the Special Assistant, VA notes that OSAGWI is represented on the RWG's parent organization, the Coordinating Board, along with other DOD elements. We have revised the report to reflect that professional staff from OSAGWI did attend RWG meetings, as participants or observers, beginning in April 1997. We have not asserted that a coordination mechanism is missing; our criticism is related to the effectiveness of this mechanism in eliminating duplicative expenditures and ensuring uniformly high confidence across agencies in the research activities undertaken.

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6. While most of OSAGWI's expenditures appear to be focused on the investigation of specific incidents for the potential exposures that might have resulted, which would be germane to epidemiological researchers, OSAGWI officials identified $13.3 million, a substantial amount of the office's expenditures, as being devoted to research. It is worth noting that this amount, while it represents a minority of OSAGWI's budget, exceeds the total of VA and CDC Gulf War research expenditures over the period we examined.

7. First, appendix II of the draft report noted that only four of the nine RAND reports submitted for interagency review had actually reached publication by mid-1999 and that publication had, in some instances, occurred over a year following submission. After receiving DOD's comments on our report, RAND's report on pyridostigmine bromide was released 16 months after its submission to interagency review in June 1998. Similarly, RAND's report on stress was published approximately a year after submission for review, and its report on chemical and biological warfare agents was submitted for interagency review 15 months ago. Thus, delaying the release of these documents to IOM until publication occurs does not seem an effective means of coordinating two such closely linked tasks.

Second, it is important to note that the Agency for Toxic Substances and Disease Registry's report on uranium (including depleted uranium) was made available for public comment on October 17, 1997 (the public comment period ended on Feb. 17, 1998, and revision was begun based on comments received). Thus, the need for an additional review of depleted uranium by RAND in 1997 was questionable. The RAND review was not submitted until August of 1998, after the Agency review had been issued in draft form.[3] We have added a discussion of this matter to our report.

8. VA asserts that the goals and methods of these two studies are different but does not explain how they are different. Because IOM will not be conducting original research to make its determinations, it will also rely on existing literature. Material distributed by IOM in connection with a recent meeting of its Committee on Health Effects Associated with Exposures During the Gulf War indicates that, "The purpose of this project would be to conduct a review of the scientific and medical literature regarding adverse

[3]See Agency for Toxic Substances and Disease Registry (Sept. 1997). Draft Toxicological Profile for Uranium. Atlanta, GA:U.S. Dept. of Health and Human Services, PHS/ATSDR.

health effects associated with exposures experienced during the Persian Gulf War." Similarly, the preface to one of RAND's literature reviews notes, "The reviews are intended principally to summarize the scientific literature on the known health effects of given exposures to these risk factors." Accordingly, we find little distinction between these two activities in terms of purpose or basic methodology.

9. The issue we are raising is not whether IOM's work ought to have been initiated but that its work has not benefited from coordination with RAND's to save time and money in accomplishing a goal that is widely regarded as important. Similarly, RAND's work was not coordinated with that of CDC's Agency for Toxic Substances and Disease Registry.

10. Even if the symptoms reported by Gulf War veterans are not confined to these veterans, their increased frequency among Gulf War veterans needs to be explained. Our report does not suggest that a single case definition is appropriate; we note simply that RWG has not endorsed one or more case definitions that might focus research on veterans' undiagnosed symptoms.

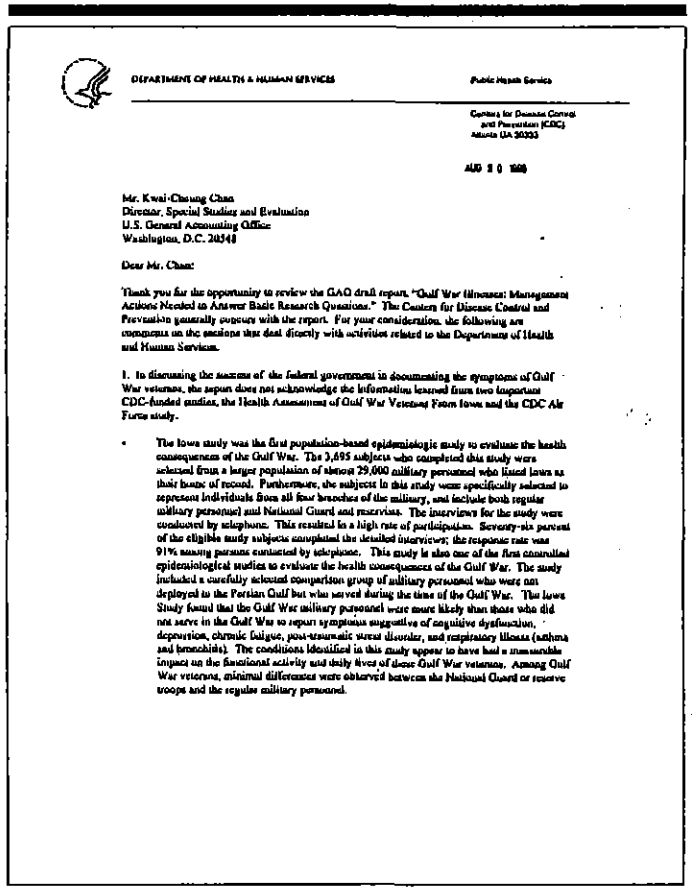
11. This recommendation has been reworded to refer to "the number of Gulf War veterans with unexplained illnesses." We understand that, in implementing the recommendation, it may be appropriate to characterize unexplained illnesses using some groupings or working case definitions for the purposes of counting.

12. We made this recommendation to prompt organizations to work more closely on behalf of veterans suffering from these illnesses. We believe that greater cooperation, exchange of information, and coordination will help expedite the process and help find solutions the veterans need. While VA indicates that RWG has provided sufficient information on the scope of activities it continues to coordinate among DOD, VA, and HHS, we found substantially similar activities that fell outside this scope. In addition, we find nothing in the law that would limit the Group's coordinating efforts to this scope of activities.

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Comments From the Centers for Disease Control and Prevention

Note: GAO comments supplementing those in the report text appear at the end of this appendix.



DEPARTMENT OF HEALTH & HUMAN SERVICES — Public Health Service

Centers for Disease Control and Prevention (CDC)
Atlanta GA 30333

AUG 2 0 1999

Mr. Kwai-Cheung Chan
Director, Special Studies and Evaluation
U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Chan:

Thank you for the opportunity to review the GAO draft report, "Gulf War Illnesses: Management Actions Needed to Answer Basic Research Questions." The Centers for Disease Control and Prevention generally concurs with the report. For your consideration, the following are comments on the sections that deal directly with activities related to the Department of Health and Human Services.

See comment 1.

1. In discussing the success of the federal government in documenting the symptoms of Gulf War veterans, the report does not acknowledge the information learned from two important CDC-funded studies, the Health Assessment of Gulf War Veterans From Iowa and the CDC Air Force study.

- The Iowa study was the first population-based epidemiologic study to evaluate the health consequences of the Gulf War. The 3,695 subjects who completed this study were selected from a larger population of almost 29,000 military personnel who listed Iowa as their home of record. Furthermore, the subjects in this study were specifically selected to represent individuals from all four branches of the military, and include both regular military personnel and National Guard and reservists. The interviews for the study were conducted by telephone. This resulted in a high rate of participation. Seventy-six percent of the eligible study subjects completed the detailed interview; the response rate was 91% among persons contacted by telephone. This study is also one of the first controlled epidemiological studies to evaluate the health consequences of the Gulf War. The study included a carefully selected comparison group of military personnel who were not deployed to the Persian Gulf but who served during the time of the Gulf War. The Iowa Study found that the Gulf War military personnel were more likely than those who did not serve in the Gulf War to report symptoms suggestive of cognitive dysfunction, depression, chronic fatigue, post-traumatic stress disorder, and respiratory illness (asthma and bronchitis). The conditions identified in this study appear to have had a measurable impact on the functional activity and daily lives of these Gulf War veterans. Among Gulf War veterans, minimal differences were observed between the National Guard or reserve troops and the regular military personnel.

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Page 2 - Kwai-Cheung Chan

- Likewise, the CDC Air Force study has significantly contributed to our understanding of the health consequences of the Gulf War. This study organized symptoms reported by Air Force Gulf War veterans into a case definition, characterized clinical features, and evaluated risk factors. The cross-sectional questionnaire was sent to 3723 currently active volunteers from four Air Force populations. Clinical evaluations were performed on 158 Gulf War veterans from one unit, irrespective of health status. A case was defined as having one or more chronic symptoms from at least 2 of 3 categories (fatigue, mood-cognition and musculoskeletal) and was further characterized as mild-to-moderate or severe depending one the severity of the symptoms. The prevalence of mild-to-moderate and severe cases were 39% and 6%, respectively, among 1155 Gulf War veterans versus 14% and 0.7% among 2520 non deployed veterans. Fifty-nine (37%) clinically evaluated Gulf War veterans were noncases, 86 (54%) were mild-to-moderate cases and 13 (8%) were severe cases. The key observation of the study was that Air Force Gulf War veterans were significantly more likely to meet criteria for severe and mild-to-moderate illness than were non deployed personnel. There was no association between the chronic multisymptom illness and risk factors specific to combat in the Gulf War (month of season of deployment, duration of deployment, duties in the Gulf War, direct participation in combat, or locality of Gulf War service). The finding that 15% of non deployed veterans also met illness criteria was equally important and suggest that the multisymptom illness observed in this population is not unique to Gulf War service. The clinical evaluation component of the study found that neither mild-to-moderate nor severe cases were associated with clinically significant physical examination or routine laboratory test abnormalities. However, Gulf War veterans classified as having mild-to-moderate and severe illness had a significant decrease in functioning and well-being compared with noncases.

See comment 2.

2. Page 8, para. 1: The draft report states that 47% of Gulf War research projects cataloged by the Research Working Group were overdue in December 1998. The report cites CDC's Health Assessment of Gulf War Veterans from Iowa as an example of a project that is overdue due to the estimated completion date being extended. It should be noted that the original telephone component of the study was completed and the results published within the projected time frame. After the original telephone study was completed, a decision was made to add on a follow-up component in order to validate the self-report data. The time required to obtain OMB clearance and collect and analyze the data for this follow-up component required that the completion date for the Iowa study be extended.

If you have any questions concerning these comments, please contact Carolyn Russell, Director, Management Analysis and Services, (404) 639-4002.

James D. Seligman
Acting Director, Office of Program Suppon

GAO Comments

The following is GAO's response to the Centers for Disease Control and Prevention's comments dated August 20, 1999.

1. CDC's Air Force study was cited in appendix III of our draft report along with the case definition it developed as one of a set of overlapping working case definitions that have been advanced since 1994. We have added information about these studies and their findings to the final report and have discussed them more fully in our response to agency comments and also in our more detailed response to DOD's comments (see comment 6 in app. IV).

2. Our draft report noted that the extensions discussed were partially attributed to efforts to incorporate additional data. We have added the word "additional" before "follow-up" to specifically clarify that the extension of the Iowa project was to provide for work not initially anticipated, not to allow additional time for work already planned.

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GAO Contacts and Staff Acknowledgments

GAO Contacts

Sushil K. Sharma (202) 512-3460
Betty Ward-Zukerman (202) 512-2732

Acknowledgments

In addition to those named above, Margaret Best, John Carter, Howard Deshong, and William Woods made key contributions to this report.

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Related GAO Products

Gulf War Illnesses: Procedural and Reporting Improvements Are Needed in DOD's Investigative Processes (GAO/NSIAD-99-58, Feb. 26, 1999).

Acquisition Reform: Multiple-Award Contracting at Six Federal Organizations (GAO/NSIAD-98-215, Sept. 30, 1998).

VA Health Care: Better Integration of Services Could Improve Gulf War Veterans' Care (GAO/HEHS-98-197, Aug. 19, 1998).

Role of the Persian Gulf Veterans' Coordinating Board in Scientific Evaluation of Research Proposals and the Funding Recommendations Made by Its Research Working Group (GAO/NSIAD-98-170R, Aug. 10, 1998).

Gulf War Veterans: Limitations of Available Data for Accurately Determining the Incidence of Tumors (GAO/T-NSIAD-98-186, May 14, 1998).

VA Health Care: Persian Gulf Dependents' Medical Exam Program Ineffectively Carried Out (GAO/HEHS-98-108, Mar. 31, 1998).

Gulf War Veterans: Incidence of Tumors Cannot Be Reliably Determined From Available Data (GAO/NSIAD-98-89, Mar. 3, 1998).

Gulf War Illnesses: Federal Research Strategy Needs Reexamination (GAO/T-NSIAD-98-104, Feb. 24, 1998).

Gulf War Illnesses: Research, Clinical Monitoring, and Medical Surveillance (GAO/T-NSIAD-98-88, Feb. 5, 1998).

Veterans' Benefits: Improvements Made to Persian Gulf Claims Processing (GAO/T-HEHS-98-89, Feb. 5, 1998).

Gulf War Illnesses: Public and Private Efforts Relating to Exposures of U.S. Personnel to Chemical Agents (GAO/NSIAD-98-27, Oct. 15, 1997).

Gulf War Illnesses: Reexamination of Research Emphasis and Improved Monitoring of Clinical Progress Needed (GAO/T-NSIAD-97-191, June 25, 1997).

Gulf War Illnesses: Enhanced Monitoring of Clinical Progress and of Research Priorities Needed (GAO/T-NSIAD-97-190, June 24, 1997).

Gulf War Illnesses: Improved Monitoring of Clinical Progress and Reexamination of Research Emphasis Are Needed (GAO/NSIAD-97-163, June 23, 1997).

VA Health Care: Observations on Medical Care Provided to Persian Gulf Veterans (GAO/T-HEHS-97-158, June 19, 1997).

Chemical and Biological Defense: Protection of Critical Overseas Ports and Airfields Remains Largely Unaddressed (GAO/NSIAD-97-9, June 13, 1997).

Operation Desert Storm: Evaluation of the Air Campaign (GAO/NSIAD-97-134, June 12, 1997).

Defense Health Care: Medical Surveillance Has Improved Since the Gulf War, but Results in Bosnia Are Mixed (GAO/NSIAD-97-136, May 13, 1997).

Veterans' Compensation: Evidence Considered in Persian Gulf War Undiagnosed Illness Claims (HEHS-96-112, May 28, 1996).

Chemical and Biological Defense: Emphasis Remains Insufficient to Resolve Continuing Problems (GAO/NSIAD-96-103, Mar. 29, 1996).

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Letter to the Utah Citizens Advisory Commission

Centers for Disease Control and Prevention
Letter to the Utah Citizens Advisory Commission

M/G John L. Matthews (Ret.) Chairman
Utah Citizens Advisory Commission
on Chemical Weapons Demilitarization/ State of Utah
Governor's Office of Planning and Budget
116 State Capitol, Salt Lake City, Utah 84114

Dear General Matthews:

You recently requested that the Centers for Disease Control and Prevention (CDC) provide the Utah Citizens Advisory Commission (CAC) with CDC's findings regarding the potential public health risk associated with the emissions from the chemical weapons incinerator at the Deseret Chemical Activity site in Tooele County, Utah.

In reviewing the emissions from the exhaust stacks at the Tooele Facility, CDC asks two fundamental questions: 1) Is a harmful level of chemical agent being emitted? and 2) Is there anything else coming out of the stack that could be harmful to the public's health?

To determine whether a harmful level of chemical agent is being emitted, CDC starts with the "general population limit" (or GPL) for each chemical agent. The GPL is defined as the concentration of agent in air that the general population could be exposed to continuously without any adverse health effect. In 1988, CDC helped to establish the GPL's for the various stockpiled agents with the input of an independent expert working group.

Starting with the GPL for each agent as a maximum safe exposure level, we then calculate (through mathematical air dispersion models) the maximum concentration of the agent that could be emitted from the incinerator exhaust stack under the most adverse weather (air dispersion) conditions. We refer to this as the maximum allowable stack concentration (or ASC). After establishing ASCs for each of the chemical agents, we then evaluate the agent-monitoring system within the exhaust stack to ensure that it is sensitive enough and dependable enough to detect the presence of any chemical agent down to or below its ASC. CDC reviews all agent monitoring data, including the associated quality assurance data biweekly and has found that agent monitors are both sensitive and dependable.

The term "allowable stack concentration" does not mean that agent is routinely emitted during the incineration process. In fact, the agent stack monitors can detect down to as little as one-fifth the allowable stack concentration for any agent. It is army operating policy that if any agent is detected in an exhaust stack, the mechanism that feeds agent into the incinerator is automatically stopped and the incinerator cannot resume operation until the reason for the agent detection is found and the problem corrected. This operating policy provides an extra margin of safety by allowing for corrective action to begin before agent levels approach any level of concern. Under actual combustion conditions, agent has never been found in the stack even at one-fifth of the allowable stack concentration.

To determine whether other potentially harmful substances are emitted from the incineration system

stack, CDC reviews the results of the regulatory trial burn data to see what chemicals/compounds were identified, what amounts are being emitted, and what the maximum ground level concentrations could be. We do this for inorganic substances, such as hydrogen chloride and metals, and for organic substances, such as chlorinated dioxins and furans. We then compare the highest anticipated ground substances, such as chlorinated dioxins and furans. We then compare the highest anticipated ground level concentrations of the various compounds with toxicity screening levels such as those used by the U.S. Environmental Protection Agency and the Agency for Toxic Substance and Disease Registry, among others. We also compare the maximum ground level concentrations of the stack emissions with levels occurring in ambient air, where such data is available. Because the new incineration system at Tooele has not yet undergone a wide array of trial burns, much of our review has been of data generated during trial burns at Johnston Island, where similar incineration technology is being used. As trial burn data from the Tooele facility becomes available, both we and the Utah Department of Environmental Quality (DEQ) review it for public health safety concerns.

To date our review of this information has led us to conclude that the stack emissions of the Tooele incineration system will not pose a threat to Tooele employees or to people living near the facility. We base this upon the following observations:

1. **Stack emission of potentially harmful compounds, including chlorinated dioxins, metals, and other compounds are below levels that would be considered to have any adverse health impact on people. (See National Environmental Health Association article for additional detail.)**

2. **Continuous agent and emissions monitoring systems are interlocked with the incineration system so that agent feed is automatically stopped if any emissions begin to go above preset limits. This design feature, required by the Tooele facility operating permit, ensures that the incinerators will not be allowed to continue to process waste chemicals under sub optimal combustion conditions.**

3. **Health risk assessments done in accordance with accepted, conservative EPA methods have shown the incineration systems at the Tooele facility to be acceptable. These assessments consider all potential pathways by which the community could possibly be exposed to stack emissions.**

4. **The Utah DEQ maintains an on-going and visible presence at the Tooele facility. We regularly contact DEQ personnel to see if they have any public health concerns regarding Tooele operations or stack emissions.**

5. **The CDC receives and evaluates all agent monitoring data from Tooele on a biweekly basis. On the basis of this evaluation, we are confident that potential agent releases, including stack releases, would be detected in a timely and dependable manner.**

6. **Other independent parties, such as the National Research Council and the State Occupational Safety and Health Administration, periodically visit and evaluate operations at Tooele.**

Finally, in our examination of Tooele stack emissions, we review the relative magnitude of mass emissions of potentially harmful compounds in comparison with other area sources of such materials to see if they would be expected to result in a noticeable increase in area air pollution levels. Although available data are somewhat limited, we found Tooele facility to be a relatively minor contributor of pollutants to the air basin for Tooele and Salt Lake Counties. In summary, we believe that the Tooele stack emissions are safe and will not adversely affect the health of people in communities located near the facility.

In your letter to CDC, you also asked us to address the current concern of some people that the stack emissions from the incinerator could lead to health effects similar to those associated with "Gulf War Syndrome." We, too, have seen this concern raised in the popular media. However, on the basis of the information available, we do not feel that this concern is well founded. Our reasons follow:

1. The symptoms described by the Gulf War veterans are diverse and often vague. They are not specific

for symptoms associated with acute exposure to the chemical agents contained at the stockpile sites.

2. The Johnston Atoll incinerator (which is similar to the Tooele incinerator) has been operating for approximately seven years. We are unaware of any information that shows any similarities between health problems reported on the island and the symptoms associated with Gulf War Syndrome.

3. The cause of Gulf War Syndrome is still subject to considerable debate and many hypotheses. Research is underway to investigate these issues and CDC will monitor the developments in this research.

If new information is produced to better support the hypothesis that Gulf War Syndrome is caused by exposure to chemical agent, we will examine it closely and let the Utah CAC, and others, know of our findings. However, in the absence of such information, we feel that it is prudent to reduce the existing stockpile storage risk by continuing to pursue the baseline recommended destruction technology, incineration, in a safe and deliberate manner.

We hope that this letter helps the CAC better understand how CDC reviews the health implications of the Tooele stack emissions and the basis for our conclusion that these emissions pose no health risk to workers or to residents of the surrounding communities. We take this oversight responsibility very seriously, and would review any technology used in the Army's demilitarization program in a similarly rigorous manner. If you have any questions or additional concerns, please feel free to bring them to our attention.

Sincerely,
Henry Falk, M.D.
Director
Division of Environmental Hazardous and Health Effects (F 28)
National Center for Environmental Health

U.S. Department of Health and Human Services (DHHS) - Centers for Disease Control and Prevention (CDC) - National Center for Environmental Health (NCEH) - CDC's Role in the Demilitarization of Chemical Weapons Home Page

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98-0655

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1500 First Interstate Center, 999 Third Avenue
Seattle, Washington 98104
Tel: (206) 624-9537, Fax: (206) 621-9832

STATE OF OREGON
DEPARTMENT OF ENVIRONMENTAL QUALITY
RECEIVED

HERMISTON OFFICE

September 11, 1998

Sue Oliver
Oregon Department of Environmental Quality
256 E. Hurlburt, Suite 117
Hermiston, Oregon 97838

Re: Review of "Review of Acute Human-Toxicity Estimates for Selected Chemical Warfare Agents"

Dear Sue:

E&E has completed a review of the document "Review of Acute Human-Toxicity Estimates for Selected Chemical Warfare Agents" (National Research Council, 1997). The purpose of E&E's review was to determine if the toxicity estimates presented in this document are applicable to the Pre-Trial Burn Risk Assessment for the Umatilla Chemical Demilitarization Facility, and if so, to determine what impacts use of the new values would have on the risk estimates and conclusions presented in the risk assessment. Also, the toxicity estimates were reviewed to determine if use of the values would be appropriate for the planned acute risk assessment.

The conclusion of E&E's review is that the toxicity values presented in the NRC document are not applicable for use in a risk assessment for the general population. As stated on page 2, "the proposed human-toxicity estimates are only for healthy male military personnel. They must *not* be used for civilians." The purpose for development of the toxicity values in the NRC document is to determine exposure levels for protection of soldiers exposed to agent in a military conflict. Consequently, these values are much less conservative than toxicity values used in the Umatilla risk assessment, which are designed to be exposure levels to which the entire population (including sensitive subgroups such as children) may be exposed without any adverse effects, with an adequate margin of safety.

Because of the differences in purpose of these toxicity values, the existing General Population Limits for agent used in the Pre-Trial Burn Risk Assessment are still the most appropriate values for use in the risk assessment. These values were derived by the Centers for Disease Control specifically for use in estimating adverse effects associated with exposures to agents by the general public.

It is also worth noting that the toxicity values developed for the NRC document do not indicate that the agents are more toxic than was previously believed. Although the estimates of the LD_{50} (the dose that would be lethal to 50% of population) for the agents are significantly lower than previously existing LD_{50}s, this difference is due to a difference in the purpose and methodology used to derive these values rather than any new toxicity data. The earlier toxicity estimates developed by the Army were designed for "offensive purposes"; i.e., these were developed to identify minimum exposure levels that would produce an effect (such as death) in a hypothetical

enemy force that was as resistant to effects as possible. Therefore, the earlier levels are much less conservative than the "defensive levels" presented in this document, which are designed for protection of friendly soldiers exposed to a chemical attack. As a result, the new lower toxicity values represent a better estimate of agent lethality under typical combat situations, rather than an indication that the agents are inherently more toxic than was shown by earlier data.

If you have any questions regarding this information, please call me at 206-624-9537.

Sincerely,

ECOLOGY AND ENVIRONMENT, INC.

Gordon Randall

cc: Project File OH6
Julie Wroble, E & E

87

98-0380

DEPARTMENT OF THE ARMY
PROGRAM MANAGER FOR CHEMICAL DEMILITARIZATION
ABERDEEN PROVING GROUND, MARYLAND 21010-5401

Program Manager for
Chemical Demilitarization

Ms. Linda Anderson
Chief, Special Programs Group
Centers for Disease Control and Prevention
4770 Buford Highway, Bldg 25/Mail Stop F16
Atlanta, Georgia 30341

Dear Ms. Anderson:

A recent report issued by the National Research Council (NRC), Subcommittee on Toxicity Values for Selected Nerve Agent and Vesicant Agents, entitled: "Review of Acute Human-Toxicity Estimates for Selected Chemical-Warfare Agents," concluded that the Army's original toxicity estimates were understated and therefore inappropriate for protecting soldiers. Although the report emphasized that only acute exposures and acute effects for healthy adult male soldiers were considered, their conclusions have inappropriately been reported by the media as having potential chronic effects on the local communities surrounding chemical stockpile storage sites.

The findings of this report have engendered numerous questions and concerns from the State regulatory agencies and local communities surrounding our operating and planned chemical disposal facilities. We recognize that the issues raised in this report will require further analysis and evaluation by the entire Army community. However, my primary focus at this point is to ensure full protection of the chemical stockpile disposal workforce and the local community. Because of the oversight exercised by your office to ensure the efficacy and accuracy of our current monitoring programs at these facilities, I would like to request that your office review the subject NRC report to assess the adequacy of protection to the workforce and local community afforded by our monitoring capabilities and systems.

Your continued oversight and support to this program are greatly appreciated. My point of contact for this effort is Robert Perry, chief of our Risk Management and Quality Assurance Office. Please feel free to call him if you have questions.

James L. Bacon

JAMES L. BACON
Program Manager for
Chemical Demilitarization

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DEPARTMENT OF HEALTH & HUMAN SERVICES
Public Health Service

Centers for Disease Control
and Prevention (CDC)
Atlanta GA 30341-3724

October 7, 1998

Mr. James L. Bacon
Program Manager for Chemical Demilitarization (SFAE-CD-Z)
Aberdeen Proving Ground, Maryland 21010-5401

Dear Mr. Bacon:

The Centers for Disease Control and Prevention (CDC) was asked to evaluate the applicability of the recently published National Research Council (NRC) report, "Review of Acute Human-Toxicity Estimates for Selected Chemical-Warfare Agents" to the occupational and general population level (GPL) exposure limits. In 1988, CDC issued the still current occupational and GPL exposure limits in the "Final Recommendations for Protecting Human Health and Safety Against Potential Adverse Effects of Long-term Exposure to Low Doses of Agents GA, GB, VX, Mustard Agent (H, HD, T) and Lewisite(L)." CDC evaluated the NRC report in consultation with Dr. Loren D. Koller, Chairman of the NRC Subcommittee on Toxicity Values for Selected Nerve and Vesicant Agents.

The exposure limits mentioned in the NRC report were developed by the Army to define exposure limits to protect soldiers from an incapacitating or lethal chemical weapon exposure during a military attack. The Army asked the NRC to independently review these exposure limits to determine their scientific validity. The NRC reviewed the quality of the data presented to them, the methodology in analyzing the data, and the assumptions used in deriving the exposure estimates. During this review, they evaluated various routes of exposure such as inhalation and skin exposures to vapor and liquid. The toxicity effects studied included mild, severe, and lethal effects. On page 2 and page 18, the report plainly states that these toxicity estimates are to be used only for healthy male military personnel and not for civilians or the general population.

In formulating the occupational and GPL exposure limits for nerve agent GB, CDC reviewed the existing exposure limits for these agents from published and unpublished reports and had input from a panel of expert consultants from academia, industry, and government, as well as comments from the public. These limits were based on data from animal studies and acute human exposures to GB at the "no effects" level (0.5 mg-min/m^3). At this level less than one percent of the people exposed to an acute dose would develop miosis (decrease in pupil size) or

other mild symptoms like rhinorrhea (runny nose) or chest tightness. These symptoms are some of the earliest signs of nerve agent exposure. In addition, this "no effects" level was further reduced by the application of safety factors to account for variations in people's susceptibility to chemical agents and duration of exposure. This resulted in an occupational exposure limit of 0.0001 mg/m^3 and a GPL of 0.000003 mg/m^3. At this occupational exposure limit, a worker could be exposed to this concentration for eight hours per workday and a 40-hour workweek without adverse effects. The occupational and GPL exposure levels were developed to protect the workers and civilians around the chemical stockpile and demilitarization sites and CDC continues to believe that these limits are still valid and protective of human health and safety.

Sincerely yours,

Paul Joe

Paul Joe, DO, MPH
Special Programs Group
National Center for
Environmental Health

Loren D Koller

Loren D. Koller, DVM, PhD

FILE

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98-0882

DEPARTMENT OF THE ARMY
PROGRAM MANAGER FOR CHEMICAL DEMILITARIZATION
ABERDEEN PROVING GROUND, MARYLAND 21010-5401

October 16, 1998

Project Manager for Chemical Stockpile Disposal

SUBJECT: Hazardous Waste Facility Permit No. AL3-210-020-027

STATE OF OREGON
DEPARTMENT OF ENVIRONMENTAL QUALITY
RECEIVED
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HERMISTON OFFICE

Mr. John A. Poole, Jr.
Chief, Land Division
Alabama Department of Environmental Management
1751 Cong. W.L. Dickinson Drive
Montgomery, Alabama 36109

Dear Mr. Poole:

The Program Manager for Chemical Demilitarization (PMCD) hereby confirms that on September 22, 1998, PMCD provided to the Alabama Department of Environmental Management (ADEM) a report from the National Resource Council (NRC) entitled *Review of Acute Human-Toxicity Estimates for Selected Chemical-Warfare Agents* (NRC Report). This report constitutes an independent review of a classified 1994 report prepared by the U.S. Army Chemical Defense Equipment Process Action Team (CDEPAT) entitled *Review of Existing Toxicity Data and Human Estimates for Selected Chemical Agents and Recommended Human Toxicity Estimates Appropriate for Defending the Soldier* (CDEPAT Report). We do not believe that either of these reports constitutes new and relevant facts as described in Permit Condition I.E.19. Nevertheless, Petitioners challenging the above-referenced permit before the Environmental Management Commission have filed a new motion on September 30, 1998, entitled Petitioners' Motion for Relief from Prejudice Caused by the U.S. Department of the Army's Failure to Submit Toxicity Value Information. In light of this new motion, we would like to take this opportunity to provide ADEM information concerning the background of these two reports and to inform ADEM of the actions we are taking as a result.

1. The CDEPAT Report.

When the Army originally prepared human toxicity estimates for chemical warfare agents, these estimates were used to predict the number of casualties that would result from the offensive use of chemical weapons (i.e. how many enemy soldiers would be killed or incapacitated by our use of chemical agent). Historically, these estimates established the point at which 50% of the least sensitive (most resistant) enemy soldiers would be killed or incapacitated. In light of the possibility that an enemy force could also use chemical weapons against U.S. soldiers, the U.S. Army Office of the Surgeon General (OTSG) initiated the CDEPAT Report. The purpose of this report was to review existing toxicity data to determine toxicity estimates for defensive purposes (i.e. how chemical agent would affect U.S. soldiers).

Because the report was concerned with force protection, it evaluated the existing data to estimate the effects of chemical agent on U.S. soldiers with average sensitivity. In addition, the report evaluated the data considering not only death and incapacitation, but other less severe effects as well. In other words, it was a broader estimate designed to err on the side of greater effects of chemical agents on U.S. soldiers in combat.

The CDEPAT Report indicated that the previous estimates of human toxicity for some chemical agents were too high for force protection purposes. The report proposed some new acute exposure estimates to be used for healthy male soldiers. The proposed estimates were not designed to be applicable to chronic, long term exposure of the civilian population. The CDEPAT Report is classified SECRET. As you are no doubt aware, distribution of classified material is somewhat limited. If anyone on behalf of the Army had attempted to provide this classified document to the state of Alabama, they would have risked violating federal criminal law.

2. The 1997 NRC Report.

Even if the Army had been able to release the CDEPAT Report, it would have been premature for them to do so at the time it was prepared. The proposed toxicity estimates in that report were values recommended by one group of scientists after a review and interpretation of existing toxicity data. Before the OTSG takes the significant step of adopting new human toxicity estimates, they requested that the National Research Council conduct an independent review of the CDEPAT Report. It is common practice to request such an independent review under these circumstances. Specifically, the NRC was to review the toxicity data that had been reviewed in the CDEPAT Report, review the methods used to derive the toxicity estimates, and to determine the adequacy of the toxicity estimates proposed in the report. The NRC Report did not consider or review any new toxicity data, but rather provided an assessment of the adequacy of the CDEPAT Report's review of the existing toxicity data.

The NRC Report concluded that some of the CDEPAT Report's estimates were valid, some estimates need to be lowered, a few estimates needed to be raised, and still other estimates were adequate until further research can be conducted. The report considered acute exposures and acute effects appropriate for healthy male soldiers.

Although the NRC Report indicates it was prepared in 1997, it was not released to the public until 1998. This delay in the release of the report was due to the need to declassify some of the information that had been in the CDEPAT Report so that it could be included.

It is important to recognize that the OTSG is still reviewing the NRC Report and the 1994 CDEPAT Report and has not yet adopted new toxicity estimates to be used by Army agencies. If the OTSG does modify existing toxicity estimates, the Department of the Army Staff will then issue guidance to all agencies and programs, including PMCD, indicating how current practices and procedures should be changed.

3. Permittees' Activities Based on the NRC Report.

Should the GTSG adopt new toxicity values, these new values could result in new Quantitative Risk Assessment (QRA) data. Although the QRA is technically not part of the permit application, we are aware that any change in the QRA has the potential to affect current emergency preparedness plans at all of the stockpile sites, including Anniston. Such new data also has the potential to affect QRA accident scenarios involving the ANCDF. Until such time as new toxicity values are adopted, new guidance issued, and new analyses conducted, there is no new relevant evidence to provide to ADEM. Should any future analyses result in new information relevant to the Permit, we will of course provide such information as required in Permit Condition I.E.19.

Shortly after the release of the NRC Report, the Program Manager for Chemical Demilitarization, Mr. James Bacon, wrote a letter to the Centers for Disease Control (CDC) requesting that they review the NRC Report on PMCD's behalf. In 1988, the CDC had issued occupational and general population level exposure limits for chemical agents. These limits are the ones currently in use. In his letter (enclosed), Mr. Bacon asks CDC to assess the adequacy of current monitoring programs to protect the workforce and local communities at the stockpile sites in light of the NRC Report. We have received CDC's assessment for the agent GB. This assessment, also enclosed with this letter, indicates that the occupational and GPL exposure levels for GB originally established by the CDC are still valid and protective of human health and safety.

U.S. Army health professionals are currently analyzing the CDEPAT Report and the NRC Report to determine what effect, if any, the toxicity values in those reports would have on the Health Risk Assessment prepared for the ANCDF. It is important to remember, however, that the toxicity values expressed in those reports were developed for healthy male soldiers involved in military operations. The chemical agent toxicity values used in the Health Risk Assessment were developed as exposure values to which the civilian population (including sensitive subgroups) could be exposed to without any adverse health effects. The U.S. Army is currently in the process of reevaluating existing airborne exposure limits for chemical agents used to protect civilian workers and the general population. These evaluations, referred to as "Health Criteria Documents," are expected to be completed for all chemical agents by September, 1999. At this time, however, the Health Criteria Document for the agent GB has been completed. This reevaluation concluded that the general population limit and the occupational limit used in the Anniston Health Risk Assessment did not require adjustment. Should these Health Criteria Documents conclude that different airborne exposure limits should be used in our Health Risk Assessments, we will of course inform the state of this new and relevant information.

As you are aware, the permit is designed to allow consideration and incorporation of new, relevant information. Under Permit Condition I.K.4, the Permittee is required to submit a revised Screening Health Risk Assessment Protocol 180 calendar days prior to the shakedown period for the initial trial burn. This protocol will reflect the most current EPA guidance at the

time of submittal, and is subject to ADEM's approval. In addition, Permit Condition II.N.1 requires the Permittees to submit a risk assessment addendum after each trial burn following the protocol provided for in Condition II.K.4. This addendum will compare the results of each trial burn to the data used in the preliminary risk assessment with respect to emission estimate, stack parameters, and toxicity values. Most importantly, Permit Condition II.N.2.iii specifically requires the Permittee to submit a post-trial burn risk assessment if the toxicity values of the substances of potential concern (including chemical agents) have changed to the degree that an unacceptable risk would result. We fully intend to comply with this and all other permit conditions in order to insure the protection of human health and the environment.

By the time these determinations are made, the tentative conclusions in the NRC Report will have been subjected to a great deal of review. Through the permit mechanism, the most up-to-date information will be included in each health risk assessment. Seen in this perspective, the NRC Report is not a cause for alarm.

Respectfully submitted,

Stephen C. DePew

Stephen C. DePew,
ANCDF Site Project Manager
United States Department of the Army, Program Manager for Chemical Demilitarization

Enclosures

Copy Furnished:

Colonel Gregory F. Potts, Commander, Anniston Army Depot
John Hevlow, ANCDF Plant Manager for Westinghouse Company

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STATE OF OREGON
DEPARTMENT OF ENVIRONMENTAL QUALITY
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Contact: Mickey Morales
(410) 436-4555/3629

[redacted]

13 October 98

Media Advisory

A recent report by the National Research Council concluded that the Army's original estimates for toxicity of chemical warfare agents were understated and therefore inappropriate for protecting soldiers in the battlefield. The report, entitled "Review of Acute Human-Toxicity Estimates for Selected Chemical-Warfare Agents", emphasized that only acute exposures and acute effects for healthy adult males were considered. The NRC's Committee on Toxicology stated that their figures "must not be used for civilians."

The reports conclusions have inappropriately been reported by some members of the public and the media as having potential chronic effects on the local communities surrounding chemical stockpile storage sites. The Army's chemical agent disposal facilities are monitoring agent levels at much lower and safer levels than suggested by the NRC report.

"This report does not have any effect on our operations which have been and will continue to be done as safely as possible," said Col. Edward Fisher, Project Manager for Chemical Stockpile Disposal. "Our chemical agent monitors are state-of-the-art and operate continuously. They are designed to monitor for extremely low levels, well below levels considered by regulators to be safe for the community. As an added precaution, monitoring data from our operations is constantly reviewed by state regulators and the U.S. Centers for Disease Control and Prevention to ensure that we meet their standards of quality and safety."

The Program Manager for Chemical Demilitarization has asked the CDC to review the NRC report and assess the adequacy of protection to the workforce and local communities afforded by the disposal facilities' monitoring capabilities and systems. The CDC has oversight over the chemical stockpile disposal program to ensure the efficacy and accuracy of PMCD's current monitoring system. It works closely with the Army on all facets of the agent monitoring programs to ensure that the Army meets their data quality objectives.

The CDC concluded that in formulating the occupational and general population level exposure limits to chemical warfare agents, a worker could be exposed to for eight hours per workday and a 40-hour workday without adverse effects.

"The exposure levels were developed to protect the workers and civilians around the chemical stockpiles sites and the CDC continues to believe that these limits are still valid and protective of human health and safety."

The study does serve as a reminder that the greatest risk to the public is continued storage of America's aging, obsolete and deteriorating chemical munition stockpiles. That is why the NRC recommended in 1994 that the Army destroy the stockpile safely and expeditiously and with the technology that will minimize the cumulative risk to the public - incineration.

"The best thing we can do is to destroy the chemical stockpile as soon and as safely as possible so that we can eliminate the storage risk to the communities," said Fisher.

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98-0879

Review of Acute Human-Toxicity Estimates for Selected Chemical-Warfare Agents

Questions and Answers

Who is the National Research Council (NRC)?
The NRC was organized in 1916 to serve as the working arm of the National Academy of Sciences and the National Academy of Engineering, carrying out most of the studies conducted in their names.

Most requests for studies come from governmental agencies or Congress. About 85 percent of NRC funding comes from the federal government and 15 percent comes from state governments, private foundations, industrial organizations, and funds provided by the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

How can I get a copy of the NRC report?
The report is available from the National Academy Press for $20.50 plus $4 shipping and handling. The National Academy Press can be reached at 800-624-6242. The report can also be ordered via the Internet at a 20% discount. The National Academy Press web site can be accessed at www.nap.edu. The report will also be posted on the National Academy Press web site for free viewing or downloading in the near future.

Who funded this report?
The Department of Defense requested and funded the NRC report. The federal government accounts for 85 percent of funding to the National Academy of Sciences.

What is the purpose and scope of the NRC report?
The NRC report is an independent assessment a 1994 Army report, entitled *Review of Existing Toxicity Data and Human Estimates for Selected Chemical Agents and Human Toxicity Estimates Appropriate for Defending the Soldier*. The original report was developed by the Army's Chemical Defense Equipment Process Action Team and establishes a set of proposed exposure limits that would be useful in protecting soldiers from toxic exposures to those agents.

Before making a decision on acceptance of proposed estimates found in the 1994 report, the Army sought the independent council of the NRC and requested the assessment. The scope of the NRC report included the following objectives:

1. Review the scientific protocols and quality of the toxicity data used in revising the human-toxicity estimates for acute exposures, as found in the 1994 report.
2. Review the toxicity estimates for mild and nonsevere effects and for severe and lethal effects.
3. Review the methods used in deriving the original estimates.
4. Evaluate the assumptions made in deriving original 1994 estimates.

The NRC report does not recommend new toxicity estimates (NRC report, pg. 2).

What were the major conclusions drawn from the report?
Major conclusions from the report address the original toxicity estimates found in the 1994 report. Some estimates were judged to be valid; some estimates were judges as adequate until

further research can be conducted; some estimates need to be lowered; and some estimates should be raised (NRC report, pg. 3).

Is the original 1994 report upon which the NRC report is based available to the public?
The original report is classified as secret and not available to the public. It can be obtained only with the permission of the Director of the Army's Edgewood Research, Engineering and Development Center.

Why does the report focus on effects to healthy male soldiers rather than civilians?
The NRC report applies only to soldiers because the original 1994 report focused only on soldiers. The whole intention of the original report was to aid in protecting soldiers in the event of an attack using chemical agent. Until that point, the Army had researched the effects of chemical agent in a more offensive manner. This means that they investigated what levels of exposure would be fatal to enemy forces. In order to protect our American troops, there was a need to more accurately determine exposure levels at which a soldier would experience toxic effects, not necessarily death. As such, the 1994 report assumed a one-time exposure to chemical agent that was massive and short-term.

Is the Army able to monitor to the levels suggested in the NRC report?
The Army, under the strict oversight of state regulatory agencies and other independent organization such as the Centers for Disease Control and Prevention, monitors for the presence of chemical agent at levels that are well below those identified in the NRC report.

What immediate impacts will this report have on ongoing chemical demilitarization efforts?
The NRC report will have no impact on current chemical demilitarization operations or safety standards. Current monitoring levels are well below those established in the report, and are strictly monitored by state regulatory agencies and other oversight organizations. We are operating at extremely safe levels and are working hard to get the job done safely and as quickly as possible. The Army will continue to eliminate the risk that this agent poses through the safest and most proven technology — incineration.

Will these new levels of toxicity require the Army to recalculate Health Risk Assessments, Quantitative Risk Assessments, emission limits and other levels of protection currently in place?
The NRC report will have no impact on current chemical demilitarization operations or safety standards. Current monitoring levels are well below those established in the report, and are strictly monitored by state regulatory agencies and other oversight organizations. We are operating at extremely safe levels and are working hard to get the job done safely and as quickly as possible. The Army will continue to eliminate the risk that this agent poses through the safest and most proven technology — incineration.

At this point, it is unclear as to whether the new toxicity levels will impact any risk assessments that have already been conducted. As stated in the report, the estimates are to be used only for healthy male military personnel and not for civilians or the general population. The new estimates will not change the ratio between continued storage and disposal. Continued storage still poses more risk than disposing of these chemical munitions.

If the Army already monitors to lower levels than the NRC report suggests, what is the significance of this report for chemical demilitarization?
There is no impact. The report is aimed at protecting soldiers, and as stated in the report has no [illegible] much lower than levels identified

in the report. The Army will continue to run a safe operation under the stringent oversight of organizations such as the NRC, state regulatory agencies and the Centers for Disease Control and Prevention. In fact, after reviewing the NRC report, the Centers for Disease Control and Prevention still believe that current limits are still valid and protective of human health and safety.

The only potential impact, should the Army choose to endorse the new estimates, would be changes to the Quantitative Risk Assessment. In any case, continued storage still poses more risk than disposing of these chemical munitions.

Will the Army adopt the new "safe" exposure levels?
No decisions have been made regarding any measures the Army will take based on recommendations in the report. The NRC report findings will be reviewed by the Army Surgeon General. If the Army Surgeon General does not see any need to change current estimates, nothing will happen. If the Army Surgeon General does find it necessary to adopt the new estimates, Army staff will have to develop implementing guidance and standards for the CSDP to implement new values.

Are workers involved with chemical warfare materiel storage and demilitarization efforts at risk?
Protection of our workers and our communities is the Army's top priority. The Army will do nothing to jeopardize this. Current monitoring levels are well below those established in the report, and are strictly monitored by state regulatory agencies and other oversight organizations. We are operating at extremely safe levels and are working hard to get the job done safely and as quickly as possible. The Army will continue to eliminate the risk that this agent poses through the safest and most proven technology — incineration.

A recent report from the General Accounting Office asserts that the Department of Defense lacks a strategy and research program to address low-level chemical warfare agent exposures. Has enough research been done on the long-term health effects of low-level exposure to nerve agents to be able to say chemical demilitarization operations are safe? What is PMCD's position on this report?
The GAO does not have an impact on the chemical demilitarization operations.

Based on the fact that the chemical agents currently stored across the country are almost twice as toxic as previously thought, doesn't it make sense that the Army expeditiously destroy all of its chemical weapons and bulk chemical agent stockpile?
Absolutely. This report serves as a reminder that the greatest risk these munitions pose to our communities is their continued storage. It also strengthens our commitment to getting rid of them as quickly as possible using the only safe and proven technology that has been demonstrated to do the job — incineration.

Do incinerators release chemical agent out of the stack?
The Army and its many oversight agencies impose the highest standards of safety to all of its chemical demilitarization operations, including emissions that exit the facility. Monitors are set at levels far below those recommended in the NRC report. No chemical agent has ever been detected in the incinerator stack at the Tooele Chemical Agent Disposal Facility.

Is it true that the Army was trying to hide the existence of this report?
No. There was no "cover up" of the report by the Army. The 1994 study was classified s secret [illegible] of national security and because the report was aimed at better protecting soldiers in

the battlefield from exposure to chemical agent. The report was not classified as secret because it had any information regarding the safety of chemical demilitarization operations. It should be clear that assessing the chemical demilitarization program was not within the scope of this report.

Even if what you say is true about no emissions from the incinerator stack, the public is more and more concerned about the safety aspects of transporting chemical weapons. It seems as though there is a great risk in that and that this risk has been understated. What is PMCD's response to this?
First, federal law prohibits the interstate transport of chemical warfare materiel. In general, the only time chemical agent is transported is when it is being brought from storage to the disposal plant, if a munition is found to be leaking, or if it is transported for research purposes.

Transportation is within the responsibilities of the Chemical and Biological Defense Command. During transport, stringent precautionary measures are taken to prevent any leaks or exposure of chemical agent. For example, On-Site Containers are specially designed transport vehicles design specifically for the transport of chemical agent.

The report recommends that an expert panel be convened to develop a research strategy for deriving more sound data for chemical agent exposure limits. Does the Army have plans to convene such a group, and will the public be part of this process?
No decision has been made at this time.

Since the human toxicity estimates cited in the NRC report only apply to young healthy male soldiers, what applies to the general public?
There is no impact, as current monitoring levels are well below those established in the report, and are strictly monitored by state regulatory agencies and other oversight organizations. We are operating at extremely safe levels and are working hard to get the job done safely and as quickly as possible. The Army will continue to eliminate the risk that this agent poses through the safest and most proven technology — incineration.

What is the likely impact, if any, on monitoring/analytical programs within and external to the chemical agent disposal facilities (CDFs)?
The only impact for CDF operations is lowering the immediately dangerous to life and health (IDLH) monitoring level for the nerve agents GB and VX. The blister agent, mustard, is not affected because its IDLH is equivalent to the time weighted average (TWA). The TWA and the general population limit (GPL) and the allowable stack concentration (ASC) are not affected y the proposed toxicological values in the NRC report. This is due to the fact the TWA and GPL toxicological values are based on chronic biological markers such as miosis and cholinesterase depression. The ASC is a source emission limit that is modeled against the GPL. Other programs that use acute toxicological values in their risk assessments or monitoring program may be affected by the proposed toxicological values.

What is the likely impact, if any, on monitoring/analytical requirements on the Umatilla CDF's Comprehensive Monitoring Workplan (CMP), the Sampling Analysis Plan and its Quality Assurance Plan?
The purpose of the CMP is to confirm the projections of the pretrial burn risk assessment. The risk assessment model, established and conducted by the state of Oregon Department of Environmental Quality, used the ASC and the GPL to model deposition of agent under worst case conditions. For the same reasons stated in the questions above, the CMP is not affected by the proposed toxicological values in the NRC report. Since the SAP and QAP are required to

implement the guidance in the CMP, these documents are not affected by the proposed toxicological values.

What is the likely impact, if any, on certifying process-derived hazardous waste as being agent free?

Process-derived hazardous waste is screened by head-space analysis to contain agent at less than one TWA. The hazardous waste in then certified to be agent free at less than the waste control limit (WCL). The WCL is 20 parts per billion (ppb) for GB and VX and 200 ppb for HD. Due to lack of Department of Army (DA) guidance on monitoring levels for liquid and solid hazardous waste, the Program Manager for Chemical Demilitarization used the DA's drinking water standards for its WCL. Since the TWA and WCL are both monitoring levels for chronic exposure to agents, process derived hazardous waste is not affected by the proposed values in the NRC report.

ATTACHMENT L

TABLE OF COMMENTS AND EXHIBITS
"Documents related to Human Health Risk Assessments"

AND

Human Health Risk Assessment Protocol for
Hazardous Waste Combustion Facilities
Environmental Protection Agency, July, 1998

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ATTACHMENT L

Documents related to Human Health Risk Assessments

EXHIBIT NO.	TITLE	DATE OF DOCUMENT	AUTHOR (IF APPLICABLE)	ADMIN RECORD NO.[1]	NOTES AND CITATIONS TO DOCUMENT[2]
27	Affidavit of Thomas Bodley Stibolt Jr. and Lisa (Elizabeth) P. Brenner	8/19/98	Thomas Bodley Stibolt Jr. & Lisa P. Brenner	No record number assigned	The Affidavit of Thomas B. Stibolt, Jr. (Senior Physician with Norwest Permanente and a Clinical Associate Professor of Medicine at Oregon Health Sciences University) and Lisa P. Brenner (Staff Scientist and President of Oregon Clearinghouse for Pollution Reduction). Drs. Stibolt and Brenner reviewed the Pre-Trial Burn Risk Assessment" for UMCDF and state that DEQ did not follow "appropriate scientific steps" in the Health Risk Assessment and that there were "important unanswered questions." Item No. **98-1275** (p. 39, line 24 and p. 61, line 1) refers to this Affidavit and its attachments to support the Petitioner's contention that the UMCDF Health Risk Assessment fails to consider "impacts of low level agent exposure; impacts on a fetus, infant, and sensitive populations; impacts that may be particular to Native Americans..." Also cited in Item No. **98-1247** (p. 4); **99-0704** (p. 7); and in **99-2201** (p. 33).

[1] The DEQ Chemical Demilitarization Program maintains a database of documents related to the Umatilla Chemical Agent Disposal Facility. Most documents are assigned a record number for tracking purposes. Individual "Exhibits" submitted during the course of G.A.S.P., et al., *v.* EQC, et al., (Case No. 9708-06159, Oregon Circuit Court) were not assigned record numbers at the time of submittal—only the document the Exhibit was attached to was assigned a number. Some Exhibits do have Administrative Record Numbers because the document had been previously received.

[2] No. **98-1247**: "Request for Contested Case Hearing and Other Relief," letter dated December 14, 1998 (Included as Attachment A)
No. **98-1275**: "Petitioners' Memorandum Supporting Cross Motion for Summary Judgment," August 20, 1998 (Case No. 9708-06159)
No. **99-0704**: "Petitioners' Opposition to Respondents' Supplemental Motion for Summary Judgment," April 12, 1999 (Case No. 9708-06159)
No. **99-2201**: "Comments of G.A.S.P., et al., in Support of Their Request to Suspend and Revoke Permits for [UMCDF]," December 17, 1999 (Included in Attachment E)

ATTACHMENT L

Documents related to Human Health Risk Assessments

EXHIBIT NO.	TITLE	DATE OF DOCUMENT	AUTHOR (IF APPLICABLE)	ADMIN RECORD NO.[1]	NOTES AND CITATIONS TO DOCUMENT[2]
27.1	Review of the inhalation modeling compounds and standards used in the RA for human health effects	8/17/98	Lisa Brenner & Tom Stibolt	No record number assigned	This is "Attachment A" to Exhibit 27. The authors present the results of the their analysis of the 1996 UMCDF Health Risk Assessment (HRA). Issues of concern to the authors include the restriction of the UMCDF HRA's analysis to only those compounds included in the EPA guidance; the level of "acceptable" risk; the lack of consideration of "non-cancer" effects and the failure of the Department to perform an "acute risk assessment."
27.2	A Listing of the Compounds that PRC claims should be included in the modeling analysis	8/16/98	Lisa Brenner and Tom Stibolt	No record number assigned	This is Attachment B to Exhibit 27., and are the tables referenced in Attachment A (Exhibit 27.1). The tables are titled: "Carcinogenic Effects Via Inhalation: Presentation and Additions" "Non-Carcinogenic Effects: Additions and Qualitative Comparisons" "A Listing of the Compounds that PRC claims should be included in the modeling analysis"
27.3	Table 1 - Comparison of Potential PICS, Recommended PICS, and Proposed Emission Rates	11/5/96	PRC Environmental Management	1977	This is Attachment "C" to Exhibit 27. It is a table from a report prepared by PRC Environmental Management. The full report is titled "Air Quality Dispersion and deposition Review and Evaluation of the Draft Pre-Trial Burn Risk Assessment of Combustion By-Products for the Proposed Umatilla Chemical Demilitarization Facility." Item No. **98-1275** (p. 57, line 10) cites a statement from PRC that "it will take a full 2 minutes for a high level response (e.g. waste feed shut off) to occur after a toxic emission is detected.".

ATTACHMENT L

Documents related to Human Health Risk Assessments

EXHIBIT NO.	TITLE	DATE OF DOCUMENT	AUTHOR (IF APPLICABLE)	ADMIN RECORD NO.[1]	NOTES AND CITATIONS TO DOCUMENT[2]
27.4	Fundamentals of Risk Analysis and Risk Management	1/1/97	Vlasta Molak, editor	No record number assigned	This is Attachment "D" to Exhibit 27. The portion of the two-page excerpt highlighted here is a sentence that states "The U.S. EPA defines negligible risk of cancer as that smaller than 1:1,000,000."
27.5	Umatilla Chemical Agent Disposal Facility Phase 1 Quantitative Risk Assessment	9/1/96	Science Applications International Corporation	1830	This is Attachment "E" to Exhibit 27. It is an excerpt of the "Quantitative Risk Assessment" discussing which exposure pathways are modeled in the QRA, and the dose-response equations that are used. (This document was reviewed and extensively discussed during the development and approval of the original UMCDF HW Permit.)
27.6	Technical Aspects of the Model and the Air Quality Impact Analysis	8/17/98	Thomas Stibolt and Lisa Brenner	No record number assigned	This is the second Attachment "E" to Exhibit 27. This document was prepared by the Authors and discusses the meteorological data that were used in the 1996 UMCDF HRA.
28	Trygve P. Steen's Affidavit	8/20/98	Trygve P. Steen	No record number assigned	Dr. Steen's Affidavit affirms his support for the work of Lisa Brenner and Tom Stibolt. There are two attachments to this Exhibit. See Exhibits 28.1 and 28.2. Item No. **98-1275** (p. 40, line 0 and p. 61, line 1) refers to this Affidavit and its attachments to support the Petitioner's contention that the UMCDF Health Risk Assessment fails to consider "impacts of low level agent exposure; impacts on a fetus, infant, and sensitive populations; impacts that may be particular to Native Americans..." Also cited in Item No. **98-1247** (p. 4); **99-0704** (p. 7); and in **99-2201** (p. 33).

ATTACHMENT L

Documents related to Human Health Risk Assessments

EXHIBIT NO.	TITLE	DATE OF DOCUMENT	AUTHOR (IF APPLICABLE)	ADMIN RECORD NO.[1]	NOTES AND CITATIONS TO DOCUMENT[2]
28.1	Thinking of Biology - Science, environmental risk assessment, and the frame problem	9/1/94	Kristin S. Shrader-Frechette	No record number assigned	This is Attachment "A" to Exhibit 28. It is an article from "BioScience" (Volume 44, No. 9, September, 1994) that discusses the use of a "two-value frame" vs. a "three-value frame" when making risk assessment decisions.
28.2	Curriculum Vitae of Trygve P. Steen	6/1/98	Trygve P. Steen	No record number assigned	This is Attachment "B" to Exhibit 28.
37.1	1997 Declaration of the Environmental Leaders of the Eight on Children's Environmental Health	7/27/98	Office of Children's Protection	No record number assigned	(See also Exhibit 37.2). Item No. **98-1275** (p. 42, lines 20-25) cites Exhibit 37 to support the statement that "Children and infants are more susceptible to air pollutants and toxic chemicals than adults."
37.2	Executive Order: Protection of Children From Environmental Health Risks and Safety Risks	4/21/97	The White House	No record number assigned	This is President Clinton's Executive Order governing the establishment of a Task Force on "Environmental Health Risks and Safety Risks to Children" and directing federal agencies to ensure that they have addressed environmental health risks and safety risks that might disproportionately affect children.

United States Environmental Protection Agency | Solid Waste and Emergency Response (5305W) | EPA530-D-98-001A July 1998 www.epa.gov/osw

EPA

Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities,

Volume One

Peer Review Draft

Printed on paper that contains at least 20 percent postconsumer fiber

EQC Meeting May 18, 2000
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EPA 530-D-98-001A
July 1998

Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities,

Volume One

U.S. EPA, OFFICE OF SOLID WASTE

U.S. ENVIRONMENTAL PROTECTION AGENCY

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DISCLAIMER

This document provides guidance to U.S. EPA Regions and States on how best to implement RCRA and U.S. EPA's regulations to facilitate permitting decisions for hazardous waste combustion facilities. It also provides guidance to the public and to the regulated community on how U.S. EPA intends to exercise its discretion in implementing its regulations. The document does not substitute for U.S. EPA's regulations, nor is it a regulation itself. Thus, it cannot impose legally-binding requirements on U.S. EPA, States, or the regulated community. It may not apply to a particular situation based upon the circumstances. U.S. EPA may change this guidance in the future, as appropriate.

ACKNOWLEDGMENTS

Jeff Yurk (U.S. EPA Region 6) and David Weeks (formerly of U.S. EPA Region 6), the primary authors/editors of this document, would like to acknowledge that the development of this document could not have been accomplished without the support, input, and work of a multitude of U.S. EPA and support contractor personnel. The foundation for the procedures and methodologies outlined in this document were first developed by the Office of Research and Development (ORD) and the Office of Solid Waste (OSW) in previous versions of combustion risk assessment guidance. The State of North Carolinas' combustion risk assessment methodology was also evaluated in preparation of this document. This version of the guidance was originally initiated in response to the desire of the Region 6 Multimedia Planning and Permitting Division to implement an up-to-date and technically sound hazardous waste combustion permitting program. The decision to incorporate guidance on a full range of national combustion risk assessment issues into the document was encouraged and supported by the Director of the Office of Solid Waste.

The development of this document was significantly enhanced by a number of capable organizations and personnel within U.S. EPA. Karen Pollard, Alexander McBride and David Layland of the Economic Methods and Risk Analysis Division in conjunction with Rosemary Workman of the Permits and State Programs Division and Karen Kraus of the Office of General Council provided overall policy, technical and legal comment on this document. David Reisman, Glenn Rice, Eletha Brady Roberts and Matthew Lorber of the National Center for Environmental Assessment (NCEA), Office of Research and Development and Dr. Dorothy Canter, Science Advisor to the Assistant Administrator for the Office of Solid Waste and Emergency Response, provided key input on breaking scientific developments in the areas of mercury speciation, the dioxin reassessment, endocrine disruptors, toxicity factors, sulfur and brominated dioxin analogs, as well as technical comment on the overall methodologies presented in the document.

Contributions by Dr. Larry Johnson of the National Exposure Research Laboratory of ORD and Jeff Ryan of the National Risk Management Research Laboratory of ORD were significant in providing methodologies for conducting TO analysis and defining appropriate detection limits to be used in the risk assessment. Donna Schwede of the National Exposure Research Laboratory of ORD and Jawad Touma of the Office of Air Quality Planning and Standards provided technical review comments to strengthen the air modeling section of the document. Review and comment on the soil and water fate and transport models was provided by Robert Ambrose of EPA's Environmental Research Laboratory in Athens, GA.

All U.S. EPA Regional Offices contributed valuable comments which have significantly improved the usability of this document. In particular, Region 4 aided in making sure guidance for conducting trial burns was consistent with this document, and Region 10 provided significant input on the subject of acute risk assessment and PCB analysis. The authors would be remiss if they did not acknowledge significant contributions from the Texas Natural Resource and Conservation Commission through both comments and discussions of real-world applications of risk assessment methodologies. Additionally, useful comments were received from the States of Colorado, Utah, and Alabama. The Region 6 Superfund Division is to be commended for its valuable review of the early document. Region 6 apologizes and bears full responsibility for any mistakes made in the incorporation of comment and input from all reviewers into the document.

Finally, this work could not have been completed without the tireless efforts of support contractor personnel. Tetra Tech EM Inc. (Tetra Tech), performed the bulk of the background research. The Air Group, under subcontract to Tetra Tech, helped develop the chapter on air dispersion modeling. The work of these contractors was performed under the technical direction of staff from the Region 6 Center for Combustion Science and Engineering, as well as key Agency project and contracting officers.

Region 6 looks forward to the insight and input yet to be provided by industry and other interested parties during the full external peer review of the document.

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LIST OF ACRONYMS

µg	Microgram
µm	Micrometer
ACGIH	American Conference of Governmental Industrial Hygienists
ADD	Average daily dose
AEFA	Average Emission Factor Approach
Ah	Aryl hydrocarbon
AHH	Aryl hydrocarbon hydroxylase
AIEC	Acute inhalation exposure criteria
AIHA	American Industrial Hygiene Association
APCS	Air pollution control system
ASTM	American Society for Testing and Materials
atm	Atmosphere
ATSDR	Agency for Toxic Substances and Disease Registry
AWFCO	Automatic waste feed cutoff
BaP	Benzo(a)pyrene
BAF	Bioaccumulation factor
BBS	Bulletin board service
BCF	Bioconcentration factor
BEHP	Bis(2-ethylhexyl) phthalate
BIF	Boiler and industrial furnace
BPIP	Building profile input program check
BSAF	Sediment bioaccumulation factor
Btu	British thermal unit
BW	Body weight
CAA	Clean Air Act
CARB	California Air Resources Board
CAS	Chemical Abstracts Service
CFR	Code of Federal Regulations
CKD	Cement kiln dust
CLP	Contract Laboratory Program
cm	Centimeters
COPC	Compound of potential concern
CRQL	Contract required quantitation limit
CSV	Unspeciated chromatographical semivolatiles
CWA	Clean Water Act
DEHP	Diethylhexylphthalate
dL	Decaliter
DNA	Dioxyribonucleic acid
DNOP	Di(n)octyl phthalate
DOE	Department of Energy
DRE	Destruction and removal efficiency

LIST OF ACRONYMS (Continued)

DW	Dry weight of soil or plant/animal tissue
EPACA	U.S. Environmental Protection Agency Correlation Approach
EQL	Estimated quantitation limit
ESP	Electrostatic precipitator
ExInter	Expert Interface Version 1.0
FW	Fresh weight (or whole/wet weight) of plant or animal tissue
g	Grams
GC	Gas chromatography
GEP	Good engineering practice
GRAV	Unspeciated gravimetric compounds
HEAST	Health Effects Assessment Summary Tables
HI	Hazard index
HQ	Hazard quotient
IARC	International Agency for Research on Cancer
IDL	Instrument detection limit
IEU/BK	Integrated exposure uptake/biokinetic
IPM	Insoluble polystryene microspheres
IRIS	Integrated Risk Information System
ISCSTDFT	Industrial Source Complex Short Term Draft
ISCST3	Industrial Source Complex Short Term 3
K	Kelvin
kg	Kilogram
LADD	Lifetime average daily dose
L	Liter
lb	Pound
LCD	Local climatological data annual summary with comparative data
m	Meters
MACT	Maximum achievable control technology
MDL	Method detection limit
MEHP	Monoethylhexyl phthalate
mg	Milligram
Mg	Megagram
MIR	Maximum individual risk
MJ	Megajoule
mL	Milliliter
MPRM	Meteorological processor for regulatory models

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LIST OF ACRONYMS (Continued)

MPTER	Air quality model for multiple point source gaussian dispersion algorithm with terrain adjustments
MRL	Minimum risk level
NCDC	National Climatic Data Center
NC DEHNR	North Carolina Department of Environment, Health, and Natural Resources
NCEA	National Center for Environmental Assessment
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NRC	Nuclear Regulatory Commission
NTP	National Toxicology Program
NWS	National Weather Service
OAQPS	Office of Air Quality Planning and Standards
ORD	Office of Research and Development
OSHA	U.S. Occupational Safety and Health Administration
OSW	Office of Solid Waste
OSWER	Office of Solid Waste and Emergency Response
PAH	Polynuclear aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PCDD	Polychlorinated dibenzo(p)dioxin
PCDF	Polychlorinated dibenzofuran
PCRAMMET	Personal computer version of the meteorological preprocessor for the old RAM program
PDF	Probability density function
pg	Picogram
PIC	Product of incomplete combustion
PM	Particulate matter
PMD	Portable monitoring device
PM10	Particulate matter less than 10 micrometers in diameter
POHC	Principal organic hazardous constituent
ppb	Parts per billion
ppm	Parts per million
ppmv	Parts per million by volume
ppt	Parts per trillion
PQL	Practicle quantitation limit
PU	Polyurethane
QA	Quality assurance
QAPjP	Quality assurance project plan
QC	Quality control
RCRA	Resource Conservation and Recovery Act
RfC	Reference concentration
RfD	Reference dose

LIST OF ACRONYMS (Continued)

RME	Reasonable maximum exposure
RPF	Relative potency factor
RTDM	Rough terrain diffusion model
RTDMDEP	Rough terrain diffusion model deposition
s	Second
SAMSON	Solar and Meterological Surface Observational Network
SCRAM	Support Center for Regulatory Air Models
SF	Slope factor
SLERA	Screening level ecological risk assessment
SOCMI	Synthetic Organic Chemical Manufacturing Industries
SQL	Sample quantitation limit
SRA	Screening ranges approach
SVOC	Semivolatile organic compound
SW-846	U.S. Environmental Protection Agency Test Methods for Evaluating Solid Waste
TCDD	Tetrachlorodibenzo(p)dioxin
TDA	Toluenediamine
TDI	Toluene diisocyanate
TEF	Toxicity equivalent factor
TEQ	Toxicity equivalent quotient
TG	Terrain grid
TIC	Tentatively identified compound
TLV	Threshold limit value
TOC	Total organic carbon
TSD	Treatment, storage, and disposal
TTN	Technology transfer network
TWA	Time-weighted average
U/BK	Uptake/biokinetic
USCA	Unit-Specific Correlation Approach
USDA	U.S. Department of Agriculture
U.S. EPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
USLE	Universal soil loss equation
UTM	Universal transverse mercator
VOC	Volatile organic compound

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LIST OF VARIABLES

β_0, β_1	=	Regression constants (unitless)
γ	=	Empirical constant (unitless)
λ_s	=	Dimensionless viscous sublayer thickness (unitless)
μ_a	=	Viscosity of air (g/cm-s)
μ_w	=	Viscosity of water corresponding to water temperature (g/cm-s)
ρ_a	=	Density of air (g/cm^3 or g/m^3)
ρ_{forage}	=	Density of forage (g/cm^3)
ρ_s	=	Bed sediment density (kg/L)
ρ_w	=	Density of water corresponding to water temperature (g/cm^3)
θ	=	Temperature correction factor (unitless)
θ_{ss}	=	Bed sediment porosity (unitless)
θ_{sw}	=	Soil volumetric water content (mL water/cm^3 soil)
a	=	Empirical intercept coefficient (unitless)
A	=	Surface area of contaminated area (m^2)
A_{beef}	=	Concentration of COPC in beef (mg COPC/kg FW tissue)
$A_{chicken}$	=	Concentration of COPC in chicken meat (mg COPC/kg FW tissue)
ADD	=	Average daily dose (mg COPC/kg BW-day)
ADD_{infant}	=	Average daily dose for infant exposed to contaminated breast milk (pg COPC/kg BW infant/day)
ADD_{mat}	=	Average daily dose (mother) (pg COPC/kg BW mother/day)
AEF	=	Applicable average emission factor for the equipment type (kg/hr-source)
A_{egg}	=	Concentration of COPC in eggs (mg COPC/kg FW tissue)
Ah	=	Area planted (m^2)
Ahi	=	Area planted to ith crop (m^2)
A_i	=	Impervious watershed area receiving COPC deposition (m^2)
A_L	=	Total watershed area receiving COPC deposition (m^2)
A_{milk}	=	Concentration of COPC in milk (mg COPC/kg FW tissue)
A_{pork}	=	Concentration of COPC in pork (mg COPC/kg FW tissue)
AT	=	Averaging time (days)
A_w	=	Water body surface area (m^2)
b	=	Empirical slope coefficient (unitless)
Bu_{beef}	=	Biotransfer factor for beef (day/kg FW tissue)
$Bu_{chicken}$	=	Biotransfer factor for chicken (day/kg FW tissue)
Bu_{egg}	=	Biotransfer factor for eggs (day/kg FW tissue)
BAF_{fish}	=	Bioaccumulation factor for fish (L/kg FW tissue)
Bu_{milk}	=	Biotransfer factor for milk (day/kg FW tissue)
Bu_{pork}	=	Biotransfer factor for pork (day/kg FW tissue)
BCF_{fish}	=	Bioconcentration factor for fish (mg COPC/kg FW tissue)/(mg COPC/kg dissolved water)—unitless
BD	=	Soil bulk density (g soil/cm^3 soil)
Br_{ag}	=	Plant-soil bioconcentration factor for aboveground produce
Br_{forage}	=	Plant-soil bioconcentration factor for forage (µg COPC/g DW plant)/(µg COPC/g soil)—unitless

LIST OF VARIABLES (Continued)

Br_{grain}	=	Plant-soil bioconcentration factor for COPC in grain (µg COPC/g DW plant)/(µg COPC/g soil)—unitless
$Br_{rootveg}$	=	Plant-soil bioconcentration factor for COPC in belowground produce (µg COPC/g FW plant)/(µg COPC/g soil)—unitless
Bs	=	Soil bioavailability factor (unitless)
$BSAF$	=	Biota-to-sediment accumulation factor (mg COPC/kg lipid tissue)/(mg COPC/kg sediment)—unitless
Bv_{ag}	=	COPC air-to-plant biotransfer factor for aboveground produce (µg COPC/g DW plant)/(µg COPC/g air)—unitless
$Bv_{forage/silage}$	=	Air-to-plant biotransfer factor for forage and silage (µg COPC/g DW plant)/(µg COPC/g air)—unitless
C	=	USLE cover management factor (unitless)
C_a	=	Total COPC air concentration (µg/m^3)
C_{acute}	=	Acute air concentration (µg/m^3)
$Cancer\ Risk_i$	=	Individual lifetime risk through indirect exposure to COPC carcinogen i (unitless)
$Cancer\ Risk_{inh(i)}$	=	Individual lifetime cancer risk through direct inhalation of COPC carcinogen i (unitless)
C_{BS}	=	Bed sediment concentration (or sediment bulk density) (g sediment/cm^3 water)
C_{gen}	=	Generic chemical concentration (mg COPC/kg tissue or media) or (mg/L)
Ccn_i	=	Stack concentration of non-Table A-1 list ith carcinogenic COPCs (carbon basis) (mg COPC/m^3 stack emissions)
Ccp_i	=	Stack concentration of Table A-1 list ith carcinogenic COPCs (carbon basis) (mg COPC/m^3 stack emissions)
C_d	=	Drag coefficient (unitless)
C_{dw}	=	Dissolved phase water concentration (mg COPC/L water)
C_{fish}	=	Concentration of COPC in fish (mg COPC/kg FW tissue)
C_i	=	Stack concentration ith identified COPC (carbon basis) (mg/m^3)
Cn_j	=	Stack concentration of non-carcinogenic COPC j (carbon basis) (mg/m^3)
CR	=	Generic contact rate (kg/day or L/day)
Cs	=	Average soil concentration over exposure duration (mg COPC/kg soil)
C_{sb}	=	Concentration sorbed to bed sediment (mg COPC/kg sediment)
Cs_{tD}	=	Soil concentration at time tD (mg COPC/kg soil)
C_{TOC}	=	Stack concentration of TOC, including speciated and unspeciated compounds (mg COPC/m^3 stack emissions)
C_w	=	Gas phase air concentration (µg COPC/m^3 air)
C_{VOC}	=	Total stack concentration of volatile speciated COPCs with boiling points less than 100°C (mg COPC/m^3 stack emissions)
$C_{VOC(i)}$	=	Stack concentration of the ith volatile speciated COPC with a boiling point less than 100°C (carbon basis) (mg COPC/m^3 stack emissions)
C_{wcnc}	=	Total COPC concentration in water column (mg COPC/L water column)
C_{wbd}	=	Total water body COPC concentration including water column and bed sediment (g COPC/m^3 water body) or (mg/L)

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LIST OF VARIABLES (Continued)

Cyp	=	Unitized yearly average air concentration from particle phase (μg-s/g-m³)
Cyv	=	Unitized yearly average air concentration from vapor phase (μg-s/g-m³)
$Cywv$	=	Unitized yearly (water body and watershed) average air concentration from vapor phase (μg-s/g-m³)
D_a	=	Diffusivity of COPC in air (cm²/s)
d_{bs}	=	Depth of upper benthic sediment layer (m)
D_{mean}	=	Mean particle size density for a particular filter cut size
Ds	=	Deposition term (mg COPC/kg soil-yr)
d_w	=	Depth of water column (m)
D_w	=	Diffusivity of COPC in water (cm²/s)
$Dydp$	=	Unitized yearly average dry deposition from particle phase (s/m²-yr)
$Dywp$	=	Unitized yearly (water body or watershed) average total (wet and dry) deposition from particle phase (s/m²-yr)
$Dywp$	=	Unitized yearly average wet deposition from particle phase (s/m²-yr)
$Dywv$	=	Unitized yearly average wet deposition from vapor phase (s/m²-yr)
$Dywwv$	=	Unitized yearly (water body and watershed) average wet deposition from vapor phase (s/m²-yr)
d_s	=	Total water body depth (m)
ED	=	Exposure duration (yr)
EF	=	Exposure frequency (days/yr)
ER	=	Soil enrichment ratio (unitless)
E_v	=	Average annual evapotranspiration (cm/yr)
f_{bs}	=	Fraction of total water body COPC concentration in benthic sediment (unitless)
Fd	=	Fraction of diet that is soil (unitless)
F_i	=	Fraction of plant type i grown on contaminated soil and eaten by the animal (unitless)
f_{lipid}	=	Fish lipid content (unitless)
Fw	=	Fraction of COPC wet deposition that adheres to plant surfaces (unitless)
f_{ws}	=	Fraction of total water body COPC concentration in the water column (unitless)
F_v	=	Fraction of COPC air concentration in vapor phase (unitless)
GEF	=	Applicable emission factor for sources with screening values >10,000 ppmv (kg/hr-source)
H	=	Henry's Law constant (atm-m³/mol)
HI	=	Hazard index (unitless)
HI_j	=	Hazard index for exposure pathway j (unitless)
HQ	=	Hazard quotient (unitless)
HQ_i	=	Hazard quotient for COPC i (unitless)
$HQ_{inh@}$	=	Hazard quotient for direct inhalation of COPC i (unitless)

LIST OF VARIABLES (Continued)

I	=	Average annual irrigation (cm/yr)
I_i	=	Daily intake of COPC (i) from animal tissue j (mg/day)
k	=	von Karman's constant (unitless)
K	=	USLE erodibility factor (ton/acre)
k_b	=	Benthic burial rate constant (yr⁻¹)
Kd_{bs}	=	Bed sediment/sediment pore water partition coefficient (cm³ water/g bottom sediment)
Kd_{ij}	=	Partition coefficient for COPC i associated with sorbing material j (unitless)
Kd_s	=	Soil-water partition coefficient (cm³ water/g soil)
Kd_{sw}	=	Suspended sediments/surface water partition coefficient (L water/kg suspended sediment)
K_G	=	Gas phase transfer coefficient (m/yr)
K_L	=	Liquid phase transfer coefficient (m/yr)
K_{oc}	=	Soil organic carbon-water partition coefficient (mL water/g soil)
K_{oij}	=	Sorbing material-independent organic carbon partition coefficient for COPC j
K_{ow}	=	Octanol-water partition coefficient (mg COPC/L octanol)/(mg COPC/L octanol)—unitless
kp	=	Plant surface loss coefficient (yr⁻¹)
ks	=	COPC soil loss constant due to all processes (yr⁻¹)
kse	=	COPC loss constant due to soil erosion (yr⁻¹)
ksg	=	COPC loss constant due to biotic and abiotic degradation (yr⁻¹)
ksl	=	COPC loss constant due to leaching (yr⁻¹)
ksr	=	COPC loss constant due to surface runoff (yr⁻¹)
ksv	=	COPC loss constant due to volatilization (yr⁻¹)
k_v	=	Water column volatilization rate constant (yr⁻¹)
K_v	=	Overall COPC transfer rate coefficient (m/yr)
k_{ws}	=	Overall total water body dissipation rate constant (yr⁻¹)
L	=	Monin-Obukhov Length (m)
$LADD$	=	Lifetime average daily dose (mg COPC/kg BW-day)
L_{dep}	=	Total (wet and dry) particle phase and wet vapor phase COPC direct deposition load to water body (g/yr)
L_{dif}	=	Vapor phase COPC diffusion (dry deposition) load to water body (g/yr)
$leak\ rate$	=	Emission rate from the individual item of equipment (kg/hr)
L_E	=	Soil erosion load (g/yr)
LEF	=	Applicable emission factor for sources with screening values <10,000 ppmv (kg/hr-source)
L_R	=	Runoff load from pervious surfaces (g/yr)
L_{RI}	=	Runoff load from impervious surfaces (g/yr)
L_T	=	Total COPC load to the water body including deposition, runoff, and erosion (g/yr)
LS	=	USLE length-slope factor (unitless)

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LIST OF VARIABLES (Continued)

M_{skin}	=	Mass of a thin (skin) layer of below ground vegetable (g)
$M_{vegetable}$	=	Mass of the entire vegetable (g)
MF	=	Metabolism factor (unitless)
n	=	Number of items of equipment of the applicable type in the stream (unitless)
N_{ge}	=	Equipment count (specific equipment type) for sources with screening values >10,000 ppmv
N_{le}	=	Equipment count (specific equipment type) for sources with screening values <10,000 ppmv
OC_i	=	Organic carbon content of sorbing material *i* (unitless)
OC_{sed}	=	Fraction of organic carbon in bottom sediment (unitless)
p°_L	=	Liquid phase vapor pressure of chemical (atm)
p°_S	=	Solid phase vapor pressure of chemical (atm)
P	=	Average annual precipitation (cm/yr)
PF	=	USLE supporting practice factor (unitless)
Pd	=	Aboveground exposed produce concentration due to direct (wet and dry) deposition onto plant surfaces (mg COPC/kg DW)
P_i	=	Total COPC concentration in plant type *I* ingested by the animal (mg/kg DW)
Pr	=	Aboveground exposed and protected produce concentration due to root uptake (mg COPC/kg DW)
Pr_{bg}	=	Belowground produce concentration due to root uptake (mg COPC/kg DW)
Pv	=	Concentration of COPC in plant due to air-to-plant transfer (mg COPC/kg DW)
Q	=	COPC emission rate (g/s)
Q_i	=	Emission rate of COPC *(i)* (g/s)
$Q_{i(adj)}$	=	Adjusted emission rate of COPC *(i)* (g/s)
$Qcp_{i(adj)}$	=	Adjusted emission rate of Table A-1 carcinogenic COPC *(i)* (g/s)
Qcp_i	=	Emission rate of Table A-1 carcinogenic COPC *(i)* (g/s)
Q_f	=	Anthropogenic heat flux (W/m^2)
Qp_i	=	Quantity of plant type *I* ingested by the animal each day (kg DW/day)
Q_S	=	Quantity of soil ingested by the animal each day (kg/day)
$Q_{VOCi,adj}$	=	Adjusted emission rate of the *i*th volatile speciated COPC with a boiling point less than 100°C (g/s)
Q_{VOCi}	=	Emission rate of the *i*th volatile speciated COPC (g/s)
Q^*	=	Net radiation absorbed (W/m^2)
r	=	Interception fraction—the fraction of material in rain intercepted by vegetation and initially retained (unitless)
R	=	Universal gas constant (atm-m^3/mol-K)

LIST OF VARIABLES (Continued)

RCF	=	Root concentration factor (µg COPC/g DW plant)/(µg COPC/ml soil water)
RO	=	Average annual surface runoff from pervious surfaces (cm/yr)
REL	=	California EPA Air Toxics Hot Spots Program acute reference exposure levels
RF	=	USLE rainfall (or erosivity) factor (yr^{-1})
Rp	=	Interception fraction of the edible portion of plant (unitless)
$SBCF$	=	Scale bias correction factor (unitless)
SD	=	Sediment delivery ratio (unitless)
ΔSf	=	Entropy of fusion [$\Delta S_f/R$ = 6.79 (unitless)]
SF	=	Slope factor (mg/kg-day)$^{-1}$
S_T	=	Whitby's average surface area of particulates (aerosols) = 3.5×10^{-4} cm^2/cm^3 air for background plus local sources = 1.1×10^{-3} cm^2/cm^3 air for urban sources
SV	=	Screening value (ppmv)
T_a	=	Ambient air temperature (K)
T_1	=	Time period at the beginning of combustion (yr)
T_2	=	Length of exposure duration (yr)
tD	=	Time period over which deposition occurs (time period of combustion) (yr)
T_m	=	Melting point of chemical (K)
TOC_{VOC}	=	Stack concentration of volatile TOC, including speciated and unspeciated compounds (mg/m^3)
TOC_{CSV}	=	Stack concentration of CSV TOC, including speciated and unspeciated compounds (mg/m^3)
TOC_{GRAV}	=	Stack concentration of GRAV TOC, including speciated and unspeciated compounds (mg/m^3)
Tp	=	Length of plant exposure to deposition per harvest of edible portion of plant (yr)
tp_i	=	Length of plant's exposure to deposition per harvest of the edible portion of the *i* th plant group (yr)
Total Cancer Risk	=	Individual lifetime cancer risk through indirect exposure to all COPC carcinogens (unitless)
Total Cancer Risk$_{Ink}$	=	Total individual lifetime cancer risk through direct inhalation of all COPC carcinogens
TSS	=	Total suspended solids concentration (mg/L)
T_{wk}	=	Water body temperature (K)
$t_{1/2}$	=	Half-time of COPC (days)
u	=	Current velocity (m/s)
Vdv	=	Dry deposition velocity (cm/s)
Vf_x	=	Average volumetric flow rate through water body (m^3/yr)

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LIST OF VARIABLES (Continued)

VG_{ag}	=	Empirical correction factor for aboveground produce (forage and silage)(unitless)
VG_{bg}	=	Empirical correction factor for below ground produce (unitless)
VOC	=	Total VOC emission rate for an equipment type (kg/hr)
VOC_s	=	VOC emission rate from all equipment in the stream of a given equipment type (kg/hr)
Vp	=	Vapor pressure of COPC (atm)
W	=	Average annual wind speed (m/s)
w_b	=	Rate of burial (m/yr)
WF_{VOC}	=	Average weight fraction of VOC in the stream (unitless)
X_e	=	Unit soil loss (kg/m²-yr)
Yh	=	Dry harvest yield = 1.22×10^{11} kg DW, calculated from the 1993 U.S. average wet weight Yh of 1.35×10^{11} kg (USDA 1994b) and a conversion factor of 0.9 (Fries 1994)
Yh_i	=	Harvest yield of ith crop (kg DW)
Yp	=	Yield or standing crop biomass of edible portion of plant (productivity) (kg DW/m²)
Yp_i	=	Yield or standing crop biomass of the edible portion of the plant (productivity) (kg DW/m²)
Z_s	=	Soil mixing zone depth (cm)
0.01	=	Units conversion factor (kg cm²/mg-m²)
10^{-6}	=	Units conversion factor (g/μg)
10^{-6}	=	Units conversion factor (kg/mg)
0.31536	=	Units conversion factor (m-g-s/cm-μg-yr)
365	=	Units conversion factor (days/yr)
907.18	=	Units conversion factor (kg/ton)
0.1	=	Units conversion factor (g-kg/cm³-m²)
0.001	=	Units conversion factor (kg-cm²/mg-m²)
100	=	Units conversion factor (mg-cm²/kg-cm²)
1000	=	Units conversion factor (mg/g)
4047	=	Units conversion factor (m²/acre)
1×10^{3}	=	Units conversion factor (g/kg)
3.1536×10^{7}	=	Units conversion factor (s/yr)

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Chapter 1
Introduction

What's Covered in Chapter 1:

- Objective and Purpose
- Related Trial Burn Issues
- Reference Documents
- Document Organization

Risk assessment is a science used to evaluate the carcinogenic risks and noncarcinogenic hazards to human health that are attributable to emissions from hazardous waste combustion units. These risk assessments include the evaluation of both direct and indirect risks. There is sufficient guidance available regarding the performance of direct inhalation risk assessments. On the other hand, indirect risk assessments are newer and more complex. As a result, this document describes the evaluation of direct inhalation risk, but primarily focuses on the procedures used to estimate risk resulting from indirect pathways. The following definitions as adopted from the National Academy of Sciences 1983, *Risk Assessment in the Federal Government*, for use throughout this guidance:

Risk Assessment	The scientific evaluation of potential health impacts that may result from exposure to a particular substance or mixture of substances under specified conditions.
Hazard	An impact to human health by chemicals of potential concern.
Risk	An estimation of the probability that an adverse health impact may occur as a result of exposure to chemicals in the amount and by the pathways identified.
Dose	Defined as one oral exposure.
Exposure	Exposure to chemicals by relevant pathways to identified receptors.
Indirect Exposure	Resulting from contact of human and ecological receptors with soil, plants, or waterbodies on which emitted chemical has been deposited. For screening level purposes, indirect exposure include ingestion of above ground fruits and vegetables, beef and milk, freshwater fish and soil.

Direct Exposure	Exposure via inhalation.

This Human Health Risk Assessment Protocol (HHRAP) has been developed as national guidance to consolidate information presented in other risk assessment guidance and methodology documents previously prepared by U.S. EPA and state environmental agencies. In addition, the HHRAP also addresses issues that have been identified while conducting risk assessments for existing hazardous waste combustion units. The overall purpose of this document is to explain how risk assessments should be performed at hazardous waste combustion facilities. This document is intended as (1) guidance for personnel conducting risk assessments, and (2) an information resource for permit writers, risk managers, and community relations personnel.

In the April 19, 1996, preamble to the proposed MACT rule, U.S. EPA recommended that site-specific risk assessments be conducted as part of the RCRA permitting process for hazardous waste combustors as necessary to protect human health and the environment. Often, the determination of whether or not a permit is sufficiently protective can be based on its conformance to the applicable technical standards specified in the regulations. Since the time that the current regulations for hazardous waste incinerators and boilers/industrial furnaces were issued (1981 and 1991, respectively), however, information has become available to suggest that these performance standards may not fully address potentially significant risks. Many recent studies (including the *Draft Health Reassessment of Dioxin-Like Compounds*, *Mercury Study Report to Congress*, and *Risk Assessment Support to the Development of Technical Standards for Emissions from Combustion Units Burning Hazardous Wastes: Background Information Document*) indicate that there can be significant risks from indirect exposure pathways (e.g., pathways other than direct inhalation). The food chain pathway appears to be particularly important for bioaccumulative pollutants which may be emitted from hazardous waste combustion units. In many cases, risks from indirect exposure may constitute the majority of the risk from a hazardous waste combustor. This key portion of the risk from hazardous waste combustor emissions was not directly taken into account when the hazardous waste combustion standards were developed. In addition, uncertainty remains regarding the types and quantities of non-dioxin products of incomplete combustion emitted from combustion units and the risks posed by these compounds.

The RCRA "omnibus" authority of §3005(c)(3) of RCRA, 42 U.S.C. §6925(c)(3) and 40 CFR. §270.32(b)(2) gives the Agency both the authority and the responsibility to establish permit conditions on a

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case-by-case basis as necessary to protect human health and the environment. Performance of a site-specific risk assessment can provide the information necessary to determine what, if any, additional permit conditions are necessary for each situation to ensure that operation of the combustion unit is protective of human health and the environment. Under 40 C.F.R. §270.10(k), U.S. EPA may require a permit applicant to submit additional information (e.g., a site-specific risk assessment) that the Agency needs to establish permit conditions under the omnibus authority. In certain cases, the Agency may also seek additional testing or data under the authority of RCRA §3013 (where the presence or release of a hazardous waste "may present a substantial hazard to human health or the environment") and may issue an order requiring the facility to conduct monitoring, testing, analysis, and reporting. Any decision to add permit conditions based on a site-specific risk assessment under this authority must be justified in the administrative record for each facility, and the implementing agency should explain the basis for the conditions.

The permitting agency should consider several factors in its evaluation of the need to perform a risk assessment (human health and ecological). These factors include:

- whether any proposed or final regulatory standards exist that U.S. EPA has shown to be protective for site-specific receptors
- whether the facility is exceeding any final technical standards
- the current level of hazardous constituents being emitted by a facility, particularly in comparison to proposed or final technical standards, and to levels at other facilities where risks have been estimated
- the scope of waste minimization efforts and the status of implementation of a facility waste minimization plan
- particular site-specific considerations related to the exposure setting (such as physical, land use, and sensitive subpopulation characteristics) and the impact of these characteristics on potential risks
- the hazardous constituents most likely to be found and those most likely to pose significant risk
- the volume and types of wastes being burned
- the level of public interest and community involvement attributable to the facility

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This list is by no means exhaustive, but is meant only to suggest significant factors that have thus far been identified. Others may be equally or more important.

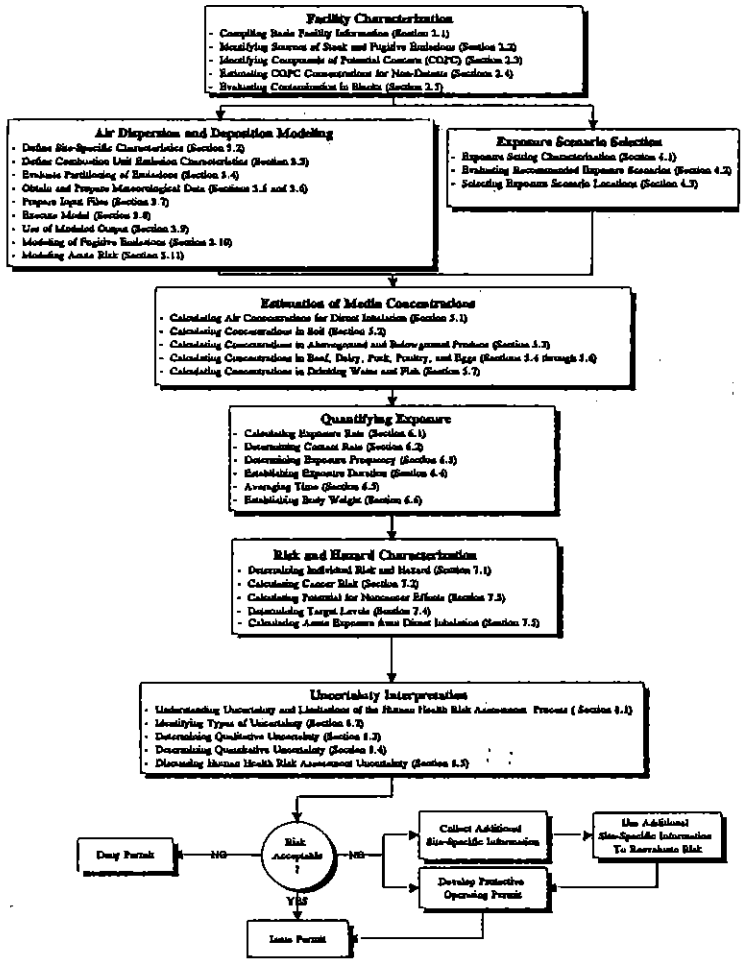
The companion document of the HHRAP is the Screening Level Ecological Risk Assessment Protocol (SLERAP). U.S. EPA OSW has prepared these guidance documents as a resource to be used by authorized agencies developing risk assessment reports to support permitting decisions for hazardous waste combustion units.

1.1 OBJECTIVE AND PURPOSE

U.S. EPA OSW's objective is to present a user-friendly set of procedures for performing risk assessments, including (1) a complete explanation of the basis of those procedures, and (2) a comprehensive source of data needed to complete those procedures. The first volume of this document provides the explanation (Chapters 1 through 9); and the second volume (Appendixes A-B) provides the data sources. Appendix A presents compound-specific information necessary to complete the risk assessment. Appendixes B and C present a user-friendly set of procedures for performing risk assessments. Figure 1-1 summarizes the tasks needed to complete a risk assessment and refers the reader to chapters in this guidance in which each task is described.

Implementation of this guidance will demonstrate that developing defensible estimates of compound emission rates is one of the most important elements of the risk assessment. As described in Chapter 2, traditional trial burns conducted to measure destruction and removal efficiency (DRE) do not sufficiently characterize organic products of incomplete combustion (PIC) and metal emissions for use in performing risk assessments. In some instances, a facility or regulatory agency may want to perform a pretrial burn risk assessment, following the procedures outlined in this document, to ensure that sample collection times during the trial burn or risk assessment burn are sufficient to collect the sample volumes needed to meet the detection limits needed for the risk assessment. The decision to perform such an assessment should consider regulatory permitting schedules and other site-specific factors.

FIGURE 1-1
HUMAN HEALTH RISK ASSESSMENT PROCESS



U.S. EPA OSW anticipates that risk assessments will be completed for new and existing facilities as part of the permit application process. The HHRAP recommends a process for evaluating *reasonable*—not theoretical worst-case maximum—potential risks to receptors posed by emissions from RCRA regulated units. The use of existing and site-specific information early in, and throughout, the risk assessment process is encouraged; conservative assumptions should be made only when needed to ensure that emissions from combustion units do not pose unacceptable risks. More conservative assumptions may be incorporated to make the process fit a classical "screening level" approach that is more conservative and may be easier to complete.

Regardless of whether theoretical worst case or more reasonable conservative assumptions are used in completing the risk assessment process, every risk assessment is limited by the quantity and quality of:

- site-specific environmental data
- emission rate information
- other assumptions made during the risk estimation process (for example, fate and transport variables, exposure assumptions, and receptor characteristics)

These limitations and uncertainties are described extensively throughout this document and the appendixes, and are summarized in Chapter 8.

Unacceptable risks or other significant issues identified by collecting preliminary site information and completing risk assessment calculations can be addressed by the permitting process or during an iteration of the risk assessment. After the initial risk assessment has been completed, it may be used by risk managers and permit writers in several ways:

- If the initial risk assessment indicates that estimated cancer risks and noncancer hazards are below regulatory levels of concern, risk managers and permit writers will likely proceed through the permitting process without adding any risk-based unit operating conditions to the permit.
- If the initial risk assessment indicates potentially unacceptable risks, additional site-specific information demonstrated to be more representative of the exposure setting may be collected and additional iterations of risk assessment calculations can then be performed.

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- If the initial risk assessment or subsequent iterations indicate potentially unacceptable risks, risk managers and permit writers may use the results of the risk assessment to revise tentative permit conditions (for example, waste feed limitations, process operating conditions, and expanded environmental monitoring). To determine if the subject hazardous waste combustion unit can be operated in a manner that is protective of human health and the environment, an additional iteration of the risk assessment should be completed using the revised tentative operating conditions. If the revised conditions still indicate unacceptable risks, this process can be continued in an iterative fashion until acceptable levels are reached. In some situations, it may be possible to select target risk levels and back-calculate the risk assessment to determine the appropriate emission and waste feed rate levels. In any case, the acceptable waste feed rate and other appropriate conditions can then be incorporated as additional permit conditions.

- If the initial risk assessment, or subsequent iterations, indicate potentially unacceptable risks, risk managers and permit writers may also choose to deny the permit.

This process is also outlined in Figure 1-1. As stated earlier, in some instances, a facility or regulatory agency may want to perform a pretrial burn risk assessment—following the procedures outlined in this document—to ensure that sample collection times during the trial burn or risk assessment burn are sufficient to collect the sample volumes necessary to meet the appropriate detection limits for the risk assessment. This is expected to reduce the need for additional trial burn tests or iterations of the risk assessment due to problems caused when detection limits are not low enough to estimate risk with certainty sufficient for regulatory decision making. For example, if detection limits are too high then estimates of risk based on detection limits may be overly conservative.

1.2 RELATED TRIAL BURN ISSUES

In the course of developing this guidance and completing risk assessments across the country, U.S. EPA OSW has learned that developing defensible estimates of compound of potential concern (COPC) emission rates is one of the most important parts of the risk assessment process. As described in Chapter 2, traditional trial burns conducted to measure destruction and removal efficiency (DRE) *do not* sufficiently characterize organic products of incomplete combustion (PIC) and metal emissions for use in performing risk assessments.

U.S. EPA OSW considers the trial burn and risk assessment planning and implementation processes as interdependent aspects of the hazardous waste combustion unit permitting process. In addition, U.S. EPA

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OSW advocates that facility planning, regulatory agency review, and completion of tasks needed for both processes be conducted simultaneously to eliminate redundancy or the need to repeat activities. U.S. EPA OSW expects that the following guidance documents will typically be used as the main sources of information for developing and conducting appropriate trial burns:

- U.S. EPA. 1989f. *Handbook: Guidance on Setting Permit Conditions and Reporting Trial Burn Results. Volume II of the Hazardous Waste Incineration Guidance Series.* Office of Research and Development (ORD). EPA/625/6-89/019. January.

- U.S. EPA. 1989g. *Handbook: Hazardous Waste Incineration Measurement Guidance Manual. Volume III of the Hazardous Waste Incineration Guidance Series.* Office of Solid Waste and Emergency Response (OSWER). EPA/625/6-89/021. June.

- U.S. EPA. 1992c. *Technical Implementation Document for EPA's Boiler and Industrial Furnace Regulations.* OSWER. EPA-530-R-92-011. March.

- U.S. EPA. 1994n. *Draft Revision of Guidance on Trial Burns. Attachment B, Draft Exposure Assessment Guidance for Resource Conservation and Recovery Act (RCRA) Hazardous Waste Combustion Facilities.* OSWER. June 2.

- Generic Trial Burn Plan and QAPPs developed by EPA regional offices or states.

1.3 REFERENCE DOCUMENTS

This section describes, in chronological order, the primary guidance documents used to prepare this HHRAP. Some of the guidance documents received a thorough review from EPA's Science Advisory Board, which mostly supported the work. Additional references used to prepare this HHRAP are listed in the References chapter of this document. These documents have been developed over a period of several years; in most cases, revisions to the original guidance documents address only the specific issues being revised rather than representing a complete revision of the original document. The following discussion lists and briefly describes each document. Overall, each of the guidance documents reflects a continual enhancing of the methodology. The most current risk assessment methodology frequently referenced in this guidance is the U.S. EPA NCEA guidance, *Methodology for Assessing Health Risks Associated with Multiple Exposure Pathways to Combustor Emissions* (In Press).

References, such as "U.S. EPA 1990e," correspond to the citation for the document specified in the Reference section of this guidance.

The following document was the first U.S. EPA guidance document for conducting risk assessments at combustion units:

- U.S. EPA. 1990e. *Interim Final Methodology for Assessing Health Risks Associated with Indirect Exposure to Combustor Emissions.* Environmental Criteria and Assessment Office. ORD. EPA-600-90-003. January.

This document outlined and explained a set of general procedures for conducting risk assessments. This document was subsequently revised by the following:

- U.S. EPA. 1993h. *Review Draft Addendum to the Methodology for Assessing Health Risks Associated with Indirect Exposure to Combustor Emissions.* Office of Health and Environmental Assessment. ORD. EPA-600-AP-93-003. November 10.

This document outlined recommended revisions to previous U.S. EPA guidance (1990e), which have been used by the risk assessment community since the release of the document; however, these recommended revisions were never formally incorporated into the original document. In 1994, U.S. EPA issued several additional risk assessment documents, including the following:

- U.S. EPA. 1994f. *Draft Exposure Assessment Guidance for RCRA Hazardous Waste Combustion Facilities.* OSWER. EPA-530-R-94-021. April.

The actual substance of the 1994 U.S. EPA guidance (1994f) is included in the following series of attachments, all issued as separate documents:

- U.S. EPA. 1994g. *Draft Guidance for Performing Screening Level Risk Analyses at Combustion Facilities Burning Hazardous Wastes. Attachment C, Draft Exposure Assessment Guidance for RCRA Hazardous Waste Combustion Facilities.* April 15.
- U.S. EPA. 1994h. Table 1, "Chemicals Recommended for Identification," and Table 2, "Chemicals for Potential Identification." *Attachment A, Draft Exposure Assessment Guidance for RCRA Hazardous Waste Combustion Facilities.* April 15.
- U.S. EPA. 1994i. *Draft Revision, Implementation Guidance for Conducting Indirect Exposure Analysis at RCRA Combustion Units. Attachment, Draft Exposure Assessment Guidance for RCRA Hazardous Waste Combustion Facilities.* April 22.

- U.S. EPA. 1994j. *Draft Guidance on Trial Burns. Attachment B, Draft Exposure Assessment Guidance for RCRA Hazardous Waste Combustion Facilities.* May 2.
- U.S. EPA. 1998 (In Press). *"Guidance on Collection of Emissions Data to Support Site-Specific Risk Assessments at Hazardous Waste Combustion Facilities.* Internal Review Draft. Prepared by EPA Region 4 and the Office of Solid Waste.

Combined, these four documents present a revised procedure for completing a risk assessment. Because the original U.S. EPA guidance documents (1990e and 1993h) contained much of the background information necessary to complete the risk assessment process, this information was not repeated. In 1994, this new guidance was further revised by the following documents:

- U.S. EPA. 1994n. *Draft Revision of Guidance on Trial Burns. Attachment B, Draft Exposure Assessment Guidance for RCRA Hazardous Waste Combustion Facilities.* OSWER. June 2.
- U.S. EPA. 1994p. *Errata, Draft Guidance for Performing Screening Level Risk Analyses at Combustion Facilities Burning Hazardous Wastes. Attachment C, Draft Exposure Assessment Guidance for RCRA Hazardous Waste Combustion Facilities.* October 4.
- U.S. EPA. 1994r. *Revised Draft Guidance for Performing Screening Level Risk Analyses at Combustion Facilities Burning Hazardous Wastes. Attachment C, Draft Exposure Assessment Guidance for RCRA Hazardous Waste Combustion Facilities.* Office of Emergency and Remedial Response. OSW. December 14.

More recently, NC DEHNR developed the following guidance document for conducting risk assessments:

- NC DEHNR. 1997. *North Carolina Protocol for Performing Indirect Exposure Risk Assessments for Hazardous Waste Combustion Units.* January.

The NC DEHNR document reiterates U.S. EPA procedures (1994r), with the addition of a tiered approach that allows the regulatory agency or facility to choose the investment they want to make in conducting risk assessments. For instance, a small, on-site unit with limited waste stream variability is allowed the opportunity to conduct a Tier 1 assessment (more worst-case), whereas a larger facility with a diverse waste feed mixture may decide to complete a Tier 2 or 3 assessment (progressively more site-specific).

Finally, U.S. EPA OSW contracted for the development of *The Background Information Document to the Risk Assessment Support to the Development of Technical Standards for Emissions from Combustion*

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Units Burning Hazardous Wastes (Research Triangle Institute 1996) to support the proposed Hazardous Waste Combustion Rule. This document was reviewed and considered throughout the development of the HHRAP in order to ensure that the approach outlined is consistent with the most current OSW risk assessment policy.

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ATTACHMENT M

TABLE OF COMMENTS AND EXHIBITS

Documents Related to the Use of Alternative Treatment Technologies and the Risk of Storage

and

"Perspectives on the Umatilla Quantitative Risk Assessment Results," SAIC, September, 1996 (begins on page M-3)

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ATTACHMENT M

Documents Related to the Use of Alternative Treatment Technologies and the Risk of Storage

EXHIBIT NO.	TITLE	DATE OF DOCUMENT	AUTHOR (IF APPLICABLE)	ADMIN RECORD NO.[1]	NOTES AND CITATIONS TO DOCUMENT[2]
48	Annual Status Report on the Disposal of Chemical Weapons and Materiel for Fiscal Year 1997	9/30/97	Department of Defense	98-0027	This Exhibit is an excerpt of the Status Report and includes a project schedule (Page number unknown) and pp. 11 and 57 which discuss the "current status" of each stockpile site. Cited in Item No. **98-1275** (p. 63, lines 13-14) support the contention that use of alternative technologies, as evidenced by the schedules given for the "alternative technology" sites in Newport, IN and Aberdeen, MD, would not have resulted in a delay at Umatilla.
63	Pilot Testing of Neutralization/Biotreatment of Mustard Agent at Aberdeen Proving Ground, Maryland - Final Environmental Impact Statement	7/1/98	U.S. Army Program Manager for Chemical Demilitarization (PMCD)	No Record Number Assigned	Exhibit 63 is a partial copy of the EIS prepared for the Aberdeen Chemical Agent Disposal Facility, that will use neutralization followed by biotreatment to destroy the stockpile of mustard agent stored at the Aberdeen Proving Ground. Petitioners state that "almost seventy percent of the HD stored at Umatilla is in bulk storage and could be disposed of using this technology." Cited in Item No. **98-1247** (p. 8); Item No. **98-1285** (p. 8); Item No. **99-0704** (p. 13); and **99-2201** (p. 35).

[1] The DEQ Chemical Demilitarization Program maintains a database of documents related to the Umatilla Chemical Agent Disposal Facility. Most documents are assigned a record number for tracking purposes. Individual "Exhibits" submitted during the course of G.A.S.P., et al., *v.* EQC, et al., (Case No. 9708-06159, Oregon Circuit Court) were not assigned record numbers at the time of submittal—only the document the Exhibit was attached to was assigned a number. Some Exhibits do have Administrative Record Numbers because the document had been previously received.

[2] No. **98-1247**: "Request for Contested Case Hearing and Other Relief," letter dated December 14, 1998 (Included as Attachment A)
No. **98-1275**: "Petitioners' Memorandum Supporting Cross Motion for Summary Judgment," August 20, 1998 (Case No. 9708-06159)
No. **98-1285**: "Petitioners' Additional Documentary Evidence," November 10, 1998 (Case No. 9708-06159)
No. **99-0704**: "Petitioners' Opposition to Respondents' Supplemental Motion for Summary Judgment," April 12, 1999 (Case No. 9708-06159)
No. **99-2201**: "Comments of G.A.S.P., et al., in Support of Their Request to Suspend and Revoke Permits for [UMCDF]," December 17, 1999 (Included in Attachment E)

ATTACHMENT M

Documents Related to the Use of Alternative Treatment Technologies and the Risk of Storage

EXHIBIT NO.	TITLE	DATE OF DOCUMENT	AUTHOR (IF APPLICABLE)	ADMIN RECORD NO.[1]	NOTES AND CITATIONS TO DOCUMENT[2]
65	Public Health Assessment for US Army Umatilla Depot Activity - Public Health Service Agency for Toxic Substance and Disease Registry	9/30/97	U.S. Department of Health and Human Services	No Record Number assigned	Exhibit 65 is an Assessment prepared by the DHHS to "evaluate the possible pathways of exposure to contamination at the former Umatilla Depot Activity." The Assessment was undertaken as part of a review of the "Superfund" sites at the Umatilla Depot. Item No. **98-1285** (p. 9) cites this Exhibit to "shatter the myth, still perpetuated by the Army, that the risk of storage is greater than the risk of incineration."

Perspectives on the Umatilla Quantitative Risk Assessment Results

Prepared by
Science Applications International Corporation
for U.S. Army Program Manager for Chemical Demilitarization

September 1996

Introduction

A risk assessment has been completed for the Umatilla Chemical Agent Disposal Facility (UMCDF). A summary of the methods and results is provided in *Umatilla Chemical Agent Disposal Facility Phase 1 Quantitative Risk Assessment* (SAIC, 1996). The study provides estimates of the public risks of accidental agent release from the chemical stockpile and from proposed disposal facility operations.

The risk assessment document includes some comparisons of risks of storage and processing. The risk assessment is only an assessment of risks and does not include conclusions regarding acceptability of risk. Acceptability of risk is determined by society, generally through the elected or appointed officials.

In deliberating the permits for the disposal process, the State of Oregon Environmental Quality Commission and Department of Environmental Quality have expressed a desire to have additional explanation of risk through comparisons to other risks that society and individuals face in everyday life. Comparisons need to be carefully selected and considered by the decision makers. Society, individuals, and decision makers have perceptions of risk that are the controlling factor in risk decision making. To aid the State officials in their understanding of risks, some risk comparisons are provided in this paper. Again, conclusions regarding acceptability are not made.

Risk comparison is a difficult endeavor because of varying risk perceptions. Several different ways of viewing the risks are provided here. More detailed comparisons can be done, and there is substantial literature on risk comparison (e.g., Covello, 1990; Okrent, 1980; and Cohen, 1991). Additional information that could be used to compare risks is also provided in Section 2 of the QRA (SAIC, 1996).

Societal Risk Results

Figure 1 is one summary of the findings of the study. It illustrates the risk of disposal processing at the UMCDF, the risk of munition storage at the Umatilla Chemical Depot (UMCD) during the approximate 3-year disposal period, and the risk of continued storage for 20 years (if no processing were undertaken). The storage risk during the disposal period accounts for the reduction in the inventory of munitions as they are processed at the facility. This is termed *societal risk* because it indicates the impact on the affected population (e.g., the society surrounding UMCD). Figure 1 illustrates, on the vertical scale, the probability of exceeding the number of fatalities shown on the horizontal scale. The scales on this graph are logarithmic, that is they are evenly divided in factors of 10, enabling the illustration of large changes on a single figure. The risk curves in the figure are specifically designed to provide the user with an understanding not only of the probability of accidents, but the probability of different size accidents. From Figure 1, it is seen that the probability of incurring one or more public fatalities is approximately:

1 in 300,000 for 3.3 years of disposal processing at UMCDF
1 in 6,000 for 3.3 years of stockpile storage at UMCD during processing
1 in 400 for continued stockpile storage at UMCD for 20 years with no processing.

The area under each of the curves in Figure 1 is the value most typically referred to as *the risk*. It represents the average risk (statistically expected fatalities) over all accidents and potential consequences. The results of the UMCDF QRA indicate that the fatality risk is approximately:

0.00002 for 3.3 years of disposal processing at UMCDF
0.04 for 3.3 years of stockpile storage at UMCD during processing
0.6 for continued stockpile storage at UMCD for 20 years with no processing.

The actual risk during the disposal process is the sum of the disposal processing risk and the risk of storage during the disposal process. During the 3.3 years of disposal processing, the risk is therefore the sum of the bottom two curves in Figure 1. From the values in the figure it is clear that the risk of the disposal process is a very small addition to the storage risk during disposal.

Figure 1 provides some other insights for decision makers. Typically decision makers consider not only the overall risk but also the risk of different size accidents, reflecting society's concern with large accidents. For example, in 1990 in the U. S. there were 46,814 deaths in motor vehicle accidents and 941 deaths due to air transport (National Safety Council, 1993). Airline crashes, however, gather the attention of media and society because they typically involve many deaths, whereas the automobile statistic, which equates to over

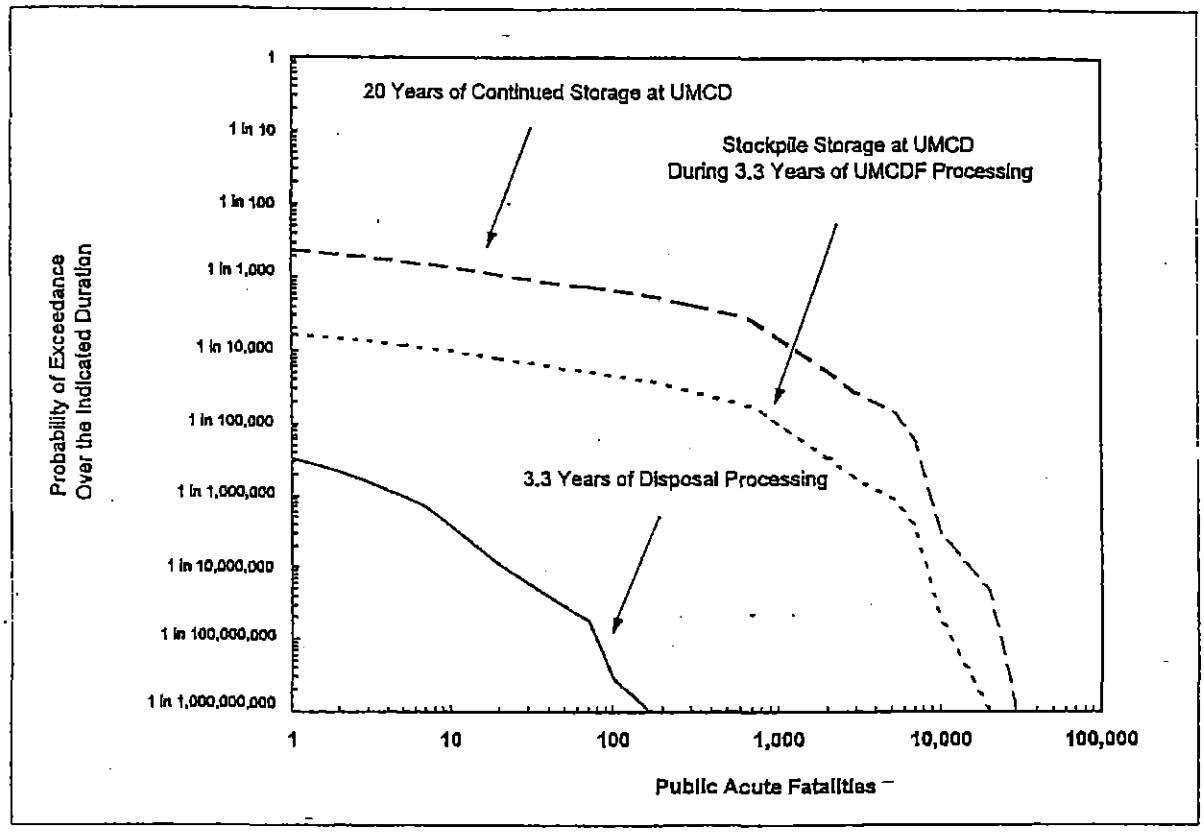


Figure 1. Summary of Umatilla Risk Results

100 people killed in motor vehicle accidents per day, appears to be more readily accepted by society because each accident typically involves a few deaths. It can be seen from Figure 1 that the risk of processing is less than storage but, perhaps more importantly, the risk of accidents with large numbers of deaths is much lower. There are an estimated 200 deaths at a 1-in-a-billion probability for the disposal processing, while at the same probability there is the potential for more than 10,000 deaths due to a storage accident.

In terms of the magnitude of the consequences, disposal processing accidents are estimated to have average consequences ranging up to 14 deaths, with an average across all accident sequences of approximately 1 death (SAIC, 1996, Table 13-1). On the other hand, accidents associated with continued storage are estimated to have average consequences up to 235 deaths with an average of 85 deaths across all scenarios (SAIC, 1996, Table 15-5).

Perspective on Societal Risk

Comparison of societal risks is problematic for a single facility. The risks associated with UMCD are limited to a specific population, whereas societal risks generally result from all endeavors over a large population. A representative list of societal risks in terms of expected deaths per year is provided in Table 1. As indicated, the accidents associated with UMCD are estimated to be very small compared to other societal risks in Oregon. This comparison may be of limited value since it does not indicate the impact on people closest to UMCD, which is captured in the estimate of the individual risks discussed in the next section.

Table 1. Some Societal Risks in Oregon (Expected Deaths per Year)

No. of Deaths in Oregon Per Year	Cause[a]
1,293	All accidental deaths
678	Motor vehicle
56	Drownings
33	Machinery (including farm equip.)
25	Fires
6	Railway
4	Electric current
0.03	Stockpile storage[b]
0.000006	Disposal processing[c]

a All except the last two entries based on actuarial data from 1989 from the National Safety Council, 1993. The last two entries from the Phase 1 QRA for Umatilla (SAIC, 1996).
b. In other words, one death every 33 years.
c. In other words, one death every 160,000 years.

Individual Risk Results

Risks have also been calculated on a per-person basis. This is typically referred to as individual risk, although it is calculated for groups of people living various distances from UMCD, not for specific individuals. Individual risk is an estimate of the probability of death for potentially exposed persons. For the most exposed people, living between 1 to 3 miles from

the facility, the individual fatality risk is

1 in 27 million per year of disposal operation
1 in 300,000 per year of continued storage.

Thus the annual risk to the individuals closest to the facility is about 90 times greater per year for continued storage versus disposal operations. These risks have also been calculated for the entire disposal process compared to 20 years of continued storage.

1 in 8 million for the total 3.3 years of disposal operations
1 in 15,000 for 20 years of continued storage.

If these are compared as options, then the individual risk associated with continued storage is over 500 times greater than disposal processing.

Perspective on Individual Risk

Although the relative difference in risk is important, it is useful for decision makers to compare the risks to other individual risks. A sampling of comparisons is provided here to illustrate this process. As noted in the introduction, decision makers and stakeholders will develop their own comparisons and conclusions based on their values and risk perceptions.

The annual chance of accidental death due to all causes (car accidents, drowning, falls, poisoning, etc.) for an average individual in the State of Oregon is approximately 4 in 10,000 (or 400 in a million). Table 2 lists the individual risks on the same basis.

Table 2. Estimated Chemical Weapons Disposal and Storage Individual Risks Compared to Individual Risk of Accidental Death in Oregon

Risk Result	% of Oregon Total Accidental Death Rate	Description
400 in a million	100%	Individual chance of accidental death per year in Oregon, all causes
3 in a million	~1%	Individual chance of death per year due to continued storage for individuals living closest to the facility
0.04 in a million	0.01%	Individual chance of death per year due to disposal operations for individuals living closest to the facility

Table 3 provides some additional comparisons of the estimated values from the QRA to other individual risks. (Oregon-specific results were not readily available, so U.S. averages are listed.) The results enable consideration of the estimated risks compared to other risks an individual might be exposed to. Society's perception of the need to be protected from various risks can then be factored into decision making.

Table 3. Average Individual Risks in the United States

Risk of Death to an Average Person in the U. S.	Percent of Total Accidental Death Risk	Description
370 in a million	100%	All accidental causes
200 in a million	54%	All motor vehicle accidents
32 in a million	9%	Pedestrian death due to motor vehicle
20 in a million	5%	Accidental poisoning
5 in a million	1%	Choking on food
3 in a million	**~1%**	**Continued storage at UMCD for individuals living closest (1-3 miles) to the facility**
0.4 in a million	0.1%	Lightning
0.1 in a million	0.03%	Dog bites
0.04 in a million	**0.01%**	**Disposal operations at UMCDF for individuals living closest (1-3 miles) to the facility**
0.04 in a million	0.01%	Venomous snakes, lizards, and spiders
0.02 in a million	0.005%	Fireworks accidents

Cancer Risk

The QRA included an estimate of risk of cancer due to accidental release of mustard agents (only mustard is a carcinogen). The cancer risk due to accidental release was estimated to be very small. Table 4 lists the individual risk of induced cancer compared to other individual risks of death. This comparison includes several limitations. First, the estimated values in the QRA are for cancer induced over a lifetime, not necessarily death due to cancer; the other entries are for death. Second, the death rate information is based on the U.S. population as a

Table 4. Individual Risk of Death (Average of U. S. Population) Compared to QRA Estimates of Cancer Incidence.

Annual Individual Risk of Death[a]	% of Total	Cause
8,630 in a million	100%	All causes of death
2,895 in a million	34%	Heart disease
2,030 in a million	24%	Cancer
570 in a million	7%	Stroke
370 in a million	4%	Accidents
120 in a million	1%	Suicide
2,645 in a million	30%	All other causes
10 in a million	—	USEPA upper bound screening for lifetime cancer incidence due to facility emissions[b]
0.00001 in a million	10^{-7} %[c]	Cancer incidence risk for accidental releases during 20 years of storage for people closest to UMCD[b]
0.000002 in a million	10^{-10} %[c]	Cancer incidence risk for accidental releases during 3.3 years of disposal processing for people closest to UMCD[b]

a. Death rates are values for an average individual in the population as a whole. There are substantial differences in death rates and causes among different age groups.
b. These items are listed for convenience, but they represent cancer incidence in a lifetime, not annual risk of death, as the other items in the table.
c. $10^{-7} = 0.0000001$, $10^{-10} = 0.0000000001$

whole. There are substantial differences among age groups as to death rates and causes. However, the table is useful for indicating the small values calculated in the QRA.

There is one other consideration regarding cancer risk. A human health risk assessment is also being completed for UMCDF to meet the requirements of the Resource Conservation and Recovery Act (RCRA) Part B permit. As part of that process, the screening risk assessment involves evaluating the cancer risk to individuals from incinerator emissions using a screening method. That is, a conservative assessment of the cancer risk is estimated and the result is compared to a threshold predetermined to be below regulatory concern (1 in 100,000 chance of lifetime induced cancer). The screening risk assessment is therefore not intended to provide a best estimate, only to show attainment of a goal that is judged to protect the public

from any undue cancer risk. The cancer risk due to emissions is therefore part of the decision makers input. However, the methodology is established so that if the individual risk to the most exposed individuals are below the threshold of regulatory concern, no additional analysis is performed. The threshold is provided in Table 4 as a point of reference.

Other Perspectives on Risk

Risk values are sometimes difficult to comprehend because they are a combination of how often something happens and how many people are affected. Another consideration useful for understanding risks is how often the accidents that could lead to public health effect could be expected to occur. In the risk assessment thousands of potential accidents were analyzed, ranging from those that might be expected to occur during the facility lifetime to accidents that are extremely rare. Tables 13-1 and 15-1 in the Phase 1 QRA (SAIC, 1996) list the accidents that contribute most to risk. Table 5 repeats some of that information and lists some other events for perspective.

Table 5. Comparison of Accident Frequencies

Recurrence Intervals	Description of Event	% Contr. to Risk
Disposal Processing		
30,000-500,000 yrs	Earthquake causes large release at UMCDF	71%
5,000 yrs	Handling accident causes igloo fire	14%
Storage		
1,500 yrs	Richter 5.5 earthquake causes large release	14%
3,800 yrs	Richter 6.5 earthquake causes large release	27%
11,000 yrs	Richter 6.8 earthquake causes large release	22%
32,000- 500,000 yrs	Richter 6.8 - 7.5 earthquake causes large release	35%
2,500,000 yrs	Aircraft crash into mustard storage	<1%
Other Rare Events		
164 yrs	Lightning strike to an acre of land near Umatilla	—
55,000 yrs	Greater than 1 pound meteorite strike per square mile	—
800,000 yrs	Lightning strike to a square yard of land near Umatilla	—
35,000,000 yrs	Greater than 1 pound meteorite strike per acre	—

For example, for disposal processing, the most frequent accident that contributes significantly has an average recurrence interval of about 5,000 years. (This is a handling accident that leads to an igloo fire.) Essentially, this can be taken as meaning that if that plant were to operate for 5,000 years, this accident would likely occur. It is difficult to gain perspective on these types of events because the time frames are outside the human range of experience. Lightning is one familiar phenomenon. For the area of Oregon around Umatilla, the lightning strike recurrence interval for an acre of land is about 164 years (based on area alone, does not account for conductors, lightning protection, or other phenomena that make some areas more likely to be struck than others.) However, to a single square yard of land, the lightning recurrence interval is 800,000 years. Meteorites striking the earth is another infrequent phenomena; for example, the recurrence interval for a 1 pound meteorite per acre is 35 million years.

Considering the fact that earthquakes are an important part of the risk, another viewpoint is gained by examining the historical record. Table 5-2 of the QRA (SAIC, 1996) lists two earthquakes that have occurred within 50 miles of the site.

Date	Approximate Richter Magnitude	Distance from UMCD
July 6, 1936	6 - 7.5	48 mi
March 7, 1893	6 - 7.5	7 mi

In earthquakes of this size, masonry is damaged, chimneys fall, etc. Thus, although not frequent, significant earthquakes do occur in this area. Generally, earthquakes that could result in releases from the facility or stockpile would be of Richter 5.5 or greater.

Finally, there has been some concern about the risk due to airplane crashes. As indicated, the recurrence interval for a crash (medium to large airplane) into the mustard storage area is about 2,500,000 years, a very rare event. Also shown in table 15-5 of the QRA (SAIC, 1996) is the average agent-related deaths associated with the crash—60 deaths. The mustard storage area covers about an acre. The air traffic over the depot is not heavy and is not higher than others areas such as Hermiston or Pasco. The average school, office building, or hospital is roughly the size of the mustard storage area. An airplane crash into any of those facilities might very well cause 60 or more deaths. Attempts to reduce the risk of airline crash to citizens in the area would require examining a broader scope than just the chemical storage area.

References

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Covello, V. T. "Risk Comparisons and Risk Communications," *Communicating Risks to the Public: International Perspectives* (R. Kasperson and P. Stallen, Editors) Boston, Kluwer/Reidel, 1990.

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Okrent, D. "Comment on Societal Risk," *Science*, Vol. 208, 25 April 1980.

Science Applications International Corporation. *Umatilla Chemical Agent Disposal Facility Phase 1 Quantitative Risk Assessment*, U. S. Army Program Manager for Chemical Demilitarization, September 1996.

ATTACHMENT N

TABLE OF COMMENTS AND EXHIBITS

Transcripts from various Utah-related proceedings
(State and Federal Courts and USHW Board)

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ATTACHMENT N

Transcripts from various Utah-related proceedings (State Court and USHW Board)

EXHIBIT NO.	TITLE	DATE OF DOCUMENT	AUTHOR (IF APPLICABLE)	ADMIN RECORD NO.[1]	NOTES AND CITATIONS TO DOCUMENT[2]
23	Deposition of John K. Cluff (CWWG, et al. *v.* U.S. Army, et al.; Case No. 96-CV-0425C; TOCDF)	7/17/96	John Cluff	99-1724	Exhibit includes pp. 14-17, 26-29, 38-61, 70-73, and 114-117 of Pages 2-117 (Volume II) of John Cluff's deposition. The Department obtained a complete copy (190 pages total) of John Cluff's July 17-18, 1996 deposition. At the time of this deposition, John Cluff was the "Assistant Project Manager for Systemization and Operations" working for the PMCD field office at TOCDF. Petitioners (**98-1275**, p.32, lines 18-23) use John Cluff's testimony (pp. 51-59 of this transcript) to support the contention that the Army decided not to burn the DPE suits in the DUN because of concern over the incineration by-products from the suit material. Petitioners (**98-1275**, p.34, lines 11-16) use John Cluff's testimony (pp. 45-49 of this transcript) to support the contention that the BRA is not being operated at TOCDF due to "mechanical problems."

[1] The DEQ Chemical Demilitarization Program maintains a database of documents related to the Umatilla Chemical Agent Disposal Facility. Most documents are assigned a record number for tracking purposes. Individual "Exhibits" submitted during the course of G.A.S.P., et al., *v.* EQC, et al., (Case No. 9708-06159, Oregon Circuit Court) were not assigned record numbers at the time of submittal—only the document the Exhibit was attached to was assigned a number. Some Exhibits do have Administrative Record Numbers because the document had been previously received.

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No. **99-2201**: "Comments of G.A.S.P., et al., in Support of Their Request to Suspend and Revoke Permits for [UMCDF]," December 17, 1999 (Included in Attachment E)

ATTACHMENT N

Transcripts from various Utah-related proceedings (State Court and USHW Board)

EXHIBIT NO.	TITLE	DATE OF DOCUMENT	AUTHOR (IF APPLICABLE)	ADMIN RECORD NO.[1]	NOTES AND CITATIONS TO DOCUMENT[2]
24	Deposition of John K. Cluff (CWWG, et al. *v.* U.S. Army, et al.; Case No. 96-CV-0425C; TOCDF)	7/18/96	John Cluff	99-1724	Exhibit includes pp. 178-181 and 186-189 of Pages 118-189 (Volume II) of John Cluff's deposition. The Department obtained a complete copy of John Cluff's July 17-18, 1996 deposition. The excerpted pages contain questions/answers related to the performance of the Dunnage Incinerator at TOCDF (See also Exhibit 23).
25	Deposition of Timothy W. Thomas (CWWG, et al. *v.* U.S. Army, et al.; Case No. 2:96-CV-0425C; TOCDF)	2/5/98	Timothy Thomas	99-1727	Exhibit 25 includes pp. 134-135 of Timothy Thomas' deposition. (The complete deposition is 258 pages.) The excerpt focuses analysis of chemical agent, especially from ton containers. Mr. Thomas is the on-site TOCDF Project Manager for the (Army's) Program Manager for Chemical Demilitarization. Item No. **98-1275** (p. 33, lines 8-11) refers to pages 204 and 206 (pages not actually included in Exhibit) of this transcript related to the Army's intention to use the DUN. Item No. **98-1275** (p. 41, line 3-4) cites this Exhibit (no page numbers were given) as supporting the Petitioner's contention that "TOCDF releases chemical warfare agent out of its stacks." Item No. **98-1275** (p. 47, line 0) cites this Exhibit (page 155, not actually included in Exhibit) to state that the Department has not "...address[ed] significant problems assessing what is in the munitions that will be incinerated." Item No. **98-1275** (p. 54, lines 15-17) cites page 30 (not included) of this Exhibit to show that Mr. Thomas "recanted" his testimony about agent releases that was given during the USHW Board hearing in March, 1997 (see Exhibit 43). **See Attachment U for additional excerpts from the testimony of Timothy Thomas.**

ATTACHMENT N

Transcripts from various Utah-related proceedings (State Court and USHW Board)

EXHIBIT NO.	TITLE	DATE OF DOCUMENT	AUTHOR (IF APPLICABLE)	ADMIN RECORD NO.[1]	NOTES AND CITATIONS TO DOCUMENT[2]
26	Affidavit of John Houston Miller	6/3/96	John Houston Miller	No Record Number Assigned	The origin of this affidavit is not clear, but it is assumed to be a document generated in CWWG v. U.S. Army (Case No. 96-CV-0425C). There are two attachments referenced within the Affidavit that were not included with this exhibit (Dr. Miller's Curriculum Vitae and "EPA Documents"). At the time of this Affidavit, Dr. Miller was a Professor of Chemistry at George Washington University in Washington, D.C. Item No. **98-1275** (p. 35, lines 22-23) cites Exhibit 26 to support the contention that the DFS is unable to meet DRE requirements, especially for PCB emissions when incinerating rockets. The Petitioners also cite Exhibit 26 in describing the failure of the DFS to meet TSCA requirements during a trial burn in 1997.
30	Deposition of James Cudahy (CWWG, et al. *v.* U.S. Army, et al.; Case No. 2:96-CV-0425C; TOCDF)	2/16/98	James Cudahy	99-1723	Exhibit 30 includes Pg. 72 of the deposition of James Cudahy. (total length of 139 pages, with various declarations prepared by Mr. Cudahy). At the time of the deposition, Mr. Cudahy was the President of Focus Environmental, Inc., an "environmental engineering firm that specializes in the design, permitting and technical evaluation of hazardous waste incineration and other thermal treatment systems." Item No. **98-1275** (p. 40, line 16; Page 54, line 22) cites this Exhibit as supporting the Petitioner's contention that "TOCDF releases chemical warfare agent out of its stacks (as will UMCDF) and into the ambient environment." Also cited in Item No. **99-0704** (p. 7) **See Attachment U (Page U-47) for additional excerpts from the Declarations of James Cudahy.**

ATTACHMENT N

Transcripts from various Utah-related proceedings (State Court and USHW Board)

EXHIBIT NO.	TITLE	DATE OF DOCUMENT	AUTHOR (IF APPLICABLE)	ADMIN RECORD NO.[1]	NOTES AND CITATIONS TO DOCUMENT[2]
33	Telephonic Deposition of Richard Holmes (CWWG, et al. *v.* U.S. Army, et al.; Case No. 2:96-CV-0425C; TOCDF)	4/14/98	Richard Holmes	99-1722	This Exhibit includes pp. 101-104 of the deposition of Richard Holmes, primarily related to the M-55 rocket processing for the TSCA trial burn. The Department obtained a complete copy of Richard Holmes' April 1998 deposition (total length of 450 pages). Richard Holmes' position at the time of this deposition was self-described as "group leader for site support" within the (Army's) Program Manager for Chemical Stockpile Disposal (PMCSD) Operations Team at Edgewood, Maryland. Item No. **98-1275** (p. 33, lines 9-10) refers to page 173 (although page 173 was not part of the Exhibit) of this transcript related to the Army's intention to use the DUN and what types of wastes were to be fed to the DUN. Item No. **98-1275** (p. 40, line 20) cites this Exhibit (no page number was given) as supporting the Petitioner's contention that "TOCDF releases chemical warfare agent out of its stacks (as will UMCDF) and into the ambient environment." Also cited in Item No. **99-0704** (p. 7). **(See Attachment U (Page U-101) for an additional excerpt from the deposition of Richard Holmes.)**
34	Continuation of the Telephonic Deposition of Richard Holmes (CWWG, et al. *v.* U.S. Army, et al.; Case No. 2:96-CV-0425C; TOCDF)	4/15/98	Richard Holmes	99-1722	This Exhibit includes pp. 240-251 of the deposition of Richard Holmes (also see Exhibit 33]. This portion of Mr. Holmes' deposition relates to the MC-1 bomb incident on March 30, 1998 described in Exhibits 31 and 32. Item No. **98-1275** (p. 40, line 21) cites this Exhibit (no page number was given) as supporting the Petitioner's contention that "TOCDF releases chemical warfare agent out of its stacks (as will UMCDF) and into the ambient environment."

ATTACHMENT N

Transcripts from various Utah-related proceedings (State Court and USHW Board)

EXHIBIT NO.	TITLE	DATE OF DOCUMENT	AUTHOR (IF APPLICABLE)	ADMIN RECORD NO.[1]	NOTES AND CITATIONS TO DOCUMENT[2]
					Item No. **98-1275** (p. 44, line 0-3) again cites this Exhibit (although the Exhibit No. cited here was incorrect), specifically p. 248 and p. 258 (pages not actually part of the Exhibit) of Holmes' deposition (which contain an examination of Mr. Holmes related to the MC-1 bomb incident). Exhibit 34 is also cited in Item No. **98-1247**, p. 5; Also cited in Item No. **99-0704** (p. 7); and in Item No. **99-2201**, p. 12.]
36	Cross-examination of John K. Cluff (CWWG, et al. *v.* U.S. Army, et al.; Case No. 2:96-CV-0425C; TOCDF)	7/25/96	John Cluff	99-1725	This Exhibit includes pp. 407-409 of a transcript from the cross-examination of John Cluff on 7/25/96. The Department obtained a copy of the complete cross-examination (Pages 384-418 of the court transcript) of Mr. Cluff. Item No. **98-1275** (p. 54, Lines 15-22) refers to this exhibit number, but the reference appears to be incorrect. This purpose of the cross examination of Mr. Cluff was to clarify some information from his deposition. (See Exhibit 26 above.)
42	Examination of Deborah Ng; Utah DEQ Solid and Hazardous Waste Control Board; Hearing on TOCDF Permit Modification; Transcript of Proceedings	3/19/97	Deborah Ng	No Record Number Assigned	This Exhibit includes pp. 424-431 of the testimony of Deborah Ng. The Department had obtained and reviewed a copy of Ng's March, 1997 testimony during the course of proceedings for the Petition for Reconsideration before the EQC in June, 1997. Ms. Ng is a Chemical Engineer with the Utah DEQ's Division of Solid and Hazardous Waste. The excerpted pages in this Exhibit include the examination of Ms. Ng of the Utah DEQ by Mick Harrison, and a cross-examination by Mr. Kohns, focusing on the issue of agent analysis that was conducted by the Utah DEQ. Item No. **98-1275** (p. 38, line 1) refers to page 472 (this page

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Transcripts from various Utah-related proceedings (State Court and USHW Board)

EXHIBIT NO.:	TITLE	DATE OF DOCUMENT	AUTHOR (IF APPLICABLE)	ADMIN RECORD NO.:	NOTES AND CITATIONS TO DOCUMENT:
					was not actually included with this Exhibit) of this transcript related to the ability of the stack ACAMS to detect chemical agent. Item No. **98-1275** (p. 51, line 3) refers to pp. 256 (this page was not actually included with this Exhibit) and 426-430 of this transcript to support their contention that "chemical warfare agents contained in the stockpiled munitions may have a substantial amount of degradation by-products."
43	Examination of Timothy Thomas (CWWG, et al. *v.* U.S. Army, et al.; Case No. 2:96-CV-0425C; TOCDF), Transcript of Preliminary Injunction Hearing	3/3/97	Timothy Thomas	98-1243	This Exhibit includes pp. 109-112 of the transcript the examination of Timothy Thomas. The Exhibit excerpt is a discussion of ACAMS stack alarms at TOCDF. A complete copy of the transcript (123 pages) of Mr. Thomas' testimony, including the conclusion of his testimony on March 4, 1997, was received in the DEQ Hermiston office on April 22, 1997. The testimony of Mr. Thomas was not, however, specifically reviewed in the staff report that was prepared for the Petition for Reconsideration that was denied by the EQC on June 5, 1997. Item No. **98-1275** (p. 51, line 7-8) refers to pp. 111-112 of this transcript to support the contention that "chemical warfare agents contained in the stockpiled munitions may have a substantial amount of degradation by-products." Item No. **98-1275** (p. 56, line 23) refers to pp. 109-112 of this transcript to support their contention that "TOCDF's stack ACAMS are unreliable and cannot determine in an accurate and timely fashion when chemical warfare agents are being released through the stack." [Also cited in Item No. **99-2201** (p. 12)]

ATTACHMENT N

Transcripts from various Utah-related proceedings (State Court and USHW Board)

EXHIBIT NO.	TITLE	DATE OF DOCUMENT	AUTHOR (IF APPLICABLE)	ADMIN RECORD NO.[1]	NOTES AND CITATIONS TO DOCUMENT[2]
44.1	Examination of Dennis Downs, Scott Anderson, and Martin Gray; Utah DEQ Solid and Hazardous Waste Control Board; Hearing on TOCDF Permit Modification; Transcript of Proceedings	3/18/97	Downs; Gray; Anderson	98-1242	This Exhibit includes pp. 111-118 (excerpt of examination of Dennis Downs, related to concrete cracking and leaks into the vestibules); pp. 210-213 (excerpt of examination of Scott Anderson regarding concrete cracks and professional conduct by HW staff); pp. 230-233, 238-241, 274-277, and 394-395 (excerpt of testimony of Martin Gray regarding vestibule leaks) at TOCDF. A complete copy of the transcript (1108 pages) of the DSHW Board hearing held March 18-20, 1997, was received in the DEQ Hermiston office on April 22, 1997. The specific testimony referenced in this exhibit was not, however, specifically reviewed in the staff report that was prepared for the Petition for Reconsideration that was denied by the EQC on June 5, 1997. Dennis Downs is the Manager of the Utah DEQ Division of Solid and Hazardous Waste. Scott Anderson is Manager of the Hazardous Waste Branch of the Utah DSHW. Martin Gray is the Manager of the DSHW Hazardous Waste Branch's Chemical Demilitarization Section. Item No. **98-1275** (p. 54, line 11) refers to page 249 (not actually included in Exhibit) of this transcript as support for their contention that "TOCDF emits agent from the stack." Item No. **98-1275** (p. 54, line 24) refers to pp. 111, 115, 211, 232, 238, 275-276, 423, and 498 (pp. 423 and 498 were not actually included in the Exhibit) of this transcript to support their contention that because "TOCDF has experienced agent migration or leaks into areas where agent is not supposed to be present," then it is "...clear that the Army is unable to fully

ATTACHMENT N

Transcripts from various Utah-related proceedings (State Court and USHW Board)

EXHIBIT NO.	TITLE	DATE OF DOCUMENT	AUTHOR (IF APPLICABLE)	ADMIN RECORD NO.[1]	NOTES AND CITATIONS TO DOCUMENT[2]
					control and contain nerve and blister agents. Releases from the UMCDF incinerator facility must be expected and subject to risk assessment." Item No. **98-1275** (p. 56, line 21) refers to pp. 349-350 (not included with exhibit) of this transcript to support their contention that "TOCDF's stack ACAMS are unreliable and cannot determine in an accurate and timely fashion when chemical warfare agents are being released through the stack."
44.2	Examination of Deborah Ng and Donald Smith; Utah DEQ Solid and Hazardous Waste Control Board; Hearing on TOCDF Permit Modification; Transcript of Proceedings	3/19/97	Ng and Smith	No Record Number Assigned	This Exhibit includes pp. 420-423 (excerpt of examination of Deborah Ng, related to a particulate sample, risk assessments, and maintaining negative pressure); pp. 496-499 (excerpt of examination of Mr. Smith regarding vestibule and concrete leaks); and pp.712-713 (adjournment). A complete copy of the transcript (1108 pages) of the DSHW Board hearing held March 18-20, 1997, was received in the DEQ Hermiston office on April 22, 1997. The specific testimony referenced in this exhibit was not, however, specifically reviewed in the staff report that was prepared for the Petition for Reconsideration that was denied by the EQC on June 5, 1997. Item No. **98-1275** (p. 56, line 23 and p. 57, line 1) refers to pp. 390-394 and p. 472 (none of the pages referenced were actually included in the Exhibit) of this transcript to support their contention that "TOCDF's stack ACAMS are unreliable and cannot determine in an accurate and timely fashion when chemical warfare agents are being released through the stack."

ATTACHMENT N

Transcripts from various Utah-related proceedings (State Court and USHW Board)

EXHIBIT NO.	TITLE	DATE OF DOCUMENT	AUTHOR (IF APPLICABLE)	ADMIN RECORD NO.[1]	NOTES AND CITATIONS TO DOCUMENT[2]
47	Examination of Mr. Timothy Thomas; Utah DEQ Solid and Hazardous Waste Control Board; Hearing on TOCDF Permit Modification; Transcript of Proceedings	3/20/97	Timothy Thomas	98-1242	This Exhibit includes partial copies of what appears to pp. 888-891, and a copy of pp. 892-895 from the testimony of Mr. Timothy Thomas during a Utah DEQ Solid and Hazardous Waste Control Board hearing held March 18-20, 1997. The excerpt focuses on agent releases and concrete cracks at TOCDF. At the time of this testimony Timothy Thomas was the TOCDF Site Project Manager for the Army's Program Manager for Chemical Demilitarization (PMCD). A complete copy of the transcript (1108 pages) of the DSHW Board hearing held March 18-20, 1997, was received in the DEQ Hermiston office on April 22, 1997. The specific testimony referenced in this exhibit was not, however, specifically reviewed in the staff report that was prepared for the Petition for Reconsideration that was denied by the EQC on June 5, 1997. Item No. **98-1275** (p. 54, lines 13-14) refers to pp. 891-892 of this transcript to support the statement that "TOCDF Project director Tim Thomas acknowledged that since August 22, 1996 there have been at least six (6) confirmed stack releases of nerve agent GB." Item No. **98-1275** (p. 58, lines 16-17) refers to pp. 877-878 of this transcript (testimony of Dr. Finley) to support the statement that "EPA's Dioxin Health Assessment Study concludes that an appropriate RfD for non-cancer effects from dioxin exposure would be 10 to 1000 times less than the current national exposure levels for dioxin." **(See Attachment U for additional excerpts from the testimony of Timothy Thomas.)**

ATTACHMENT N

Transcripts from various Utah-related proceedings (State Court and USHW Board)

EXHIBIT NO.	TITLE	DATE OF DOCUMENT	AUTHOR (IF APPLICABLE)	ADMIN RECORD NO.[1]	NOTES AND CITATIONS TO DOCUMENT[2]
49	Deposition of Robert Bruce Perry (CWWG, et al. *v.* U.S. Army, et al.; Case No. 96-CV-0425C; TOCDF)	7/16/96	Robert Bruce Perry	99-1728	This Exhibit is an excerpt of the deposition of Robert Bruce Perry related to the use of the DUN at TOCDF and includes pp. 230-233 of a 247-page transcript. Mr. Perry is the Chief of the Risk Management quality Assurance Office within the Office of the [Army's] Program Manager for Chemical Demilitarization." The Department obtained a complete copy of Mr. Perry's July 16, 1996, deposition. The deposition itself is 247 pages long, with approximately 400 pages of attachments. See Exhibit 59.
59	Deposition of Robert Bruce Perry (CWWG, et al. *v.* U.S. Army, et al.; Case No. 96-CV-0425C; TOCDF)	7/16/96	Robert Bruce Perry	99-1728	Item No. **98-1285** (p. 7) cites p. 231 of this Exhibit to support the contention that the Dunnage incinerator was never planned for use at TOCDF because of concerns about its performance. (This Exhibit is a duplicate of Exhibit 49.) [Also cited in Item No. **98-1247** (p. 8)]
64	Excerpts from the testimony of Army expert Gary Boyd (CWWG, et al. *v.* U.S. Army, et al.; Case No. 96-CV-0425C; TOCDF)	7/29/96	Gary Boyd Science Applications International Corporation (SAIC)	99-1726	Exhibit includes pp. 923-926, 931-938, 951-958 of Pages 923-1017 of Gary Boyd's testimony related to the Quantitative Risk Assessment (QRA) conducted for TOCDF.(Mr. Boyd was one of the authors of the QRA.) Cited in Item No. **98-1275** (p. 46, lines 16-20) assert that the "QRA provides very limited information which is unsuited for the analyzes (sic) the DEQ/EQC were mandated to perform." and in Item No. **98-1285** (p. 8) to state that the [DEQ and EQC] "improperly relied on the QRA to provide substantial evidence regarding the determination that the risk of continued storage was more significant than incineration." [Also cited in Item No. **98-1247** (p. 8-9), and Item No. **99-0704** (p. 14).

ATTACHMENT O

TABLE OF COMMENTS AND EXHIBITS

Miscellaneous documents related to the Tooele Chemical Agent Disposal Facility (TOCDF)

and

"Tooele Chemical Agent Disposal Facility: Update on National Research Council Recommendations," National Research Council, 1999
(begins on Page O-3)

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ATTACHMENT O

Miscellaneous documents related to the Tooele Chemical Agent Disposal Facility (TOCDF)

EXHIBIT NO.	TITLE	DATE OF DOCUMENT	AUTHOR (IF APPLICABLE)	ADMIN RECORD NO.[1]	NOTES AND CITATIONS TO DOCUMENT[2]
31	Affidavit of Pat Costner	7/27/98	Pat Costner	Record Number Not Assigned	This Affidavit gives Ms. Costner's credentials and states that she has reviewed information concerning an incident at TOCDF (see Exhibit 32) and that she believes the incident resulted in a "significant" release of agent out the stack at TOCDF on March 30, 1998. Item No. **98-1275** (p. 40, line 17; and p. 44, lines 3-11) cites this Exhibit as supporting the Petitioner's contention that "TOCDF releases chemical warfare agent out of its stacks (as will UMCDF) and into the ambient environment." Exhibit 31 is also cited in Item No. **98-1247**, p. 5; Item No. **99-0704**, p. 7; and in Item No. **99-2201**, p. 12.
32	TOCDF Unusual Occurrence Report: Metal Parts Furnace Feed Rate Exceedance	4/2/98	Michael J. Rowe, Timothy Thomas, Harold Oliver	Record Number Not Assigned	This Report describes the event that occurred on March 30, 1998, related to insufficient draining of an MC-1 bomb that was subsequently processed through the MPF. Item No. **98-1275** (p. 40, line 19; and pp. 43-44) cites this Exhibit as supporting the Petitioner's contention

[1] The DEQ Chemical Demilitarization Program maintains a database of documents related to the Umatilla Chemical Agent Disposal Facility. Most documents are assigned a record number for tracking purposes. Individual "Exhibits" submitted during the course of G.A.S.P., et al., *v.* EQC, et al., (Case No. 9708-06159, Oregon Circuit Court) were not assigned record numbers at the time of submittal—only the document the Exhibit was attached to was assigned a number. Some Exhibits do have Administrative Record Numbers because the document had been previously received.

[2] No. **98-1247**: "Request for Contested Case Hearing and Other Relief," letter dated December 14, 1998 (Included as Attachment A)
No. **98-1275**: "Petitioners' Memorandum Supporting Cross Motion for Summary Judgment," August 20, 1998 (Case No. 9708-06159)
No. **99-0704**: "Petitioners' Opposition to Respondents' Supplemental Motion for Summary Judgment," April 12, 1999 (Case No. 9708-06159)
No. **99-2201**: "Comments of G.A.S.P., et al., in Support of Their Request to Suspend and Revoke Permits for [UMCDF]," December 17, 1999 (Included in Attachment E)

ATTACHMENT O
Miscellaneous documents related to the Tooele Chemical Agent Disposal Facility (TOCDF)

EXHIBIT NO.	TITLE	DATE OF DOCUMENT	AUTHOR (IF APPLICABLE)	ADMIN RECORD NO.[1]	NOTES AND CITATIONS TO DOCUMENT[2]
					that "TOCDF releases chemical warfare agent out of its stacks (as will UMCDF) and into the ambient environment." Exhibit 32 is cited in **98-1247** (p. 4) as support for the Petitioners' contention that "incidents like this one demonstrate why the current incineration technology is unsafe and not the best available technology." Exhibit 32 is also cited in Item No. **99-2201**, p. 12 and in Item No. **99-0704**, p. 7.
46	Excerpts from the Journals of Gary Millar	9/9/96	Unknown	Record Number Not Assigned	This Exhibit is a document entitled "From the Journals of Gary Millar," although there is no indication who prepared the document (assumed to be transcribed from a hand-written journal). There are reference numbers after each statement, although there is no indication what the numbers are referencing. Item No. **98-1275** (page 56, lines 4-5) cites this exhibit, but also the "Memoranda between Tim Thomas and Gary Millar at 460-464, 467-473, 478-479, and 481," which were not included with the copy of Exhibit 46 received by the Department.

Tooele Chemical Agent Disposal Facility

Update on National Research Council Recommendations

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EQC Meeting May 18, 2000
Attachment O, Page O-3

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Tooele Chemical Agent Disposal Facility

Update on National Research Council Recommendations

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Army Chemical Stockpile Disposal Programm

Board on Army Science and Technology

Commission on Engineering and Technical Systems

National Research Council

NATIONAL ACADEMY PRESS
Washington, D.C. 1999

EQC Meeting May 18, 2000
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NOTICE: The project that is the subject of this report was approved by the Governing Board of the National Research Council, whose members are drawn from the councils of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. The members of the committee responsible for the report were chosen for their special competencies and with regard for appropriate balance.

The National Academy of Sciences is a private, nonprofit, self-perpetuating society of distinguished scholars engaged in scientific and engineering research, dedicated to the furtherance of science and technology and to their use for the general welfare. Upon the authority of the charter granted to it by the Congress in 1863, the Academy has a mandate that requires it to advise the federal government on scientific and technical matters. Dr. Bruce Alberts is president of the National Academy of Sciences.

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This is a report of work supported by Contract DAAD19-99-C-0010 between the U.S. Army and the National Academy of Sciences. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the organizations or agencies that provided support for the project.

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DAVID S. KOSSON, *chair,* Rutgers, The State University of New Jersey, New Brunswick
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DENNIS C. BLEY, Buttonwood Consulting, Inc., Oakton, Virginia
JERRY L. R. CHANDLER, George Mason University, McLean, Virginia *(as of 7/1/99)*
FRANK P. CRIMI, Lockheed Martin (retired), Saratoga, California
ELISABETH M. DRAKE, Massachusetts Institute of Technology, Cambridge *(until 3/31/99)*
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PETER B. LEDERMAN, New Jersey Institute of Technology, Newark *(as of 7/1/99)*
RICHARD S. MAGEE, New Jersey Institute of Technology, Newark *(until 1/27/99)*
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WALTER G. MAY, University of Illinois, Urbana *(until 7/31/99)*
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ALVIN H. MUSHKATEL, Arizona State University, Tempe *(until 3/31/99)*
H. GREGOR RIGO, Rigo & Rigo Associates, Inc., Berea, Ohio
KOZO SAITO, University of Kentucky, Lexington
W. LEIGH SHORT, URS Greiner Woodward-Clyde (retired), Mount Pleasant, South Carolina *(as of 7/1/99)*
ARNOLD F. STANCELL, Georgia Institute of Technology, Atlanta
STEVEN R. TANNENBAUM, Massachusetts Institute of Technology, Cambridge *(as of 7/1/99)*
CHADWICK A. TOLMAN, National Science Foundation, Arlington, Virginia
WILLIAM TUMAS, Los Alamos National Laboratory, Los Alamos, New Mexico

Board on Army Science and Technology Liaison

RICHARD A. CONWAY, Union Carbide Corporation (retired), Charleston, West Virginia

Staff

DONALD L. SIEBENALER, Study Director
HARRISON T. PANNELLA, Research Associate
WILLIAM E. CAMPBELL, Senior Project Assistant

EQC Meeting May 18, 2000
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DEANNA SPARGER, Senior Project Assistant

Preface

The United States has maintained a stockpile of highly toxic chemical agents and munitions for more than half a century. In 1985, Public Law 99-145 mandated an "expedited" effort to dispose of M55 rockets containing unitary chemical warfare agents because of their potential for self-ignition. This program soon expanded into the Army Chemical Stockpile Disposal Program (CSDP), whose mission was to eliminate the entire stockpile of unitary chemical weapons. The CSDP developed the baseline incineration system for that purpose. Since 1987, the National Research Council (NRC), through its Committee on Review and Evaluation of the Army Chemical Stockpile Disposal Program (Stockpile Committee), has overseen the Army's disposal program and has endorsed the baseline incineration system as an adequate technology for destroying the stockpile. In 1992, after setting several intermediate goals and dates, Congress enacted Public Law 102-484, which directed the Army to dispose of the entire stockpile of unitary chemical warfare agents and munitions by December 31, 2004.

In the 1970s, the Army had commissioned studies of different disposal technologies and tested several of them. In 1982, the Army selected incineration as the method it would use for the disposal of agents and associated propellants and explosives and the thermal decontamination of metal parts. In 1984, the NRC Committee on Demilitarizing Chemical Munitions and Agents reviewed a range of disposal technologies and endorsed the Army's selection of incineration. In response to public concerns about incineration and the evolution of other potential disposal technologies, the NRC has also carried out several evaluations of alternative technologies and recommended the development of chemical detoxification technologies for application at the two stockpile storage sites where chemical agent is stored only in bulk (with no energetically configured munitions).

Incineration technology is embodied in today's baseline incineration system, which was developed largely at the Chemical Agent Munitions Disposal System (CAMDS) experimental facility at Tooele Army Depot, Utah. The first full-scale operational plant, the Johnston Atoll Chemical Agent Disposal System (JACADS), in the Pacific Ocean southwest of Hawaii, was completed in 1990 and is nearing the conclusion of chemical weapons disposal operations on Johnston Island. Construction of the first disposal facility in the continental United States was started in 1989 at the Tooele Army Depot (now Deseret Chemical Depot) in Utah. The design of the Tooele Chemical Agent Disposal Facility (TOCDF) represents a second generation baseline system, which incorporates improvements based on experience with the JACADS facility, advances in technology, and recommendations made by the Stockpile Committee. Systemization testing began in August 1993, and agent operations began on August 22, 1996.

The Stockpile Committee has monitored operations at the TOCDF since the start-up of systemization. The following NRC reports were issued by the Stockpile Committee in its TOCDF oversight role:

- *Review of Systemization of the Tooele Chemical Agent Disposal Facility*
- *Risk Assessment and Management at the Deseret Chemical Depot and the Tooele Chemical Agent Disposal Facility*

Published in 1996, the *Systemization* report reviewed the status of the TOCDF as systemization (pre-operational) testing was nearing completion and the facility was about to start agent operations. The report contained several sets of recommendations: some that were general and continuing; some that were to be coordinated with the start of agent operations; some that were to be completed prior to agent operations; and some that were to be completed during the first year of agent operations. The more recent *Risk Assessment and Management* (1997) report addressed issues related to the quantitative and health risk assessments performed for the TOCDF and the adjacent storage site and the Army's implementation of a risk management plan.

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Following up on the recommendations in the *Systemization* report and the *Risk Assessment and Management* report, this report reviews the status of the TOCDF after more than two years of agent operations. This report also follows up on relevant recommendations from earlier Stockpile Committee reports and a recent letter report, *Public Involvement and the Army Chemical Stockpile Disposal Program*. The committee's intent is to document the Army's responses to these recommendations, noting which ones have been satisfactorily addressed and which ones have not been completely or adequately addressed. The latter group will provide a basis for the Stockpile Committee's oversight in the future. Although the focus of this report is on the TOCDF, some of the findings and recommendations also apply to other sites and to the CSDP as a whole.

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David S. Kosson, *chair*
Charles E. Kolb, *vice chair*
Committee on Review and Evaluation of the
Army Chemical Stockpile Disposal Program

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James G. Droppo, Pacific Northwest National Laboratory
Gene H. Dyer, Bechtel Corporation (retired)
B. John Garrick, Garrick Consulting
Erik B. Herzik, University of Nevada
Ronald A. Hites, Indiana University
David H. Johnson, PLG, Inc.
Noam Lior, University of Pennsylvania
Hyla Napadensky, Napadensky Energetics, Inc. (retired)
Lanny D. Schmidt, University of Minnesota
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Acronyms

ACAMS	automatic continuous air monitoring system
ATB	agent trial burn
BRA	brine reduction area
CAC	Citizens Advisory Commission
CAMDS	Chemical Agent Munitions Disposal System
CEMS	continuous emission monitoring system(s)
CMP	change management process
CSDP	Chemical Stockpile Disposal Program
CSEPP	Chemical Stockpile Emergency Preparedness Program
CWC	Chemical Weapons Convention
DAAMS	depot area air monitoring system
DCD	Deseret Chemical Depot
DFS	deactivation furnace system
DRE	destruction removal efficiency
DSHW	Utah Division of Solid and Hazardous Waste
DUN	dunnage furnace
EG&G	Edgerton, Germerhausen and Grier
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FTIR	Fourier transform infrared (spectrometer)
GA	tabun (a nerve agent)
GB	sarin (a nerve agent)
GC-MSD	gas chromatograph-mass spectrometric detector
H	nondistilled mustard
HD	distilled mustard
HRA	health risk assessment
HT	thickened mustard
ITEQ	International Toxic Equivalence
JACADS	Johnston Atoll Chemical Agent Disposal System
LIC	liquid incinerator

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MPF	metal parts furnace
NRC	National Research Council
OSHA	Occupational Safety and Health Administration
OVT	operational verification testing
PAS	pollution abatement system
PCB	polychlorinated biphenyl
PCDD/F	polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans
PFPD	pulsed-flame photometric detector
PFS	PAS carbon bed filter system
PLL	Programmatic Lessons Learned
PMCD	Program Manager for Chemical Demilitarization
POIO	Public Outreach and Information Office
PQL	practical quantification limits
QRA	quantitative risk assessment
RCRA	Resource Conservation and Recovery Act
RIR	recordable injury rate
RMP	Risk Management Plan
SVOC	semivolatile organic compound
TOCDF	Tooele Chemical Agent Disposal Facility
TSCA	Toxic Substances Control Act
VOC	volatile organic compound
VX	a nerve agent

Executive Summary

This report reviews the status of the U.S. Army Chemical Stockpile Disposal Program (CSDP) operations at Tooele, Utah, with respect to previous recommendations and observations made by the National Research Council (NRC) Committee on Review and Evaluation of the Army Chemical Stockpile Disposal Program (Stockpile Committee). The committee recognizes actions that have satisfied recommendations, identifies recommendations that require further action, and provides additional recommendations for improving the overall CSDP performance at the Tooele Chemical Agent Disposal Facility (TOCDF), Tooele, Utah, and other sites. In a 1994 NRC report, *Recommendations for the Disposal of Chemical Agents and Munitions*, the Stockpile Committee established the following general criterion for evaluating CSDP activities: "The Chemical Stockpile Disposal Program should proceed expeditiously and with technology that will minimize total risk to the public at each site."

The TOCDF is the first operational baseline incineration system for the disposal of chemical agents and munitions in the continental United States. The facility is adjacent to the Deseret Chemical Depot (DCD), where 43 percent of the total chemical agent stockpile was stored before the start of TOCDF operations in August 1996. Since then, more than 20 percent of the chemical agent stored at the DCD has been destroyed. The Johnston Atoll Chemical Agent Disposal System (JACADS), located about 700 miles southwest of Hawaii, was the prototype baseline incineration system and the first to become operational (July 1990). To date, it has destroyed more than 80 percent of the chemical agent and munitions stored on Johnston Atoll (originally about 6 percent of the total stockpile). Baseline facilities are under construction at three additional storage sites in the continental United States (Anniston, Alabama; Umatilla, Oregon; and Pine Bluff, Arkansas).

Chemical agents are stored at four additional sites. Two of these, Aberdeen, Maryland, and Newport, Indiana, contain only bulk quantities of agent (no munitions). Chemical-based "neutralization" disposal technologies are being implemented at these sites. The remaining two sites, Pueblo, Colorado, and Blue Grass, Kentucky, contain chemical agent in munitions. Alternative disposal technologies, which are presently undergoing evaluation, may be implemented at these sites. The focus of this report is primarily on operational and planned baseline incineration facilities, especially the TOCDF, but broader programmatic matters, such as risk management and public involvement, are also addressed and are applicable to all CSDP sites.

The major aspects of TOCDF operations reviewed in this report are:

- systems performance and plant operations (Chapter 2)
- trial burn tests to establish compliance with Resource Conservation and Recovery Act (RCRA) and Toxic Substances Control Act (TSCA) emission levels (Chapter 2)
- improvements to the monitoring systems for airborne agent (Chapter 2)
- risk management (Chapter 3)
- safety programs and performance (Chapter 4)
- public and community interactions (Chapter 5)

Findings and recommendations are presented in Chapter 6.

Systems Performance and Plant Operations

The Army and its TOCDF contractor, EG&G Defense Materials, Inc., have satisfied many, but not all, of the Stockpile Committee's recommendations related to system performance and plant operations. The start-up period has been completed, and operations so far indicate that program destruction goals can be met. Because of TSCA permit delays on the deactivation furnace system (DFS), the Environmental Protection Agency

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(EPA) mandated a delay in processing M55 rockets, which has significantly slowed the planned reduction of stockpile storage risk. In the interim, operations were continued on bulk items. Following the successful DFS trial burn in November 1998, the Army was processing M55 rockets at half rate under a RCRA permit limitation.[1] When the TSCA permit was issued in mid-1999, the RCRA limitation was lifted. The TOCDF is now authorized to process M55 rockets at the full rate and is proceeding toward meeting its original risk reduction goals as soon as possible.

Some early operational problems were linked to important safety management issues. These problems, and the investigations necessitated by them, have taken time and management resources that might otherwise have been applied to improving operating performance.

Unresolved issues involving the disposal of dunnage and problems with the slag removal system heater are not critical to continuing safe performance, but their prompt resolution (in the interest of minimizing waste and reducing the number of plant shutdowns for heater replacement) remains a high priority. For example, because it is more economical to ship waste brine off site, the Army has not retested the compliance of the brine reduction area (BRA) with particulate emissions standards. If off-site brine disposal becomes infeasible, this could affect TOCDF operations.

Trial Burn Tests to Establish Compliance with RCRA and TSCA

The committee has reviewed and evaluated the results of trial burns conducted on the various incinerators comprising the baseline system. Trial burns were conducted in accordance with RCRA and TSCA protocols. The acceptance criteria for the RCRA trial burn of the liquid incinerators, the DFS, and the metal parts furnace have been met. A second test of the DFS polychlorinated biphenyl (PCB) destruction efficiency showed that emissions levels meet TSCA criteria. The TOCDF has been issued a TSCA permit for the DFS, and activities to obtain a national TSCA permit are still ongoing. Certification of the BRA is not required as long as waste brine is being processed off site. An application was submitted in late 1998 for the RCRA permit renewal, allowing six months for regulators to review the application before the present permit expired in June 1999. At the time of publication, the regulators had completed work with the Army on the permit renewal, but its issuance was pending until the conclusion of a public comment period.

Improvements in Monitoring Systems

False-positive alarms from the current automatic continuous air monitoring system continue to occur and interrupt agent destruction operations. Although the Army appears to be making reasonable progress in addressing the committee's previous recommendations—including upgrading both the automatic continuous air monitoring system and the depot area air monitoring system—the development, testing, and deployment of more reliable agent monitors should be expedited as much as possible. The development and testing of Fourier transform infrared technology for the real-time detection of an agent release is also proceeding, but real-time alarms are still in development.

Risk Management

The risk management program[2] uses the health risk assessment (HRA) and quantitative risk assessment (QRA) as quantitative tools to evaluate and manage the

[1] Because of artifact contamination, some of the initial DFS test runs after the destruction and removal of polychlorinated biphenyl (PCB) were inconclusive. The retest unambiguously demonstrated compliance with TSCA requirements.

[2] Risk management is a decision-making process for balancing alternative strategies and consequences and a process for implementing those decisions. Risk management is based on: (1) a thorough assessment of performance and the full spectrum of risks to the public, workers, the environment, and property; (2) the prioritization of risks so they can be addressed in order of seriousness; (3) methods of assessing the impact of proposed changes in procedures, management, or equipment; (4) evaluations of abnormal incidents for effects on facility risk; and (5) a commitment to continual evaluation and improvement. Risk management usually involves the following steps:

- understanding the risk (including identifying major contributors to risk)
- suggesting alternative ways to reduce risk
- evaluating alternatives for risk reduction
- selecting preferred alternatives (including implementing decisions)

facility risks.[3] The HRA for the TOCDF, completed by the Utah Department of Environmental Quality before the start of agent operations, showed that risks were well below regulatory thresholds. However, the data from the TOCDF trial burn indicate that a few compounds were measured at higher concentrations than were assumed in the HRA; the detection limits for others were too high to confirm the validity of the assumed HRA emission rates. Furthermore, a review of some of the models used in the HRA revealed that the HRA did not use the air-dispersion and deposition models and risk assessment methods then recommended by the EPA (i.e., all guidance and updates issued by the EPA through December 1994).

Now that the TOCDF trial burns have been completed, the State of Utah or the Army may wish to issue a brief update of the results of the HRA based on actual TOCDF emissions data and the original EPA guidance. Although the risks posed by individual compounds may change in the updated results, the overall estimate of risk is not likely to change significantly. The committee urges that the results of the revised HRA be made widely available.

Although higher emission rates were found during the trial burn, they would not necessarily significantly change the results of the HRA because the HRAs performed to meet regulatory compliance requirements and HRAs directed toward risk management have different focuses. The former use high-biased assumptions designed to provide realistic bounds but may significantly overstate anticipated effects. The latter use more realistic estimates as a basis for risk mitigation. Hence, significant changes in the emission rates of individual compounds, particularly those that do not contribute significantly to overall risk, may not significantly change HRA results.

The implementation of an effective risk management program at the TOCDF will have important implications for the CSDP as a whole. The Stockpile Committee has made several recommendations in previous NRC reports for improving risk management. In both the 1996 report, *Review of Systemization at the Tooele Chemical Agent Disposal Facility*, and the 1997 report, *Risk Assessment and Management at Deseret Chemical Depot and the Tooele Chemical Agent Disposal Facility*, the committee observed that certain aspects of risk assessment and risk management at DCD/TOCDF and throughout the CSDP program required further work and refinement. For example, based on experience from the TOCDF, the committee now recommends that Phase 2 QRAs[4] for chemical disposal facilities under development be performed as soon as feasible. This will allow risk mitigation measures to be implemented through design changes as necessary.

The committee is pleased with the manner in which the Army has responded to safety issues identified in QRAs. However, risk management continues to be an informal, albeit thorough, process. The committee is concerned that an informal process driven by key individuals in the office of the Program Manager for Chemical Demilitarization (PMCD) could break down with a change in personnel or that the risk management process might not be fully transferred to specific sites. Therefore, the committee urges the PMCD to consider the establishment of a formal management program for QRA-identified safety issues, including a tracking mechanism for identifying new issues and monitoring their resolution.

The committee concluded that another critical aspect of risk management is the change management process (CMP). In this process, effects on risk as measured by the HRA and QRA, as well as public input, are used to evaluate proposed system or operational changes. The PMCD claims that public involvement will be part of changes with a significant impact on risk or changes that are of public concern. The committee believes that public involvement is an important element in the timely disposal of the stockpile—including, but not limited to, the CMP.

The committee strongly believes that the Army should rapidly document and formalize the effective risk

[3]The TOCDF QRA estimates the risk to the public and workers from accidental releases of chemical agent associated with all activities during storage at DCD and throughout the disposal process at the TOCDF. The HRA is a screening analysis to estimate possible off-site human health risks associated with exposure to airborne emissions from the TOCDF under normal and upset conditions. The HRA also estimates risks to wildlife and the environment. Whereas the HRA is a screening tool using conservative upper limit assumptions on releases of hazardous materials, the QRA is a more exhaustive and thorough analysis using actual data and addressing uncertainties.

[4]A Phase 1 QRA evaluates public risks from a proposed facility before it is constructed. A Phase 2 QRA is a detailed evaluation of the risks and consequences of accidental releases of agent to workers and the community based on the site-specific design and operations.

management programs being used on the site-specific and programmatic levels. Cross-communication, cooperation, and learning between sites has greatly enhanced the entire program. The Army must continue and strengthen this process to improve safety and environmental performance.

Safety Programs and Performance

The Stockpile Committee has been monitoring the CSDP safety performance since its evaluations of operational verification testing at JACADS in 1993 and 1994 and has recommended improvements in the overall management of safety, particularly the development of a well qualified, well trained workforce that operates within an established safety culture. Safety at the TOCDF has also become a public issue because of detailed allegations by two former employees that safety programs and performance at the facility were deficient. As a result of these allegations, seven independent assessments of the safety program at the TOCDF have been conducted. All these assessments reached the same conclusion—that agent operations are being conducted safely.

The Stockpile Committee agrees that TOCDF agent operations are being conducted in a manner that protects the public. Nevertheless, instances of failure to wear required protective equipment, poor housekeeping, and some unsafe working conditions observed by the committee during site visits indicate that a total safety culture has yet to take root at the TOCDF. The recent spill of 140 gallons of nerve agent GB within the containment area caused by the improper reassembly of a filter following maintenance suggests that more training and emphasis on following procedures are needed for maintenance and other operations-related activities.

In response to the committee's observations and recommendations, and out of a stated desire to improve safety performance, TOCDF management has implemented several programs and initiatives to develop and maintain a "safety culture" at the site. Despite these efforts, safety performance has not improved significantly since the agent destruction operations began.

The formal and informal communications about safety that are now issued by TOCDF management on a regular basis have reinforced the commitment to safety and created an environment in which safety is valued. These communications should be continued. The committee is satisfied that some progress has been made toward creating a better environment for the development of a safety culture at the TOCDF. Continued attention to balancing the safety of agent operations and traditional industrial safety issues, as well as continued management involvement and commitment, will be necessary.

Public and Community Interactions

The Stockpile Committee's recommendations regarding public involvement in the CSDP and emergency management/preparedness in the 1996 *Systemization* report dealt only with activities at the TOCDF. The recommendations in the 1997 *Risk Assessment and Management* report were related to risk management in the overall disposal program.

Since 1996, important changes have been made in the PMCD management of the CSDP, especially in the Public Outreach and Information Office (POIO). After a comprehensive self-examination, the POIO redefined its mission and organization and is no longer the primary point of contact for local public involvement activities for specific sites. Much of the responsibility for site-specific public involvement activities has been delegated to on-site contractors. Although it is still too early to assess the impact of the reorganization and realignment of the POIO, the supporting documentation and goals are much improved.

Although reorganization of the POIO and its goals is important, as is the shift to developing strategies to increase public involvement, neither is a satisfactory substitute for an organizational culture that proactively seeks the involvement of stakeholders and the personnel of the local outreach office. Neither the personnel of the local outreach office nor the public had input into the draft CMP prior to the Army's first public presentation of the process. The committee was disappointed by the CSDP's failure to implement its CMP for any proposed change to the facility. The Army needs to engage the public, not only in changes to already established technology at baseline sites—a topic of limited interest as evidenced by poor public turnout—but also in pending decisions on topics of interest to neighboring communities, such as plans for decommissioning a facility.

Despite improvements in outreach at the local level and the reorganization of the POIO, the committee sees little evidence that stakeholder and public views have been incorporated into the decision-making process. The CSDP has clearly expanded its ability

nd capacity for public outreach, but it has not yet achieved ne meaningful public involvement the committee ecommended.

The Chemical Stockpile Emergency Preparedness Program (CSEPP) has also been reorganized. The Army still controls on-site emergency preparedness, but all off-site responsibilities, including budgeting, have been assigned to the Federal Emergency Management Agency. Consequently, off-site preparations are no longer within the scope of the Stockpile Committee's oversight. The committee remains concerned about CSEPP's relation to the CSDP and the horizontal fragmentation of responsibility at the federal level. Since the TOCDF became operational, local emergency preparedness activities have intensified and have resulted in some excellent preparedness exercises. The emergency communications system in Tooele County is nearly complete, the decontamination equipment is substantially in place, and tone alert radios are being distributed. At least at Tooele, indications are that the activities of on-site and off-site emergency managers are well coordinated.

1

Introduction

DESCRIPTION OF THE CHEMICAL AGENT AND MUNITIONS STOCKPILE

For more than 50 years, the United States has maintained a stockpile of chemical agents and munitions distributed among eight sites in the continental United States and at Johnston Atoll in the Pacific Ocean. Two basic types of chemical agents comprise the stockpile: neurotoxic (nerve) agents and mustard (blister) agents. Both types are frequently, and erroneously, referred to as "gases" even though they are liquids at normal temperature and pressure.[1]

The nerve agents include organic phosphorus compounds designated as VX, GB (sarin), and GA (tabun). These chemicals present a significant toxic hazard because of their action on the nervous systems of humans and animals through inhibition of the acetylcholinesterase enzyme. VX is more acutely toxic than GB, but the latter represents a greater potential hazard because of its higher volatility (about the same as water) and, thus, the greater likelihood of being inhaled. Chronic health effects and cancer from low-level exposures have not been associated with nerve agents or with chemically (and toxicologically) similar commercially available organic phosphorus insecticides (Leffingwell, 1993). Only short-term symptoms have been documented in individuals who have survived exposure to nerve agents.

The mustards (designated H [nondistilled mustard], HD [distilled mustard], and HT [thickened mustard]) do not present significant acute lethal hazards. Their principal effect is severe blistering of the skin and mucous membranes. They have been implicated as possible carcinogens, however, and may present a cancer hazard to individuals suffering acute exposure (Leffingwell, 1993; IOM, 1993). Estimates of induced cancers from accidental agent exposures only apply to mustard agents.

Once chemical agents are fully dispersed, they do not tend to persist in the environment because of their high chemical reactivity, particularly with water. However, in extremely dry desert climates, they can persist for a considerable period of time (U.S. Army, 1988).

The chemical agents in the U.S. stockpile are stored in a variety of containers, including bulk (ton) containers, rockets, projectiles, mines, bombs, cartridges, and spray tanks. Figure 1-1 summarizes the stockpile configuration for the eight continental U.S. sites by agent, munition, and containment system prior to the start of agent destruction operations at the Tooele Chemical Agent Disposal Facility (TOCDF) (NRC, 1997).

CALL FOR DISPOSAL

Chemical Stockpile Disposal Program

Because of the age of the stockpiled chemical weapons, their lack of utility as effective weapons or deterrents, the continuing costs of maintenance, and the potential for accidental release, the United States and other countries have strong incentives to dispose of them. In 1985, Congress enacted Public Law 99-145 to initiate the process of eliminating the U.S. chemical weapons stockpile with an expedited program to dispose of

[1]The *stockpile* (the subject of the Army's Chemical Stockpile Disposal Program) consists of both bulk containers of nerve and blister agents and munitions, including rockets, mines, bombs, cartridges, projectiles, and spray tanks loaded with nerve or blister agents. Buried chemical warfare materiel, recovered chemical warfare materiel, binary weapons (in which two nonlethal components are mixed after firing to yield a lethal nerve agent), former production facilities, and miscellaneous chemical warfare materiel are not included in the stockpile. The disposition of these five classes of materials is the subject of the separate Non-Stockpile Chemical Materiel Program. Information on the Army's overall chemical material disposal programs is available at http://www-pmcd.apgea.army.mil/

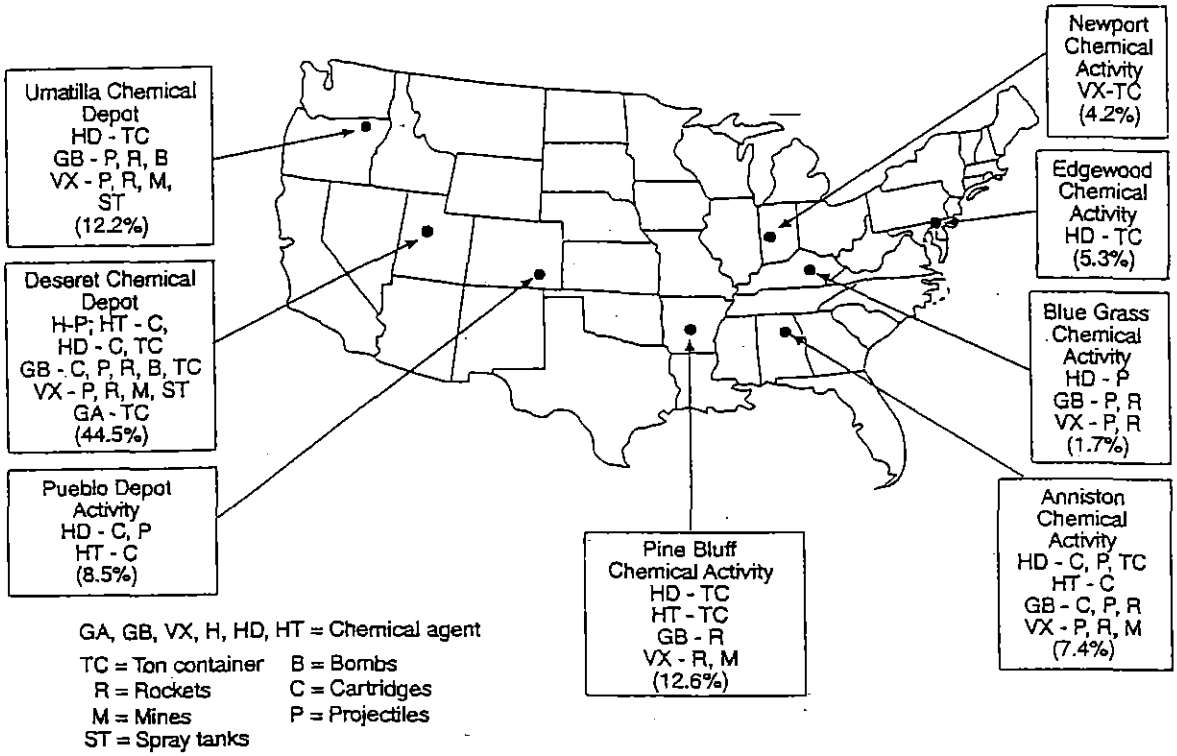


FIGURE 1-1 Location and size (percentage of original stockpile) of eight continental U.S. storage sites. Source: OTA, 1992; NRC, 1997.

M55 rockets. These munitions raise special concerns because they are aging and because they contain agent, explosives, and propellants in an integrated configuration (as propellants age, stabilizer components degrade—increasing the potential for autoignition). In 1992, Congress enacted Public Law 104-484, which directed the Army to dispose of the entire unitary[2] chemical agent and munitions stockpile by December 31, 2004. Congress also directed that the Chemical Stockpile Disposal Program (CSDP) be implemented in a manner that ensured maximum protection of workers, the public, and the environment.

Chemical Weapons Convention

The CSDP has evolved in parallel with worldwide efforts to establish international control of chemical agent precursors and eliminate chemical agents and munitions. Over the course of several decades, a broad and complex agreement known as the Chemical Weapons Convention (CWC) was negotiated. Since 1993, the CWC has been signed by 165 countries and ratified by more than 100. The convention went into effect on April 29, 1997, six months after 65 countries had ratified it. Since then, the United States, which was actively involved in negotiating the CWC agreement, and Russia, the world's largest holder of chemical agents and munitions, have also ratified it.

The CWC prohibits the development, production, acquisition, stockpiling, retention, transfer, or use of chemical weapons. Article IV requires that signatories destroy chemical weapons and any special facilities for their manufacture within 10 years, (by April 29, 2007). Destruction of chemical weapons is defined as "a process by which chemicals are converted in an essentially

[2]The term *unitary* refers to a single chemical loaded in munitions or stored as a lethal material. More recently *binary* munitions have been produced, in which two relatively safe chemicals are loaded into separate compartments to be mixed to form a lethal agent after the munition is fired or released. The components of binary munitions are stockpiled separately, in separate states. They are not included in the present Chemical Stockpile Disposal Program. However, under the Chemical Weapons Convention of 1993, they are included in the munitions that will be destroyed.

irreversible way to a form unsuitable for production of chemical weapons, and which, in an irreversible manner, renders munitions and other devices unusable as such" (Smithson, 1993). The method of destruction is to be determined by each country, but the manner of destruction must ensure public safety and protect the environment.

Selection and Development of the Baseline Incineration System

In the early 1980s, the Army investigated a number of strategies and technologies for the destruction or disposal of chemical weapons. Among these were chemical destruction ("neutralization"), ocean disposal (now banned by federal law), stockpile consolidation with subsequent destruction, and disassembly followed by component incineration. The Army then selected incineration as the preferred technology for stockpile disposal. The National Research Council (NRC) Committee on Demilitarizing Chemical Munitions and Agents was formed in August 1983 to review the status of the stockpile and to assess the available disposal technologies. In that committee's final report in 1984, incineration was endorsed as an adequate technology for the safe disposal of chemical warfare agents and munitions (NRC, 1984).

Pursuant to the enactment of Public Law 99-145, the Army began the development of components of the baseline incineration system at the Chemical Agent Munitions Disposal System (CAMDS) facility at Deseret Chemical Depot (DCD), formerly Tooele Army Depot, Utah. Construction and systemization of the first fully integrated baseline incineration system, the Johnston Atoll Chemical Agent Disposal System (JACADS), was completed in July 1990 on Johnston Island, located in the Pacific Ocean approximately 700 miles southwest of Hawaii. The JACADS facility has a twofold mission:

- to destroy the chemical agents and munitions stored there
- to serve as a demonstration facility for the baseline incineration system

INCINERATION SYSTEM AT THE TOOELE CHEMICAL AGENT DISPOSAL FACILITY

The incineration system at the TOCDF represents a second-generation baseline system that incorporates improvements based on operating experience at the JACADS facility, advances in technology, and recommendations by the Committee on the Review and Evaluation of the Army Chemical Stockpile Disposal Program (Stockpile Committee), the successor to the Committee on Demilitarizing Chemical Munitions and Agents. The design was also based on the concept that the performance and safety of disposal are greatly enhanced if stockpile feed materials are separated into distinct streams of agent, energetic materials, metal parts, and dunnage (packing, activated carbon, and other waste material) prior to disposal treatment. A schematic drawing of the TOCDF incineration system is shown in Figure 1-2 (see Appendix A for a description of specific features of the TOCDF incineration system). Systemization (preoperational) testing at TOCDF began in August 1993, and agent operations began on August 22, 1996. Prior to the start of agent operations, a quantitative risk assessment (QRA) and a health risk assessment (HRA) were conducted (U.S. Army, 1996a; Utah DSHW, 1996).[3]

In the TOCDF baseline system, feed materials are separated inside a building that has areas capable of withstanding explosions. The atmospheric pressure in these and other areas where agent may potentially be present is controlled to be lower than the ambient atmospheric pressure to prevent leakage from the building to the outside atmosphere. Agents are removed from munitions and containers via remote control by two methods. Most containers are simply mechanically punched open and drained. Munitions, which also contain energetics (explosives/propellants), are mechanically disassembled and drained. These processes yield three material streams: agent, energetics, and metal parts. Energetics and metal parts may be

[3]The TOCDF QRA estimates the risk to the public and to workers from accidental releases of chemical agent associated with all activities during storage at DCD and throughout the disposal process at the TOCDF. The HRA, which was conducted by the Utah Division of Solid and Hazardous Waste (Department of Environmental Quality), was a screening analysis to estimate possible off-site human health risks associated with exposure to airborne emissions from the TOCDF under normal and upset conditions. The HRA also estimates risks to wildlife and the environment.

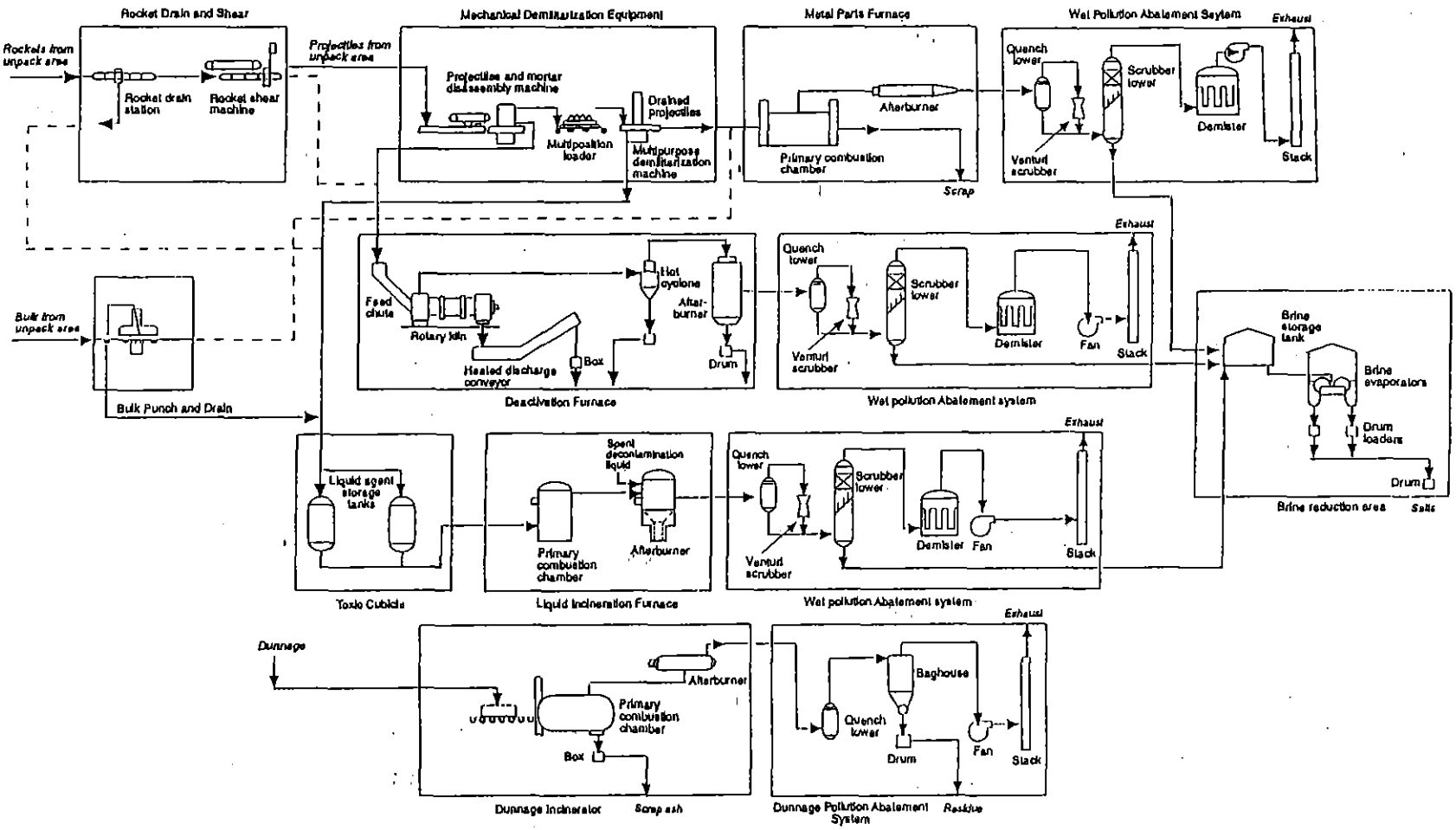


FIGURE I-2 Schematic drawing of the TOCDF incineration system. Source: U.S. Army, 1988; NRC, 1994a, 1994b, 1994c.

ontaminated by residual agent, but the vast majority of agent (95 percent or more) is usually recovered during the draining procedure. This material separation is a major safety feature of the TOCDF baseline system, which has parallel disposal systems for the treatment of these very different material streams.

At the TOCDF, agents are pumped to and destroyed in one of two specially designed liquid incinerators (LICs). Each LIC consists of a primary and secondary combustion chamber, and is followed by a pollution abatement system (PAS) consisting of a quick quench that saturates the gas stream, a venturi scrubber to control particulates, a tower scrubber to remove gaseous contaminants, and a demister to minimize water droplet carryover to the stack. Agent flow is stopped if the combustion chamber temperature drops below 2,550°F. Energetics are burned in a rotary kiln deactivation furnace system (DFS); exhaust gases are sent to an afterburner and then treated by a PAS before release to the atmosphere. Metal parts are decontaminated by heating in a metal parts furnace (MPF) to 1,000°F for a minimum of 15 minutes to vaporize and burn any residual agent; exhaust gases are t to an afterburner and then to a PAS.

Agent compounds contain various inorganic elements that result in significant acid gas incineration products. Acidic gases in the discharge streams are scrubbed in the PAS of each furnace with alkali solutions to form salts. In the original plan, these wet salts, or brine, were to be processed in a brine reduction area (BRA) and the resultant dry salts stored for later disposal in hazardous-waste landfills. However, brine from the TOCDF is now shipped off site to a hazardous-waste disposal facility.

According to the original plan, contaminated and uncontaminated packing materials and miscellaneous waste, or dunnage, were to be burned in a dunnage furnace (DUN) and the exhaust gases discharged through a separate stack without acid gas scrubbing because only trace amounts of agent or other acid-producing species were expected to be present. Current practice at the TOCDF is to dispose of dunnage that is not contaminated with agent off site through normal waste-handling processes. Some agent-contaminated materials are decontaminated and disposed of as hazardous waste. Used activated carbon from the facility's air filtration system is a major waste component originally slated to be posed of in the DUN. An alternate procedure for cinerating this material in the DFS is scheduled for esting in 2001.

Two auxiliary material streams are also processed: decontamination fluids are incinerated in the secondary combustion chamber of the LIC; and ventilation air is passed through banks of activated carbon filters to remove any trace contaminants.

Baseline monitoring systems are used to detect agent release and to monitor adherence to environmental requirements. The agent monitoring system consists of a combination of the automatic continuous air monitoring system (ACAMS) and the depot area air monitoring system (DAAMS). The ACAMS detects immediate threats with a three- to eight-minute response time for agent levels at 20 percent of the permissible eight-hour exposure concentration for workers. The DAAMS, which provide a much more sensitive and definitive measurement, has a slower response time because it requires transporting collection tubes to a central laboratory for analysis. An ACAMS alarm from monitoring the exhaust flow through the PAS results in an immediate shutoff of agent feed. Because the less selective ACAMS field monitors sometimes produce false alarms for certain nonagent emissions, DAAMS laboratory analyses are used to confirm or disprove ACAMS alarms and to document environmental compliance.

ROLE OF THE COMMITTEE ON REVIEW AND EVALUATION OF THE ARMY CHEMICAL STOCKPILE DISPOSAL PROGRAM

Concurrent with the beginning of construction of the baseline incineration facility at JACADS in 1987, the Army requested that the NRC review and evaluate the CSDP in order to provide advice and counsel. The NRC established the standing Stockpile Committee at that time to perform these tasks, beginning with a study of operational verification testing at JACADS, which was completed in March 1993. Several reports issued by the committee (e.g., *Recommendations for the Disposal of Chemical Agents and Munitions* [NRC, 1994a] and *Review of Systemization of the Tooele Chemical Agent Disposal Facility* [NRC, 1996a]) concluded that the baseline incineration system was an adequate and safe means of disposing of the chemical weapons stockpile (see Appendix B for a complete list of Stockpile Committee reports).

Composition of the Stockpile Committee

Since its inception in 1987, the Stockpile Committee has exercised an advisory and oversight role over the Army's CSDP. Over the years, the Stockpile Committee has adjusted the composition of its membership to

maintain a balance of disciplines necessary to meet the task at hand. Current members have expertise in analytical chemistry; biochemical engineering; chemistry; chemical engineering; chemical industry management; combustion engineering; community health and urban studies; environmental health policy; environmental restoration; health risk assessment and environmental toxicology; mechanical engineering; monitoring and instrumentation; risk assessment, management, and communication; statistics and incinerator performance analysis; toxicology; and waste treatment and minimization.

OVERVIEW OF RELEVANT NRC RECOMMENDATIONS

Table 1-1 is a summary of recommendations from past NRC reports that are relevant to the present study. In the 1994 NRC report, *Recommendations for the Disposal of Chemical Agents and Munitions* (*Recommendations* report), the Stockpile Committee established its general criterion for evaluating CSDP activities. This criterion is included in the first recommendation (subsequently referred to as [RC-1]: "The Chemical Stockpile Disposal Program should proceed expeditiously and with technology that will minimize total risk to the public at each site" (NRC, 1994a).

Although the minimization of public risk continues to be the committee's major concern, the total risk is dependent on a number of factors:

- integrity of facility design, construction, operation, and maintenance
- a safety culture throughout the organization
- qualified, well trained, highly motivated managers and workers
- current, detailed safety analyses
- positive working interactions with regulatory agencies, emergency response services, community groups, and the general public

The 1996 NRC report, *Review of Systemization of the Tooele Chemical Agent Disposal Facility* (*Systemization* report), which was published several months before the start of agent operations at the TOCDF, contained 18 specific recommendations organized by the timing of the start of agent operations (NRC, 1996a). However, for the purposes of the present report, they are considered topically. A 1996 letter report, *Public Involvement and the Army Chemical Stockpile Disposal Program*, contained two recommendations (NRC, 1996b). In the 1997 NRC report, *Risk Assessment and Management at—Deseret Chemical Depot and the Tooele Chemical Agent Disposal Facility* (*Risk Assessment and Management* report), 10 additional recommendations were made (NRC, 1997). In Table 1-1, the *Recommendations* report is designated [RC]; the *Systemization* report is designated [S]; the *Risk Assessment and Management* report [R]; and the *Public Involvement* report [PI]. A complete list of TOCDF-related recommendations is presented in Appendix C.

PURPOSE OF THIS REPORT

This report reviews the status of the CSDP with respect to earlier recommendations made by the Stockpile Committee. The primary objectives of this report are to assess the Army's progress and to acknowledge actions that satisfy prior recommendations, to identify recommendations that require further action, and to provide additional recommendations for improving overall performance at the TOCDF after more than two years of agent disposal operations. Although the focus of this report is on the TOCDF, some findings and recommendations apply to other sites and the CSDP as a whole. The statement of task concerning this report follows:

Statement of Task

The NRC study will accomplish the following:

- Gather and assess data and information from the Tooele Chemical Agent Disposal Facility (TOCDF) on systems performance and plant operations, e.g., incineration trial burns, brine reduction area testing and certification, slag removal system operations, monitoring systems operations, and other performance characteristics.
- Assess progress in the area of safety and risk management, e.g., establishment of a safety culture, establishment of safety performance goals, implementation of high quality, adequately staffed safety management systems, and implementation of other elements important to a sound risk management program.
- Evaluate and assess the Army's actions and programs designed to enhance public and community

TABLE 1-1 NRC Recommendations Addressed in This Report

Prior Recommendation	Area(s) Addressed by Recommendation	Chapter in Which Recommendation Is Discussed
RC-1	Program-wide risk reduction	2, 3, 4
S-1	Implementation of a safety program	3, 4
S-2	Incorporation of safety and environmental goals into award fees	4
S-3	Completion of QRA, resolution of safety-related issues	3
S-4	Improved public interactions and communications	5
S-5	Emergency preparedness training	5
S-6	Completion and practice of emergency preparedness plans	5
S-7	Completion of emergency-preparedness communications system for Tooele site	5
S-8	Completion of Army preoperational survey	2
S-9	Attainment of LIC 99.9999% DRE	2
S-10	Safety management	4
S-11	Completion of RCRA and TSCA trial burns	2
S-12	BRA certification; dunnage disposal	2
S-13	LIC slag removal	2
S-14	Completion of risk management plan (RMP)	3
S-15	Risk assessment integration	3
S-16	"Near misses" tracking and safety	3
S-17	Improvements in monitoring	2
R-1	Updating of QRA, HRA	3
R-2	Development and review of program-wide site-specific QRAs and HRAs	3
R-3	Update of QRA methodology manual	3
R-4	Inclusion of "safety culture" in *Guide*	4
R-5	Definitions of risk management roles and responsibilities in *Guide*	4
R-6	Inclusion of public involvement in RMP	5
R-7	Tracking of CMP performance	5
R-8	Understanding of risk assessment by workers, etc.	3
R-9	Implementation and updating of RMP	3, 4, 5
PI-1	Commitment of CSDP to public involvement	5
PI-2	Coordination of CSDP, CSEPP, public affairs, and RMP	3, 5

Legend: RC = *Recommendations for the Disposal of Chemical Agents and Munitions* (NRC, 1994a); S = *Review of Systemization of the Tooele Chemical Agent Disposal Facility* (NRC, 1996a); R = *Risk Assessment and Management at Deseret Chemical Depot and the Tooele Chemical Agent Disposal Facility* (NRC 1997); and PI = *Public Involvement and the Army Chemical Stockpile Disposal Program* (NRC, 1996b). See Appendix B for a complete list of reports by the NRC Stockpile Committee.

interactions on issues of mutual concern, e.g., risk reduction, change management, emergency management, etc.

- Extract valuable lessons learned and their programmatic implications.
- Provide recommendations that the committee believes are needed to enhance the overall Chemical Stockpile Disposal Program at the TOCDF and at other sites.

In performing this assessment, the entire Stockpile Committee visited the TOCDF in March 1997 and met with TOCDF staff in Salt Lake City in February 1998 (see Table 1-2). A working group of the committee also visited the site on December 9, 1997, and March 11, 1999. This report is based on those visits, prior visits, a review of reports and briefings by the Army and other groups, and the committee's extensive knowledge of the CSDP and the construction and systemization of the TOCDF.

This chapter has provided a brief description of the TOCDF facilities and the CSDP. Chapter 2 assesses systems performance and plant operations. Chapters 3 and 4 discuss risk assessment and risk management and safety issues, respectively. Chapter 5 reviews the relationships between the TOCDF (which is operated by Edgerton, Germerhausen and Grier [EG&G] Defense Materials Incorporated, an Army contractor, and the office of the U.S. Army Program Manager for Chemical Demilitarization [PMCD]) and relevant government and community groups. Committee findings and recommendations are presented in Chapter 6.

TABLE 1-2 Site Visits and Briefings

TOCDF Site Visits (1997–1999)	Committee Attendance
March 1997	full committee
July 1997	working group
December 1997	working group
February 1998	new members
TOCDF Briefings (1997–1999)	
March 6, 1997	full committee
June 19, 1997	full committee
September 18, 1997	full committee
February 26, 1998	full committee
June 25, 1998	full committee
September 24, 1998	full committee
January 7, 1999	full committee
March 18, 1999	full committee

2

Systems Performance and Plant Operations

In the areas of systems performance and plant operations, the Stockpile Committee recommended that the following conditions be satisfied:

- mandatory Army Preoperational Survey requirements prior to the start of agent operations [S-8]
- all Resource Conservation and Recovery Act (RCRA) and Toxic Substance Control Act (TSCA) trial-burn requirements for the LICs and DFS [S-9, S-11]
- testing and certification of the BRA and DUN or implementation of a satisfactory alternative [S-12] demonstration of the slag-removal system for the LICs [S-13]
- active pursuit of continual improvements in monitoring systems [S-17]
- continued evaluation of the proposed addition of a carbon-bed filter to the PAS [S-18] (the subject of a separate NRC report, *Carbon Filtration for Reducing Emissions from Chemical Agent Incineration* [NRC, 1999])

OVERVIEW

Activities since the Start of Agent Operations

The TOCDF began agent operations on August 22, 1996. As of May 19, 1999, 20,001 GB M55 rockets, 2,710 GB ton containers, 137,754 GB 105 mm projectiles, and 4,463 GB MC-1 bombs had been destroyed. The destruction schedule for M55 rockets had fallen behind the original timetable because of a delay in obtaining the TSCA permit; and more projectiles and fewer ton containers had been processed than was projected by the TOCDF QRA schedule. Approximately 51 tons of GB have been destroyed, more than 20 percent of the total DCD stockpile.

Every year the Army submits a report to Congress on the CSDP that includes a description of "other events" and a summary of significant events that resulted in plant shutdowns, of which there have been two each year. The most recent shutdown, which occurred on December 13, 1998, was caused by improper reassembly of an in-line filter after maintenance that resulted in 140 gallons of GB leaking into the toxic cubicle sump. Although all agent was contained by the safeguards built into the facility, this significant maintenance error suggests that there are problems in training and the implementation of a safety culture throughout the organization. This event also suggests insufficient communication between control room operations and maintenance personnel. None of the events resulted in exposure of personnel to chemical agent or its release to the environment.

RCRA trial burns have been satisfactorily completed with GB for LIC-1 and LIC-2, the MPF, and the DFS. The TSCA trial burn for the DFS had to be redone, however, which delayed the processing of M55 rockets. The second TSCA trial burn was successful.

The BRA did not pass its initial compliance test because of excessive particulate emissions, but the probable cause of the problem was identified. However, because economics favor the off-site disposal of brine, the Army has decided not to retest the BRA at this time. This has raised concerns on the committee about what would happen if the off-site shipping of brine becomes unavailable. TOCDF site managers have discussed alternatives to the off-site disposal of brine, and the BRA is presently in a long-term lay-up configuration, which means the equipment will be protected while it is inactive. Approximately four weeks would be necessary for the equipment to be made operational. The state of Utah has verbally agreed that, in the event of a change to requirements for brine management, it would allow the Army time to effect the transition. This could include authorizing the temporary storage of brines in isolation containers (as is done at JACADS) until the equipment in the BRA can be brought on line and tested to demonstrate compliance with regulatory requirements.

The DUN at the TOCDF has not been used because contaminated wastes that were scheduled for destruction in the DUN are being disposed of at qualified hazardous-waste management facilities. Although off-site disposal was always an option, the DUN was originally designed as part of the overall waste-minimization program required by the Environmental Protection Agency (EPA) and endorsed by the committee. The major contaminated waste stream scheduled for destruction in the DUN is the activated carbon from the facility's ventilation system. As an alternative, the Army is studying the installation of a micronizer and burner designed to dispose of activated carbon in the DFS. A prototype unit will be tested at JACADS during the closure phase of that facility (calendar year 2001).

Modifications to improve the LIC slag-removal system have been successful. As of December 1998, slag had been tapped approximately 45 times, almost all from LIC-1, which has an improved slag-removal system. During a recent maintenance shutdown, the slag-removal system for LIC-2 was also upgraded, but LIC-2 has not been operated long enough since then to demonstrate the performance of the upgraded system. To date, a total of approximately 22,000 lbs of slag has been drained from both incinerators; this has avoided approximately three maintenance shutdowns that would have been necessary to remove slag manually. A recurrent problem in the slag-removal system has been the failure of the heater, and the Army is evaluating ways to extend heater life.

Disposal Schedule

Because risk to the public is directly related to the existence of the stockpile, its rate of destruction is of key concern to the Stockpile Committee. The faster the stockpile can be safely destroyed, the lower the overall risk to the public becomes, and the Army has organized the disposal schedule to maximize risk reduction. The first campaigns, therefore, were focused on the disposal of M55 GB rockets, with co-processing of GB ton containers. At the start of agent processing, the expected value of the public acute fatality risk as calculated in the QRA was 1.4×10^{-3} per year.[1]

According to the schedule issued at the start of agent destruction operations, all GB M55 rockets were to have been processed within the first nine months of operation. In actuality, after about one-third of the rockets (11,592 units) had been processed, rocket processing was stopped because some of the exhaust gas samples collected during the first TSCA trial burn contained a specific polychlorinated biphenyl (PCB) cogener that later proved to be a random sampling or analysis artifact. Thus, results of the first PCB destruction and removal efficiency test were ambiguous, and the TSCA permit for processing M55 rockets at the full rate was delayed pending a successful retest. The recovery efficiencies of surrogate spikes during the TSCA trial burns were low, which was probably due to the severe weather conditions during testing in January 1997. (Severe weather can affect the sampling procedures.) When the trial burns were repeated in November 1998, the results met regulatory requirements, and the processing of M55 rockets was resumed. In the interim, ton containers were processed, and GB MC-1 bombs and 105 mm projectiles were moved up in the schedule to make the most effective use of the facility.

At the end of calendar year 1998 (after 28 months of agent operations), the TOCDF had processed 71,771 items (rockets, bombs, projectiles, and ton containers) containing approximately 2,495 tons of agent. The public acute fatality risk calculated in the QRA for the condition at the end of 1998 was 2.5×10^{-4} expected fatalities per year. According to the operations schedule in the QRA, by this time 47,162 items were to have been processed containing approximately 4,004 tons of agent. In percentage terms, 52 percent more items had been processed by the end of calendar year 1998, but 37 percent less agent had been destroyed than originally scheduled. The difference reflects that more projectiles and fewer ton containers have actually been processed than were projected in the QRA schedule.

Thus, the TOCDF is ahead of the original QRA schedule in the number of items processed but behind in the tonnage of agent destroyed. The changes in the order of agent disposal operations have reduced the

[1] To understand the expected value (average number) of fatalities, imagine a large number of identical plants, each operating for an identical disposal mission. Most would have no accidents; some would have accidents involving one fatality, and some might have accidents involving more than one fatality. The average number of fatalities for all of the plants is the expected value. See Appendix A of the *Risk Assessment and Management* report (NRC, 1997) for a more thorough discussion.

erall risk and enabled efficient utilization of the facility, which is processing three munitions (GB-filled rockets, ton containers, and projectiles) at the same time. Because of the delay, the stacking height of stored VX rockets was lowered to reduce the storage risk. The current schedule allows for a constant rate of agent processing during the overall GB campaign, but the delay in processing GB-filled M55 rockets has slowed the rate of risk reduction. At the completion of the GB processing campaign (third quarter of calendar year 2001), the TOCDF is now projected to have destroyed 929,865 items containing approximately 6,097 tons of agent. At a similar point in the original schedule, the TOCDF was projected to have destroyed a total of 942,561 items containing approximately 6,683 tons of agent, including some non-GB agent.

At the start of agent processing, the public acute-fatality risk calculated in the QRA for accidental agent release was 1.4×10^{-3} per year. This was based on five phases of disposal: (1) disposal of GB rockets and ton containers; (2) disposal of VX rockets and spray tanks; (3) processing of remaining GB items; (4) processing of maining VX items; and (5) disposal of HD. Because the delay in the processing of GB rockets, the Army decided to complete disposal of all other GB items first, followed by all VX items. Thus, the public acute-fatality risk at the end of 1998 was 2.5×10^{-4} per year (18 percent of the original rate at the start of operations). This risk is based on the disposal of the GB munitions and ton containers and the reconfiguration (by reducing the stacking height and banding rockets together) of the stored VX rockets. At the same time in the original QRA schedule, the calculated public acute-fatality risk was to have been 7.0×10^{-5} per year, or 5 percent of the original risk at the start of operations, based on the assumption that all GB rockets, VX rockets, spray tanks, MC1 bombs, weteye bombs, and a little more than half of the GB ton containers had been processed.

The TOCDF destruction program was behind schedule by approximately one month (33 days) as of the end of calendar year 1998. Given the recent regulatory approvals for the operation of both of the LICs and the DFS at the full rate and the successful completion of the TSCA trial burn for the DFS, the committee believes that the current schedule delay can be made up. The cessing of GB rockets is expected to resume after the sposal of the M360 projectiles (which are processed in the MPF) has been completed in the third quarter of calendar year 2001. The remaining GB ton containers and munitions can be coprocessed during this same time, and GB rockets are being processed, as the system allows. Their disposal is expected to be completed in calendar year 1999. GB ton containers are processed whenever there is enough capacity in the LICs. This overall strategy is the shortest pathway through the TOCDF operations schedule that is consistent with the principle of processing the items with the highest storage risk as soon as practical.

At its meeting in September 1998, the committee was informed that the recent program-wide audit performed by the Arthur Anderson Company indicated that the present schedule and budget estimates were probably optimistic (Evans, 1998a; Arthur Anderson, 1998). Although safety is the committee's highest priority, the prompt destruction of the stockpile is the primary factor in risk reduction. A strong commitment program-wide and by site management to meeting schedules without compromising operational safety is essential to meeting the overall goal of safe and expeditious destruction of the stockpile.

TRIAL BURNS

Trial burns are conducted to demonstrate that incinerator systems perform as designed and meet applicable state and federal regulations and permit restrictions. The specific purpose of a trial burn is to demonstrate permissible emissions while processing at maximum allowable chemical agent feed rates under projected worst-case operating conditions for both the combustion chamber(s) and the air-pollution control equipment. The demonstrated worst-case operating conditions then become the operating limits in the operating permit. The facility operator is allowed to operate the incinerators at conditions equal to or better than the worst-case conditions. Hence, normal incinerator performance should always be as good or better than the performance demonstrated during the trial burn.

The TOCDF's LICs, DFS, and MPF were first tested using agent surrogates (i.e., chemicals that behave similarly to agents in incinerators but are not nearly as toxic at the same concentration). Once the surrogate trial burns demonstrated that the incinerators met the Army's performance standards, chemical agent trial burns were conducted to satisfy RCRA and TSCA requirements.

The sections that follow summarize the results of the surrogate and agent trial burns, discuss the implications of the agent trial-burn data for the HRA, and describe the problem with the TSCA trial-burn data that delayed

the processing of M55 rockets. If compounds of concern were present in concentrations below the detection limits, the practical quantification limits (PQLs) were reported for most tests.[2] Consequently, the maximum amount of a compound of concern that might have been present is overstated by a factor of at least 3.3.

Surrogate Trial Burns

The TOCDF DFS, MPF, and one of two identical LICs were tested using agent surrogates. The DUN was not tested because DUN operations are no longer planned. The purpose of a surrogate trial burn is to demonstrate that an incinerator system (combustor plus air-pollution control system) can efficiently destroy and remove typically hard-to-burn compounds. The Army set a target destruction and removal efficiency (DRE) of 99.9999 percent, which is more stringent than the federal DRE requirement for all substances that do not contain polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/F). Surrogates were selected to meet the Utah Division of Solid and Hazardous Waste criteria. The surrogate trial burn for LIC-1 was successfully conducted between June 30 and July 7, 1995 (the results are summarized in NRC, 1996a). The results of the other three surrogate trial burns are summarized below.

Results of Surrogate Trial Burns

The TOCDF operates under RCRA permit UT5210090002 issued by the state of Utah. Under the requirements of this permit, the incinerator systems must demonstrate that they meet performance standards that ensure effective and safe destruction of chemical agents before beginning routine operations. The primary objective of the surrogate trial burns was to demonstrate that the incinerators meet the following performance criteria:

- DRE of at least 99.9999 percent for the surrogates, also known as principal organic hazardous constituents—
- emissions of total particulate matter lower than the federal requirement of 180 milligrams per dry standard cubic meter (mg/dscm), which is equivalent to 0.08 grains per dry standard cubic foot (gr/dscf) at 7 percent oxygen (O_2); and the state requirement of 0.016 gr/dscf at 7 percent O_2 for particulate matter smaller than 10 microns[3] (PM_{10})
- hydrogen chloride (HCl) emissions, measured downstream of the pollution control equipment, less than four pounds per hour (lbs/hr) or less than 1 percent of the total organically-bound chlorine input to the furnace (i.e., chlorine in the surrogate, not salts that might contaminate the fuels)
- minimal emissions of products of incomplete combustion evidenced by 60-minute moving average carbon monoxide (CO) concentrations of less than 100 parts per million (ppm) on a dry, volumetric basis corrected to 7 percent O_2

Liquid Incinerator #2

LIC-2 surrogate trial burns were conducted on January 29 and 30, 1996. The surrogates selected to simulate the chemical agents were 1,2,4-trichlorobenzene and tetrachloroethylene (also known as perchloroethylene), which contain a lot of organically bound chlorine to challenge the PAS and have chemical bonds similar to those in the agents. The results should be reasonably representative of chemical agent operations.

Table 2-1 is a summary of the particulate matter, HCl, and CO emissions and DREs for the LIC-2 surrogate trial burns. Total particulate emissions were significantly lower than the PM_{10} requirement, showing that the fraction of emissions of sub-10 micron particulates was lower than the requirement. A greater than 99.9999 percent DRE was

[2]Footnotes in some test reports (see, for example, Tables 5-9 and 5-19 in EG&G, 1997b) state that practical quantification limits (PQLs) were reported when results were below the detection limit. When the concentration of a sample with 3 to 5 times the estimated detection limit was repeatedly measured, the replicates show some scatter, which typically follows a bell-shaped, Gaussian distribution. The standard deviation of this distribution (S_0) is used to define the detection limit as three times S_0 (EPA, 1997). For measurements at the detection limit, the analyst can be confident that the analyte is present but cannot make a firm statement about the amount. At or above the PQL, however, the analyst can be confident about the quantity. The PQL is defined as 10 times S_0 for air pollution control measurements, but in 1999 this unique definition was termed inappropriate (EPA, 1999). Based on these definitions, the PQL is 3.3 times the detection limit. Consequently, by reporting the PQL for results that are below detection limits, the maximum amount of pollutant is overstated by a factor of at least 3.3.

[3]A micron is a millionth of a meter, so 10 microns is 10^{-5} meters.

TABLE 2-1 Surrogate Trial Burns for LIC-2 in January 1996

Parameter	Requirement	Test Run Results 1	2	3
PM concentration[a] (gr/dscf)	< 0.08[b]	0.0040	0.0040	0.0017
HCl emission rate (lb/hr)	4[c]	< 0.003	< 0.003	< 0.003
CO Concentration[d] (ppm)	100	10.0	9.1	14.5
1,2,4-Trichlorobenzene DRE (%)	> 99.9999	> 99.999973	> 99.999973	> 99.999973
Perchloroethylene DRE (%)	> 99.9999	> 99.999983	> 99.999984	> 99.999991

[a]PM = particulate matter, corrected to 7 percent oxygen, dry basis.
[b]< 0.016 gr/dscf for particulate matter with a size ≤ 10 microns (PM_{10}).
[c]Or less than 1 percent of organically bound chlorine in exhaust gas prior to entering pollution control equipment, which averaged 8.7 lb/hr for all three test runs.
[d]Corrected to 7 percent oxygen, dry basis.

Source: Adapted from EG&G, 1996a.

demonstrated. Limitations for particulate matter, HCl, and CO emissions were met during the test.

Metal Parts Furnace

MPF surrogate trial burns were conducted on June 4, 5, and 6, 1996. The surrogates selected to simulate the chemical agents were a combination of monochlorobenzene and hexachloroethane. This combination was recommended by the Utah DSHW as one that would be more difficult to destroy than the chemical agents and would provide a maximum challenge to the PAS.

Six of the first seven runs were invalidated because of sampling and analytical problems, such as the inadvertent use of an incorrectly spiked resin or a sampling system leak. Another run, Run 6, was aborted because of operating difficulties with the MPF. Because the sampling problems are not associated with the ability of the incinerator to meet performance standards, and because the operating difficulty during Run 6 involved ancillary equipment that was not likely to affect emissions, the Utah DSHW, with the guidance of the EPA, agreed that additional performance runs could be conducted. The next few runs, Runs 8 through 10, were completed without incident.

Table 2-2 summarizes the particulate matter, HCl, and CO emissions and DREs for the MPF surrogate trial burns. The particle-size distribution was not measu so no information is available on the amount of PM actually emitted, but compliance with the PM_{10} standa (see performance criteria given earlier) was demc strated because the total particulate emissions were l than the PM_{10} performance standard. The Arm 99.9999 percent DRE requirement was also demc strated. Hence, the MPF surrogate trial burns demc strated that the system could safely proceed to t second phase of the RCRA demonstration and testi requirements—the chemical agent trial burn (ATB).

Deactivation Furnace System

The DFS surrogate trial burns were conducted b tween September 30, 1995, and October 6, 1995. TI tests included one run using only supplementary fu and five performance runs with surrogates. The surr gate compounds selected by the Utah DSHW we monochlorobenzene and hexachloroethane. An error sample recovery voided run 1. Run 2 was not complete because of a mechanical failure in a feed chute th interrupted incinerator operations. Incinerator perform ance was assessed using runs 3, 4, and 5.

Table 2-3 summarizes the particulate matter, HC and CO emissions and DREs for the DFS surrogate tri burns. Although particulate size was not measured, tot

TABLE 2-2 Surrogate Trial Burns for the MPF in June 1996

Parameter	Requirement	Test Run Results		
		8	9	10
PM concentration[a] (gr/dscf)	PM < 0.08[b]	0.0018	0.0015	0.0038
HCl Emission Rate (lb/hr)	< 4[c]	< 0.016	< 0.009	< 0.009
CO concentration[d] (ppm)	< 100[e]	7.9 7.2	8.3 6	8.4 7.3
Monochlorobenzene DRE (%)	> 99.9999	> 99.999966	> 99.999975	> 99.999976
Hexachloroethane DRE (%)	> 99.9999	> 99.999955	> 99.999955	> 99.999956

[a]PM = particulate matter, corrected to 7 percent oxygen, dry basis.
[b]< 0.016 gr/dscf for particulate matter with a size ≤ 10 microns (PM_{10}).
[c]The 4 lb/hr emissions standard is greater than 1 percent of organically bound chlorine input to the furnace (1.05, 1.06, and 1.07 lb/hr for runs 8, 9, and 10, respectively).
[d]Corrected to 7 percent oxygen, dry basis.
[e]Standard is based on 60-minute moving average. The average of the one-minute moving averages recorded by two different continuous emission-monitoring system analyzers were reported to provide a more representative value over the feed time.

Source: Adapted from EG&G, 1996b.

TABLE 2-3 Surrogate Trial Burns for the DFS in September 1995

Parameter	Requirement	Test Results		
		3	4	5
PM concentration[a] (gr/dscf)	< 0.08[b]	0.0043	0.0048	0.0049
HCl emission rate (lb/hr)	< 4[c]	< 0.0183	< 0.0532	< 0.0040
CO concentration[d] (ppm)	100	10	10	10
Monochlorobenzene DRE (%)	> 99.9999	> 99.999990	> 99.999967	> 99.999999
Hexachloroethane DRE (%)	> 99.9999	> 99.999989	> 99.999988	> 99.999991

[a]PM equals particulate matter, corrected to 7 percent oxygen, dry basis.
[b]< 0.016 gr/dscf for particulate matter with a size ≤ 10 microns (PM_{10}).
[c]Or less than 1 percent of organically bound chlorine in exhaust gas prior to entering any pollution control equipment (0.40, 0.39, and 0.40 lbs/hr for runs 3, 4, and 5, respectively).
[d]Corrected to 7 percent oxygen, dry basis.

Source: Adapted from EG&G, 1995.

...rticulate emissions were less than the PM_{10} emissions standard. Therefore, the fraction of emissions smaller than 10 microns (10^{-6} m) meets the requirement. The Army's 99.9999 percent DRE requirement was also demonstrated. Hence, the DFS surrogate trial burns demonstrated that the system could proceed to the second phase of the RCRA demonstration and testing requirements—the ATBs.

Agent Trial Burns

The agent trial burns (ATBs) at the TOCDF site demonstrated that the incineration systems meet emissions requirements when burning chemical munitions. The ATBs are conducted (1) to demonstrate a DRE requirement for agent in accordance with the state of Utah permit, the Code of Federal Regulations (Title 40 Part 264), and RCRA regulations, and (2) to demonstrate system performance and the control of emissions. The results of the ATBs conducted to date for LIC-1, LIC-2, the DFS, and the MPF using agent GB are summarized below.[4] The following performance standards were characterized:

- DRE for the incinerator using agent GB as the principal organic hazardous constituent for fulfillment of RCRA requirements (i.e., 99.99 percent)
- compliance with the particulate-matter emission-rate limits in both the RCRA permit UT5210090002 and the Approval Order issued by the state of Utah
- compliance with the HCl emission-rate limits in the RCRA permit
- emission rates for phosphorus and the 20 metals estimated by the state of Utah for the screening HRA conducted by the Department of Environmental Quality DSHW (Utah DSHW, 1996)
- emissions of PCDD/F
- emissions of certain semivolatile organic compounds (SVOCs) and volatile organic compounds (VOCs)
- exhaust gas concentrations of O_2 and CO using the TOCDF continuous emission-monitoring systems (CEMS) to document one aspect of combustion conditions in the system and show compliance with the CO concentration limits in the RCRA permit

Liquid Incinerators

LIC-1 ATBs were conducted on February 26, 27, and 28, 1997, and LIC-2 ATBs, on August 20, 22, and 23, 1997 (EG&G, 1997a, 1997b). During these performance trials, agent GB was processed. The results presented in Table 2-4 show that emissions of particulate matter, HCl, agent GB, and CO were within the permit limits established by the state of Utah for liquid incinerator systems. Agent destruction was better than the minimum DRE requirement of 99.99 percent.

Emission rates of VOCs, SVOCs, PCDD/F, phosphorus, and metals were compared to the emission rates used in the HRA (Utah DSHW, 1996). The results of this comparison are summarized below and shown in Table 2-5:

- Emission rates for 20 of the metals were below the rates used in the screening HRA. The highest measurement for LIC-1 lead is a statistical outlier indicating a potential sampling problem (which, had it been confirmed prior to the publication of the test report, would have invalidated that particular run and indicated compliance). The phosphorus concentration measured for LIC-1 was above the HRA estimated rate. Mercury was not detected, but the detection limit was above the rate used in the HRA.
- The international toxic equivalent concentrations (ITEQ) for the PCDD/F averaged 0.00034 ng/dscm and 0.00053 ng/dscm (at 7 percent O_2) for LIC-1 and LIC-2, respectively. These are lower than the federal hazardous-waste incinerator regulatory limit of 0.2 ng/dscm (at 7 percent O_2) for new sources.
- Emission rates for two VOCs, ethylbenzene and m,p-xylene, were above the emission rates used in the HRA in at least one run on LIC-1. The other VOCs were either not detected or their emission rates were below the emission rates used in the HRA.
- The majority of the 141 target SVOCs were below measurement method detection limits. The measured emission rate for one SVOC, bis(2-ethylhexyl)phthalate. was above the assumed HRA

[4]See Chapter 2 of the 1999 NRC report, *Carbon Filtration for Reducing Emissions from Chemical Agent Incineration*, for a thorough discussion of measuring trace emissions, sampling and analysis methodologies, and the characteristics of exhaust gas emissions at the TOCDF and JACADS.

BLE 2-4 Agent Trial Burns of LIC-1 and LIC-2

issions Parameter	State of Utah Permit Limit	LIC-1 Results	LIC-2 Results
aximum concentration of agent GB[a]	0.3 $\mu g/m^3$	< 0.0037 μ/m^3	< 0.0034 $\mu g/m^3$
inimum DRE for GB	99.99%	> 99.999999969%	> 99.999999973%
aximum concentration of rticulate matter	0.016 gr/dscf @ 7% O_2[b] 0.08 gr/dscf @ 7% O_2[c]	0.0023 gr/dscf, @ 7% O_2	0.0016 gr/dscf, @ 7% O_2
aximum emission rate of HCl	4 lbs/hr or 1% of total HCl prior to PAS	0.009 lbs/hr	< 0.016 lbs/hr
aximum concentration of CO[d]	100 ppm @ 7% O_2	16 ppm @ 7% O_2	50 ppm @ 7% O_2
aximum concentration of CEMS O_2	15%	9.2%	9.8%
inimum concentration of CEMS O_2	3%	6.7%	6.7%
aximum concentration dioxin ITEQ[f]	0.2 ng/dscm @ 7% O_2[e]	0.00046 ng/dscm @ 7% O_2	0.00093 ng/dscm @ 7% O_2
verage concentration dioxin ITEQ[f]	0.2 ng/dscm @ 7% O_2[e]	0.00034 ng/dscm @ 7% O_2	0.00053 ng/dscm @ 7% O_2

[a]Determined from analysis of DAAMS sorbent tubes (Station PAS 704 - LIC-1; 705 - LIC-2).
[b]Limit set by Air Approval Order for *PM10* (i.e., particulate matter with a size of ≤ 10 microns).
[c]Limit set by RCRA Permit.
[d]Maximum one hour moving average.
[e]Proposed EPA limit; there is no state limit.
[f]ITEQ (international toxic equivalency) dioxin is 2,3,7,8 TCDD (2,3,7,8-tetrachlorodibenzo-p-dioxin), with toxicity equivalent to the complex mixture of 10 dioxin and furan isomers (with 4 through 8 chlorine atoms). This equivalency is based on the ITEQ scheme adopted by the United States and most other ountries to simplify the reporting of dioxin emissions.

Source: Adapted from EG&G 1997a, 1997b.

emission rate. Measurement method detection limits were above the equivalent HRA emission rates for dimethylphthalate, however, so conclusions cannot be drawn about the relation of actual and projected emissions for this SVOC.

The list in Table 2-5 includes compounds for which a neasured emission rate from LIC-1 or LIC-2 was higher nan the value used in the HRA or for which the detection imit was too high to draw a meaningful conclusion.

Deactivation Furnace System

DFS ATBs with GB were conducted on January 7, 0, and 11, 1997. During these performance runs, M55 rockets were processed at an average rate of 35 rockets per hour. The rockets were punched and drained of GB prior to entering the DFS, although some residual agent remained after the draining operation. The test results are summarized below and in Tables 2-6 and 2-7:

- Emissions of particulate matter, HCl, GB, and CO were below the state of Utah permit limits established for the DFS.
- The measured 99.999981 percent DRE was better than the minimum 99.99 percent DRE requirement.
- Emission rates for 16 metals were below the HRA estimated values. Cadmium, lead, zinc, and phosphorus were higher than the HRA estimated emission rates. The detection limit for mercury was too

TABLE 2-5 Measured LIC-1 and LIC-2 Emissions or Reported Upper Limits That Exceed Values Estimated in the HRA

	Maximum Emission[a] (g/sec)	HRA Estimated Rate (g/sec)[b]	Source
Metals and Phosphorus			
Lead	4.0 E-04	6.01 E-05	EG&G, 1997a, Table 5-18
Mercury	< 1.1 E-05	2.44 E-06	EG&G, 1997a, Table 5-18
	< 5.7 E-06	2.44 E-06	EG&G, 1997b, Table 1-1
Phosphorus	1.9 E-03	1.18 E-03	EG&G, 1997a, Table 5-18
VOCs			
Vinyl chloride	< 3.6 E-06	4.07 E-07	EG&G, 1997a, Table 5-7
	< 6.7 E-06	4.07 E-07	EG&G, 1997b, Table 5-7
Chloroform	< 3.8 E-06	4.07 E-07	EG&G, 1997a, Table 5-7
	< 1.3 E-05	4.07 E-07	EG&G, 1997b, Table 5-7
Carbon tetrachloride	< 3.3 E-06	4.07 E-07	EG&G, 1997a, Table 5-7
Bromodichloromethane	< 5.2 E-06	4.07 E-07	EG&G, 1997a, Table 5-7
	< 1.7 E-05	4.07 E-07	EG&G, 1997b, Table 5-7
Dibromochloromethane	< 6.4 E-06	4.07 E-07	EG&G, 1997a, Table 5-7
	< 1.7 E-05	4.07 E-07	EG&G, 1997b, Table 5-7
Ethylbenzene	4.5 E-06	4.07 E-07	EG&G, 1997a, Table 5-7
	< 6.4 E-06	4.07 E-07	EG&G, 1997b, Table 5-7
m,p-xylene	6.1 E-06	3.98 E-06[c]	EG&G, 1997a, Table 5-7
	< 7.7 E-06	3.98 E-06	EG&G, 1997b, Table 5-7
Styrene	< 2.5 E-05	1.39 E-05	EG&G, 1997b, Table 5-7
	< 2.1 E-05	1.39 E-05	EG&G, 1997a, Table 5-7
Bromoform	< 1.3 E-05	1.19 E-05	EG&G, 1997b, Table 5-7
SVOCs			
Dimethyl phthalate	< 1.2 E-04	8.18 E-05	EG&G, 1997a, Table 5-9
	< 1.5 E-04	8.18 E-05	EG&G, 1997b, Table 5-9
Bis (2-ethylhexyl) phthalate	< 3.2 E-04	4.79 E-05	EG&G, 1997a, Table 5-9
	2.2 E-04	4.79 E-05	EG&G, 1997b, Table 5-9

[a]For the emissions of VOCs and SVOCs reported as "<," the PQL is reported. The PQL is 3.3 times the detection limit.

[b]The highest concentrations measured during the initial JACADS trial burns were used by the State of Utah DSHW to estimate TOCDF emissions.

[c]HRA value is for total xylene.

Source: Adapted from EG&G 1997a, 1997b.

TABLE 2-6 Agent Trial Burns for the DFS in January 1997

Emissions Parameter	State of Utah Permit Limit	DFS ATB Results
Maximum concentration of agent GB[a]	0.3 $\mu g/m^3$	< 0.0117 $\mu g/m^3$
Minimum DRE for GB	99.99%	>99.999981%
Maximum concentration of particulate matter	0.016 gr/dscf @ 7% O_2[b] 0.08 gr/dscf @ 7% O_2[c]	0.0053 g/dscf, @ 7% O_2
Maximum emission rate of HCl	4 lbs/hr or 1% of total HCl prior to PAS	< 0.040 lbs/hr
Maximum concentration of CO[d]	100 ppm @ 7% O_2	8 ppm @ 7% O_2
Maximum concentration of CEMS O_2	15%	9.6%
Minimum concentration of CEMS O_2	3%	9.0%
Maximum concentration of dioxin ITEQ[f]	0.2 ng/dscm @ 7% O_2[e]	0.00061 ng/dscm @ 7% O_2
Average concentration of dioxin ITEQ[f]	0.2 ng/dscm @ 7% O_2[e]	0.00055 ng/dscm @ 7% O_2

[a]Determined from analysis of DAAMS sorbent tubes (Station PAS 702).
[b]Limit set by Air Approval Order for PM_{10} (i.e. particulate matter with a size of ≤ 10 microns).
[c]Limit set by RCRA Permit.
[d]Maximum one hour moving average.
[e]Proposed EPA limit; there is no state limit.
[f]ITEQ (international toxic equivalency) dioxin is 2,3,7,8 TCDD (2,3,7,8-tetrachlorodibenzo-p-dioxin), with toxicity equivalent to the complex mixture of 210 dioxin and furan isomers (with 4 through 8 chlorine atoms). This equivalency is based on the ITEQ scheme adopted by the United States and most other countries to simplify the reporting of dioxin emissions.

Source: Adapted from EG&G, 1998.

high to make a definitive statement. The measured concentration for lead plus cadmium was less than 20 percent of the 24 $\mu g/dsm^3$ corrected to 7 percent O_2 limit for hazardous waste incinerators.

- The ITEQ concentrations for the PCDD/F emissions averaged 0.00055 ng/dscm (at 7 percent O_2), compared to the new source performance standard of 0.2 ng/dscm for hazardous waste incinerators.
- Detection limits for seven VOCs and three SVOCs were higher than the estimated values in the HRA in at least one sample set. The measured emission rates or detection limits for the other VOCs and SVOCs were below those used in the HRA or were not detected at all.

Table 2-7 lists compounds for which measured emission rates or detection limits from the DFS were higher than the value used in the HRA.

Metal Parts Furnace

ATBs of GB in the MPF were conducted on April 4, 15, and 17, 1997. During these performance runs, ton containers with residual GB were spiked with metals to represent the worst case of munitions feed containing heavy metals and agent-contaminated dunnage. In addition, 75 pounds of GB were added to each ton container. The agent feed rate for the MPF was nominally 110 lbs/hr, including both undrained heels (of gelled agent) and added agent. Packages of metal spiking compounds were placed on the feed cradle adjacent to each ton container. The results shown in Tables 2-8 and 2-9 are summarized below:

- Emissions of particulate matter, HCl, GB, and CO were within the state of Utah permit limits established for the MPF

TABLE 2-7 Measured DFS Emissions or Reported Upper Limits That Exceed Values Estimated in the HRA

	Maximum Emission (g/sec)	HRA Estimated Rate (g/sec)[a]
Metals and Phosphorus		
Cadmium	1.8 E-04	1.83 E-05
Lead	7.3 E-03	4.32 E-04
Mercury	< 1.1 E-05	5.15 E-06
Zinc	1.3 E-03	8.23 E-04
Phosphorus	2.5 E-03	9.14 E-04
VOCs[b]		
Bromodichloromethane	< 1.5 E-05	1.15 E-06
Mono-chlorobenzene	< 9.9 E-06	3.77 E-06
Chloroform	< 1.1 E-05	7.84 E-06
Dibromochloromethane	< 2.3 E-05	1.15 E-06
Ethylbenzene	< 1.0 E-05	2.88 E-06
4-methyl-2-pentanone (MIBK)	< 5.0 E-05	1.15 E-06
Tetrachloroethene	< 2.2 E-05	1.15 E-06
SVOCs[b]		
di-n-butyl phthlate	< 2.6 E-05	2.24 E-05
Dimethyl phthalate	< 1.6 E-04	8.18 E-05
Bis (2-Ethylhexyl) phthalate	< 8.6 E-04	4.79 E.05

[a]The highest concentrations measured during the initial JACADS trial burns were used by the state of Utah DSHW to estimate TOCDF emissions.

[b]For emissions of VOCs and SVOCs reported as "<," the PQL is reported. The PQL is 3.3 times the detection limit.

Source: Adapted from EG&G, 1998.

- The measured DRE was 99.9999 percent, which is better than the required minimum 99.99 percent DRE.
- Metals emission rates were below the rates used in the HRA. Phosphorus emission rates were higher than the HRA estimates.
- Emission rates for the PCDDs were below th used in the HRA. Emission rates for tetra-, and hexa-chlorodibenzofurans in two run higher than the HRA rates for these homol However, the ITEQ concentrations for the P emissions averaged 0.025 ng/dscm (corre

TABLE 2-8 Agent Trial Burns for the MPF in April 1997

Emissions Parameter	State of Utah Permit Limit	Results
Maximum concentration of agent GB[a]	0.3 mg/m^3	< 0.0046 mg/m^3
Minimum for DRE	99.99%	> 99.99999972%
Maximum concentration of particulate matter	0.016 gr/dscf @ 7% O_2[b] 0.08 gr/dscf @ 7% O_2[c]	0.0097 g/dscf, @ 7% O_2
Maximum emission rate for HCl	4 lbs/hr or 1% of total HCl prior to PAS	< 0.015 lbs/hr
Maximum concentration of CO[d]	100 ppm @ 7% O_2	12 ppm @ 7% O_2
Maximum concentration of CEMS O_2	15%	13.9%
Minimum concentration of CEMS O_2	3%	12.6%
Maximum concentration of dioxin ITEQ[f]	0.2 ng/dscm @ 7% O_2[e]	0.042 ng/dscm @ 7% O_2
Average concentration of dioxin ITEQ[f]	0.2 ng/dscm @ 7% O_2[e]	0.025 ng/dscm @ 7% O_2

[a]Determined from analysis of DAAMS sorbent tubes.
[b]Limit set by Air Approval Order for PM_{10}, i.e. particulate matter with a size of ≤ 10 microns.
[c]Limit set by RCRA Permit.
[d]Maximum one hour moving average.
[e]Proposed EPA limit; there is no state limit.
[f]ITEQ (international toxic equivalency) dioxin is 2,3,7,8 TCDD (2,3,7,8-tetrachlorodibenzo-p-dioxin), with toxicity equivalent to the complex mixture of 210 dioxin and furan isomers (with 4 through 8 chlorine atoms). This equivalency is based on the ITEQ scheme adopted by the United States and most other countries to simplify the reporting of dioxin emissions.

Source: Adapted from EG&G, 1997c.

7 percent oxygen), which is well below the new source performance standard for hazardous waste incinerators of 0.2 ng/dscm corrected to 7 percent oxygen.

- Two VOCs, m,p-xylene and o-xylene, were measured at levels slightly above the HRA estimated emission rate.
- The detection limits for four SVOCs and 12 VOCs were too high to verify that the maximum emission rates were lower than the assumed HRA emission rate.

Table 2-9 lists compounds for which measured emission rates or detection limits from the MPF were higher than the values used in the HRA.

Implications of the Trial Burn Data for the Health Risk Assessment

The purpose of a screening HRA is to estimate an upper bound of health risks to people outside the facility fence-line who could be exposed to facility emissions under worst-case conditions. The HRA is not intended to represent actual risk but to indicate whether risk thresholds have been exceeded and further investigation is warranted. Because the estimated emission rates generated by the Utah Department of Environmental Quality and used in the HRA (Utah DSHW, 1996) differ from several of the actual emission rates, the risks in the HRA would certainly be different if they were recalculated today. Many of the measured emission rates are lower

TABLE 2-9 Measured MPF Emissions or Reported Upper Limits Higher Than Values Estimated in the HRA

	Maximum Emission Rate[a] (g/sec)	HRA Estimated Rate (g/sec)[b]
Phosphorus		
Phosphorus	6.9 E-3	1.16 E-03
VOCs		
Bromodichloromethane	< 8.1 E-06	1.15 E-06
Chlorobenzene	< 5.3 E-06	3.77 E-06
Dibromochloromethane	< 1.2 E-05	1.15 E-06
1,1-dichloroethane	< 5.3 E-06	1.15 E-06
1,2-dichloropropane	< 5.3 E-06	1.15 E-06
Cis-1,3-dichloropropene	< 5.3 E-06	1.15 E-06
Trans-1,3-dichloropropene	< 5.3 E-06	1.15 E-06
Ethylbenzene	< 5.3 E-06	2.88 E-06
2-hexanone	< 2.7 E-05	1.15 E-06
4-methyl-2-pentanone	< 2.7 E-05	1.15 E-06
1,1,2,2-tetrachloroethane	< 5.3 E-06	1.15 E-06
Tetrachloroethene	< 5.3 E-06	1.15 E-06
M,p-xylene	4.8 E-06	1.15 E-06
O-xylene	4.8 E-06	3.98 E-06
SVOCs		
Diethylphthalate	< 4.7 E-05	3.21 E-06
Dimethylphthlate	< 4.7 E-05	4.45 E-06
Di-n-octylphthalate	< 4.7 E-05	3.21 E-06
3/4-methylphenol	< 4.7 E-05	3.60 E-06
Napthalene	< 4.7 E-05	3.21 E-06

[a]For emission values reported as "<," the PQL is reported. The PQL is 3.3 times the detection limit.

[b]The highest concentrations measured during the initial JACADS trial burns were used by the state of Utah DSHW to estimate TOCDF emissions.

Source: Adapted from EG&G, 1997c.

than those used in the HRA—particularly for major risk contributors, such as dioxins, furans, arsenic, and hexavalent chromium. A few are either higher than the estimated values or are measured with a technique whose detection limits are too high to determine that actual emission rates were below the estimated values. Therefore, to determine the net effect, the calculations will have to be revised using the original HRA model and actual emissions. To assess the potential effect of revised emission rates on the HRA, the committee members made preliminary computations based on the human health medium-specific screening levels established by the EPA (EPA, 1998). The committee found that the revised risk estimates would probably be lower than the original HRA values. Thus, the committee believes that the Army could facilitate use of the measured emission rates in HRAs in the following ways:

- The Army does not have jurisdictional authority for the TOCDF HRA, which was performed by the state of Utah. However, the committee believes the Army, which provided the initial trial burn data (from JACADS), should take the initiative in revising the HRA by issuing a brief update of HRA results based on measured emissions concentrations/upper limits. If and when these revisions are made, the committee urges that the revised figures be widely distributed to the public.
- Emissions estimates for future incineration facilities should take into consideration data from all existing facilities and not just JACADS, which was the only operating facility when the TOCDF emission rate estimates were prepared. New estimates should be based on appropriate statistical bounds scaled to the feed rates of the new facilities and should take into account differences in air pollution control technologies and measurement techniques. Upper confidence limits should be used for assessing latent risks; tolerance limits should be used for assessing acute risks.[5]
- Every effort should be made to ensure that the trial burn conditions and measurement techniques are consistent with the assumptions used for developing the emissions estimates and preliminary operating plans.

[5]Confidence limits set the bounds of expected long-term emissions performance; tolerance limits set the bounds of selected future emission rates.

TABLE 2-10 Trial Burn Results for DFS PCB DREs

Run Number	PCB Train	PCDD/F Train
	January 1997	
1	> 99.999973	> 99.999950
3	> 99.999596	> 99.999949
4	> 99.999795	> 99.999940
Average	> 99.999783	> 99.999946
	November 1998	
1	> 99.999986	———
2	> 99.999986	———
3	> 99.999984	———
Average	> 99.999985	———

Source: Adapted from EG&G, 1997d; Holmes, 1999.

Public confidence in the risk estimates is eroded when actual emission rates are higher than those used in the initial assessment. Consequently, every effort should be made to use reasonable upper-bound emissions estimates at the outset of the HRA process, and the consequences of deviations should be explained in the HRA, not after the fact. In addition to design differences, estimates must account for differences in testing techniques and laboratory detection limits between the data used to prepare the projections and the testing procedures that will be used to demonstrate compliance and establish actual emissions rates.

Toxic Substances Control Act (TSCA) Trial Burns

A TSCA trial burn was required for the DFS because PCBs were used as lubricants inside the shipping and firing tubes of M55 rockets. During these trial burns, M55 rockets were processed at an average rate of 35 rockets per hour. The first TSCA trial burn was conducted in January 1997 and the second in November 1998. Results from both agent trial burns are presented in Table 2-10.

Analyses of some of the January 1997 trial burn samples found a tetra-chlorinated PCB congener (four

...orine atoms in the PCB molecule) in Runs 3 and 4. The tetra-chlorinated congener peak was not present in the samples for Run 1 or in one of the two scrubber liquor samples taken during Run 3. The tetra-chlorinated PCB congener appeared *randomly* throughout other process samples.

The PCB test series from the January 1997 trial burn resulted in calculated DREs that were better than 99.9995 but averaged slightly below the required 99.9999 regulatory limit for dioxin-containing wastes. During the trial burn, PCDD/F and PCB samples were taken simultaneously using the same sampling, recovery, and cleanup and analysis procedures. The PCDD/F sampling train was spiked with PCDD/F field and recovery surrogates, but not with PCB surrogates, and vice versa. Therefore, quality assurance indicators for the PCB test method cannot be calculated for PCB analyses performed on the archived portion of the PCDD/F samples. Archived PCDD/F samples were analyzed for PCBs and did not exhibit the tetra-chlorinated PCB congener peak. Because the tetra-chlorinated PCB congener only appeared randomly in the first PCB test series ...was not found in the simultaneous PCDD/F sam... ng train, it is probably a sampling or analysis artifact that invalidates the PCB sampling train results. Consequently, the actual DRE for PCBs using the complete required methodology is unknown. PCB DRE results calculated from the PCDD/F samples (better than 99.99994 percent) are probably more representative of actual incinerator performance.

A second TSCA ATB with GB was conducted November 17 to 21, 1998. The uncertified November 1998 test results (the final report was not available when this report was prepared) showed no detectable dioxins, and only near-detection-limit values of dichlorobiphenyls (1.2 to 4.6 ng versus a 1 ng detection limit). Trichlorobiphenyls (2.1 to 2.7 ng versus a 1 ng detection limit) were also observed. The reported concentrations were lower than the concentrations found in the field-blank train (11 ng[5] and 2.7 ng[7] for dichlorobiphenyls and trichlorobiphenyls, respectively); however, regulatory practice prohibits deducting field-blank train results from sample measurements to correct for contamination (a common practice for analytical chemists). Consequently, the reported concentrations are likely too large. If these reported concentrations are simply extreme realizations of measurement uncertainty (i.e., data noise) or the result of undetected sample contamination, real PCB emissions may be zero and the calculated DREs significantly understated. The resulting PCB DREs (shown in Table 2-10) calculated from these test results range from 99.999984 to 99.999986 percent, all better than the 99.9999 percent DRE requirement for PCDD/F-contaminated wastes. Consequently, on December 23, 1998, the facility was authorized to process rockets at a rate equal to one-half the rate demonstrated during the November trial burn.

IMPROVING MONITORING SYSTEMS FOR AGENTS AND NONAGENTS

Background

In 1994, after reviewing monitoring systems for the detection and quantification of chemical agents and the by-products of agent and nonagent destruction at JACADS and proposed for the TOCDF, the Stockpile Committee issued the *Review of Monitoring Activities Within the Army Chemical Stockpile Disposal Program* (NRC, 1994b). This report included a wide range of recommendations for supplementing the ACAMS active alarms and passive DAAMS sampling systems routinely used at chemical demilitarization facilities for agent detection. It also recommended revising the operating procedures of on-site chemical laboratories that analyze DAAMS sample tubes for agent on a daily basis, as well as an aggressive program of the monitoring and analysis of stack emissions for a wide range of products of incomplete combustion at the TOCDF.

Progress made by the CSDP in addressing those recommendations was reviewed in the *Systemization* report (NRC, 1996a), which generally endorsed the Army's ongoing efforts to improve monitoring instruments and procedures at the TOCDF. The following additional recommendation was made in the *Systemization* report: "An active program for continual improvement of monitoring instrumentation, including techniques for more rapid recognition of significant levels of agent release, should be pursued" [S-17].

This section reviews the experience at the TOCDF with agent and nonagent (i.e., products of incomplete combustion) monitoring since the beginning of agent

[5] 11 ng is 11 times the detection limit. This is a real analytic ponse and indicates the existence of a procedural (contamination) problem.

[7] 2.7 ng is less than 3 times the detection limit. This value is lower than the quantification limit and could be data noise.

operations and the Army's progress in improving agent monitoring technology. EG&G and the Army have responded to the issue of monitoring products of incomplete combustion by installing a reasonable suite of CEMS on the common stack and feed ducts and have provided an active stack-sampling protocol for ongoing analysis of a wide range of SVOCs (EG&G, 1994).[8]

The major issues that required attention were both agent related: (1) the problem of sporadic, but too frequent, false positive ACAMS alarms; and (2) the selection, testing, and eventual deployment of advanced technology capable of more rapid (< 10 sec) detection of the release of significant levels of agent in the plant or through the common stack.

False Positive ACAMS Alarms

The problem of sporadic false positive alarms from plant and exhaust stack ACAMS monitors is apparent in operational data from the TOCDF (Holmes, 1998a). Between August 22, 1996, when agent operations began, and October 20, 1998, the seven ACAMS monitors associated with the PAS, including those sampling the common stack (PAS701A,B,C) and those sampling the ducts between individual furnaces and the common PAS (PAS702-PAS705), registered 98 false positive alarms. (In a false positive alarm, an ACAMS response indicates the possible presence of agent above threshold values although no agent is subsequently detected in the much more sensitive and discriminating analyses of material desorbed from the associated DAAMS tubes.) Of these, 39 were attributed to probable interference compounds, 35 were attributed to furnace upsets (which may include responses to odorant compounds in unburned natural gas), 18 were attributed to alarm malfunctions, and 6 were attributed to operator error (Holmes, 1998a). (False positive responses to sulfur-based natural gas odorant compounds may become more frequent when the ACAMS are switched from their current phosphorus-detection mode to the sulfur-detection mode used for mustard agent operation.)

Twenty-two of these PAS ACAMS false alarms automatically shut down agent feed to the LIC, interrupting operations for about an hour each time. Although the false alarm rate was lower than the rate during early JACADS operation, the committee believes that these disruptions are unnecessary and that the Army should continue to improve the instrument specificity and robustness of the monitoring systems.

The committee notes with approval the steps taken by the Army in response to this problem. First, they have defined specifications for an improved ACAMS instrument, which includes improved chromatography to increase specificity, better quantification algorithms to improve accuracy, and more modern electronics to improve signal processing. A competitive procurement for the development and demonstration of this improved ACAMS is planned. Second, the Army has instituted a parallel effort to upgrade the microprocessor and signal processing software of the existing ACAMS and has initiated plans to test a prototype of the enhanced ACAMS at the TOCDF. Finally, the Army is investigating enhancements to the commercial gas chromatograph-mass spectrometric detector (GC-MSD) units deployed in the laboratories at CAMDS, JACADS, and TOCDF. These units are currently being used to identify interferant compounds that trigger false positive ACAMS alarms so that they can be eliminated from the plant and/or exhaust stream.

A GC-MSD unit with a parallel atomic emission detector designed to recognize phosphorus and sulfur containing compounds that can trigger the ACAMS flame photometric detectors has been developed and is being tested at CAMDS. In addition, laboratory GC units, with and without MSDs, are being equipped and tested with recently developed pulsed-flame photometric detectors (PFPDs), which promise better, more reliable performance than the flame photometric detectors currently used (DAAMS tube analysis) (Amirav and Jing, 1996). These GC-PFPD and GC-MSD-PFPD units

[8]Agent emissions are the only highly toxic compounds monitored continuously. Although ACAMS alarms have a three to eight minute response time, emissions are continuously sampled by DAAMS tubes, which are analyzed daily or more often. Carbon monoxide concentration and system temperature are frequently used as continuously monitorable surrogate parameters for other hazardous compounds that might be emitted from the combustion zone under poor burning conditions or that might be formed between the flame of the incinerator and the downstream air pollution control equipment. These parameters have been incorporated into the TOCDF operating procedures and operating permit. Therefore, being unable to monitor trace pollutants directly and continuously is an intellectual concern for which a practical solution has already been implemented.

uld also be used to identify interferant species that lead to ACAMS false positive alarms.

Real-Time Detection of Significant Agent Releases

The desirability of real-time or near real-time (< 10 sec) detection of significant agent releases from the viewpoint of both worker and resident safety has been discussed in two previous NRC reports (1994b, 1996a). The Army has responded to the Stockpile Committee's concerns in several ways. First, it has installed multiple ACAMS units on the common stack at the TOCDF. By phasing the sampling and chromatography cycles of these units, the intrinsic response time of the ACAMS has been cut from about eight to ten minutes to four to five minutes, providing significantly shorter response times for most releases. The Army has also made shorter intrinsic ACAMS response times a design specification for the improved ACAMS system.

Finally, the Army is supporting a project contracted to the University of Denver to investigate using Fourier sform infrared (FTIR) spectrometers as true real-ıe detectors. The initial FTIR project by the University of Denver investigated agent-detection limits of a commercial FTIR spectrometer with a conventional open-path, multipass absorption cell and spectral signal-processing techniques. The prototype unit was calibrated for GB and HD and tested at CAMDS. Under laboratory conditions, the system demonstrated an absolute detection limit for GB of ~0.005 mg/m^3 (Stedman and McLaren, 1996). Detection limits in the initial field trial at CAMDS, which were affected by the cleanliness of the multipass mirrors and their alignment, were significantly worse than the laboratory values. A second field trial designed to test the feasibility of detecting both agent and products of incomplete combustion in exhaust gases from the CAMDS incinerator stack was unsuccessful because of spectral interference from the high concentration of water vapor in the exhaust samples (Stedman and McLaren, 1996). Further field trials of the FTIR technology at CAMDS are planned.

The committee believes that the theoretical one to ten second FTIR spectral measurement times are encouraging enough that further development and testing of this nology for high-risk venues, such as the munitions packing area and the common stack, are warranted. The committee also encourages the Army to monitor published research that may result in new methods of fast-response agent detection.

Summary of the Monitoring Issues

The Stockpile Committee believes that the Army is pursuing a wise course in upgrading the current ACAMS monitors and simultaneously funding the development of a faster, more specific, more reliable ACAMS. In addition, the promise of combined GC MSD-atomic emission detector, GC-PFPD, and GC-MSD-PFPD for improving the laboratory identification and quantification of both agents and interferants is encouraging and should be vigorously pursued. Finally, FTIR spectroscopy, coupled with state-of-the-art multipass absorption cells and spectral signal-processing algorithms, is a promising technology for real-time monitoring of higher agent concentrations. The committee urges the Army to continue to support its development.

OVERALL ASSESSMENT

Although the Army has not fulfilled *all* of the Stockpile Committee's recommendations related to system performance and plant operations, it has completed the period of start-up operations, and its operating mode indicates that program destruction goals will be met (Holmes, 1998b). However, the delay in the processing of M55 rockets has significantly slowed the rate of risk reduction from stockpile storage. Some of the problems in early operation linked to safety management are addressed in Chapters 3 and 4. Although these problems, and the investigations that were necessary to follow up on them, have taken time and management resources that might otherwise have been applied to improving operations, the committee believes the management problems were of much higher priority.

LIC-1, LIC-2, MPF, and DFS RCRA trial burns have been passed satisfactorily, and the DFS TSCA permit is expected in 1999. Unresolved issues involving the management of dunnage, the slag-removal heater, and the need for a BRA are not critical to safe plant performance, although their prompt resolution remains a priority. The renewal application for the RCRA permit was submitted in late 1998. Thus, regulatory authorities had at least six months for review before the permit expired in June 1999.

The Army appears to be making progress in addressing the committee's previous recommendations for upgrading the ACAMS and DAAMS agent-monitoring systems and developing new technologies for real-time detection of agent release

3

Risk Management

COMMITTEE OVERSIGHT

In keeping with the governing recommendation that the CSDP should proceed expeditiously and with technology that minimizes total risk to the public at each site [RC-1], the Stockpile Committee has continued to evaluate the risk assessment[1] and risk management[2] practices at the TOCDF and throughout the CSDP. The *Risk Assessment and Management* report provided a detailed overview of the status of risk evaluation and management as of September 1997 at the TOCDF (NRC, 1997). The present report concerns how the results of risk assessments; screening health, safety, and environmental evaluations; and other information have been used (from the Programmatic Lessons Learned [PLL] and other programs) to implement a sound risk management program. Recommendations are focused on the following areas: overall safety, risk assessment, and risk management. The recommendations in each of these areas are summarized below.[3]

Overall Safety

The development and implementation of the overall safety program at the TOCDF must be given a high priority [S-1]. Safety and environmental goals should be given at least equal weight with production goals in establishing contractor award fees [S-2]. Applicable portions of the QRAs (quantitative risk assessments) must be completed for all safety-related concerns before the start of agent destruction campaigns [S-3]. High-quality, well staffed safety management systems must be completely implemented prior to the start of agent

[1]As described in the *Systemization and Risk Assessment* and *Management* reports, the risk assessment of the TOCDF was performed in two separate studies, called by the Army the quantitative risk assessment (QRA) and the health risk assessment (HRA) and used consistently throughout the CSDP and in its public statements. The committee has adopted the Army's usage to avoid confusion, although the terms are not standard in the wider risk assessment community. (The Army's HRA is, however, consistent with a screening-level HRA completed for other RCRA facilities.) In fact, both assessments look at impacts on human health, although from different perspectives.

The TOCDF QRA evaluated fatality risk to workers and the public from accidents involving agent due to all identifiable causes in the TOCDF and the associated DCD storage facility. Its purpose was to assist the Army in the management of the stockpile destruction process. The QRA analysis is intended to be realistic and current, with a realistic treatment of uncertainty. It was performed under the control of CSDP personnel by an Army contractor. Risk methodologies were developed for this particular application and extensively reviewed by an independent scientific peer review panel.

The TOCDF HRA is a screening assessment of the risk to the public associated with stack releases during routine operations and is performed in accordance with EPA guidance, the development of which is ongoing. The HRA evaluates normal operations under defined worst-case emissions and conservative upset conditions. It does not attempt to be realistic or to evaluate uncertainty. By agreement between the Army and the state of Utah, the TOCDF HRA was performed under state control, by the state's contractor. The assessment, which was not independently reviewed, was reportedly prepared according to guidance provided by the permitting agency and demonstrated that risk for particular individuals at particular locations would be below the regulatory thresholds.

[2]Risk management is a decision-making process focused on balancing alternative strategies and consequences associated with risk reduction and a process for implementing those decisions. It is based on: (1) a thorough assessment of performance and the full spectrum of risks to the public, workers, the environment, and property; (2) the ranking of risks so they can be addressed in order of their seriousness; (3) assessments of the impact on risk of proposed changes in procedures, management, or equipment; (4) evaluation of abnormal incidents for their effects on risk; and (5) a commitment to continual evaluation and improvement.

[3]Bracketed alpha-numeric designations refer to specific prior NRC recommendations. The full text of these recommendations appears in Appendix A. [RC] = *Recommendations for the Disposal of Chemical Agents and Munitions.* [S] = *Review of Systemization of the Tooele Chemical Agent Disposal Facility.* [R] = *Risk Assessment and Management at Deseret Chemical Depot and the Tooele Chemical Agent Disposal Facility.* [PI] = *Public Involvement and the Army Chemical Stockpile Disposal Program.*

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operations [S-10]. The risk management plan (RMP) must be fully implemented during the first year of agent operations [S-14].

Risk Assessment

During the first year of agent operations, a comprehensive, integrated TOCDF risk assessment, including a full description of all significant, acute, and latent agent and nonagent risks (QRA and HRA) associated with disposal operations, as well as with the continued maintenance of the DCD stockpile, should be completed. A full explanation of the uncertainties associated with the various estimates should be included [S-15]. A system for tracking "near-misses" during operation should be developed and integrated into a plan for continual safety improvements at the TOCDF [S-16]. In addition, the Army should update both the QRA and the HRA at the TOCDF whenever system or operational changes occur that could significantly affect the risk estimates and should document the changes in *A Guide to Risk Management Policy and Activities* (the draft *Guide*) [R-1]. The Army should continue the site-specific QRA and HRA processes at all PMCD sites and heed the lessons learned from development of the TOCDF QRA [R-2]. If the QRA methodology is changed, the methodology manual should be updated [R-3].

Risk Management

The Army should expand its draft Guide to encourage the establishment of a "safety culture," including industrial safety, in all groups involved in the program and develop a management program (and include it in the *Guide*) that defines the integration of management roles, responsibilities, and communications across activities by risk management functions (e.g., operations, safety, environmental protection, emergency preparedness, and public outreach) [R-4]. The CMP (change management process)[4] developed in the *Guide* should be institutionalized and improved [R The Army should expand the implementation of RMP to ensure that workers and emergency preparedness officials understand it and the QRA, as well how their activities might affect risk [R-8]. The R should be implemented and updated as necessar ensure that it reflects current practices and less learned [R-9].

OVERVIEW

Risk management at the DCD/TOCDF involv number of activities intended to control the risks to public and workers from potential releases of agent products of incomplete combustion and to reduce incidence of worker injuries during normal indus operations (NRC, 1997). There are four steps to management:

- understanding the risk
- suggesting alternative ways to reduce risk
- evaluating risk-reduction alternatives
- selecting and implementing preferred alternati

These steps must be tailored to address site-spec factors. A number of very diverse groups affected DCD/TOCDF operations must be involved in the r management process to ensure its effectiveness. E group must understand the risk assessment process, results of the assessments, and the significance of results; each group must also participate in the proc of resolving issues of interest. The Stockpile Commit has made several recommendations in previous NI reports for improving risk management. Recommen tions related to worker safety (industrial safety) considered in Chapter 4. Recommendations related public and community interactions are considered Chapter 5. The recommendations related to chemi releases and general risk management policies are co sidered in this chapter.

In the *Systemization and Risk Assessment and Ma agement* reports (NRC, 1996a, 1997), the committ reviewed the DCD/TOCDF risk assessments and ri management program. Findings in these reports in cated that the QRA was well done and that the HR had satisfied most of the committee's previous recor mendations (NRC, 1996a). These two reports al include extensive information about the risks

[4] *The Risk Assessment and Management* report characterized the Army's CMP as "a process for managing changes that may affect the risk associated with PMCD activities" (NRC, 1997, p. 41). The CMP was conceived as a means of distinguishing risk assessment issues (the science) from risk management issues (policy and value judgments). The CMP attempts to establish an approach to integrating these issues in a process that involves the public.

DCD/TOCDF and the quality of the risk assessments. The committee concluded that certain aspects of risk assessment and risk management at DCD/TOCDF, and throughout the CSDP program, required refinement. Therefore, both reports also included additional risk-related recommendations.

RECOMMENDATIONS FROM THE *SYSTEMIZATION* REPORT

In the *Systemization* [S] report (NRC, 1996a), the committee endorsed the approach developed for the DCD/TOCDF QRA and initial risk management activities. To ensure continued application of these analytic methods and further development of the risk management processes, the committee recommended that the QRA be completed for all campaigns [S-3] and that the approach to risk assessment and risk management be formally established [S-14, 15, 16] (see Appendix C). As the committee noted in the *Risk Assessment and Management* report, the TOCDF Phase 2 QRA[5] was completed before the start of agent operations at the TOCDF. To date, all safety-related concerns identified in the Phase 2 QRA have been addressed before the start of each campaign.

Several of the issues identified in the *Systemization* report have been the subject of discussions between representatives of the Army and the Stockpile Committee, and the committee commends the Army for its proactive response. Nevertheless, risk management continues to be an informal, albeit thorough, process. The committee is concerned that an informal process directed by key individuals in the PMCD could break down if there are changes in personnel or that the process might not be fully transferred to the specific sites. Therefore, the committee urges the PMCD to order that a formal RMP be established for QRA-identified safety issues, including a tracking mechanism for identifying and compiling new issues as they arise and for monitoring their resolution.

In the *Risk Assessment and Management* report, the committee described the Army's draft *Guide and Chemical Agent Disposal Facility Risk Management Program Requirements* (U.S. Army, 1996b), which were developed during the first year of agent operations at the TOCDF. Unfortunately, significant gaps in the draft *Guide* still must be resolved [R-4, 5, 6, 7].

The two studies, the QRA and the HRA, that make up the complete DCD/TOCDF risk assessment are based on different methodologies for reasons documented in the *Risk Assessment and Management* report. Both the QRA and HRA were completed before the start of agent operations. The QRA provided a full analysis of the uncertainties, while the HRA calculated only an upper limit of risk. Therefore, it would be extremely difficult to integrate their data. Consequently, although the Army has not developed a single integrated risk report as recommended by the committee in the *Systemization* report [S-15], the committee believes that the Army has met the functional requirements of the recommendation.

In several cases, the HRA emissions estimates turned out to be lower than actual emissions in the subsequent trial burns. Therefore, the Army should provide a brief update of the HRA as necessary to reflect the trial-burn results. As discussed in Chapter 2, the overall results and conclusions of the HRA are not expected to change because of these higher measured emissions.

The PMCD collects key information on problems encountered through the PLL and publishes the information on a regular basis in a newsletter distributed to all sites. The PMCD has also held regular program-wide meetings at which Army and contractor managers from each site can share information. Managers at individual sites are responsible for disseminating the information to site employees.

The PLL programs have gone a long way toward providing a system for documenting and tracking unexpected upsets, errors, failures, and other concerns during operation of the facilities. The PLL programs have also provided a means of disseminating this information with the aim of promoting continual safety improvements at the TOCDF, as the committee had recommended [S-16], and at all other CSDP sites. However, at the site level, implementation is informally directed by certain individuals. The committee believes the Army should make PLL programs formal requirements for all CSDP organizations to ensure that this information is disseminated to employees at all sites.

[5]A Phase 1 QRA evaluates public risks for a proposed facility before it is constructed. A Phase 2 QRA is a detailed evaluation of the risks and consequences of accidental releases of agent to workers and the community based on the site-specific design and operations.

RECOMMENDATIONS FROM THE *RISK ASSESSMENT AND MANAGEMENT* REPORT

In the *Risk Assessment and Management* [R] report, the committee evaluated the QRA and HRA, as well as the independent Expert Panel review process for the QRA. The committee found that the QRA was performed to standards that met or exceeded the previous state of the art and appropriately modeled a wide variety of potential accidents involving the release of agent. The results and insights of the QRA were endorsed by the Expert Panel and the committee and were directly useful to PMCD and TOCDF personnel in managing the facility and developing practices to reduce risk to the surrounding population. The committee attributes the high quality of the assessment to the competence of the QRA team, the strength of the Expert Panel and other reviewers, and the responsiveness of the PMCD and the QRA team to comments and questions from reviewers.

The committee also evaluated the HRA in the *Risk Assessment and Management* report.

> The HRA performed by the Utah DSHW, which is based on many assumptions and follows EPA-mandated protocols, is appropriate at this stage of TOCDF operations because it approximates a worst case for all evaluated parameters . . . The HRA screens latent cancer risk to "maximally exposed" individuals, imposes an acceptability criterion (1×10^{-5} carcinogenic risk level over a 70-year lifetime), and infers that the exposure to multiple individuals at or below the screening level is acceptable.

The EPA screening approach defines a plausible "worst-case" scenario that is evaluated using a point-estimate HRA. This is not the realistic, integrated analysis (including uncertainty parameters) that the committee had recommended. However, the state of Utah's HRA, a "screening risk assessment," found the public risk from routine operations (normal operations with defined worst-case emissions and conservative upset conditions)[6] to be much lower than the risk from accidents determined by the QRA. Therefore, because the risk is dominated by the accidents modeled in the QRA, the committee agreed that Army funding of a more realistic analysis of the risk of routine operations was not necessary.

[6] *Conservative* in this sense means intentionally overestimating operating time under upset conditions and overestimating emissions during upsets.

The data from the TOCDF trial burns showed that emissions of several compounds were actually higher than the estimated emissions in the HRA, indicating that some of the assumptions in the HRA were not as conservative as the state of Utah had intended (although the overall results and conclusions of the risk assessment are not expected to change). In subsequent reviews, the committee found that neither the most current risk assessment methods nor the air-dispersion and deposition models recommended by EPA at the time (e.g., guidance issued through December 1994) had been used in the HRA. The committee concluded that the Army should issue a brief update of HRA results using the measured trial-burn emission rates. To be comparable, the Army should follow the same guidance used in the original HRA.

For QRAs, continuing interactive review by an Expert Panel (whereby new methods were being developed as the TOCDF QRA progressed) may not be necessary. But before detailed analysis proceeds, the protocols, input data, calculations, and results should be reviewed.

In the *Risk Assessment and Management* report, the committee expressed its satisfaction with the risk assessment process at DCD/TOCDF. The committee included a number of recommendations related to risk management [R-1, 2, 3, 7, 8, 9, 10] to ensure that the lessons learned in the DCD/TOCDF risk assessment process would be applied at all CSDP sites and that the developing RMP would be strengthened. An analysis of the status of these recommendations follows.

> **Recommendation 1.** The Army should update both the QRA and HRA at the TOCDF whenever changes to system design or operations occur that could affect QRA or HRA calculations to ensure that estimates of risk are current and reflect changes in operating conditions and experience, assumptions, and program status (current Established Configuration). The process for updating the QRA and HRA should be included in the *Guide*.[R-1]

The Army has the overall responsibility for the safe operation of the TOCDF and must be in compliance with regulatory requirements in order to operate. The HRA is vital for understanding potential off-site health effects and for meeting regulatory requirements. Thus, the HRA has at least two uses: (1) off-site risk management, and (2) permit acquisition. The characteristics of a "good" or "correct" assessment vary, depending on whether the HRA is considered a compliance instrument or a risk management tool. As a tool used to manage risk on a continuing basis, the models must be applicable to

the current conditions at the facility and, therefore, the HRA should have the following characteristics:

- It should be realistic and include a thorough exposition of uncertainty.
- It should be a living analysis maintained on site and continually updated and recalculated to guide risk management decisions.
- It should be done early enough for the results to affect design and operating decisions.

An HRA for regulatory compliance is designed to show one-time permitting compliance and, therefore, should have the following characteristics:

- It should conform to guidance provided by the permitting agency, which will necessitate it being conservatively biased. This is particularly true for screening-level HRAs.
- It should show that the maximum plausible risk for particular individuals at particular locations is less than regulatory thresholds, reflecting design or operational changes if necessary.
- It should be a one-time analysis, possibly supplemented with letter reports on particular issues (e.g., actual emissions data that are higher than estimates in the original HRA).

An HRA based on a conservative analysis acceptable for regulatory decision making, such as whether to grant a permit, lacks many essential details. If efforts to control risk are based on an HRA, they could mistakenly be focused on areas that have been artificially inflated in terms of frequency or consequences for the purposes of the conservative analysis. Problems that could arise from using an HRA performed for regulatory compliance in communicating with other interested parties are listed below:

- The HRA may be assumed to describe actual releases rather than upper-bound results. Thus, the Army could be accused of releasing more agent and products of incomplete combustion than are actually being released.
- Attempts to correct "conservative" assumptions could be interpreted as a cover-up.
- Risk management is likely to be focused on aspects of the HRA with the most pessimistic assumptions, rather than those with the most impact.
- The scenarios required for the HRA may not reflect the most serious facility risks.

Problems could also arise from using an HRA intended to be a risk management tool in communicating with other interested parties for the following reasons:

- It contains complex results that acknowledge uncertainties.
- It does not include simple worst-case scenarios based on point-estimate analyses, and results may be more difficult to interpret and explain.
- Because it is site-specific, it does not necessarily follow established generic screening guidance for compliance-oriented HRAs, which may compromise the credibility of the results.

The draft *Guide* requires that the QRA and HRA be updated to include significant changes to the facility (U.S. Army, 1997a). However, the process for updating analyses when plant changes are planned has not yet been incorporated into the *Guide*. All plant changes require some review of risk management. The procedure for determining the appropriate level of review, the review process, and whether or not the change may affect the QRA or HRA has not been described. For example, a change in paperwork that has no health or safety impacts may require minimal review. Major changes that could impact the QRA, or, in rare cases, the HRA, would require thorough review. Changes that may affect worker safety and health but do not involve any agent release would not be part of the QRA and might require an intermediate level of review.

The *Guide* should also outline the procedures for performing the health, safety, and environmental evaluations (e.g., hazard analyses, job activity analyses, training requirements) to assess whether a proposed change could affect worker safety, for reviewing options for mitigating increases in worker risk, and for deciding whether a change is justified. If PLL programs identify ways to reduce worker risk, mechanisms for incorporating these recommendations into the change management process should be described.

Another problem is that no requirements for updating the analyses based on new information (new emissions measurements or lessons learned) have been promulgated. It is particularly important that the QRA be updated because it can be significantly affected by plant changes. In addition, although Army plans call for

updating QRAs at each site on an ongoing basis, the QRA at the TOCDF has yet to be updated (Holmes, 1998b).

Recommendation 2. The Army should continue the site-specific QRA and HRA processes at all PMCD sites. The development of assessments for sites other than the DCD will be greatly simplified because much of the QRA methodology has already been established. The Army should continue to obtain interactive, independent expert reviews of all site-specific assessments. The Army should heed the lessons learned from development of the TOCDF QRA and should incorporate the changes recommended by the Expert Panel. [R-2]

The Army has continued site-specific QRA processes at other CSDP sites and has issued Phase 1 QRA reports for the Anniston, Pine Bluff, and Umatilla sites. It is important that the Phase 2 QRAs be initiated while construction at these sites is in the early stages so that the results can be used to implement necessary changes to the design or operations. The Army has stated that it intends to continue independent expert reviews for all site-specific risk assessments and is incorporating the lessons learned from the TOCDF QRA, including the recommendations by the Expert Panel that were adopted for the TOCDF QRA. The ongoing QRAs for the other sites have not yet progressed far enough to determine whether other recommendations by the Expert Panel will be adopted. The independent reviews of the QRAs for these sites have not yet begun. The committee believes these reviews should be in progress by the time the Phase 2 QRA process begins. Otherwise, the kind of productive, interactive process that resulted at the TOCDF will be impossible.

The committee has not been asked to review HRA studies for the other sites, all of which are now completed and show that the HRA risks are largely secondary to QRA risks at each site. In accordance with current EPA guidelines, however, uncertainty analyses (as part of HRAs) at future sites may not be necessary for screening-level HRAs if the risks are well below regulatory thresholds.

Recommendation 3. The QRA methodology manual should be updated to reflect the significant improvements that have been made. [R-3]

The QRA methodology manual has not been revised. Extensive improvements to the methodology evolved during the DCD/TOCDF QRA. Although members of the QRA team are aware of the lessons learned, there is no guarantee that experienced individuals will not leave the team. In fact, several already have. The committee hopes the Army will capture their expertise while it still can.

Recommendation 7. The Army should institutionalize the management of change process developed in the *Guide*. The Army should track performance of the change process and document public involvement and public responses to decisions. The Army should use this experience to improve the change process. [R-7]

Public input in the CMP was supposed to begin with a series of workshops to discuss and refine the process. After that, a revised draft of the *Guide* was expected to address the issues raised in the *Risk Assessment and Management* report. The revision to the *Guide* is not yet complete, and the entire process is far off schedule. (The public involvement aspects of this recommendation are discussed further in Chapter 5.)

Recommendation 8. The Army should expand implementation of the risk management program to ensure that workers understand the results of the risk assessments and risk management decisions. The Army should also ensure that CSEPP and other emergency preparedness officials understand the QRA and how their activities might affect risk. CSEPP activities should be tracked by the Army as part of their risk management program. [R-8]

The RMP at DCD/TOCDF has been effective in dealing with technical issues related to risk. The draft *Guide* was issued by CSDP managers at the PMCD, and, more recently, *The Change Management Process to Accompany the Guide to Risk Management Policy and Activities* was issued (U.S. Army, 1997a; 1998b). Together, they have begun to define the CSDP's overall approach to risk management. In addition, CSDP managers have provided briefings on the HRA and QRA (which are both publicly available) to the communities near the TOCDF. However, in discussions with DCD/TOCDF workers and the public, it has become apparent that neither has a real understanding of the risks portrayed in these analyses. The CSDP will have to redouble its efforts to ensure that the information is understood. (The aspects of this recommendation that deal with the Chemical Stockpile Emergency Preparedness Program [CSEPP] are discussed in Chapter 5.)

Recommendation 9. The Army should implement risk management plans and update them whenever necessary to ensure that they reflect current practices and lessons learned. [R-9]

At the time of the *Risk Assessment and Management* Report, the Army had implemented a successful *ad hoc* risk management approach for the TOCDF, established preliminary RMPs, and issued the draft *Guide* and its companion volume. However, the recommended updates to the *Guide* have not yet been completed.

The committee strongly believes that the Army should rapidly document and formalize the RMPs that are presently being used effectively on site-specific and programmatic levels. Cross-communication, cooperation, and learning between sites has greatly enhanced the entire program and should be continued.

Recommendation 10. The Army should proceed with the application of its proposed methodology for evaluating the use of PAS carbon filters on a site-specific basis. For consistency with the HRA assumptions, the QRA should take into account the possible sudden release of agent that may have accumulated on the filter at a gas concentration equal to the lower detection limit. [R-10]

The PAS carbon bed filter technology and risk management is the subject of another NRC report that was not available at the time of this writing (NRC, 1999).

4

Safety Programs and Performance

The Stockpile Committee has been concerned with the CSDP's safety performance since its early evaluations of operational verification testing (OVT) at JACADS and has made many recommendations for improving safety, including the development of a well qualified and trained workforce and the establishment of a safety culture. This chapter revisits the recommendations discussed in Chapter 3 that pertain to worker safety and the implementation of sound industrial safety practices. These include: (1) putting a high priority on the development and implementation of the overall safety program [S-1]; (2) setting management goals for high levels of safety and environmental performance in all work areas and giving these goals at least equal weight with production goals [S-2]; and (3) developing strong safety management systems [S-10].

OVERSIGHT

When Congress authorized the destruction of the chemical agent and munitions stockpile in 1985 (PL 99-145), the law specified that destruction should be accomplished in a way that ensured the safety of the public, workers, and the environment. As part of its oversight responsibility, the Stockpile Committee has expressed continuing concerns over safety and has made many observations and recommendations in several reports for improving safety at specific sites and at the programmatic level. A summary of relevant observations and recommendations follows.

In an NRC letter report, *Evaluation of the Johnston Atoll Chemical Agent Disposal System Operational Verification Testing: Part I,* issued in July 1993, the committee made the following recommendation:

> The Army should use systemization of the Tooele Chemical disposal facility to implement improvements relating to safety, environmental performance, and plant efficiency. These improvements should be made at Tooele prior to initiating the destruction of agents and munitions (NRC, 1993).

In April 1994, the Stockpile Committee completed its evaluation of OVT at JACADS and issued Evaluation of the Johnston Atoll Chemical Agent Disposal System Operational Verification Testing: Part II, which contained the following findings and recommendations (NRC, 1994b):

> *Overall safety management.* Many OVT incidents [observed failure events] involved human error indicative of deficiencies in procedures, training, or management priorities.
>
> *Enforcement of safety requirements.* Safety violations observed during OVT, . . . are serious problems that require changes in training, job priorities, and management accountability.
>
> **Recommendation 1.** Give safety considerations priority over production goals.
>
> **Recommendation 5.** Develop systems to improve overall management of safety.

In March 1996, the committee issued *Review of Systemization of the Tooele Chemical Agent Disposal Facility,* the continuation of several earlier NRC reports, with the intention of (1) reviewing the completion of testing of certain secondary systems that had not been completely tested at JACADS, (2) reviewing the changes implemented by the Army in response to earlier recommendations pertaining to the TOCDF, and (3) providing an overview of the status of the facility at the end of the systemization period (NRC, 1996a). The following excerpts from this report are related to safety issues:

> *Personnel Issues (Recruitment, Training, Turnover).* Training in process operations and agent operations appears to be thorough, but training in general safety practices requires improvement.
>
> *A General Observation.* There appears to be a general belief at the TOCDF that safety practices are primarily for agent

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operations. As a result, the emphasis on safety has been focused on agent-related issues with less emphasis being given to industrial safety practices.

Recommendation 1. Development and implementation of the overall safety program at the TOCDF must be given high priority.

Recommendation 2. Safety and environmental performance goals should be given at least equal weight with production goals in establishing award fee criteria.

Recommendation 10. High quality, adequately staffed management systems must be completely implemented (including procedures for testing critical equipment; all necessary operating, maintenance, and emergency procedures; management of change procedures; training and cross-training programs; programmatic lessons learned activities; subject area reviews; and other safety oversight activities).

Safety at the TOCDF became a public issue when two former employees released detailed allegations that safety programs and performance were deficient. As a result of these allegations, seven independent assessments of the safety program at the TOCDF have been conducted:

- a courtesy chemical surety inspection by the U.S. Army Inspector General Agency, August 15–18, 1994 (U.S. Army, 1994a)[1]
- an investigation by the Army Safety Office into 119 safety-related deficiencies alleged by a former EG&G safety and security manager (U.S. Army, 1994b)
- a review of the 119 alleged safety-related deficiencies by the Army Chief of Engineers for design implications (U.S. Army, 1994c)
- a report by an independent evaluation team led by the Director of Army Safety (U.S. Army, 1997b)
- a joint review by the PMCD and EG&G Management Assessment Team (U.S. Army, 1997c)
- a report by AMH Consulting (commissioned by EG&G) (AMH Consulting, 1996)
- a report by IHI Environmental and Ralston Consulting Group (commissioned by the Utah Citizens Advisory Commission) (IHI, 1997)

[1]The term "courtesy chemical surety inspection" means that the U.S. Army Inspector General Agency conducts an informal inspection. Any deficiencies found at that time can be remedied without prejudice.

ASSESSMENT OF PROGRESS AND CURRENT STATUS

In general, the Stockpile Committee believes that TOCDF operations are being conducted in a way that protects the public. All of the independent assessments conducted at the site reached the same basic conclusion. The following discussion points out opportunities for further improvement.

The committee began its ongoing dialogue with TOCDF management and the Army regarding safety performance at the site before the commencement of agent destruction. Numerous site visits by the Stockpile Committee, its subgroups, and individual committee members have focused on safety and the Army's progress in developing a safety culture. Several visits included meetings with employees and representatives of the Employee Safety Committee. The Stockpile Committee has systematically communicated its safety concerns to both the site management and the Army through recommendations in its reports.

In response to the committee's observations and recommendations, and out of desire to improve safety performance, management personnel at the TOCDF have developed a *TOCDF Safety Culture Plan* and have implemented several programs and initiatives to ensure that a "safety culture" is developed and sustained at the site (U.S. Army, 1997d). The safety culture plan includes comprehensive timelines and milestones, as well as interim goals and objectives. Key elements of the plan are described below.

Implementation of the Safety Training Observation Program

TOCDF management has purchased (from DuPont) and begun the implementation of the Safety Training Observation Program. This program focuses on training managers, supervisors, and employees to observe people and their work environments in terms of safety in order to identify and correct unsafe practices and conditions. The Safety Training Observation Program emphasizes the positive aspects of safety training and behavior and has been used successfully by many companies as a tool for driving behavioral change.

Occupational Safety and Health Administration Voluntary Protection Program

The Voluntary Protection Program developed by the Occupational Safety and Health Administration

(OSHA) is a performance-oriented program that identifies the key elements of safety and health programs and provides measurement criteria for assessing them. The primary elements of this OSHA program are: management leadership, employee involvement, work site analysis, hazard prevention and control, and safety and health training. Each of these elements has a number of associated sub-elements. The Voluntary Protection Program is largely a self-assessment program, but it does provide for external audits. The TOCDF has completed its assessment of current status, and plans for corrective action have been generated. The TOCDF management has submitted an application for the facility to obtain Voluntary Protection Program status.

Safety Metrics

Recordable Injury Rate

The recordable injury rate (RIR), which can be used for comparisons with other industries, represents injuries and illnesses per 200,000 hours worked as defined by OSHA. The TOCDF management uses a 12-month moving ("rolling") average as its primary metric for tracking RIR (see Figures 4-1 and 4-2). The RIR is also tracked monthly and on a trimester basis, with the latter used to determine award fees. Since the commencement of agent operations, the rolling RIR at the TOCDF has been consistently higher than 3.0 and in some instances has exceeded 4.0. These values are within the range of the chemical industry as a whole but are not close to the best in the industry (< 1.0). Nor are they the best in the CSDP (the rate at JACADS was less than 2.0 during the same time period).

In keeping with its mandate to provide maximum protection, and with effective utilization of lessons learned and successful implementation of Safety Training Observation Program and Voluntary Protection Program, the management and staff at the TOCDF should strive to achieve a rolling RIR comparable to the best performing companies in the chemical industry.

Lost Workday Cases

TOCDF management tracks *hours since last lost workday case* as a measure of performance. This measure can also be tracked as *cases with days away.* The record through December 1998 was 478 days worked without a lost workday case. The 1998 lost workday case rate was zero.

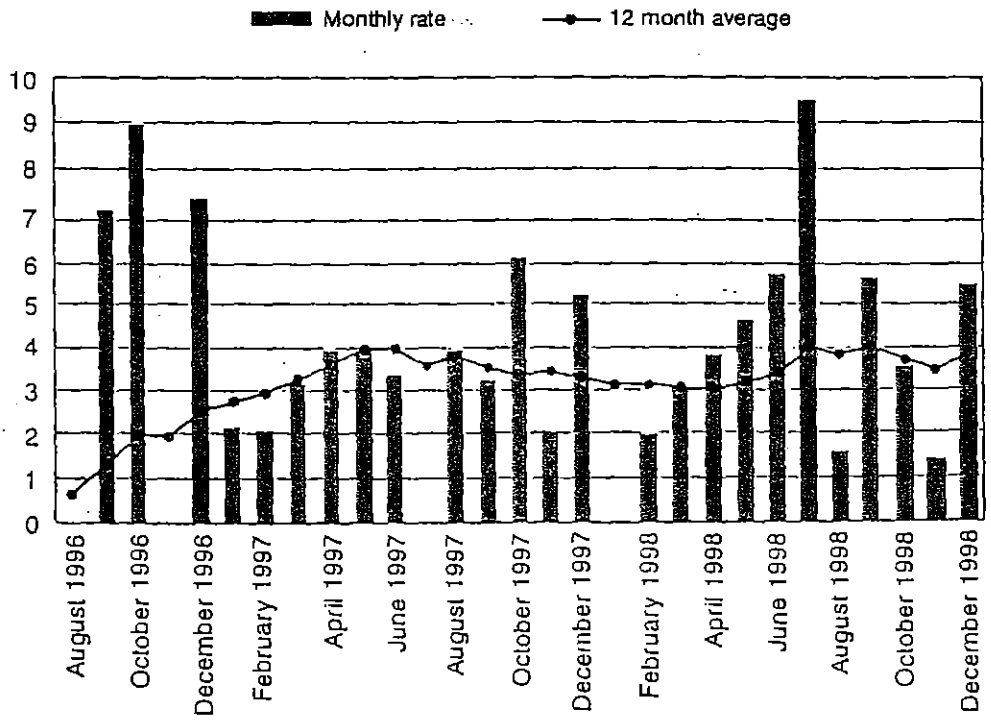


FIGURE 4-1 TOCDF recordable injury rate (RIR) 12-month rolling average since the start of agent operations. Source. Evans, 1998b.

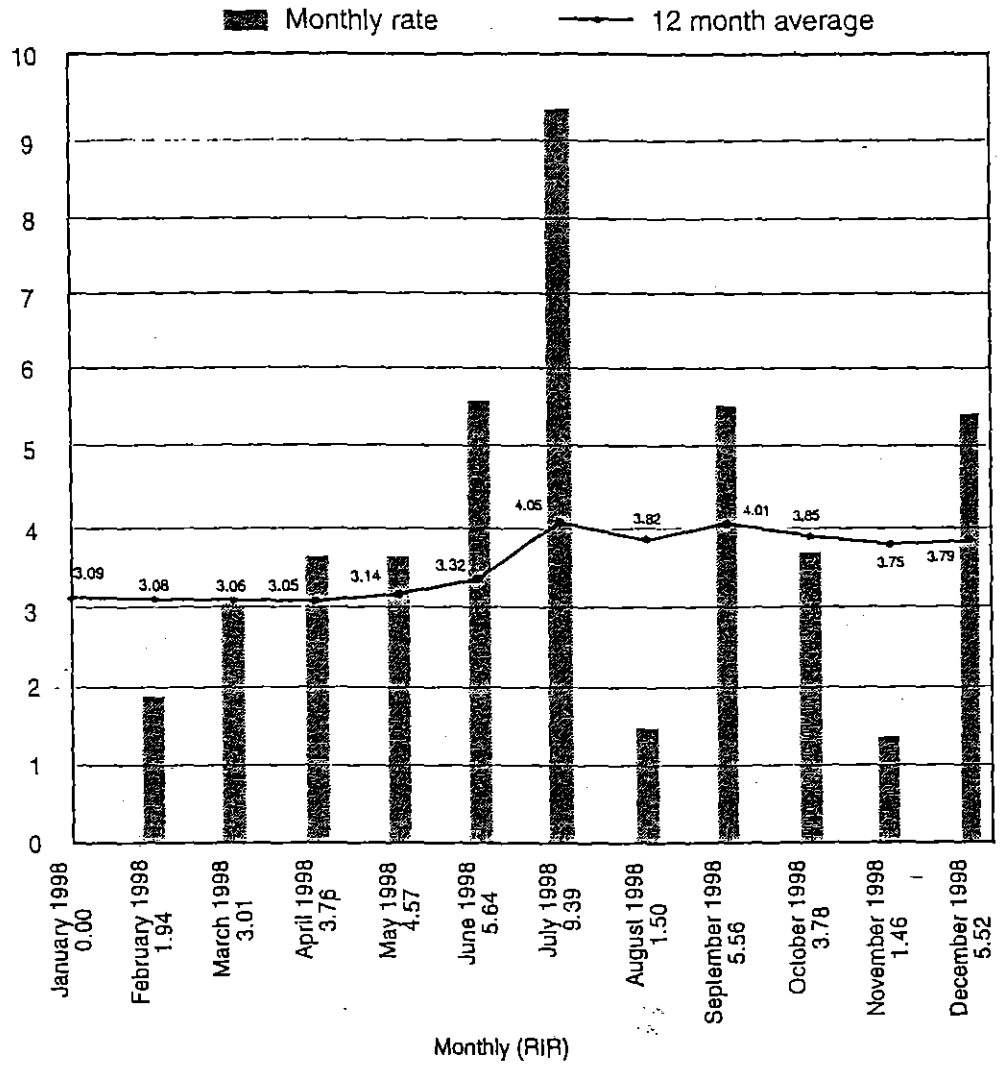


FIGURE 4-2 TOCDF 12-month recordable injury rate (RIR) rolling average and monthly RIRs from January 1998 to December 1998. Source. Evans, 1998b.

Total Number of Injuries

This measure is documented monthly by type—lost workday injury, recordable injury, and first-aid injury; the total for all three types is also tracked. Figure 4-3 shows the 12-month rolling average for all injuries. Although the trend for total injuries has been generally downward, this is largely because there have been fewer first-aid cases. The number of more serious recordable injuries has not decreased.

Safety Training Observation Program

Observations from the Safety Training Observation Program are tracked as the *overall safe percent* of total observations during each month. This metric, which was initiated at the TOCDF in late 1997, has averaged about 86 percent.

Other Metrics

The top five unsafe acts or conditions identified via the Safety Training Observation Program are tracked monthly. This metric is very useful for identifying areas that require more training, corrective action, or changes in procedures.

In general, the Stockpile Committee believes that the current metrics used at the TOCDF are all relevant and appropriate. As safety performance improves, some of them will become less meaningful; at that point they should be complemented with additional metrics relevant to the stage of development of the TOCDF safety culture.

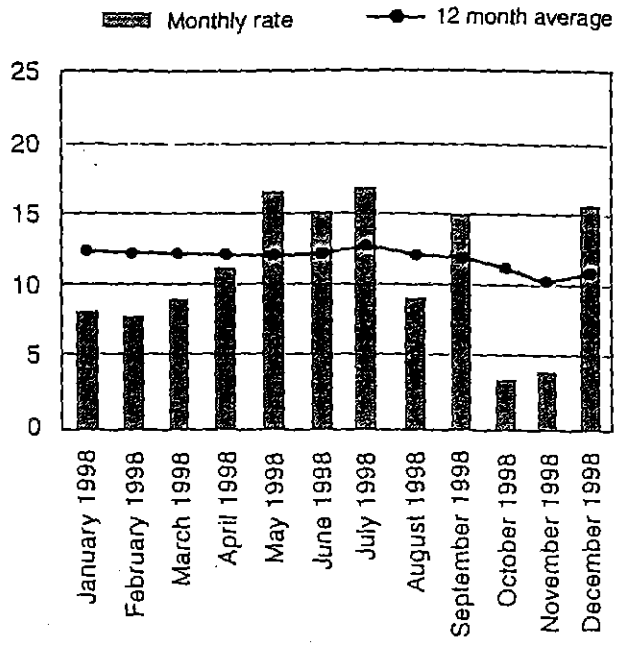


FIGURE 4-3 Total injury 12-month rolling average for the TOCDF. Source. Evans, 1998b.

Employee Involvement

A key feature of a safety culture is the active involvement and commitment of all employees. The TOCDF management has established an Employee Safety Committee and has involved all employees in the Safety Training Observation Program and Voluntary Protection Program. Safety has also been included in job descriptions, and safety responsibilities, including training, are clearly defined. Management has also established reward and recognition programs for contributions to safety by employees. Safety messages and news are also included in employee communications, such as the "DEMIL-TRIB" newsletter. These regular formal and informal communications about safety can help to create an environment in which safety is highly valued.

Management Involvement and Commitment

After persistent urging from the Stockpile Committee and in the aftermath of allegations of poor safety practices by two former employees, management at the TOCDF has implemented a number of programs and procedures to improve safety. These activities are intended to establish a safety culture with equal emphasis on agent-related safety and general industrial safety and to balance production goals with safety goals.

One of the committee's continuing concerns has been that safety at the TOCDF has been primarily focused on agent-related issues and that traditional industrial safety practices and procedures have been neglected (NRC, 1996a). During visits to the TOCDF, the committee noted some improvements in this area, but progress has been slow. Many unsafe conditions and actions have been documented through the Safety Training Observation Program and observed by committee members during site visits. Failure to wear required protective equipment, poor housekeeping, and the existence of other unsafe conditions may be considered minor infractions, but the committee believes that they indicate the lack of an established safety mindset at the TOCDF and reflect negatively on management's commitment to establishing a true safety culture.

Although the absence of a pervasive safety culture with equal emphasis on agent-related and nonagent-related safety matters is unlikely to change public risk estimates, it could significantly increase worker risk. The establishment of a safety culture at the TOCDF will require continuous active involvement, knowledge, awareness, and a highly visible commitment by management to all aspects of the safety program—including management training and development. The committee notes that safety is included in all job descriptions and is clearly identified as an expectation for all managers and supervisors. Although progress in this area is diffi-

cult to assess, the committee believes that sustained improvement will only be possible with strong management involvement and commitment.

Criteria for Award Fees[2]

A growing body of evidence shows that chemical operations with a strong safety culture also have the highest productivity. The committee's recommendation that safety be given at least equal weight with production in establishing criteria for award fees has been satisfactorily addressed at the TOCDF and JACADS. However, considering that baseline incineration system facilities are currently under construction at three additional sites, the committee believes that modifying the criteria for award fees to include programmatic safety performance would enhance the overall CSDP and facilitate communications among disposal sites. Also, the committee believes that as new facilities are brought on line, their safety performance should reflect the lessons learned from other facilities. That is, at the start of operations, the performance metrics of the new facility should be equal to or better than those at operating facilities.

[2]The term "award fees" refers to contractual payments provided to a contract facility operator for meeting predetermined performance criteria or milestones.

Programmatic Lessons Learned Program

In 1995, the Army implemented the PLL Program to facilitate the transfer of information from one site to another. Although TOCDF safety lessons learned are frequently included in PLL communications, a review of incidents in 1997 revealed that only about 27 percent of safety incidents (most of which were agent-related) were included in the PLL. In contrast, about 70 percent of operating and permit incidents were included. The committee reiterates its prior recommendation that agent and industrial safety be given *equal* emphasis.

SUMMARY

Overall, the committee is satisfied that its recommendations are being addressed and that progress has been made toward creating an environment conducive to the development of a safety culture at the TOCDF. Nevertheless, the committee also notes that safety performance at the TOCDF (as measured by RIRs, the frequency of unsafe actions identified by the Safety Training Observation Program, and such occurrences as the error in maintenance that resulted in a contained GB spill) has not improved significantly. A better balance between agent and industrial safety and strong management involvement and commitment will be necessary to meet the goals of the *Safety Culture Plan* (U.S. Army, 1997d).

5

Public and Community Interactions

INTRODUCTION

The Stockpile Committee has made several recommendations related to both public involvement in the CSDP and emergency management and preparedness. In the *Systemization* report (NRC, 1996a), the recommendations dealt explicitly with activities at the TOCDF. In the *Risk Assessment and Management* report (NRC 1997), the recommendations were addressed to the overall disposal program as it relates to risk management and the involvement of the public in risk management decisions. The *Public Involvement* report (NRC, 1996b), a letter report issued subsequent to the *Systemization* report, focused on institutionalizing public involvement within the CSDP.

On the subject of public and community interactions for the duration of TOCDF operations, the Stockpile Committee recommended that the Army make a substantial effort to increase and improve communications with the host community and the Utah State Citizens Advisory Commission (CAC) on issues of mutual concern (e.g., the CSEPP, decommissioning of the facility, its future use, and risk reduction) [S-4]. The committee also recommended that the Army review and expand its draft RMP (risk management plan) to include public involvement in more areas than the CMP [R-6].

The Stockpile Committee recommended that at the start of agent operations the Army increase its efforts to work with the Utah Division of Comprehensive Emergency Management to ensure that: (1) first responders are properly trained and well equipped [S-5]; (2) local and state CSEPP plans are complete and have been practiced [S-6]; and (3) resources are provided in coordination with the Federal Emergency Management Agency (FEMA) to complete the emergency communications system for the Tooele County Department of Emergency Management [S-7]. The committee also recommended that the Army ensure that CSEPP and other emergency preparedness officials understand the QRA and its implications for emergency management and that the Army track CSEPP activities as part of its RMP [R-8].

The Stockpile Committee has repeatedly recommended that the Army and CSDP management at all levels make a strong commitment to public involvement throughout the entire program [PI-1]. Also, public affairs programs for all Army activities at stockpile locations and the CSEPP (now managed by FEMA), should be closely coordinated, which should be reflected in the RMP at each site [PI-2].

This chapter reviews the Army's responses to these recommendations, which are all concerned with emergency management or preparedness, public involvement, and the intersection of the CMP and public involvement. The following discussion is based on direct observations by committee members, briefings by the Army, and telephone interviews with key community personnel, local officials, county personnel, and CAC members. Either the full committee or a subgroup has visited the TOCDF and the Tooele community six times since the Systemization report was issued. In addition, members of the committee have been briefed by local officials on a regular basis on measures undertaken in Tooele County related to CSEPP. The following discussion focuses on: (1) public involvement, (2) surveys of public opinion, (3) emergency management and preparedness, and (4) the CMP.

PUBLIC INVOLVEMENT

The PMCD's past attempts at developing a national public outreach (i.e., public involvement) plan, as well as some site-specific plans, have not been successful. The Stockpile Committee has repeatedly emphasized the importance of "community involvement in decisions regarding the technology selection process, oversight of operations, and plans for decommissioning the facilities" [RC-6] (NRC, 1994a). Meaningful public involvement was also the subject of the *Public Involvement* letter report and a topic in the *Risk Assessment and Management* report.

The committee strongly believes that meaningful public involvement would enable the Army to respond

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to the concerns of local communities, thereby building trust and minimizing impediments to the timely disposal of the stockpile. The committee also addressed the importance of public involvement in a recommendation in the *Systemization* report:

> **Recommendation 4.** A substantial effort should be made by the Army to enhance interactive communications with the host community and the Utah Citizens Advisory Commission on issues of mutual concern (e.g., various elements of the Chemical Stockpile Emergency Preparedness Program, decontamination and decommissioning, future use of the facility, and risk reduction. [S-4])

The committee has monitored the development of the Army's public outreach programs through briefings by the Army, meetings with the Utah CAC, and public meetings. Since 1996, important changes have been made in the PMCD's management of the CSDP, specifically in the Public Outreach and Information Office (POIO) (U.S. Army, 1998a).

The PMCD's overarching strategy has shifted the POIO's mission from an "operational emphasis providing site-specific support to providing public involvement support on the program level" (U.S. Army, 1998d). Since 1998, the director of the POIO has been responsible for providing staff liaisons and some staffing for outreach activities at specific sites and other related programs. Two contractors were hired to help the Army: SAIC assisted in establishing public involvement (storefront) offices in major towns and communities near each site; Booz-Allen & Hamilton assisted the Army in developing both the *PMCD Overarching Public Involvement Strategy* (U.S. Army, 1998b) and the *Public Involvement Strategy for the CSDP* (U.S. Army 1998c). The POIO office now has the following responsibilities:

- public outreach at the baseline incineration sites at Tooele, Utah; Umatilla, Oregon; Anniston, Alabama; Pine Bluff, Arkansas; and Johnston Atoll (U.S. Army, 1998b)
- public outreach and public involvement in the selection and implementation of alternative disposal technologies for the bulk storage sites at Aberdeen, Maryland, and Newport, Indiana[1]
- public outreach in the nonstockpile program (i.e., the disposal of buried chemical warfare materials and binary chemical weapons, the cleanup of former production sites, etc.)
- outreach in the Army's cooperative threat-reduction program for assisting the Russian Federation with its disposal program (U.S. Army, 1998b).

The POIO will also provide legislative support, media relations, training, and crisis communication to the CSDP. Perhaps more importantly, the POIO now has a clearly stated mission (to provide "a public involvement program that supports meaningful public participation and dialogue") and a clearly stated vision ("to gain public acceptance of the need for the safe expeditious disposal of chemical materiel") (U.S. Army, 1998b). The *PMCD Overarching Public Involvement Strategy* is the first document that clearly indicates the direction of PMCD's public outreach.

Booz-Allen & Hamilton also helped the Army develop a public-involvement strategy document for the CSDP, the *Public Involvement Strategy for the CSDP* (U.S. Army, 1998c). This document outlines the "objectives, key messages, and operational framework" for the CSDP's public information and public involvement program. The document is designed to be continually updated and provides specific guidelines for public involvement programs at storage and disposal sites. The updated (September 1998) *Umatilla Chemical Agent Disposal Facility Public Involvement Implementation Plan* was reviewed by the committee for this report (U.S. Army, 1998d). Implementation plans for Anniston, Pine Bluff, Tooele, Aberdeen, and Newport, which are in various stages of development, will also be constantly updated as circumstances and resources change.

It is still too early to assess the impact of the reorganization and realignment of the POIO. Nevertheless, both the PMCD *Overarching Public Involvement Strategy* document and the *Umatilla Chemical Agent Disposal Facility Public Involvement Implementation Plan* represent significant improvements over previous efforts. Moreover, the new strategy seems to have encouraged the site outreach offices, which are closest to the local communities, to take the initiative in developing their

[1]The two remaining stockpile storage sites at Pueblo, Colorado, and Blue Grass, Kentucky, are no longer the responsibility of the PMCD but are currently under review in conjunction with the Assembled Chemical Weapons Assessment program of the Department of Defense to investigate alternative technologies.

own strategies within the context of the mission, vision, and programs of the POIO. All elements of the program organization are now united by a common mission and appear to have received strong leadership from the POIO (Campbell, 1998).

If the other site-implementation plans are of the same high quality as the plan prepared for the Umatilla site, then significant improvements have been made. For example, the Umatilla plan attempts to relate future activities to both past efforts at public involvement by the Army and present sentiments in the community, which were expressed in surveys (see below) (U.S. Army, 1998d). Perhaps even more important is the description of opportunities for public involvement, which reflects a substantial step in the right direction.

> For public involvement to be meaningful, it must come when stakeholders believe that what they have said or contributed has been heard, understood and incorporated into the decision-making process (U.S. Army, 1998d, p. 11).

Since the start of operations at the TOCDF, public outreach has been less than successful. First, involvement of the public and the CAC in several important developments could have improved communications and meaningful public involvement by the local community. For example, the committee learned that the Tooele public outreach office did not involve the public or the CAC in the development of its draft public-involvement implementation plan. A few CAC members were involved informally, but the Army made no formal attempt to obtain input from the CAC or the public. In the future, the Army should obtain public input before any plan (or substantive modification) is finalized.

Second, a public meeting sponsored by the Army on July 14, 1997, to discuss the proposed CMP (change management process) was not successful. Neither the personnel of the local outreach office nor the public had been involved in the development of the draft CMP prior to the meeting (Campbell, 1998). As a result, only a few members of the public and the CAC were present at the meeting, along with about 30 personnel associated with the Army and the TOCDF. This lack of public interest reflects both the past lack of communication between the community and the Army and the fact that the public has little interest in changes to the established technology. Based on this experience, the committee concluded that at sites where the technology is already established, the Army should expand the CMP to include other topics of interest to the public, such as plans for decommissioning the facilities.

Although reorganization of the POIO and the development of strategies for obtaining public involvement are important, neither is a substitute for an organizational culture that proactively seeks the involvement of not only the public, but also personnel of the local outreach office, who are best informed about local interests and issues.

In the 1996 *Systemization* report, the committee noted that the Army had missed an excellent opportunity by not making a concerted effort to involve the public in the development of the risk assessments for the TOCDF. The drafting of the CMP appears to be another lost opportunity, and as the committee notes in the recent report, *Carbon Filtration for Reducing Emissions from Chemical Agent Incineration*, the CMP has yet to be linked to issues that could arouse public interest (NRC, 1999).

In 1997, the Tooele outreach office had 575 visitors, participated in 35 speaking engagements attended by 2,800 people, and conducted 380 tours of the facility (U.S. Army, 1998e). The local outreach office at Tooele has since improved its tracking capability and expanded its staff and office space to three times its original size. The CAC meeting at the opening of this new office on April 16, 1998, was attended by more than 50 people involved in emergency management operations (Campbell, 1998; Sagers, 1998a). The office is now staffed by four Booz-Allen & Hamilton employees. In addition, it now maintains its own mailing lists. All of these changes are consistent with the new expanded mission for local offices and should provide local citizens with better information and more accessibility to the CSDP.

Nevertheless, despite these improved outreach capabilities at the local level and the reorganization of the POIO, this site has a long way to go to reach the level of public involvement in the decision-making process the committee recommended in the *Systemization* report [S-4] and again in the *Public Involvement* letter report [PI-1]. The sooner the public becomes meaningfully involved, the more widely accepted program decisions will be.

COMMUNITY SURVEY RESEARCH PLANS

In the past, the Stockpile Committee has been critical of the POIO's efforts to ascertain public views and

attitudes, as well as to provide relevant information about the disposal program (NRC, 1996b). In June 1998, and again in December 1998, the POIO provided the committee with an overview of its preparations for conducting a stakeholder survey and incorporating the survey results into a database and tracking system (Williams, 1998; U.S. Army, 1998f). The survey plan indicates that local outreach offices will be involved in developing the surveys, and as of mid-April 1998, the Tooele County outreach office had already convened a meeting of various stakeholders to identify issues to be included in the survey (Campbell, 1998). One of the first decisions made by this local group was to invite some of the leaders or representatives of groups interested in the TOCDF, or incineration generally, to participate (Campbell, 1998). A consultant has informed the committee that similar stakeholder meetings have been held at the other sites and that additional efforts are under way to ensure the participation of a broad spectrum of stakeholders, including opponents of the baseline incineration system (Williams, 1998).

The committee is encouraged that the Delphi survey technique is being used to identify important issues that should be included in the survey. The extremely ambitious survey plan raises concerns, however, that the large number of responses necessary at each site to produce generalizable results may not be received. Therefore, the Army must seek the cooperation of *all* stakeholder groups at each site. The committee urges the Army and its contractor to build on this excellent beginning and take the necessary steps to obtain the cooperation from these groups.

EMERGENCY MANAGEMENT AND PREPAREDNESS

In the 1996 *Systemization* report, the Stockpile Committee made three recommendations concerning the coordination of emergency management, response, and preparedness with the start of agent operations. These recommendations are discussed below. In addition to these recommendations, part of another recommendation [S-4] called upon the Army to enhance its interactive communications with the host community on issues involving the CSEPP.

> **Recommendation 6.** The Army, and where appropriate the Federal Emergency Management Agency (FEMA), should ensure that local and state Chemical Stockpile Emergency Preparedness Program Plans for responding to potential chemical events are complete and well exercised as soon as possible. [S-6]

Since this recommendation was made, the CSEPP has been reorganized. The Army has retained control of on-site emergency preparedness, but all off-site responsibilities, including budgeting, have now been assigned to FEMA. Consequently, off-site emergency preparedness is no longer within the scope of the Stockpile Committee's oversight. Nevertheless, the committee has made several observations based on its oversight experience.

The General Accounting Office has prepared at least seven reports citing problems in the CSEPP (GAO 1993, 1994, 1995a, 1995b, 1995c, 1996, 1997). The committee is also concerned about the CSEPP and about the horizontal fragmentation of responsibility at the federal level. Previous briefings by directors (both Army and FEMA) of the CSEPP, as well as discussions with directors of state emergency management agencies, have all stressed the importance of a well coordinated response-management capability with the technical capacity to respond effectively to a chemical event. The recent reorganization will require excellent coordination and communication to overcome the barriers of separate organizational responsibilities. In fact, the committee is not convinced that the reorganization will improve the capacity for responding to an emergency.

The committee strongly recommended that the Tooele County Emergency Management Plan be completed and that the Army ensure that training exercises be carried out. Two issues underlie this recommendation. First, the committee's initial review in 1996 of the Tooele County Emergency Operations Plan and the functional appendices on chemical hazard/agent response revealed that several components of the plan and appendices were still in draft form. Second, the committee determined that, because of the disagreements over issues pertaining to the procurement of personal protective equipment, Utah County had not participated in the latest training exercise at that time. Moreover, for some time, both Salt Lake and Utah counties participated only minimally in these exercises. Both Army and FEMA guidelines state that all plans must be completed and that personnel must be trained to carry them out in order to ensure a comprehensive emergency-response capability to a chemical event (FEMA and Department of the Army, 1994).

In mid-1998, committee members were able to review the completed and updated Tooele County Emergency

Operations Plan (and the functional appendices pertaining to a chemical agent event). The Tooele County director of the Department of Emergency Management informed the committee that DCD, county, and state personnel had participated in a successful exercise of the Emergency Operations Plan (Sagers, 1998a). In September 1998, another exercise was held in which both Salt Lake and Utah counties participated. Observers from several FEMA regions, as well as FEMA headquarters personnel, also attended. In fact, more than 300 evaluators or observers were present (Sagers, 1998b). The increased interest in the September exercise was partly due to the Army's Integrated Process Teams' attempts to develop better exercises for CSEPP (Sagers, 1998b). At the time of this report, there were no negative findings on the exercise, and the basic response activities were positive (Sagers, 1998b). Thus, it appears that the committee's concerns in this area have been adequately addressed.

Recommendation 5. The Army should increase its efforts to work with the Utah Division of Comprehensive Emergency Management to ensure that first-responders have been adequately trained to use personal protective equipment approved by the Occupational Safety and Health Administration. [S-5]

The committee recommended that the Army provide OSHA-approved personal protective equipment to local first-responders and train them in its use. In interviews with the director of the Tooele County Department of Emergency Management, the committee was assured that the equipment had been provided and that 250 local first-responders had been trained (Sagers, 1997, 1998a).

The committee had also been concerned about the delegation of responsibility for determining when an area was safe for reentry and whether adequate decontamination equipment was available for local emergency medical personnel. The committee has learned that three mobile decontamination units (to decontaminate patients prior to treatment) have been deployed in Tooele County, one of them stationed at the Tooele Valley Regional Medical Center. The adequacy of the decontamination capacity in Rush Valley is still being assessed by Tooele County (Sagers, 1998b). The reentry issue has been resolved through cooperation between local officials and DCD personnel. Emergency preparedness exercises have been planned and implemented for both decontamination and evacuation scenarios (Sagers, 1997, 1998a).

Two different emergency-management software packages are being used in Utah: FEMIS and EMIS. The Tooele County Department of Emergency Management now has the capacity to interface between the two so that it can work with the Army, which uses EMIS, and the state, which uses FEMIS. The committee commends the cooperative efforts of Army, state, and county emergency-management personnel. However, the committee notes that the use of different software packages is evidence of the lack of cooperative planning.

Recommendation 7. The Army/FEMA should provide the necessary resources for completing the communications system planned by the Tooele County Department of Emergency Management. [S-7]

In 1994, the committee found that both the Army and FEMA recognized the importance of a highly reliable, highly redundant communications system that would serve the following functions (FEMA and the Department of the Army, 1994):

- issue notifications and warnings
- serve as incident command center
- function as emergency operations center
- establish and maintain links to state, county, and Army emergency operations centers
- maintain communications with local officials
- maintain links to all first responders, as well as various sheltering, medical, and decontamination sites

As of early 1996, however, Tooele County had still not completed its communication system.

Interviews in 1997 and 1998 with the Utah Department of Emergency Management showed that the communication system was almost completed. The Tooele County Department of Emergency Management's Communication Plan has been revised, and the system is now both highly reliable and highly redundant. Virtually the entire county is now covered by some type of communication band (microwave, 400 MHz, 800 MHz, or 900 MHz) (Sagers, 1998a). Although there are still some dead spots in Rush Valley, three critical links in the system have now been funded and are being phased into place. The communications system thus appears to be adequate to handle an incident. Most of Tooele County is covered by an 800-MHz band, except for police, fire, and emergency medical agencies (Sagers,

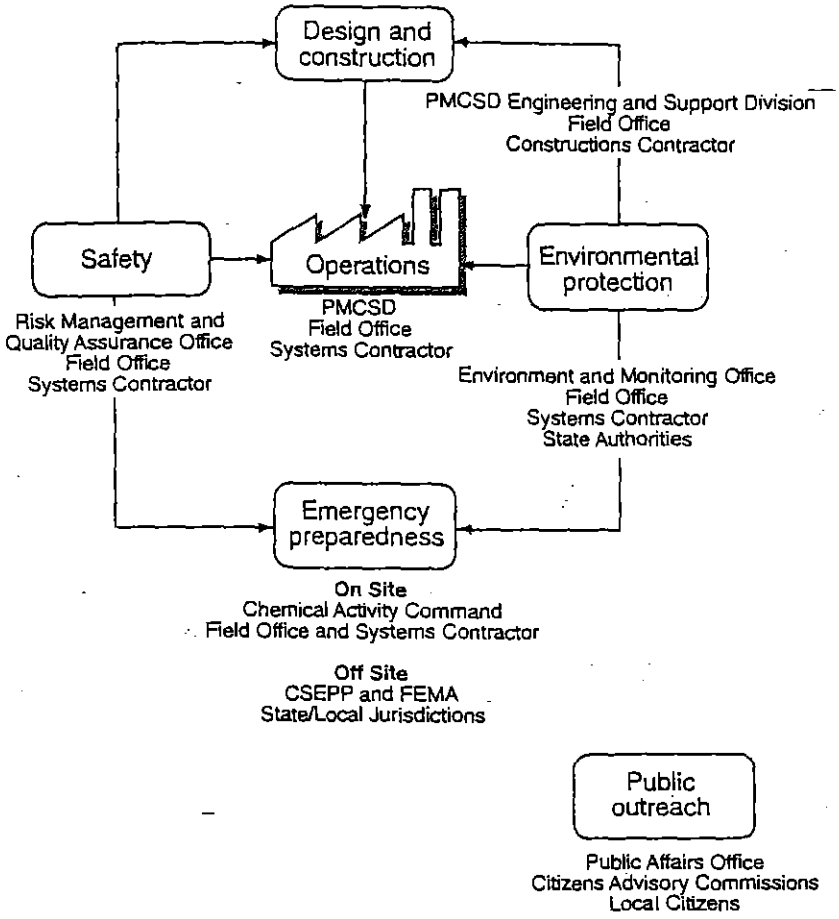


FIGURE 5-1 PMCD's organizational elements directly related to risk management (p. 63 in the *Guide*). Source: U.S. Army, 1997a.

1998c). However, the county can interface with all relevant response agencies.

The communications system can now notify and warn residents. Originally, Tooele County had planned to use tone-alert radios (indoor alert notification system 990-MHz radios), which had been funded but had not been distributed when the *Systemization* report was issued. The current notification system relies on National Weather Service radios (through an agreement concluded in 1994–1995). These radios have been widely distributed and can be activated in the event of an incident by either the National Weather Service or the operations center of the Department of Emergency Management (Sagers, 1998a). A small part of Rush Valley is without these radios because of difficulties with distribution or resident preferences. The Department of Emergency Management, in cooperation with other Tooele County departments and the local Army POIO outreach office, has devised and implemented a plan for distributing radios to new residents. (Warning sirens are included in the plan but were not evaluated for this report.) It is clear that substantial progress has been made in the critical area of communications and that the system is almost complete.

CHANGE MANAGEMENT PROCESS

The *Risk Assessment and Management* report included several recommendations ([R-5] through [R-8])

concerning the integration of the public-involvement and emergency-management functions (CSEPP) into the Army's draft Guide and RMP (risk management plan):

> **Recommendation 5.** The Army should develop a management plan (and include it in the Guide) that defines the integration of management roles, responsibilities, and communications across activities by risk management functions (e.g., operations, safety, environmental protection, emergency preparedness, and public outreach). [R-5]
>
> **Recommendation 6.** The Army should review and expand the current draft risk management plan to include public involvement in appropriate areas beyond the management of change process. [R-6]
>
> **Recommendation 7.** The Army should institutionalize the management of change process developed in the *Guide*. The Army should track performance of the change process and document public involvement and public responses to decisions. The Army should use this experience to improve the change process. [R-7]
>
> **Recommendation 8.** The Army should expand implementation of the risk management program to ensure that workers understand the results of risk assessments and risk management decisions. The Army should also ensure that CSEPP and other emergency preparedness officials understand the QRA and how their activities might affect risk. CSEPP activities should be tracked by the Army as part of its management program. [R-8]

These recommendations clearly reflect the committee's conviction of the importance of integrating both the public-outreach and the emergency-preparedness programs into the Army's draft *Guide*, as well as the CMP (which was planned as the last chapter of the *Guide*). The committee was convinced that the development of a CMP and its inclusion in the *Guide* would break new ground. The CMP would be "a process for managing changes that may affect the risk associated with PMCD activities" (NRC, 1997, p. 41), would distinguish matters of risk assessment (the science) from matters of risk management (policy and value judgments), and would establish an approach for integrating them that involved the public. In addition, the *Guide* would define and integrate management functions as they relate to risk management (Holmes, 1998c). The committee concluded that the development of an institutionalized CMP would be critical to comprehensive risk management. At the same time, the committee noted with concern that public involvement, as reflected in the draft *Guide's* organizational components, was not being integrated with risk management (see Figure 5-1). Nevertheless, the committee encouraged the completion of the draft *Guide*, especially Chapter 7, which focused on public involvement, so that the *Guide* could become policy.

Since the *Risk Assessment and Management* report was issued, the committee has monitored the Army's efforts to complete the draft *Guide*, especially the CMP and the public involvement components, and has documented its disappointment with the slow development of the CMP. (The lack of implementation of the CMP in the carbon filtration issue is discussed in the recent *Carbon Filtration for Reducing Emissions from Chemical Agent Incineration* [NRC, 1999]). The committee continues to be concerned that the results of both the QRA and HRA may still not be well understood by CSEPP and other emergency-management personnel, or by the public. The absence of a CMP that includes meaningful public and stakeholder involvement in the Army's risk management decisions is a notable lapse in the program. The Army has failed to use the CMP as a way of initiating two way communication and providing a mechanism for the public to participate in decision making.

6

Findings and Recommendations

In this report, the Stockpile Committee has reviewed the operations at DCD/TOCDF in terms of previous NRC recommendations. Table 6-1 summarizes these recommendations, indicates the chapter of this report where they are discussed, notes the committee's evaluation of the Army's response, and enumerates related new recommendations (presented below). If the committee found that a prior recommendation had been satisfied, the issue was considered closed. The new findings and recommendations in this chapter reflect the remaining and new issues that require further attention by the Army. Some of the new recommendations also have implications for future CSDP sites.

Finding 1. The committee considers the quantitative risk assessment (QRA) and the evolving risk management plan (RMP) as effective steps toward meeting the objective of minimizing public and worker risk.

Recommendation 1. The Stockpile Committee reiterates its earlier recommendation that the Chemical Stockpile Disposal Program should proceed expeditiously and should use technology that will *minimize* overall risk to the public and to the workers at each site.

Finding 2. The initial disposal campaigns at the Tooele Chemical Agent Disposal Facility (TOCDF) have destroyed a significant quantity of GB nerve agent, although the delay in the issuance of the Toxic Substances Control Act permit caused an interruption in the processing of GB M55 rockets. As a consequence, risk-reduction is well behind the original schedule. Although the Army seems confident that it can overcome this schedule slippage, a recent audit by the Arthur Andersen Company raises questions about the likelihood of meeting the disposal schedule. Extending the schedule will have adverse risk and cost implications.

Recommendation 2. The Army should process M55 GB rockets as soon as possible. The Army should also maintain a strong management commitment and close and effective working relationships with the relevant regulatory agencies to avoid future schedule slippages with their associated adverse risk and cost implications.

Finding 3. Several waste-handling aspects of TOCDF operations have not been resolved. These include performance in the brine reduction area (although the Army now plans to continue to treat brine off site), and plans to replace the dunnage furnace with an alternative method for the disposal of activated carbon. A micronizer and burner for activated-carbon disposal will be tested in the deactivation furnace system at the Johnston Atell Chemical Agent Disposal System (JACADS) in 2001.

Recommendation 3. The Army should expedite the resolution of issues associated with the disposal of brine and dunnage in the interest of minimizing landfill disposal and minimizing overall waste as additional sites become operational.

Finding 4. The Army is pursuing a wise course in upgrading current automatic continuous air monitoring system (ACAMS) monitors while simultaneously funding the development of a faster, more reliable ACAMS. The Army has also significantly upgraded laboratory analysis tools for identifying species adsorbed on depot area air monitoring system (DAAMS) tubes that may trigger ACAMS false alarms. Infrared technology that may provide real-time detection of agent release is being investigated, and some progress has been made.

Recommendation 4. The Army should take the following steps to improve its monitoring systems:

- continue its vigorous efforts to improve the response times, agent specificity, and overall reliability of the ACAMS alarms
- continue to test and introduce improved laboratory instruments that can identify and quantify

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TABLE 6-1 Summary of Prior and New NRC Recommendations

Prior Recommendation	Area(s) Addressed by Recommendation	Chapter in Which Recommendation Is Discussed	Response to Date	New Recommendation
RC-1	Program-wide risk reduction	2,3,4	Ongoing process	1
S-1	Implementation of a safety program	3,4	Ongoing process	1, 5, 6, 7, 9, 11
S-2	Incorporation of safety and environmental goals into award fees	4	Satisfied at the TOCDF and JACADS, but not program-wide	8
S-3	Completion of QRA and resolution of QRA safety-related issues	3	Good implementation at the TOCDF to date, but incomplete program-wide	5, 6, 7
S-4	Improved public interactions and communications	5	Ongoing process	10
S-5	Emergency-preparedness training	5	Satisfactory cooperative effort at the TOCDF, but ongoing concern about federal coordination at other sites	11
S-6	Completion and practice of emergency-preparedness plans	5	Satisfactory ongoing process	11
S-7	Completion of emergency-preparedness communications system for Tooele site	5	Significant progress and essentially complete	
S-8	Completion of Army preoperational survey	2	Completed	
S-9	Attainment of LIC 99.9999% DRE	2	Accomplished	
S-10	Safety management	4	Progress, but continuing concerns	5, 6, 7, 9
S-11	Completion of RCRA and TSCA trial burns	2	Completed	
S-12	BRA certification; dunnage disposal	2	Off-site disposal alternatives implemented; BRA certification on hold; DFS alternative to DUN to be investigated	3
S-13	LIC slag removal	2	Satisfactory performance of equipment	
S-14	Completion of risk management plan (RMP)	3	Progress but not complete	7

Prior Recommendation	Area(s) Addressed by Recommendation	Chapter in Which Recommendation Is Discussed	Response to Date	New Recommendation
S-15	Risk assessment integration	3	Satisfied in principle	
S-16	"Near misses" tracking and safety	3	Progress but not complete	6
S-17	Improvements in monitoring	2	Progress but continuing effort required	4
R-1	Updating of QRA, HRA	3	Documentation of updating process pending	6
R-2	Development and review of program-wide site-specific QRAs and HRAs	3	Ongoing process	6
R-3	Update of QRA methodology manual	3	Still pending	7
R-4	Inclusion of "safety culture" in *Guide*	4	Progress but not complete	9
R-5	Definitions of risk management roles and responsibilities in *Guide*	4	Progress but not complete	7, 8, 9
R-6	Inclusion of public involvement in RMP	5	Further refinement necessary	10
R-7	Tracking of CMP performance	5	Disappointing performance to date on carbon-filter issue	10
R-8	Understanding of risk assessment by workers, etc.	3	Progress but not complete	5
R-9	Implementation and updating of RMP	3,4,5	Progress but not complete	5, 6, 7
PI-1	Commitment of CSDP to public involvement	5	Recent indications of improved strategy but commitment yet to be demonstrated	10
PI-2	Coordination of CSDP, CSEPP, public affairs, and RMP	3, 5	RMP not complete	7, 10

Code Legend: RC = *Recommendations for the Disposal of Chemical Agents and Munitions* report; S = *Review of Systemization of the Tooele Chemical Agent Disposal Facility* report; R = *Risk Assessment and Management at Deseret Chemical Depot and the Tooele Chemical Agent Disposal Facility* report; and PI = *Public Involvement and the Army Chemical Stockpile Disposal Program* report. See Appendix B for a complete list of reports by the NRC Stockpile Committee.

interference species to minimize false positive ACAMS alarms

- continue to sponsor the development, testing, and potential deployment of new analytical instrumentation capable of providing real-time or near real-time (< 10 s) detection of significant levels of agent release and keep abreast of research in the area of rapid-response agent detection

Finding 5. No comprehensive, integrated program for managing risks or communicating them to workers and nearby residents has been established or implemented.

Recommendation 5. The Risk Management Program at stockpile storage and disposal facilities must be comprehensive and integrated to protect workers, the public, and the environment. The Army should incorporate current and planned risk management tools (quantitative risk assessments [QRAs]; health, safety, and environmental evaluations; health risk assessments [HRAs], etc.) into a comprehensive, integrated risk-reduction program to identify, prioritize, and reduce any (as yet undetermined) residual risks to workers and the public at Tooele and other disposal sites. The risk management program should be updated in response to experience and new information and should be a living, ongoing process that is integral to facility operations and adequately communicated. When used iteratively, it can help to identify and manage on-site and off-site risks. For example, lessons learned from Phase 2 QRAs can be incorporated into facility designs. Risk management decisions and HRA results should be used to determine if other mitigation measures are required.

Finding 6. The Army has briefed the committee on how various issues related to the QRA have been resolved, but no formal process has been established for identifying and tracking QRA issues that must be resolved before the beginning of each campaign. The committee was briefed on the Programmatic Lessons Learned (PLL) program and concluded that two aspects of the program require additional work: (1) formal specification of the lessons-learned program, including site responsibilities in responding to lessons learned, and (2) the dissemination of lessons learned among the personnel at each site. Moreover, procedures for updating the QRA, and when necessary the HRA, based on new information (as identified in the PLL) have not been established, and the process for updating them when plant configuration or operational changes are planned has not yet been incorporated into the *Guide*. The committee notes that the Army has fallen significantly behind schedule in implementing major elements of the RMP at the TOCDF.

Recommendation 6. As a formal process for each site, a list of outstanding issues related to the QRA for each campaign should be prepared and the resolution of each issue documented before the campaign begins. The Army should provide a formal specification for the lessons-learned programs, including individual responsibilities and definitions of how safety improvements at each site will be developed based on the lessons learned. The *Guide to Risk Management Policy and Activities* should be revised to include the process for updating the QRA and/or the HRA when significant new information is identified through the lessons-learned programs, or when significant plant, processing, or scheduling changes are planned. Based on its experience at the TOCDF, the Army should initiate Phase 2 QRAs for the chemical disposal facilities under development as soon as feasible, preferably while the risk information can still be used to improve the design and construction of the facility.

Finding 7. The Army has successfully implemented an informal risk management process for DCD/TOCDF, but has not finalized a formal plan or institutionalized programmatic lessons learned for the risk management process or for other informal cross-site risk communication programs. The QRA methodology manual has not been revised to reflect recent improvements.

Recommendation 7. The Army should formally and expeditiously implement risk management practices at site and programmatic levels into coordinated, well-documented plans and update them whenever necessary to ensure that they reflect current practices and lessons learned. The methodology manual for the quantitative risk assessment should be updated to reflect the significant improvements that have been made.

Finding 8. At the start-up of operations, industrial safety performance was poor at both of the currently operating facilities (JACADS and the TOCDF). The committee believes this reflects a disproportionate focus on chemical agent and a failure of management to build a total safety culture prior to plant start-up. Sharing of lessons learned among sites will be critical for improving CSDP-wide safety performance.

Recommendation 8. The Army should consider adding a Chemical Stockpile Disposal Program (CSDP)-wide factor for safety into the criteria for award fees at each site. This factor should be based on the safety performance at all CSDP sites. Operating sites should be required to demonstrate continued improvements in key safety metrics with "best of industry" standards, rather than "industry averages," as the target goal. The Army should insist that the safety performance of new

cilities be comparable to the best safety performance operating facilities.

inding 9. After public allegations of safety deficiencies at the TOCDF by two employees, seven independent safety investigations at the site, and previous tockpile Committee recommendations, TOCDF management implemented programs to improve safety performance and to lay the foundations of safety culture at ie site. However, safety metrics do not yet indicate that ierformance has improved.

Recommendation 9. The Army should continue the rigorous implementation of all elements of the *Safety Culture Plan*, with visible commitment and involvement by management.

Finding 10. Recent efforts by the Army to improve public outreach are listed below:

- the reorganization of the Public Outreach and Information Office
- the development of the *PMCD* [Program Manager for Chemical Demilitarization] *Overarching Public Involvement Strategy*
- the publication of *Public Involvement Strategy for the CSDP*
- the publication of *Umatilla Chemical Agent Disposal Facility Public Involvement Implementation Plan*
- plans for a CSDP stakeholder survey
- the significant expansion of the capacity of the local Tooele public outreach office

The Army has not, however, increased the opportunities for meaningful public input and review of CSDP activities and plans. Furthermore, a component of meaningful public involvement, which is recognized in the *Umatilla Chemical Agent Disposal Facility Public Involvement Implementation Plan*, is still missing at the TOCDF. Public involvement has not come at a point in time "when stakeholders believe that what they have said or contributed has been heard, understood, and incorporated into the decision-making process." The change management process will be a major step forward, but public involvement should not be limited to the CMP.

Recommendation 10. The Army should continue to increase the involvement of local Citizens Advisory Commissions (CACs), stakeholder groups, and the public in the development of future CSDP planning, implementation, and public outreach activities (e.g., surveys). The public outreach activities should be integrated with other CSDP activities, and the committee again recommends that the public, CACs, and stakeholder groups play early and meaningful roles in the implementation of significant operational changes and in planning for the decontamination and decommissioning of disposal facilities. The integration of the Army's public outreach program and the CMP should be the first step in the development of a coordinated, efficient, effective, and meaningful public involvement program. Once the criteria are finalized for using the CMP and involving the public, the Army should actively expedite implementation of the process.

Finding 11. Most of the committee's recommendations concerning emergency management and preparedness at the TOCDF have been addressed. First responders have been well trained in the use of personal protective equipment. Emergency preparedness plans for Tooele County for incidents involving chemical agent have been completed, and training exercises are continuing. Efforts are being made to coordinate responses by the Army with state and local emergency management agencies. Although these efforts are being hampered by the use of different software packages, significant improvements in preparedness and planning have been made. Significant improvements have also been made toward completing the communications system in Tooele County, and radios for using the National Weather Service as a notification system are being distributed.

The committee is concerned that the current reorganization of the Chemical Stockpile Emergency Preparedness Program, under which FEMA now has responsibility for off-site plans and activities, may fragment authority and interfere with a well coordinated emergency management program.

Recommendation 11. The Army and the Federal Emergency Management Agency should work together to ensure that preparedness and planning, warning, response, and mitigation activities of the emergency management program for the TOCDF are well coordinated. Informal relationships and agreements among state, local, and federal personnel should be formalized to ensure a permanent emergency preparedness capacity. Interfaces for emergency management software should be provided as soon as possible.

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Appendices

Appendix A

Specific Design Features of the Tooele Chemical Agent Disposal Facility Baseline Incineration System

PROCESS DESCRIPTION

The Tooele Chemical Agent Disposal Facility (TOCDF) consists of five interconnected process systems:

1. The unloading and unpack system for receiving munitions from the Deseret Chemical Depot.
2. The demilitarization processing systems for handling rockets, containers, mines, and projectiles separately.
3. The furnace and incinerator systems, which include a deactivation furnace system, a metal parts furnace, two liquid incinerators, and a dunnage incinerator.
4. Various safety systems, including explosive containment, ventilation and filtering, fire protection, agent monitoring, and door monitoring.
5. Various support systems, including electric, fuel gas, instrumentation, compressed air, hydraulics, cooling, and the very important pollution abatement systems.

These systems are linked, monitored, and controlled through an advanced process management system operated from a central control room.

For practical purposes, the TOCDF is a scaled up and updated version of the Johnston Atoll Chemical Agent Disposal System (JACADS), which has been operating for nine years. Although JACADS was the first chemical agent disposal facility, its design was based on pre-existing commercial incinerators, as well as years of development and testing of special munitions-handling machinery. Very little new technology was incorporated into the TOCDF. The layout of the TOCDF is shown in Figure A-1.

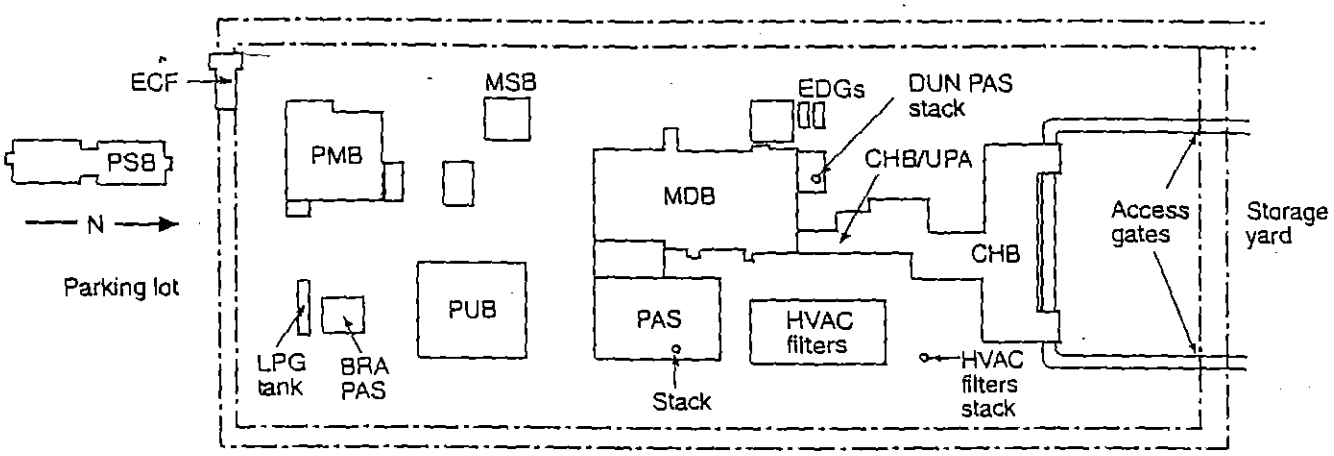
Unloading and Unpack System

Munitions are brought by truck in sealed containers from the storage area in Deseret Chemical Depot into the container-handling building along dedicated and highly secure roads. The containers are lifted to the second floor of the building into the unpack area where they are opened, and the munitions are conveyed into the munition demilitarization building. No human contact with the munitions occurs after the munitions leave the unpack area.

Demilitarization Processing Systems

The purpose of demilitarization processing is to separate the components of munitions into separate streams that can be handled safely in the downstream furnace and incinerator systems. Each type of munition is unique and must be processed separately. Rockets, for example, contain agent, propellant and burster energetics, which must be separated for processing. The rocket-handling system feeds rockets into an explosion-containment room through a rotating vestibule. In the explosion-containment room, the agent cavity is punched open, and the agent is drained into a separate holding tank. Eventually, the agent is fed into a liquid incinerator (LIC) and burned. The drained rocket proceeds to a shearing device where the fuse is sheared off, the burster is sheared off, and finally the propellant-containing motor is sheared off. The fuse, burster, and motor fall into a hopper that discharges them into the deactivation furnace system (DFS). The rocket-handling system is shown in Figure A-2.

Bulk munitions contain agent but no energetics. Therefore, they bypass the explosion-containment room and are conveyed into the upper munitions corridor of the munitions processing building to a bulk item station. Bulk containers are hydraulically punched so that agent can be drained into a holding tank prior to incineration in a LIC. The drained container and the tray it was on are conveyed to the metal parts furnace (MPF) for cleanup. The bulk handling system is shown in Figure A-3.



BRA	brine reduction area	MDB	munitions demilitarization building
CHB	container handling building	MSB	monitoring support building
DUN	dunnage furnace	PAS	pollution abatement system
ECF	entry control facility	PMB	personnel maintenance building
EDG	emergency diesel generator	PSB	personnel support building
HVAC	heating, ventilation, and air conditioning	PUB	process utility building
LPG	liquefied propane gas	UPA	unpack area

FIGURE A-1 Layout of the TOCDF. Source: Adapted from U.S. Army, 1996.

Projectiles are processed in a system similar to the rocket-handling system. Projectiles, either artillery shells or mortar shells, contain both agent and energetics. Projectiles enter the explosion-containment room by conveyer and are fed mechanically onto a projectile/mortar disassembly table. The table rotates so that nose closures (fuses or lifting lugs) can be mechanically removed. At another stop, burster material is removed. The shells are then placed in an egg-crate metal tray and conveyed into the munitions processing bay located in the upper munitions corridor. A robot unloads the shells onto another rotating table called the multipurpose demilitarization machine, where they are milled to cut through burster tube welds, if necessary. Then the burster tubes are removed, and the agent is drained. Finally, the burster tube is crimped and reinserted, and the projectile is sent through the MPF. The projectile-handling system is shown in Figure A-4.

The mine-handling system is the last demilitarization processing system. Operators unpack mines from their drum containers in the unpack area. Each mine is then cycled through a glove box onto a conveyer in the explosion-containment vestibule. This conveyer takes them to a workstation where the arming plugs, fuses, and activators are removed and placed in a fuse box. The fuse box and the mine are then transported to the explosion-containment room, where a mine machine punches the mine and drains the agent. A burster punch machine removes the burster from the mine. The remnants of the mine and the fuse box are then sent to the DFS. Figure A-5 depicts the mine-handling system.

Furnaces and Incinerators

The DFS is used to destroy explosives and propellants from rockets, projectiles, and mines. Basically, the DFS is a gas-fired rotary kiln (Figure A-6). Munitions pieces are fed down a chute from the explosion-containment room into the DFS. The chute has two blast gates that open sequentially. As the kiln rotates, the pieces are moved through the kiln by a spiral baffle that pushes them along. For rocket campaigns, the kiln runs at 1,100°F. For other campaigns, it runs at 1,500°F. The pieces burn rapidly rather than detonating. As added protection against detonation, the charge end of the kiln is constructed of two-inch thick steel. The burned munitions exit onto a discharge conveyer that carries them under two electric heater banks that keep the scrap at 1,000°F for 15 minutes. This ensures that the scrap is 5X clean, (i.e., 99.99999 percent free of agent). DFS exhaust gases go through a blast-attenuation duct, a cyclone separator (to remove ash), and an afterburner before entering the pollution abatement system (PAS).

The function of the MPF is to decontaminate munitions bodies after removal of agent and explosives. The

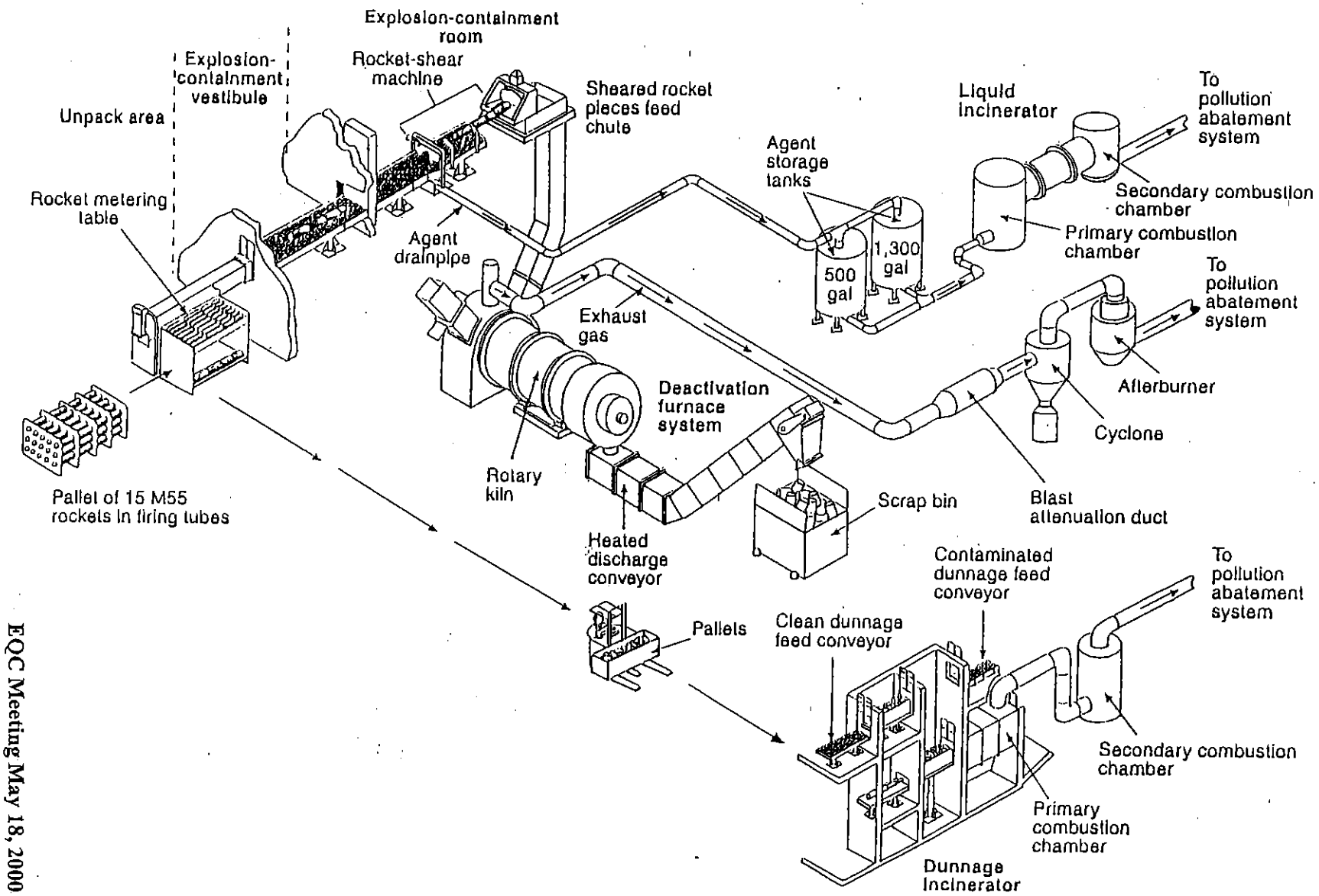


FIGURE A-2 Rocket-handling system. Source: Adapted from U.S. Army, 1996.

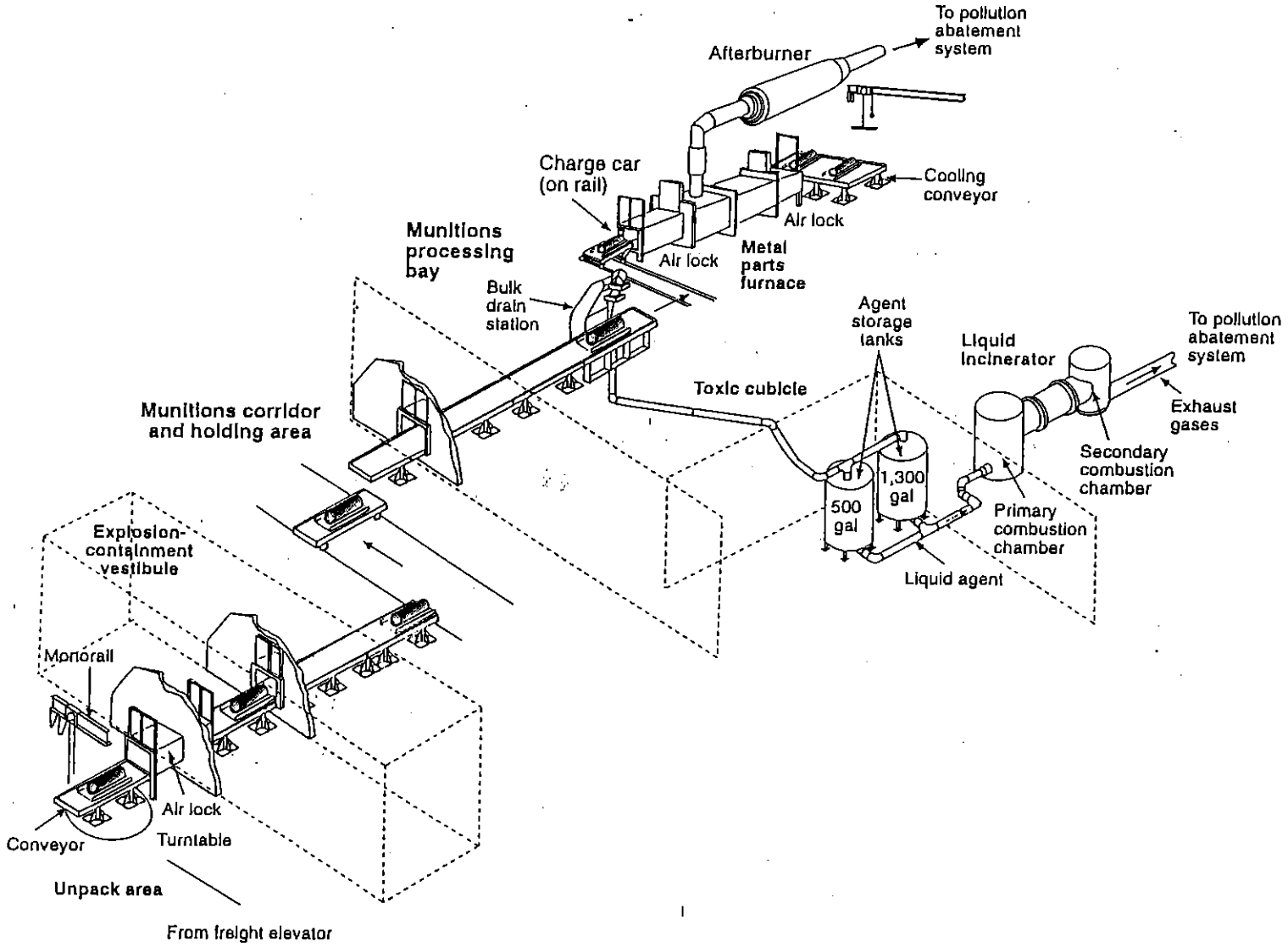


FIGURE A-3 Bulk handling system. Source: Adapted from U.S. Army, 1996.

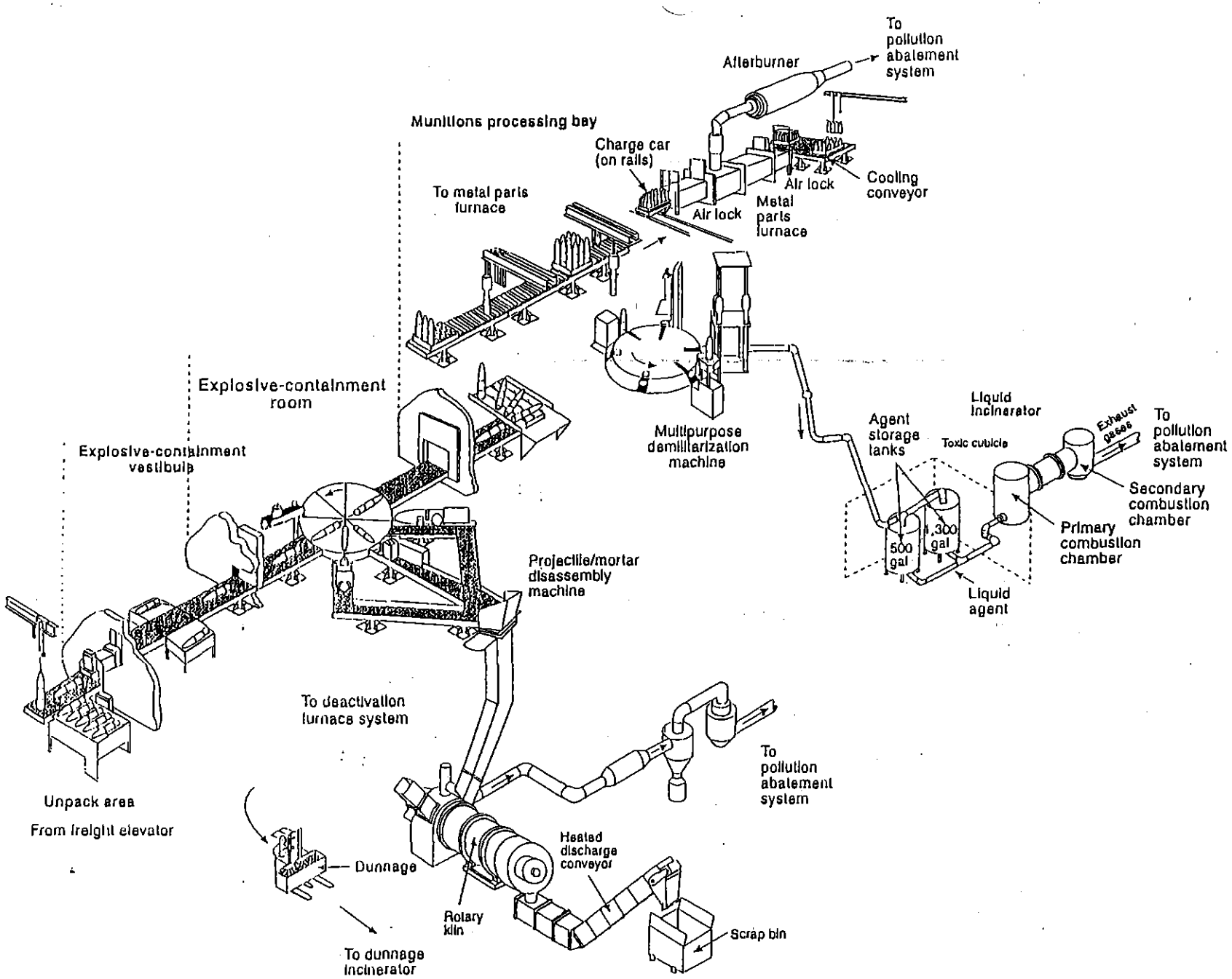


FIGURE A-4 Projectile-handling system. Source: Adapted from U.S. Army, 1996.

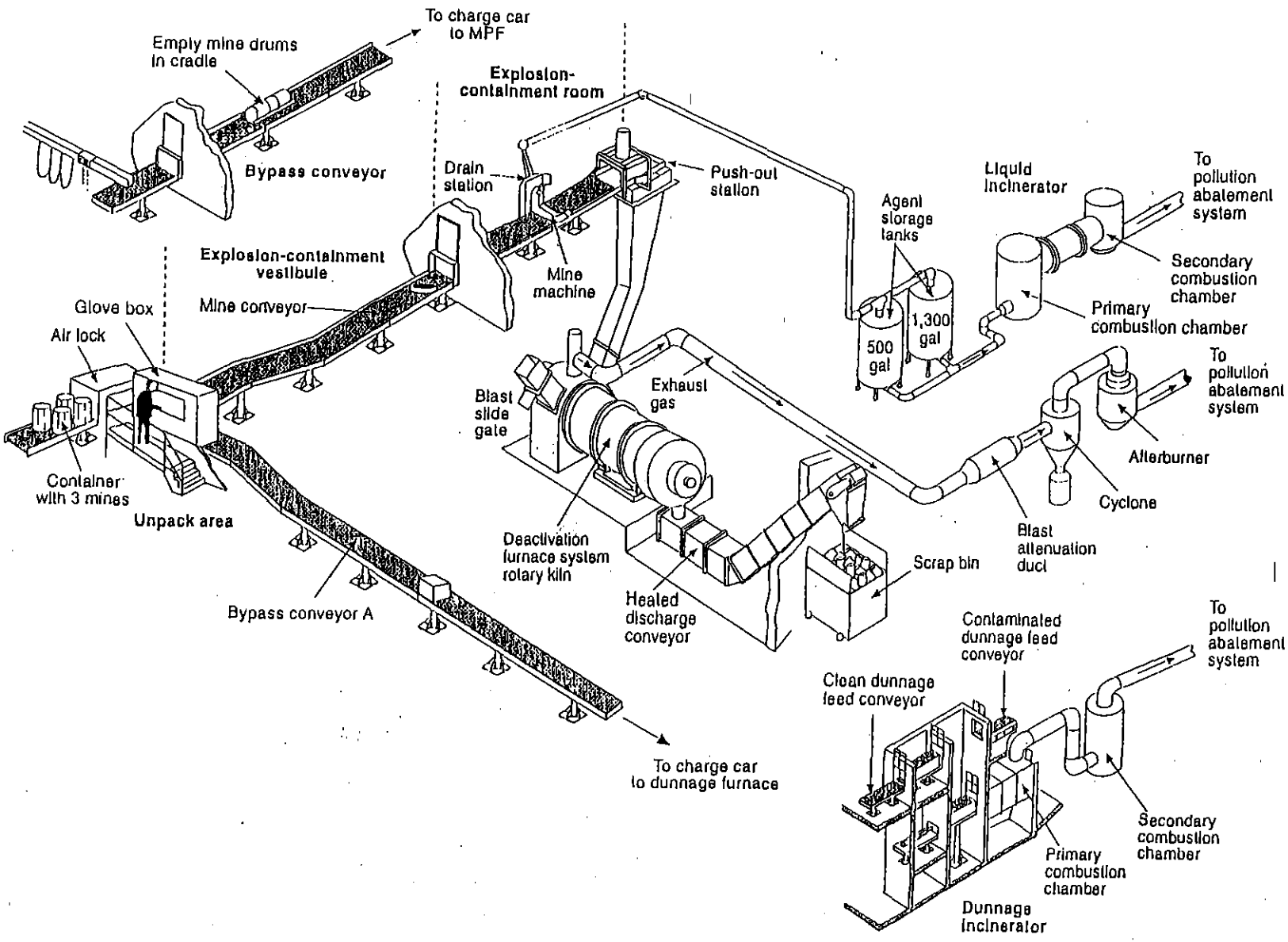


FIGURE A-5 Mine-handling system. Source: Adapted from U.S. Army, 1996.

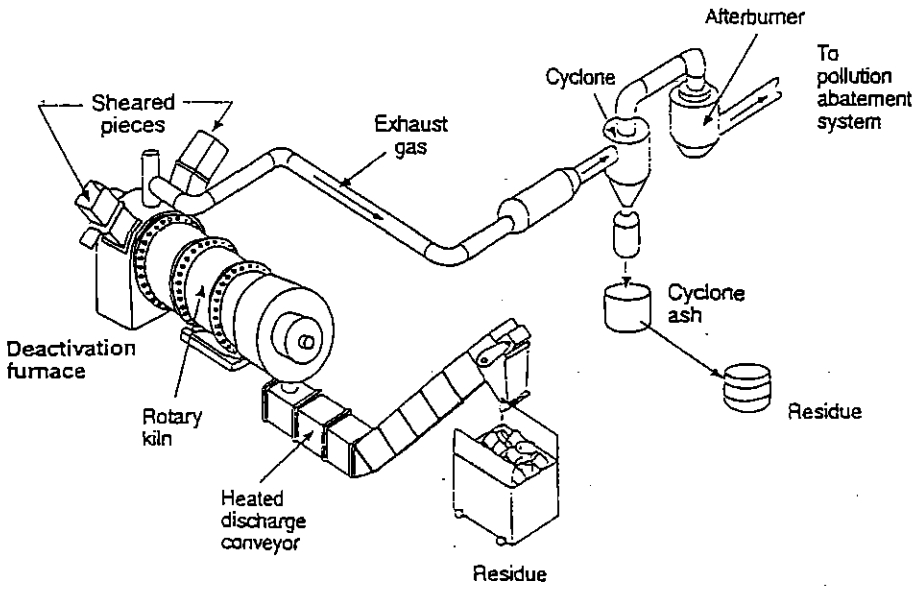


FIGURE A-6 Deactivation furnace system. Source: Adapted from U.S. Army, 1996.

MPF is diagrammed in Figure A-7. For ton containers, the MPF peaks at 1,450°F. For spray tanks, it operates at 525°F. For smaller items, it operates at 1,600°F. Contaminated items are conveyed semicontinuously through a charge air lock into the first of three heating zones, each of which has an air-lock door. Pieces are held in the discharge air lock until they cool enough so that agent levels can be monitored. Pieces that are 5X clean are cooled and containerized for disposal. The exhaust gas from the MPF goes through an afterburner and then to the PAS.

Two LICs destroy liquid agent. Figure A-8 shows the LIC configuration. The primary chamber, a vertical refractory-lined cylinder with a natural gas burner, operates at 2,700°F. Agent is atomized as it is injected into the air stream going into the burner. As the agent burns,

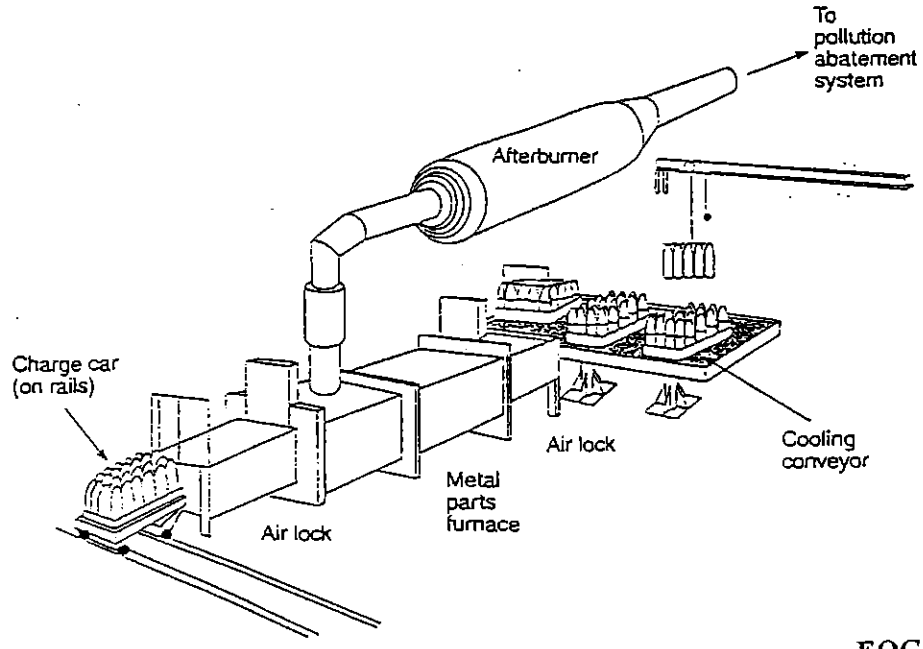


FIGURE A-7 Metal parts furnace. Source: Adapted from U.S. Army, 1996.

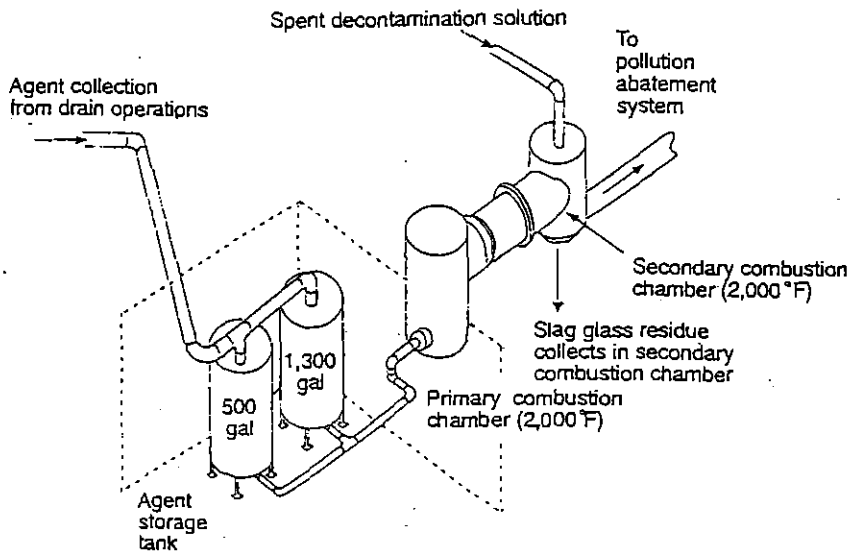
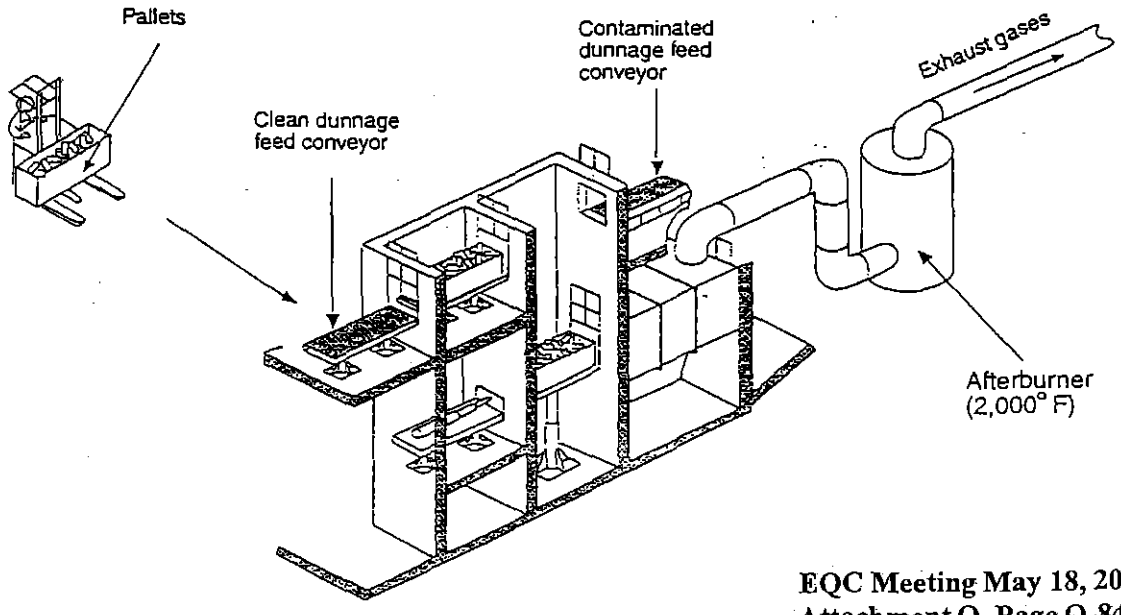


FIGURE A-8 Liquid incinerator. Source: Adapted from U.S. Army, 1996.

the natural gas supply is cut back to maintain the temperature at the desired level. The exhaust from the primary chamber goes into a similar, refractory-lined secondary chamber, in which the temperature is maintained at 2,050°F by burning natural gas. Spent decontamination solution is atomized and injected into the second combustion chamber. All of this forms a molten slag, which is drawn off through a bottom tap into barrels, where it solidifies. Once cool, these barrels are covered and stored prior to disposal.

A dunnage incinerator (DUN) is designed to destroy the plastic, wood, or paper packing cases, pallets, and other objects that may be contaminated by agent. In practice at the TOCDF, the DUN has not operated routinely because the listed materials could be safely disposed in other ways. The DUN is designed to burn natural gas and dunnage combustibles at a temperature of 1,400°F. The configuration of the DUN is shown in Figure A-9. The primary combustion chamber is refractory-lined and has four side burners. Air is supplied both through



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FIGURE A-9 Dunnage furnace. Source: Adapted from U.S. Army, 1996.

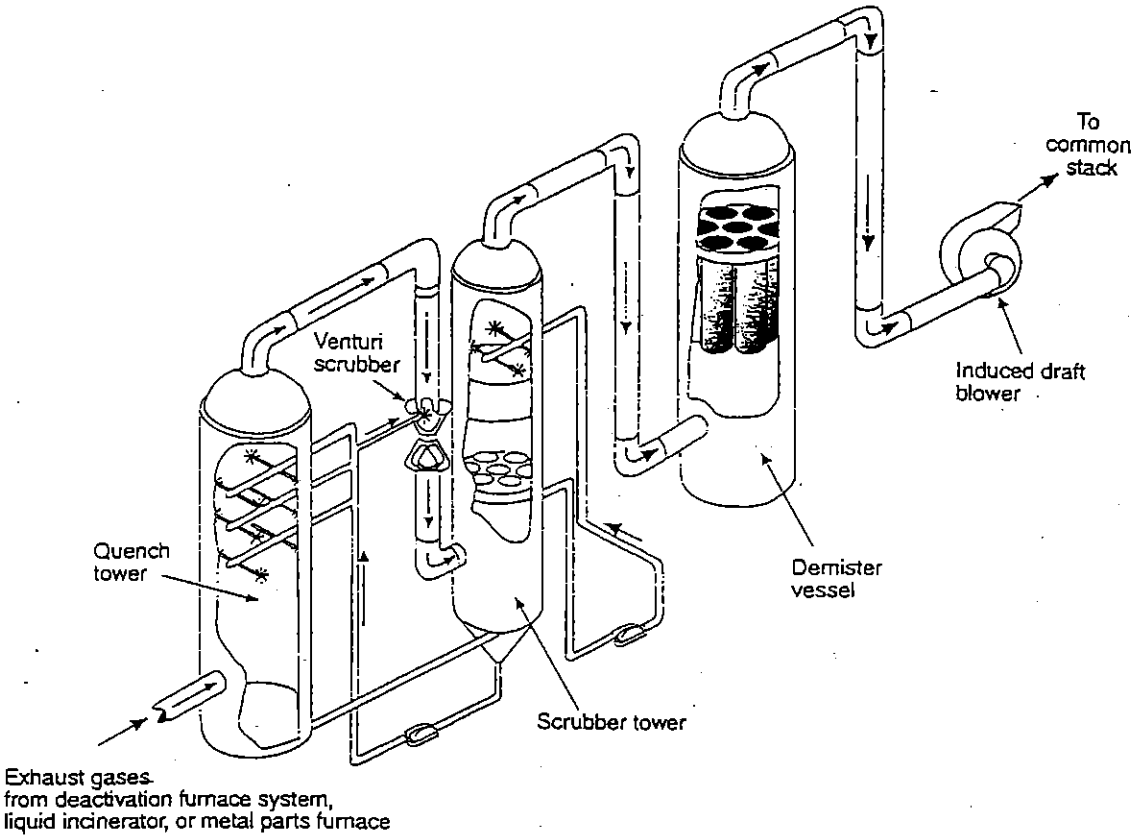


FIGURE A-10 Pollution abatement system. Source: Adapted from U.S. Army, 1996.

the burners and through side wall ports. Ashes are removed from the furnace periodically. Exhaust gases go to the afterburner, which operates at 2,000°F. Secondary exhaust passes into the PAS.

Safety Systems

Ensuring process safety is the prime concern of the design and operation of the TOCDF. Explosion-containment requirements were mentioned in several of the preceding sections. The overall design for explosion-containment rooms requires containment of a blast from 15 pounds of TNT. The DFS room is designed to contain a blast from 28.2 pounds of TNT. Interlocked blast gates and blast doors are used to ensure containment.

Agent dispersion in the air stream is another major safety concern. Avoiding contamination is accomplished by pressure cascading the air flow throughout the plant from areas with low contamination probability through areas with increasing contamination probability. The air from the most susceptible areas to agent contamination (the furnace rooms and the munition demilitarization building) is filtered through a series of high efficiency particulate air filters and carbon adsorption beds before being exhausted to a stack. In situ monitoring for agent occurs at many points within and around the perimeter of the plant. In addition, ambient air is continuously pumped through contaminant concentration tubes that are periodically collected and analyzed for agent by gas chromatography. There is also a system for monitoring and controlling doors so that the ventilation flowpaths are not upset even when personnel enter or leave the munition demilitarization building areas.

Fire protection is another critical safety concern. Automatic fire detectors are located throughout the plant. Sprinkler systems supplied from a large storage tank come on automatically in the event of a fire in the unloading and unpack areas. In other areas, dry chemical systems are deployed. Halon systems protect the control room and power supply room.

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Support Systems

The electric, instrumentation, compressed air, hydraulics, fuel gas, and cooling systems are fairly standard industrial systems, but they are often paralleled to ensure reliability. Each furnace system has a downstream PAS to neutralize and remove the acidic components (hydrochloric, hydrofluoric, sulfuric acids, etc.) formed during the combustion of the agent so the exit gas can be safely released to the atmosphere. Figure A-10 illustrates a typical PAS configuration. The furnace outlet gases enter a quench tower in which a caustic solution is sprayed. The cooled gases exit into a venturi scrubber where they are again in contact with caustic brine. Finally, they go through a scrubber tower where they are in contact with additional brine, through an induced draft fan, and then to a common stack. The PAS for the DUN is simple. It has only a quench tower because the exit gases are far less acidic than those from the other furnaces.

The brine reduction area (BRA) process involves evaporating brine with steam generated on site, then drying it to salt with less than 10 percent water content. The gas from the evaporator is superheated and passed through a bag filter system before being exhausted to the atmosphere. Currently, brine from the PAS is collected, stored temporarily, and then disposed of off site as a hazardous waste. This brine disposal strategy is currently a cheaper alternative than operating the BRA.

Operations Control Room

The central control room provides surveillance and direction for all phases of TOCDF activities. It is kept at a higher positive pressure to prevent the possibility of any agent entering it, and the air intake is doubly filtered. Several consoles line the room, each with two advisor screen monitors, two closed-circuit TV monitors, and a keyboard through which commands are entered to control plant operations. Redundant computers, software, and plant instrumentation ensure that continuous real-time control is maintained.

Reference

U.S. Army. 1996. Tooele Chemical Agent Disposal Facility Quantitative Risk Assessment. SAIC-96/2600. Aberdeen Proving Ground, Md.: U.S. Army Program Manager for Chemical Demilitarization.

Appendix B

Reports of the Committee on Review and Evaluation of the Army Chemical Stockpile Disposal Program (Stockpile Committee)

Comments on Operational Verification Test and Evaluation Master Plan for the Johnston Atoll Chemical Agent Disposal System (JACADS) (1989)

Demilitarization of Chemical Weapons: On-Site Handling of Munitions (1989)

Demilitarization of Chemical Weapons: Cryofracture (1989)

Workshop on the Pollution Abatement System of the Chemical Agent Demilitarization System (Letter Report, May 1991)

Letter report on siting of a cryofracture chemical stockpile disposal facility (August 1991)

Comments on Proposed Cryofracture Program Testing (Letter Report, August 1991)

Review of the MITRE report: Evaluation of the GB Rocket Campaign: Johnston Atoll Chemical Agent Disposal System Operational Verification Testing, dated May 1991 (Letter Report, September 1991)

Review of the Choice and Status of Incineration for Destruction of the Chemical Stockpile (Letter Report, June 1992)

Letter Report to recommend specific actions to further enhance the CSDP [Chemical Stockpile Disposal Program] risk management process (January 1993)

Recommendations for the Disposal of Chemical Agents and Munitions (February 1994)

Review of Monitoring Activities Within the Army Chemical Stockpile Disposal Program (April 1994)

Evaluation of the Johnston Atoll Chemical Agent Disposal System Operational Verification Testing: Part I (July 1993) and *Part II* (April 1994)

Evaluation of the Army's Draft Assessment Criteria to Aid in the Selection of Alternative Technologies for Chemical Demilitarization (December 1995)

Review of Systemization of the Tooele Chemical Agent Disposal Facility (March 1996)

Public Involvement and the Army Chemical Stockpile Disposal Program (Letter Report, October 1996)

Risk Assessment and Management at Deseret Chemical Depot and the Tooele Chemical Agent Disposal Facility (September 1997)

Using Supercritical Water Oxidation to Treat Hydrolysate from VX Neutralization (May 1998)

Carbon Filtration for Reducing Emissions from Chemical Agent Incineration (July 1999)

Appendix C

TOCDF-Related Recommendations by the Stockpile Committee Addressed in This Report[1]

SYSTEMIZATION REPORT (NRC, 1996a)

Duration of TOCDF Operations

Recommendation 1. Safety program development and implementation at the TOCDF must be given high priority.

Recommendation 2. Safety and environmental performance goals should be given at least equal weight with production goals in establishing award fee criteria.

Recommendation 3. Applicable portions of the accident quantitative risk assessments must be completed and all safety-related concerns resolved before the start of specific agent-destruction campaigns.

Recommendation 4. A substantial effort should be made by the Army to enhance interactive communications with the host community and the Utah State Citizens Advisory Commission on issues of mutual concern (e.g., various elements of the Chemical Stockpile Emergency Preparedness Program [CSEPP], decontamination and decommissioning, future use of the facility, and risk reduction).

Coordinated with the Start of Agent Operations

Recommendation 5. The Army should increase efforts to work with the Utah Division of Comprehensive Emergency Management to ensure that first-responders have been adequately trained to use the personal protective equipment approved by the Occupational Safety and Health Administration. Tooele County must ensure their capability for responding to an emergency incident, especially because this condition relates to state requirements for the start of agent operations.

Recommendation 6. The Army, and where appropriate the Federal Emergency Management Agency (FEMA), should ensure that local and state Chemical Stockpile Emergency Preparedness Program (CSEPP) plans for responding to potential chemical events are complete and well exercised as soon as possible.

Recommendation 7. The Army/FEMA should provide the necessary resources for completing the communications system planned by the Tooele County Department of Emergency Management.

Prior to the Start of Agent Operations

Recommendation 8. All mandatory requirements of the Army's Pre-Operational Survey must be satisfied.

Recommendation 9. The liquid incinerator and deactivation furnace system must have demonstrated a destruction removal efficiency of 99.9999 percent (6-nines) during surrogate trial burns.

Recommendation 10. High-quality, adequately staffed safety management systems must be completely implemented (including procedures for testing

[1]Throughout the text of this report, references to recommendations from the 1996 NRC report, *Review of Systemization of the Tooele Chemical Agent Disposal Facility* (*Systemization* report), are designated by [S-#]; recommendations from the 1996 NRC report, *Public Involvement and the Army Chemical Stockpile Disposal Program* (*Public Involvement* letter report), are designated by [PI-#]; and recommendations from the 1997 NRC report, *Risk Assessment and Management at Deseret Chemical Depot and the Tooele Chemical Agent Disposal Facility* (*Risk Assessment and Management* report), are designated by [R-#].

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cal equipment; all necessary operating, maintenance, and emergency procedures; management of change procedures; training and cross-training programs; programmatic lessons-learned activities; subject area reviews; and other safety oversight activities).

During the First Year of Agent Operations

Recommendation 11. The liquid incinerator must pass all required Resource Conservation and Recovery Act (RCRA) trial burns; and the deactivation furnace system must pass required Toxic Substances Control Act trial burns.

Recommendation 12. Testing and certification of the brine reduction area and the dunnage incinerator should be completed at the TOCDF, or a satisfactory disposal alternative must be implemented.

Recommendation 13. Performance of the slag removal tem for the liquid incinerators should be demonated when sufficient slag has accumulated.

Recommendation 14. The Risk Management Plan must be fully implemented.

Recommendation 15. A comprehensive, integrated, and clear TOCDF risk assessment study, including a full description of all significant acute and latent agent and nonagent risks associated with disposal operations, as well as with the continued maintenance of the Tooele chemical stockpile, should be completed. A full explanation of the uncertainties associated with the various estimates should be included.

Recommendation 16. A system for documenting and tracking unexpected upsets, errors, failures, and other sources of problems that lead to "near misses" during operation of the facility should be developed as soon as possible. A program for integrating this information into a plan for continual safety improvements at the TOCDF should be implemented.

ecommendation 17. An active program for continual improvement of monitoring instrumentation, including techniques for more rapid recognition of significant levels of agent release, should be pursued.

PUBLIC INVOLVEMENT LETTER REPORT (NRC, 1996b)

Recommendation 1. The Army and the Chemical Stockpile Disposal Program management at all levels must make an increased commitment to public involvement throughout the entire program.

- The Program Manager for Chemical Demilitarization should establish and develop mechanisms and processes that allow direct input by affected citizens into the decision-making process for destruction of the stockpile.
- The Program Manager for Chemical Demilitarization should develop and implement a detailed public involvement plan that identifies program elements where the public and affected parties can make significant contributions to program decisions. The plan should be developed with input from the public, citizens advisory commissions, and other affected parties. The plan should define the goal of public involvement, a process for identifying opportunities for public input and review, mechanisms for interaction between the public and the parties responsible for implementing the disposal program, and individual and collective roles and accountability on the part of the Army, citizens advisory commissions, and others. Senior management of the Chemical Stockpile Disposal Program and management at each chemical stockpile site should be active and visible participants in the public involvement process.
- The Program Manager for Chemical Demilitarization should institute policies and procedures to ensure feedback to the communities detailing the Army's response to and use of input from the public and other parties in the decision-making process and program oversight.
- The Program Manager for Chemical Demilitarization is encouraged to provide independent technical assistance to the citizens advisory commissions as requested. This assistance should come from individuals or organizations that are without bias and have no conflicts of interest concerning the Chemical Stockpile Disposal Program.

Recommendation 2. The public affairs programs for the Chemical Stockpile Disposal Program, the Chemical Stockpile Emergency Preparedness Program, and other Army activities at stockpile locations should be

closely coordinated to avoid adversely affecting public perceptions of the Chemical Stockpile Disposal Program and delaying implementation of stockpile destruction. In addition, the public affairs program for the Chemical Stockpile Disposal Program should be coordinated with the risk management plan at each stockpile site.

RISK ASSESSMENT AND MANAGEMENT REPORT (NRC, 1997)

Risk Assessments

Recommendation 1. The Army should update both the QRA and HRA at the TOCDF whenever changes to system design or operations occur that could affect QRA or HRA calculations to ensure that estimates of risk are current and reflect changes in operating conditions and experience, assumptions, and program status (current Established Configuration). The process for updating the QRA and HRA should be included in the *Guide*.

Recommendation 2. The Army should continue the site-specific QRA and HRA processes at all PMCD sites. The development of assessments for sites other than the DCD will be greatly simplified because much of the methodology has already been established. The Army should continue to obtain interactive, independent expert reviews of all site-specific QRAs. The Army should heed the lessons learned from development of the TOCDF QRA and should incorporate the changes recommended by the Expert Panel.

Recommendation 3. The QRA methodology manual should be updated to reflect the significant improvements that have been made.

Risk Management

Policy

Recommendation 4. The Army should expand its draft report on risk management policy, *A Guide to Risk Management Policy and Activities*, to encourage the establishment of a "safety culture" within the PMCD and its field offices and among contractors and other government agencies. The *Guide* should elucidate the Army's policy on industrial safety, including the responsibilities of individuals and managers in the field and the definitions of acceptable performance.

Recommendation 5. The Army should develop a management plan (and include it in the *Guide*) that defines the integration of management roles, responsibilities, and communications across activities by risk management functions (e.g., operations, safety, environmental protection, emergency preparedness, and public outreach).

Recommendation 6. The Army should review and expand the current draft risk management plan to include public involvement in appropriate areas beyond the management of change process.

Recommendation 7. The Army should institutionalize the management of change process developed in the *Guide*. The Army should track performance of the change and document public involvement and public responses to decisions. The Army should use this experience to improve the change process.

Recommendation 8. The Army should expand implementation of the risk management program to ensure that workers understand the results of the risk assessments and risk management decisions. The Army should also ensure that CSEPP and other emergency preparedness officials understand the QRA and how their activities might affect risk. CSEPP activities should be tracked by the Army as part of their risk management program.

Recommendation 9. The Army should implement their risk management plans and update them whenever necessary to ensure that they reflect current practices and lessons learned.

References

NRC (National Research Council). 1996a. Review of Systemization of the Tooele Chemical Agent Disposal Facility. Committee on Review and Evaluation of the Army Chemical Stockpile Disposal Program, Board on Army Science and Technology. Washington, D.C.: National Academy Press.

NRC. 1996b. Public Involvement and the Army Chemical Stockpile Disposal Program. Committee on Review and Evaluation of the

Army Chemical Stockpile Disposal Program, Board on Army Science and Technology. Washington, D.C.: National Academy Press.

NRC. 1997. Risk Assessment and Management at Deseret Chemical Depot and the Tooele Chemical Agent Disposal Facility. Committee on Review and Evaluation of the Army Chemical Stockpile Disposal Program, Board on Army Science and Technology. Washington, D.C.: National Academy Press.

Appendix D

Biographical Sketches of Committee Members

David S. Kosson (*chair*) has a B.S. in chemical engineering, an M.S. in chemical and biochemical engineering, and a Ph.D. in chemical and biochemical engineering from Rutgers, The State University of New Jersey. He joined the faculty at Rutgers in 1986 and was made an associate professor with tenure in 1990 and a full professor in 1996. Dr. Kosson teaches graduate and undergraduate courses in chemical and environmental engineering and conducts research for the Department of Chemical and Biochemical Engineering on the development of microbial, chemical, and physical treatments for hazardous waste. He is responsible for project planning and coordination, from basic research through full-scale design and implementation. He has published extensively in the fields of chemical engineering, waste management and treatment, and contaminant fate and transport in, soils and groundwater. Dr. Kosson has served on several Environmental Protection Agency advisory panels involved in waste research and is the director of the Physical Treatment Division of the Hazardous Substances Management Research Center in New Jersey. He is a member of the American Institute of Chemical Engineers and recently served as a member of the National Research Council Committee on Alternative Chemical Demilitarization Technologies.

Charles E. Kolb (*vice chair*) is president and chief executive officer of Aerodyne Research, Inc. Since 1971, his principal research interests at Aerodyne have included atmospheric and environmental chemistry, combustion chemistry, materials chemistry, and the chemical physics of rocket and aircraft exhaust plumes. He has served on several National Aeronautics and Space Administration panels dealing with atmospheric chemistry and global change, as well as on five National Research Council committees and boards dealing with environmental issues. From 1996 to 1999, he was atmospheric sciences editor for *Geophysical Research Letters*. In 1997, he received the Award for Creative Advances in Environmental Science and Technology from the American Chemical Society.

David H. Archer, a member of the National Academy of Engineering, has a Ph.D. in chemical engineering and mathematics from the University of Delaware. He is a retired consulting engineer with the Westinghouse Electric Company and is currently adjunct professor at Carnegie Mellon University. Dr. Archer has worked in both industry (at Westinghouse as an engineer, supervising engineer, department manager, and consulting engineer) and academia (at the University of Delaware and Carnegie Mellon University for almost 10 years). He has considerable experience in research and management related to chemical engineering, as well as experience with combustion and plant management.

Piero M. Armenante has a Ph.D. in chemical engineering from the University of Virginia and is currently professor of chemical engineering at the New Jersey Institute of Technology. Dr. Armenante's research interests include multiphase mixing in agitated systems, the biological treatment of hazardous waste, industrial sterilization processes, and biomedical engineering. He has an extensive list of peer-reviewed and other publications and has administered numerous grants, studies, and projects.

Dennis C. Bley is president of Buttonwood Consulting, Inc., and a principal of The WreathWood Group, a joint venture company that supports multidisciplinary research in human reliability. He has more than 25 years of experience in nuclear and electrical engineering, reliability and availability analysis, plant and human modeling for risk assessment, diagnostic system development, and technical management. Dr. Bley has a Ph.D. in nuclear engineering from the Massachusetts Institute of Technology and is a registered professional engineer in the state of California. He has served on a number of technical review panels for U.S. Nuclear Regulatory Commission and U.S. Department of Energy programs and is a frequent lecturer in short courses for universities, industries, and government agencies. He is active in many professional organizations and is

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e Board of Directors of the International Association for Probabilistic Safety Assessment and Management. Dr. Bley has published extensively on subjects related to risk assessment. His current research interests include applying risk analysis to diverse technological systems, modeling uncertainties in risk analysis and risk management, technical risk communication, and human reliability analysis.

Jerry L.R. Chandler has a Ph.D. in biochemistry from Oklahoma State University and has done extensive postgraduate study in mathematics. He is currently a research professor at the Krasnow Institute for Advanced Study at George Mason University. During his long career, Dr. Chandler served with the U.S. Public Health Service, the National Institute for Occupational Safety and Health (NIOSH), the Food and Drug Administration, and the National Cancer Institute Epidemiology Program. More recently, he was a neuropharmocologist in the Epilepsy Branch of the National Institute of Neurology and Stroke for the National Institutes of Health. Dr. Chandler is a founding member and president of the Washington Evolutionary Systems Society and has published extensively on using mathematical category theory to understand the origins of disease. He previously served as a NIOSH observer with the National Academy of Science/National Research Council Panel on Risk Assessment.

Frank P. Crimi is a part-time consultant and retired vice president of Lockheed Martin Advanced Environmental Systems Company. He has a B.S. in mechanical engineering from Ohio University and has done graduate studies in mechanical engineering at Union College in Schenectady, New York. In addition to his appointment to the National Research Council Committee on Decontamination and Decommissioning of Uranium Enrichment Facilities, Mr. Crimi has firsthand knowledge and experience with radioactive and hazardous-waste treatment and disposal technologies.

Elisabeth M. Drake, a member of the National Academy of Engineering, is the associate director of the Massachusetts Institute of Technology Energy Laboratory. A chemical engineer with experience in risk management and technology associated with the transport, processing, storage, and disposal of hazardous materials, as well as chemical engineering process design and control systems, Dr. Drake has a special interest in the interactions between technology and the environment. She has often been a consultant to government and industry and has been active in the American Institute of Chemical Engineers, especially the Center for Chemical Process Safety. She belongs to a number of environmental organizations, including the Audubon Society, the Sierra Club, and Greenpeace.

J. Robert Gibson is the assistant director of the Haskell Laboratory, E.I. du Pont de Nemours and Company, and an adjunct associate professor of marine studies at the University of Delaware. Since receiving his Ph.D. in physiology from Mississippi State University, Dr. Gibson has specialized in toxicology. He has been certified by the American Board of Toxicology and has written numerous publications.

Michael R. Greenberg is a professor in the Department of Urban Studies and Community Health at Rutgers, The State University of New Jersey, and is an adjunct professor of environmental and community medicine at the Robert Wood Johnson Medical School. His principal research and teaching interests include urbanization, industrialization, and environmental health policy. Dr. Greenberg holds a B.A. in mathematics and history, an M.A. in urban geography, and a Ph.D. in environmental and medical geography.

Kathryn E. Kelly received her Ph.D. in public health from Columbia University, with a concentration in environmental toxicology and the health effects of hazardous waste incineration. She also studied toxicology at the New York University Institute of Environmental Medicine. Dr. Kelly is the founder and president of three companies: Delta Toxicology, Inc., Crystal Bay, Nevada; Environmental Toxicology International, Seattle, Washington; and Alden Analytical Laboratories of Seattle, Washington. She has broad experience in toxicology, waste combustion, environmental policy, and risk communication.

Peter B. Lederman is director of the Center for Environmental Engineering and Sciences, executive director of the Office of Intellectual Property, and research professor of chemical engineering and environmental policy at the New Jersey Institute of Technology. He received his Ph.D. in chemical engineering from the University of Michigan. Dr. Lederman has 45 years of experience in all facets of environmental management, control, and policy development; hazardous substance treatment and management; process engineering; and more than 18 years of experience as an educator. He is

a registered professional engineer and a diplomate of the American Academy of Environmental Engineers. Dr. Lederman has worked on environmental policy at the federal and state levels and has served on several National Research Council committees, most recently the Committee on Decontamination and Decommissioning of Gaseous Diffusion Plants.

Richard S. Magee (chair from 7/94 to 7/98) is a professor in the Department of Mechanical Engineering and the Department of Chemical Engineering, Chemistry, and Environmental Science and associate provost for research and development at the New Jersey Institute of Technology (NJIT). He also directs the Environmental Protection Agency's Northeast Hazardous Substance Research Center. He is a fellow of the American Society of Mechanical Engineers (ASME) and a diplomate of the American Academy of Environmental Engineers. Dr. Magee's research expertise is in combustion, with a focus on the incineration of municipal and industrial wastes. He has served as vice chairman of the ASME Research Committee on Industrial and Municipal Wastes and as a member of the United Nations Special Commission (under Security Council Resolution 687) Advisory Panel on Destruction of Iraq's Chemical Weapons Capabilities. He was recently a member of the North Atlantic Treaty Organization (NATO) Science Committee's Priority Area Panel on disarmament technologies and is presently a member of the NATO Science Committee's Security-Related Civil Science and Technology Panel. He recently chaired the National Research Council Panel on Review and Evaluation of Alternative Chemical Disposal Technologies.

James F. Mathis, a member of the National Academy of Engineering, graduated from the University of Wisconsin with a Ph.D. in chemical engineering. Dr. Mathis was vice president of science and technology for Exxon Corporation, where he was responsible for worldwide research and development programs, and chair of the New Jersey Commission on Science and Technology until his retirement in 1997. Dr. Mathis' expertise is in research and development and chemical engineering.

Walter G. May has a B.S. in chemical engineering and an M.S. in chemistry from the University of Saskatchewan and a D.Sc. in chemical engineering from the Massachusetts Institute of Technology. He joined the faculty of the University of Saskatchewan as a professor of chemical engineering in 1943. In 1948, he began a distinguished career with Exxon Research and Engineering Comp[illegible] where he was a senior science advisor from 1976 to 1983. From 1983 until his retirement in 1991, he was professor of chemical engineering at the University of Illinois, where he taught process design, thermodynamics, chemical reactor design, separation processes, and industrial chemistry and stoichiometry. Dr. May has published extensively, served on the editorial boards of *Chemical Engineering Reviews* and *Chemical Engineering Progress,* and has obtained numerous patents in his field. He is a member of the National Academy of Engineering, a fellow of the American Institute of Chemical Engineers, and has received special awards from the American Institute of Chemical Engineers and the American Society of Mechanical Engineers. He is also a registered professional engineer in the state of Illinois. Dr. May was a member of the National Research Council Committee on Alternative Chemical Demilitarization Technologies and the Committee on Decontamination and Decommissioning of Uranium Diffusion Plants.

Charles I. McGinnis has an M.E. from Texas A&M University. He retired from the U.S. Army as a major general and former director of civil works for the U.[illegible] Army Corps of Engineers and recently served in senior positions at the Construction Industry Institute in Austin, Texas. He was also director of engineering and construction for the Panama Canal Company and was subsequently vice president of the company and lieutenant governor of the Canal Zone. As director of civil works for the Corps of Engineers, he was responsible for a $3 billion per year budget for the planning, design, construction, operation, and maintenance of public works nationwide.

Alvin H. Mushkatel, professor in the School of Planning and Landscape Architecture, Arizona State University, is an expert in emergency management risk perceptions. His research interests include emergency management, natural and technological hazards policy, and environmental policy. He has been a member of the National Research Council Committee on Earthquake Engineering, the Committee on Decontamination and Decommissioning of Uranium Enrichment Facilities, and the Panel on Review and Evaluation of Alternative Chemical Disposal Technologies. His most recent research has been focused on intergovernmental policy conflicts involving high-level nuclear waste disposal and the role of citizens in decision-making processes. He has published extensively on issues related to siting.

J. Gregor Rigo attended Ohio University and earned his Ph.D. in mechanical and environmental engineering from the University of Illinois. He is currently president of Rigo & Rigo Associates, Inc., in Berea, Ohio. He has extensive experience in plant start-up, process and environmental engineering, and applied statistics focused on the use and control of emissions from nontraditional fuels; technical, environmental, and economic evaluations; and multipathway health risk assessments.

Kozo Saito has a Ph.D. in mechanical engineering from Seikei University in Tokyo and is currently professor of mechanical engineering in the Department of Mechanical Engineering at the University of Kentucky. Dr. Saito's expertise and experience are in experimental combustion studies, thermal sensing and control, and lean manufacturing and control. He is a member of the Combustion Institute, the American Society for Engineering Education, and the American Society of Mechanical Engineers.

V. Leigh Short earned his Ph.D. in chemical engineering from the University of Michigan. He recently retired as a principal and vice president of Woodward-Clyde, where he was responsible for management and business development associated with the company's hazardous waste services in Wayne, New Jersey. Dr. Short has expertise in air pollution, chemical process engineering, hazardous waste services, feasibility studies, site remediation, and project management. He has taught courses in control technologies, both to graduate students and as a part of the Environmental Protection Agency's (EPA's) national training programs. He has also served as chairman of the EPA's NO_x Control Technology Review Panel.

Arnold F. Stancell, a member of the National Academy of Engineering, graduated from the Massachusetts Institute of Technology with an Sc.D. in chemical engineering. Dr. Stancell is currently a professor of chemical engineering at Georgia Institute of Technology and recently was visiting professor of chemical engineering at the Massachusetts Institute of Technology. For many years he worked for Mobil Oil, where he started in research and eventually became vice president of Mobil Chemical and then vice president in the crude oil and natural gas business, both domestic and international. He was responsible for a $5 billion per year business with 5,000 employees. Dr. Stancell's expertise is in the management of large businesses, including chemical operations.

Steven R. Tannenbaum, a member of the Institute of Medicine, has a Ph.D. in food science and technology from the Massachusetts Institute of Technology. He is currently the codirector and Underwood-Prescott Professor, Division of Bioengineering and Environmental Health, and professor of chemistry, Department of Chemistry at the Massachusetts Institute of Technology. Dr. Tannenbaum's research interests include the chemistry and pathophysiology of nitric oxide, the quantitative measurement of human exposure to carcinogens, and tissue-based microsensors for toxin detection and drug metabolism. He has been a member of the National Research Council (NRC) Board on Environmental Studies and Toxicology and several NRC committees.

Chadwick A. Tolman received his Ph.D. in physical chemistry from the University of California at Berkeley and is currently a program officer in organic and macromolecular chemistry in the Division of Chemistry at the National Science Foundation. He has extensive experience and expertise in chemistry and chemical process development. Dr. Tolman spent 31 years in Central Research at the DuPont Experimental Station. His work has spanned a broad range of subjects, including hydrocarbon oxidation, organometallic chemistry, and the destruction of toxic organic compounds in wastewater.

William Tumas graduated from Ithaca College with a B.A. in chemistry and earned his Ph.D. in organic chemistry from Stanford University, with a National Science Foundation and Hertz Foundation Fellowship. After conducting postdoctoral research in organometallic chemistry at the California Institute of Technology as a National Institutes of Health and Chaim Weizman Postdoctoral Fellow, he worked for six years at DuPont Central Research and Development. Since 1993, Dr. Tumas has been at Los Alamos National Laboratory, where he is currently group leader of the Chemical and Environmental Research and Development Group in the Chemical Sciences and Technology Division. He has previously served on two National Research Council committees, including the Panel on Review and Evaluation of Alternative Chemical Demilitarization Technologies (1995–1996). His research interests include catalysis, supercritical fluids, environmental chemistry, and waste treatment technology assessment.

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ATTACHMENT P

TABLE OF COMMENTS AND EXHIBITS

Documents related to the
Confederated Tribes of the Umatilla Indian Reservation (CTUIR)

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ATTACHMENT P

Documents related to the Confederated Tribes of the Umatilla Indian Reservation

EXHIBIT NO.	TITLE	DATE OF DOCUMENT	AUTHOR (IF APPLICABLE)	ADMIN RECORD NO.[1]	NOTES AND CITATIONS TO DOCUMENT[2]
29	James R. Wilkinson's Affidavit	8/19/98	James R. Wilkinson	No Record Number Assigned	Mr. James R. Wilkinson is the Program Manager for the Special Sciences and Resources Program, Department of Natural Resources, Confederated Tribes of the Umatilla Indian Reservation. This Affidavit contains two attachments (see Exhibits 29.1 and 29.2). Mr. Wilkinson states that the Affidavit is the "personal view of the author, and does not represent the views of the tribal government." Cited in Item No. **98-1275** (p. 40, line 0, and p. 61, line 2) to support the Petitioner's contention that the UMCDF Health Risk Assessment fails to consider "impacts of low level agent exposure; impacts on a fetus, infant, and sensitive populations; impacts that may be particular to Native Americans..." Item No. **98-1275** (pp. 64-65) refers to this Affidavit (pp. 5-6) to support the Petitioner's contention that the DEQ and EQC did not sufficiently consider reconfiguration when conducting analysis of alternative technologies. Also cited in Item No. **98-1247** (p.4); Item No. **99-0704** (p. 7); and in Item No. **99-2201** (p. 33).

[1] The DEQ Chemical Demilitarization Program maintains a database of documents related to the Umatilla Chemical Agent Disposal Facility. Most documents are assigned a record number for tracking purposes. Individual "Exhibits" submitted during the course of G.A.S.P., et al., *v.* EQC, et al., (Case No. 9708-06159, Oregon Circuit Court) were not assigned record numbers at the time of submittal—only the document the Exhibit was attached to was assigned a number. Some Exhibits do have Administrative Record Numbers because the document had been previously received.

[2] No. **98-1247:** "Request for Contested Case Hearing and Other Relief," letter dated December 14, 1998 (Included as Attachment A)
No. **98-1275**: "Petitioners' Memorandum Supporting Cross Motion for Summary Judgment," August 20, 1998 (Case No. 9708-06159)
No. **99-0704**: "Petitioners' Opposition to Respondents' Supplemental Motion for Summary Judgment," April 12, 1999 (Case No. 9708-06159)
No. **99-2201**: "Comments of G.A.S.P., et al., in Support of Their Request to Suspend and Revoke Permits for [UMCDF]," December 17, 1999 (Included in Attachment E)

ATTACHMENT P

Documents related to the Confederated Tribes of the Umatilla Indian Reservation

EXHIBIT NO.	TITLE	DATE OF DOCUMENT	AUTHOR (IF APPLICABLE)	ADMIN RECORD NO.[1]	NOTES AND CITATIONS TO DOCUMENT[2]
29.1	Resolution of the CTUIR Board of Trustees	1/17/96	Donald Sampson, Chairman	98-1391	This is Attachment "A" to Exhibit 29. This document is a Resolution of the Board of Trustees of the Confederated Tribes of the Umatilla Indian Reservation requesting there be a "one year moratorium on consideration of the Army's incinerator request, pending the completion, in cooperation with the CTUIR, of an analysis of the relative capabilities presented by alternate chemical disposition technologies and the relative risks those technologies pose to the members and residents of the CTUIR as compared to incineration and to continued storage of these weapons."
29.2	Lines Drawn in the Sand: A Review of Challenges, Opportunities, and Options for Chemical Weapons Disposal	11/14/96	Donald Sampson, Armand Minthorn, J.R. Wilkinson	98-1391	This is Attachment "B" to Exhibit 29. This is the text of the presentation given by the CTUIR to the EQC in November, 1996. Mr. Sampson outlined CTUIR concerns with UMCDF and the permitting process proposed that the chemical weapons stockpile be reconfigured to reduce risks and that a Governor's Task Force be established to review alternatives.

ATTACHMENT Q

TABLE OF COMMENTS AND EXHIBITS

Documents related to the treatment and/or off-site disposal of secondary wastes

and

"Follow-up to August 18, 1999 Environmental Quality Commission Meeting," Letter from the Chair of the Environmental Quality Commission to the Assistant Secretary of the Army and the Program Manager for Chemical Demilitarization September 24, 1999 (DEQ Item No. 99-1640)

Letter from the Program Manager for Chemical Demilitarization to the Chair of the Environmental Quality Commission (response to EQC letter of September 24, 1999) December 17, 1999 (DEQ Item No. 99-2272)

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ATTACHMENT Q

Documents related to the treatment and/or off-site disposal of secondary wastes

EXHIBIT NO.	TITLE	DATE OF DOCUMENT	AUTHOR (IF APPLICABLE)	ADMIN RECORD NO.[1]	NOTES AND CITATIONS TO DOCUMENT[2]
60	"Information Paper" regarding dioxin emissions from the DUN	5/21/96	LTC John Ontiveros	No record number assigned	The Information Paper discusses the causes of dioxin formation and test results from the DUN operation at JACADS that indicate the DUN will be the greatest source of dioxin emissions at the demilitarization facilities. Cited in Item Nos. **98-1247** (p. 8); **98-1285** (p. 7); and **99-0704** (p. 13).
61	EG&G Memo - Discontinuing op. Of BRA at the Tooele Facility	7/28/98	Tom Kurkjy & Debbie Sweeting	No record number assigned	Exhibit 61 is an EG&G memorandum discussing the discontinuing of BRA operations at the at the Tooele Facility and inviting affected employees to apply for other available positions at TOCDF. Cited in Item Nos. **98-1247** (p. 8); **98-1285** (p. 7), and **99-0704** (p. 13).

[1] The DEQ Chemical Demilitarization Program maintains a database of documents related to the Umatilla Chemical Agent Disposal Facility. Most documents are assigned a record number for tracking purposes. Individual "Exhibits" submitted during the course of G.A.S.P., et al., *v.* EQC, et al., (Case No. 9708-06159, Oregon Circuit Court) were not assigned record numbers at the time of submittal—only the document the Exhibit was attached to was assigned a number. Some Exhibits do have Administrative Record Numbers because the document had been previously received.

[2] No. **98-1247**: "Request for Contested Case Hearing and Other Relief," letter dated December 14, 1998 (Included as Attachment A)
No. **98-1275**: "Petitioners' Memorandum Supporting Cross Motion for Summary Judgment," August 20, 1998 (Case No. 9708-06159)
No. **98-1285**: "Petitioners' Additional Documentary Evidence," November 10, 1998 (Case No. 9708-06159)
No. **99-0704**: "Petitioners' Opposition to Respondents' Supplemental Motion for Summary Judgment," April 12, 1999 (Case No. 9708-06159)

ATTACHMENT Q

Documents related to the treatment and/or off-site disposal of secondary wastes

EXHIBIT NO.	TITLE	DATE OF DOCUMENT	AUTHOR (IF APPLICABLE)	ADMIN RECORD NO.[1]	NOTES AND CITATIONS TO DOCUMENT[2]
62	Table titled "TOCDF Hazardous Waste Off-Site Disposal Activities"	(undated, but appears to have been faxed by the Utah DEQ in June, 1998.)	Utah DEQ	No record number assigned	The Petitioners have described this as a Table prepared by the Utah Division of Solid and Hazardous Waste - compiling data concerning the enormous off-site waste disposal needs of the Tooele Facility - based on data from 8/96 through 3/98. This Table is referenced in Item No. **98-1275** (p. 35, line 8) as a demonstration of the consequences of not operating the BRA or the DUN and the resulting need for off-site shipment. Also cited in Item Nos. **98-1247** (p. 8); **98-1285** (p. 7), and Item No. **99-0704** (p. 13).

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FILE

Oregon

ENVIRONMENTAL QUALITY COMMISSION

September 24, 1999

SEP 28 1999

OFFICE OF THE DIRECTOR

Dr. Theodore Prociv
Assistant Secretary of the Army
Office of the Assistant Secretary of the Army
Acquisition, Logistics, and Technology
2511 Jefferson Davis Highway, Room 11300
Arlington, VA 22202

Mr. James L. Bacon
Program Manager for Chemical Demilitarization (PMCD)
ATTN: SFAE-CD-Z, Building E4585
Corner of Hoadley and Parrish Roads, Edgewood Area
Aberdeen Proving Ground, Maryland 21010-5401

STATE OF OREGON
DEPARTMENT OF ENVIRONMENTAL QUALITY
RECEIVED
OCT 04 1999
HERMISTON OFFICE

Re: Follow-up to August 18, 1999
Environmental Quality Commission meeting

Dear Dr. Prociv and Mr. Bacon:

Thank you both for your personal attendance at the meeting of the Environmental Quality Commission on August 18, 1999. The Commission has considered the information you presented about the secondary waste treatment technologies that the Army is studying for utilization at the Umatilla Chemical Agent Disposal Facility (UMCDF). The information was disconcerting, to say the least.

The UMCDF hazardous waste permit that the Commission approved in 1997 permitted five treatment units for all waste stored at the Umatilla Chemical Depot, to include the wastes generated by any activities (past, present, or future) related to the storage, treatment, or disposal of the chemical weapons stockpile. The Dunnage incinerator was the treatment unit designated for secondary wastes. The Army has now come before the Commission, almost three years later and with 60% of the facility constructed, and informed us that the Dunnage incinerator is "too expensive" and has "throughput" problems.

We want to emphasize to you that the primary mission given to the Commission by the Governor of the State of Oregon is the protection of human health and the environment. When a Permittee from a hazardous waste facility in Oregon approaches the Commission concerning major modifications to their permit, the Commission's responsibility is to insure that any modifications do not impact human health and the environment and will result in adequate protection for the citizens of Oregon. Although the Commission appreciates the need to save the taxpayer's money, the cost to the Permittee to conduct operations in a protective manner and in compliance with their Permit is rarely a key criterion when evaluating a Permittee's request.

The Commission is very concerned about the potential for "legacy wastes" remaining at the Umatilla Chemical Depot after the chemical weapons themselves have been

SW Sixth Avenue
tland, OR 97204-1390
3) 229-5696

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destroyed. The hazardous waste permit granted to the U.S. Army in 1997 was crafted to ensure the destruction of all chemical warfare materiel stored at the Depot at the time of permit issuance, and any and all byproducts from the storage activities or the demilitarization process.

As discussed at the August 18 meeting, the Commission has requested the Department of Environmental Quality staff work with the Army to insure that any Permit Modification Request concerning a compliance schedule contains sufficient information for the Commission to evaluate its merits on the basis of providing equal or better protection to the citizens of Oregon than that originally proposed by the Army and permitted by the Commission.

Any Permit Modification Request submitted to the Department of Environmental Quality that involves the implementation of a Compliance Schedule for developing secondary waste treatment technologies should include the identification and amount of all waste streams, proposed treatment methodology (or treatments being researched), and proposed disposal methods. The Army should clearly define in the Modification Request any benefits to the citizens of Oregon in terms of protection of public health and the environment, and the risks of the various treatment options, including the risks caused by potential delays in the destruction schedule.

The Commission does not want to delay the start of hazardous waste treatment operations at the Umatilla Chemical Depot, and yet we would hesitate to approve any Permit Modification Request that allows the generation of wastes for which there is no permitted treatment technology in place to process the waste. As I indicated at the August 18, 1999 work session, I don't think it's an unreasonable request from the state to insist that the entire process be operational before it starts. The Commission has always expected that all the permitted treatment units will be operational prior to the start of the processing of hazardous wastes.

The Commission learned from the Army that the existing permitted DUN must be modified to improve processing throughput and efficacy. We believe the Army should move forward immediately with implementing improvements to the design of the Dunnage incinerator and any permit modifications should be approved by the Department prior to the start of hazardous waste operations. This approach will provide a degree of assurance for the Commission that the Army is committed to implementing a technology at Umatilla that is capable of processing the agent contaminated secondary wastes.

Sincerely,

Carol Whipple

Carol Whipple, Chair
Environmental Quality Commission

cc: Governor John Kitzhaber
Environmental Quality Commission members
Langdon Marsh, Director, DEQ
Wayne Thomas, Umatilla Program Manager, DEQ
Raj Malhotra, Site Manager, Program Manager for Chemical Demilitarization
LTC Woloszyn, Commander, Umatilla Chemical Depot
Jay Bluestein, Site Project Manager, Raytheon

FILE

DEPARTMENT OF THE ARMY
PROGRAM MANAGER FOR CHEMICAL DEMILITARIZATION
ABERDEEN PROVING GROUND, MARYLAND 21010-4005

99-2272

December 17, 1999

Program Manager for
Chemical Demilitarization

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Ms. Melinda Eden
Chair, Environmental Quality Commission
811 SW Sixth Avenue
Portland, Oregon 97204

Dear Ms. Eden:

Thank you for the letter of September 24, 1999, clarifying the Commission's views relative to the processing of secondary waste at the Umatilla Chemical Agent Disposal Facility (UMCDF). Only through continued effective and direct communication can we achieve our mutual goal of the safe and environmentally responsible destruction of the chemical agents and munitions stored at the Umatilla Chemical Depot.

The Chemical Stockpile Disposal Project is managed to ensure full compliance with Public Law 99-145, which requires the program to ensure maximum protection to the general public, the workers involved in the demilitarization effort, and the environment. Any changes to how we would propose to carry out destruction must meet the stringent mandate that this public law creates. We share the Commission's priority in ensuring that protection of human health and the environment remains paramount in carrying out the demilitarization effort.

We are beginning the effort to design the specific changes to the Dunnage Incinerator which are necessary to improve its performance. We will use the information gained by this engineering process to continue to evaluate the options for destruction of secondary wastes at the UMCDF.

I would be remiss, however, if I did not point out that it is also our responsibility to ensure that the approaches used to carry out the disposal effort are fiscally responsible and remain a sound investment by the American taxpayers. That is not to say or imply that any less costly approach can be considered; however, there may be opportunities for equally-protective, less-expensive approaches to be implemented. This is important from a financial perspective. Divorcing the financial realities of the demilitarization effort from the public safety issue is not representative of the realities facing this project. In a time of increasing competition for tax dollars, budget reductions or cuts in programs, to include the demilitarization program, are common. The best way to ensure that the

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destruction of the Umatilla stockpile and all associated wastes is not artificially delayed is to continue to identify and implement opportunities for reducing cost while still meeting the stringent maximum protection mandate of the program. I believe that the process outlined by the Army at our August 18, 1999, meeting is wholly consistent with this approach and represents a complete commitment on the part of the Army to deal with all wastes in a responsible manner--both from a public health and environmental protection perspective as well as from a fiduciary one.

I share the Commission's concerns about any delay to the start of agent operations at the UMCDF. The greatest risk to the public remains the continued storage of the chemical stockpile; and I am committed to continuing to work with the Commission on our path forward.

As presented in our August meeting, we are evaluating and demonstrating alternate secondary waste treatment processes as part of the Johnston Atoll Chemical Agent Disposal System closure operation. In preparing our permit modification, we are working closely with the Oregon Department of Environmental Quality (DEQ) to develop a Compliance Schedule for the implementation of these processes at UMCDF.

Since our meeting, we have met with the DEQ on a weekly basis concerning secondary waste as we move forward to submit a Compliance Schedule to the Commission. In addition, we have formed a secondary waste Integrated Product Team which includes membership from the DEQ. The goal of the team is to assist the Permittees in defining the requirements necessary to demonstrate to the citizens of Oregon, the Environmental Quality Commission, and the DEQ that the Permittees have developed viable secondary waste treatment technologies for all wastes currently stored at the Umatilla Chemical Depot and any waste expected to be generated by operations at the UMCDF. This group will be used to develop the proposed Compliance Schedule.

Again, I thank you for the Commission's letter. I am committed to working with the Commission and Oregon DEQ in order to achieve our mutual goal of the safe and environmentally responsible destruction of the chemical agents and munitions stored at the Umatilla Chemical Depot. This commitment extends to secondary wastes as well, resulting in removing the legacy of chemical weapons from the State of Oregon forever.

Sincerely,

James L. Bacon

James L. Bacon
Program Manager for
Chemical Demilitarization

ATTACHMENT R

TABLE OF COMMENTS AND EXHIBITS

Affidavits of Legal Standing from Petitioners

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ATTACHMENT R

Affidavits of Legal Standing from Petitioners

The following list of Exhibits (1-22) are "Standing Affidavits" filed with the *"Petitioner's Memorandum Supporting Cross Motion for Summary Judgment and Opposing Respondents Motion for Summary Judgment,"* August 20, 1998, G.A.S.P., et al. *v.* Environmental Quality Commission, et al., State of Oregon Circuit Court, Multnomah County, Case No. 9708-06159 (DEQ Item No. 98-1275).

The Department does not challenge Petitioners claim to standing.

EXHIBIT NO.	TITLE	DATE OF DOCUMENT	AUTHOR (IF APPLICABLE)
1	Standing Affidavit	8/17/98	Karyn Jones (and G.A.S.P.)
2	Standing Affidavit	8/7/98	Dr. Robert J. Palzer (and the Sierra Club)
3	Standing Affidavit	8/17/98	Cindy Beatty
4	Standing Affidavit	8/18/98	Christine Clark
5	Standing Affidavit	8/12/98	David Burns
6	Standing Affidavit	8/11/98	Debra Burns
7	Standing Affidavit	8/17/98	Gail L. Horning
8	Standing Affidavit	8/13/98	Heather Billy
9	Standing Affidavit	8/17/98	Janet S. Nagy
10	Standing Affidavit	8/13/98	Karla Stuck
11	Standing Affidavit	8/17/98	LaDonna King
12	Standing Affidavit	8/17/98	Pius Horning
13	Standing Affidavit	8/14/98	Stuart Dick
14	Standing Affidavit	8/10/98	Andrea E. Stine
15	Standing Affidavit	8/17/98	Merle Jones
16	Standing Affidavit	8/15/98	Janice Lohman
17	Standing Affidavit	8/17/98	John Spomer
18	Standing Affidavit	8/17/98	Susan L. Jones
19	Standing Affidavit	8/15/98	Leandra Phillips
20	Standing Affidavit	8/18/98	Melanie Beltane
21	Standing Affidavit	8/13/98	Dorothy Irish
22	Standing Affidavit	8/20/98	Paul Loney, Oregon Wildlife Federation

ATTACHMENT R

Affidavits of Legal Standing from Petitioners

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ATTACHMENT S

LEGAL RULINGS RELATED TO THE TOOELE CHEMICAL AGENT DISPOSAL FACILITY (TOOELE, UTAH)

Date Decided	Ruling Body	Disposition	Page
8/13/96	U.S. District Court for the District of Utah (Central Division) (Civil No. 2:96-CV-425C)	Plaintiffs' motion for a preliminary injunction is denied	S-1
12/6/96	U.S. Court of Appeals for the Tenth Circuit (No. 96-4166)	Appellants' motion for stay pending appeal is denied. Motion to expedite appeal is granted.	S-13
3/24/97	U.S. District Court for the District of Utah (Central Division) (Civil No. 2:96-CV-425C)	Plaintiffs' second motion for a preliminary injunction denied.	S-17
4/22/97	U.S. Court of Appeals for the Tenth Circuit (No. 96-4166)	Judgment of Utah District Court's ruling on August 13, 1996 is affirmed.	S-31
7/22/97	Utah Solid and Hazardous Waste Control Board Order	First and Second Requests for Agency Action by the Petitioners is denied.	S-39
10/14/97	U.S. District Court for the District of Utah (Central Division) (Civil No. 2:96-CV-425C)	Defendant's motion for summary judgment on Count 10 is granted.	S-53
8/20/98	Court of Appeals of Utah (Case No. 971313-CA)	Declined to disturb the Order of the USHW Board of July 22, 1997	S-57
1/19/99	U.S. District Court for the District of Columbia [Misc. Action No. 98-156 (AER)]	Plaintiff's motion to compel production of documents is denied	S-67
4/14/00	U.S. District Court for the District of Utah (Central Division) (Civil No. 2:96-CV-425C)	"Findings of Fact and Conclusions of Law," granting judgment for the defendants on all claims against them brought by the plaintiffs.	S-71

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CHEMICAL WEAPONS WORKING GROUP INC., et al., Plaintiffs, vs. UNITED STATES DEPARTMENT OF THE ARMY, et al., Defendants.

Civil No. 2:96-CV-425C

UNITED STATES DISTRICT COURT FOR THE DISTRICT OF UTAH, CENTRAL DIVISION

935 F. Supp. 1206; 1996 U.S. Dist. LEXIS 12033; 44 ERC (BNA) 1352; 27 ELR 20022

August 13, 1996, Decided

DISPOSITION:
[**1] Plaintiffs' motion for a preliminary injunction is DENIED.

COUNSEL:
For CHEMICAL WEAPONS WORKING GROUP, SIERRA CLUB, VIETNAM VETERANS OF AMERICA FOUNDATION, plaintiffs: Paul Van Dam, Mr., JONES WALDO HOLBROOK & MCDONOUGH, SALT LAKE CITY, UT. Randall M. Weiner, LAND AND WATER FUND OF THE ROCKIES, BOULDER, CO. Mick G. Harrison, Robert Ukeiley, Ashley Schannauer, GREENLAW INC, BLOOMINGTON, IN. Robert Guild, COLUMBIA, SC. Richard Condit, WASHINGTON, DC.

For DEPARTMENT OF THE ARMY, UNITED STATES DEPARTMENT OF DEFENSE, defendants: Stephen L. Roth, Mr., US ATTORNEYS OFFICE - UTAH. Lisa Ann Holden, US DEPARTMENT OF JUSTICE, ENVIRONMENTAL & NATURAL RESOURCES DIV, WASHINGTON, DC. Alan David Greenberg, Robert H. Foster, US DEPARTMENT OF JUSTICE, ENVIRONMENTAL DEFENSE, DENVER, CO. For EG&G DEFENSE MATERIAL, defendant: David Tundermann, Mr., Michael A. Zody, Craig D. Galli, PARSONS BEHLE & LATIMER, SALT LAKE CITY, UT. Lisa Ann Holden, US DEPARTMENT OF JUSTICE, ENVIRONMENTAL & NATURAL RESOURCES DIV, WASHINGTON, DC. Robert H. Foster, US DEPARTMENT OF JUSTICE, ENVIRONMENTAL DEFENSE, DENVER, CO.

JUDGES:
TENA CAMPBELL, United States District Judge. Judge Ronald N. Boyce

OPINIONBY:
TENA CAMPBELL

OPINION:

[*1208] MEMORANDUM [**2] DECISION AND ORDER

On May 10, 1996, plaintiffs filed this suit challenging defendants' proposed operation of the Tooele Chemical Agent Disposal Facility (TOCDF). The amended complaint alleges that defendants have violated the National Environmental Policy Act (NEPA), the Resource Conservation and Recovery Act (RCRA), the Toxic Substances Control Act (TSCA), the Defense Authorization Act, and the Clean Water Act, and that defendants' operation of TOCDF will constitute a nuisance under Utah law. The court has granted defendants' motions to dismiss certain of the counts. Remaining for disposition in this case are plaintiffs' claims (1) that defendants are in violation of NEPA for failing to supplement the necessary environmental impact statements in light of substantial new information regarding the project and due to substantial changes having been made to the project, (2) that the operation of TOCDF will violate TSCA due to defendants' failure to show that the TOCDF incinerator will destroy the chemical warfare agent at the required level of efficiency, and (3) that the operation of TOCDF will constitute a nuisance. n1

n1 This claim was subject to a motion to dismiss by all defendants, and the court dismissed the claim as against the federal defendants on immunity grounds. The court took defendant EG&G Defense Material, Inc.'s

motion to dismiss this count under advisement.

[**3]

On June 12, 1996, plaintiffs filed a motion for preliminary injunctive relief seeking to enjoin defendants from beginning preliminary incineration tests of chemical warfare [*1209] agent. n2 A hearing on plaintiffs' motion for a preliminary injunction was held over several days from July 22, 1996, through August 2, 1996. Having considered the evidence presented at that hearing, the memoranda filed by the parties, and the relevant law, the court denies plaintiffs' motion and enters the following findings of fact and conclusions of law:

n2 When defendants later obtained final permits to begin testing the TOCDF incinerator, plaintiffs filed a motion for a temporary restraining order. Defendants agreed to refrain from beginning test burns of chemical warfare agent pending this court's resolution of the motion for preliminary injunction.

FINDINGS OF FACT

Background

1. The United States has a stockpile of 30,000 tons of chemical warfare agent manufactured during and after World War II, which is stored [**4] at eight sites in the United States, including the Tooele Army Depot at Tooele, Utah. Fourty-four percent of this stockpile is stored at Tooele. There are three types of chemical agent stored at Tooele: a blistering agent known as mustard and two nerve agents known as "GB" and "VX." This agent is stored in over 1.1 million separate containers in three basic configurations: (1) projectiles, cartridges, mines, and rockets containing propellant and/or explosives (referred to generally as "energetics"), (2) other projectiles that do not contain energetics; and (3) spray tanks and large steel bulk storage containers known as "ton containers."

2. Continued storage of these dangerous weapons poses significant problems. The stockpile is vulnerable to catastrophic events such as earthquakes or airplane crashes, which could result in a fatal release of agent. As the stockpile of chemical munitions ages, it presents increasing dangers due to leakage of the containers and destabilization of rocket propellants. The M55 rockets which form a pan of the munitions stored are of particular concern, as the stabilizer in the rocket propellant degrades slowly over time, creating an increased risk of shock [**5] sensitivity. In addition, there is some indication that leaking chemical agent may cause corrosion which could lead to accidental arming of a rocket's fuse. Of the approximately 30,000 rockets stored at Tooele Army Depot, approximately 1,000 have been identified as "leakers." In addition, leakage of GB nerve agent from ton containers has been cited as a significant risk.

3. In the Department of Defense Authorization Act of 1986, Pub. L. No. 99-145, Title XIV, Part B, Sec. 1412, 99 Stat. 583 (1985) (codified as amended at *50 U.S.C. § 1521),* Congress mandated that the stockpile of chemical warfare agent be destroyed by September 30, 1994. See *50 U.S.C. § 1521*(a) This deadline has since been extended to December 31, 2004. *50 U.S.C. § 1521*(b)(5) (Supp. 1996). Congress directed the Army to accomplish the destruction of this agent in such a manner as to provide (1) maximum protection of the environment, the general public, and the personnel who will be involved in the destruction process; (2) adequate and safe facilities designed solely for the destruction of the chemical agent; and (3) cleanup, dismantling, and disposal of the facilities when the disposal program is complete. *50* [**6] *U.S.C. § 1521*(c)(1).

4. The Army determined that the "baseline" technology for destruction of these weapons is on-site incineration at each of the storage facilities. The Army has considerable experience with large-scale incineration of agent materials. In 1979, the Army began operation of the Chemical Agent Munitions Disposal System pilot facility (CAMDS), located at the Tooele Army Depot. CAMDS was built to evaluate incineration and neutralization disposal methods. By 1988, CAMDS had incinerated 75,000 pounds of GB, 8,000 pounds of VX, and 38,000 items of munitions. CAMDS continues to be used for testing. The Army has also been operating an incineration facility at Johnston Atoll (JACADS) for six years and during that time has destroyed over two million pounds of agent and over nine million pounds of drained containers and dunnage. The operation of JACADS has been successful and generally free of significant incidents or risk.

[*1210] NEPA Compliance Process

5. In order to evaluate the environmental effects of the proposed destruction of chemical munitions and agent, the Army completed and circulated a Draft Programmatic Environmental Impact Statement in 1986 (DEIS). This document [**7] evaluated the impacts of disposal of the stockpile as against

continued storage. In 1988, the Army issued the Final Programmatic Environmental Impact Statement (FPEIS) and the Record of Decision (ROD). Incineration was selected for the disposal program Other destruction technologies were rejected as either unreasonable or immature and unproven.

6. The DEIS and FPEIS were national in scope and did not focus on a particular site. In the ROD, the Army committed to conducting site-specific NEPA reviews for each of the eight stockpile locations. Consequently, in 1988, the Army prepared a Phase I Report at Tooele which concluded that the FPEIS on-site destruction alternative remained valid for Tooele. In 1989, the Army prepared a draft environmental impact statement to address the environmental impacts resulting from the construction and operation of TOCDEF. After public comment and review, the Army issued a Final Environmental Impact Statement for Tooele (FEIS) and a ROD in 1989. On-site incineration was selected as the preferred alternative.

7. On July 13, 1996, the Army, through Major General Robert D. Orton, Program Manager for Chemical Demilitarization, adopted a Record of Environmental [**8] Consideration (REC) which found that "no new and significant information has appeared since the signing of the Chemical Demilitarization Programmatic EIS and Tooele Site-Specific EIS and associated RODs that requires completion of a supplement (sic) environmental impact statement." This document was based on an attached 84 page report which evaluated new information on dioxin emissions, alternative technologies, and baseline incineration. "Evaluation of Information on Dioxin Emissions, Alternative Technologies and Baseline Incineration" (hereinafter, "REC Report").

The Prototype Facility: JACADS

8. As part of the further development of its incineration plan, the Army constructed JACADS as a full-scale operational incineration plant, intended to serve as a prototype for the eight planned incinerator facilities located in the continental United States, including TOCDF. The February 28, 1988 ROD, which memorialized the Army's decision to adopt incineration as the baseline technology for agent destruction discusses the role of JACADS in the development of the incinerator technology, and states that the Congressional mandate of agent destruction by 1994 would of necessity be [**9] postponed in order to evaluate the incineration process as conducted at a full-scale operation such as JACADS and implement changes to later incinerator plans in light of that experience. The National Defense Authorization Act of 1989, Pub. L. No. 100-456 (1988), required the Army to complete Operational Verification Testing (OVT) of JACADS before proceeding to destroy the stockpiles of chemical agent and munitions in the continental United States. Before it could proceed with its destruction program, the Army was required to certify to the Secretary of Defense and subsequently to Congress that the JACADS operation had been successful. The Secretary of Defense certified to Congress that OVT at JACADS had been completed in August, 1993.

9. The MITRE Corporation was retained by the Army to monitor, evaluate, and report the results of all phases of OVT. In 1987, the National Research Council's standing Committee on Review and Evaluation of the Army Chemical Stockpile Disposal Program (Stockpile Committee) was formed to provide the Army with technical advice on the disposal program. The Stockpile Committee was chartered to monitor OVT at JACADS and to review the results of OVT as reported [**10] by the MITRE Corporation.

10. The MITRE OVT reports found that, although there were events that occurred at JACADS that increased the probability of agent exposure or injury to workers, JACADS met the OVT safety performance goals. Similarly, although the Stockpile Committee found problems with the JACADS [*1211] operations, none were "show stoppers."

11. The operation and problems arising out of the operation of JACADS were discussed in the REC Report. The report concluded that, although the operation was not flawless, the program had effectively and safely disposed of chemical agent and munitions and that the JACADS operation had not revealed any new or significant information to indicate that operation of TOCDEF would create significant environmental impacts not contemplated in the site-specific Tooele FEIS.

12. Over 2 million pounds of agent have been processed at JACADS, including 1.8 million pounds of GB, 141,000 pounds of VX, and 250,000 pounds of mustard. JACADS has also processed 1.7 million pounds of energetics, and over 9 million pounds of drained containers and dunnage. Problems which have occurred at JACADS during its operation have been investigated, analyzed, and used in a [**11] "lessons learned" program. Through the lessons learned program, modifications and changes have been incorporated in the design of the facility and the operation procedures of TOCDEF.

TOCDEF

13. TOCDEF has five separate incinerators. Two

liquid incinerators (LIC) will be used to incinerate liquid agent that is drained from munitions and bulk containers. The LIC destroys agent by burning it as a fuel after it is mixed with natural gas and air. A Deactivation Furnace System (DFS) will be used to incinerate munitions containing energetics, such as rockets and land mines, which have been drained of agent but are still contaminated. A Metal Parts Furnace will be used to thermally decontaminate non-energetic metal parts that have been drained of agent, such as ton containers. A Dunnage Incinerator (DUN) was planned for burning non-agent-contaminated and agent-contaminated dunnage, such as pallets and used carbon filters. The DUN is presently not operational and the dunnage will be stored on the Tooele facility until the DUN begins operations. A Brine Reduction Area was designed to treat slag from the wet pollution abatement system. Problems have been encountered with this system [**12] and current plans are to begin operations at TOCDEF without it.

Regulatory Compliance

14. The Army has been in the process since 1986 of obtaining the numerous necessary permits to operate TOCDEF. It began the process by submitting to the Executive Secretary of the Solid and Hazardous Waste Control Board within the State of Utah's Department of Environmental Quality its application for a hazardous waste operation plan for TOCDF. The Executive Secretary published a draft plan for TOCDEF in April 1989. The Executive Secretary then conducted public hearings on the proposed plan and approved the proposed plan in June 1989. Since the initial approval, the Executive Secretary has approved numerous modifications to reflect changes in the design and operation of the incinerators, often to reflect the lessons learned from JACADS.

15. TOCDEF has obtained a RCRA permit to operate from the State of Utah under Utah's delegated program. TOCDF has obtained a Clean Air Act permit, also from the State of Utah. The United States Environmental Protection Agency (EPA) regulates the disposal of polychlorinated biphenyls (PCBs) found in the shipping and firing tubes. TOCDEF is also subject [**13] to health and safety regulations such as OSHA.

Trial Burns

16. The Army completed construction of TOCDEF in July 1993. Before becoming fully operational, TOCDEF is required by RCRA and TSCA to undergo a series of trial burns to determine whether the facility can destroy agent and other materials without releasing a significant amount of toxics into the environment. TOCDEF has completed two trial burns for the LIC and the DFS: a "shakedown burn" with no agent and an "R&D Burn" with no agent. The two trial burns remaining are to be conducted with agent. The destruction removal efficiency (DRE) for each of the two completed tests was in excess of the 99.9999% required under RCRA, and the State of Utah approved the results of both tests.

17. The shipping and firing tubes of the M55 rockets are the only source of PCBs to [*1212] be incinerated at TOCDEF. This will be done in the DFS. Pursuant to its TSCA permit, issued by the EPA, TOCDEF conducted a trial burn of M55 rockets, without agent, in the DFS and achieved a DRE of at least 99.9999%. EPA has approved the test results and has now authorized TOCDF to proceed with trial burns of agent-containing rockets.

Accidents and [14] Equipment Failures**

18. The Army's experience in operating JACADS and the implications of that experience for the proposed operation of TOCDF form the basis for part of plaintiffs' claim that there is significant new information regarding the environmental effects of TOCDF that have not been evaluated in a supplemental EIS. Accordingly, the specifics of various alleged incidents at JACADS and the defendants' implementation of corrective measures at TOCDF to address such problems has been the subject of dispute between the parties in this case.

19. In support of their allegation that significant problems have arisen in the operation of JACADS that have not been addressed or corrected at TOCDF, plaintiffs have submitted evidence in the form of records and reports dealing with JACADS operations and the testimony of Mr. Steve Jones, who was employed by the Army Inspector General's Office as a Safety and Occupational Health Manager. Plaintiffs question the effectiveness of the lessons learned program, and cite several examples of JACADS problems which are alleged to have been left uncorrected at TOCDF. However, the court finds that many of these allegations are largely based on hearsay [**15] evidence provided by Steve Jones, or that the cited problems were, in fact, addressed by defendants in the process of construction and systemization of TOCDF. For each of the allegations made regarding equipment and procedural failures at JACADS and TOCDF, no matter how thinly supported by evidence by plaintiffs, defendants have presented affirmative evidence that indicates that the problems either do not exist or that corrective actions have been taken in constructing and testing the systems at TOCDF For

example, Mr. Jones states in his declaration that deterioration of firebricks caused an explosion at JACADS and offers a theory about how this could occur. But no source for this information is cited, and plaintiffs do not present any evidence as to whether any alleged problem with firebricks continues at TOCDF. Robert Perry, Chief of Risk Management, Quality Assurance Office within the Office of the Program Manager for Chemical Demilitarization, testified that no such explosion had occurred. Mr. Perry testified that the only problem with the firebricks was erosion of the brick over time. Mr. Jones states in his declaration that he "observed" problems with blast gates at both JACADS [**16] and TOCDF, but cites only incidents alleged to have occurred at JACADS, and Mr. Jones acknowledged that he has no personal knowledge of such incidents. Mr. Jones testified concerning a number of design and operation deficiencies in equipment at TOCDF, but has no qualifications regarding equipment design, and has no knowledge as to the current status of the equipment to be used at TOCDF. Ultimately, the court finds that the importance and/or credibility of Mr. Jones' allegations are questionable in light of his lack of personal knowledge regarding many of them, and his failure to report many of these occurrences at the time he allegedly learned of them.

20. Defendants acknowledge that there have been three confirmed atmospheric releases of live agent, but these releases were minimal and posed no risk of harm to JACADS employees or to the environment. Each of these releases were investigated and changes were made in equipment, design, and operations in order to address the problems. These changes were also implemented at TOCDF as part of the lessons learned program. See e.g., REC Report, p. 3-5 (Modifications and changes to the LIC agent line/nozzle purge system design, purging [**17] sequence and LIC agent nozzle removal procedure implemented in response to agent release on December 8, 1990). Defendants also confirmed that one employee was slightly injured by a nerve agent spill within the facility, but the testimony of Robert Perry indicated that this accident was caused by a failure to follow standard procedures.

[*1213] **Dioxin hazards**

21. It is not disputed that the incinerators at TOCDF will create and release dioxins to the environment. Plaintiffs assert that there is new information regarding the overall effects of dioxin exposure and the exposure levels at which dioxin becomes harmful, and that the dioxin risks associated with the operation of TOCDF to particular individuals (especially infants) living in the vicinity of the plant have not been adequately evaluated.

22. The evidence indicates that the existence and amount of the health risks associated with exposure to background levels of dioxin, and the likely significance and effects of the incremental increases in the dioxin levels due to the operation of TOCDF, are largely uncertain. The conflicting opinions offered by the experts who presented testimony in this case emphasize the fact that the [**18] effects of dioxin at various levels of exposure are far from settled issues within the scientific community. Plaintiffs rely to a great extent on the draft document "Health Assessment Document for 2,3,7,8 Tetrachlorodibenzo-p-Dioxin (TCDD) and Related Compounds" (Dioxin Reassessment) issued by EPA in 1994, which by its terms is not to be cited or quoted. Certain of the findings in the Dioxin Reassessment were questioned in significant areas by EPA's Science Advisory Board in 1995. The document is still under review and does not currently represent a final position of the EPA.

23. Plaintiffs also rely on a "reference dose" of 1 picogram/kg/day level noted by the Agency for Toxic Substances and Disease Control (ATSD) in 1989 to establish harm to humans. However, this reference dose is derived by dividing the lowest level at which adverse effects are shown in animals by 1,000 in order to conservatively account for unknown factors. Accordingly, although this "reference dose" may indicate a safe level for exposure, it does not follow that exceeding this level is likely to result in harm. The EPA Dioxin Reassessment itself states that the use of such a reference dose would be "inappropriate" [**19] and of "doubtful significance." Dioxin Reassessment, p. 9-84. The evidence presented indicates that this level of exposure is already exceeded in most industrialized areas of the world. Although plaintiffs argue that any increase in the levels of dioxin exposure is unacceptable, the danger associated with relatively small increases is far from certain, and the evidence presented by plaintiffs is insufficient to support a finding that such danger is likely to be significant.

24. Prior to approving trial burns of chemical agent at TOCDF, the State of Utah Department of Environmental Quality (DEQ) performed a screening health risk assessment which analyzed the impacts on human health and the environment resulting from the expected emissions from TOCDF. The assessment followed EPA guidance in adopting conservative assumptions. The assessment modeled TOCDF emissions by using maximum JACADS levels and increasing them to account for the greater capacity at TOCDF. The assessment also assumed that emissions at TOCDF would be twice the JACADS detection limits for the many compounds which were not detected. Concerning dioxin, the assessment also made

the conservative assumption that all dioxin [**20] emissions consist of only the 17 types of dioxins (out of 210 possible) that have been determined to be toxic.

25. The Utah DEQ used these assumptions to calculate the potential exposures to hypothetical individuals residing within six miles north (usually downwind) of TOCDF. Assuming simultaneous operation of all five furnaces at TOCDF, the overall cancer and non-cancer risks were at or below EPA screening risk levels. As far as the cancer effects of dioxin, the risk assessment found that EPA guidance levels were not exceeded for 10, 15, and 30 year operating periods. The risk assessment did not calculate non-cancer effects of the dioxin exposure because there is currently no applicable reference dose for dioxin, as indicated above. Defendant's expert, Dr. Finley, calculated average daily intakes of dioxin for the scenarios used in the Utah DEQ assessment and concluded that the exposures should be below the level of concern for non-cancer effects.

26. The Utah DEQ assessment had originally included in a draft form scenarios regarding a subsistence farmer and a breast-feeding [*1214] infant. This report was not released to the public. Instead of the subsistence farmer scenario, the final [**21] form the of the DEQ assessment considered three farmer scenarios based on a survey of actual farming practices in the area, n3 and simply deleted the breast-feeding infant scenario. Plaintiffs presented evidence that risks of dioxin exposure are particularly high for a breast-feeding infant and question the deletion of this scenario from the Utah DEQ assessment. However, defendants' experts calculated the exposure risks for a breast-feeding infant and found that such exposures would result in only nominal increases of dose and risk, and would be at or below levels deemed acceptable under current EPA guidelines. Ultimately, the court finds that the Utah DEQ assessment is intended to show an area of safety, not predict an actual level of risk Although plaintiffs have shown that the assumptions applied in the State's health risk assessment may indicate a higher level of risk for some hypothetical persons, this does not constitute a showing that there is an actual risk to some person or persons posed by the emissions levels predicted for the facility.

n3 This is apparently a standard practice in creating risk assessments; if a "worst case" hypothetical person appears to have an unacceptable risk, the assumptions are made more realistic (less conservative) by conducting a survey of the actual area being assessed.

[**22]

Alternative Technologies

27. Plaintiffs have submitted evidence regarding several alternative processes or technologies which could be used to destroy the chemical weapons, and which plaintiffs assert offer significant safety and efficiency advantages over incineration. Indeed, it appears that many of these technologies have been developed in response to Army requests for alternatives to the incineration technology adopted at TOCDF.

28. In 1992 and 1993, the National Research Council undertook a major study to re-evaluate the Chemical Disposal Program and the progress of alternative technologies. As part of this process, the NRC held a public forum to address the criteria for evaluating these alternatives. The NRC's 1994 Report endorsed the Army's choice of incineration, finding that there is no currently feasible alternative for disposal of energetics, but recommending that the Army continue to evaluate these technologies for sites other than the Tooele stockpile. There has been no change in the NRC recommendation of incineration as the preferred technology at Tooele. On June 4, 1996, Dr. Magee, Chairman of the Stockpile Committee, stated in his testimony before Congress: [**23] "To sum up, the Stockpile Committee has endorsed the baseline incineration system as the technology to accomplish the overall chemical stockpile disposal program effectively and expeditiously. However, the committee by its recommendations regarding alternative technologies left open the door for the possible employment of a technology other than incineration at selected sites, depending on comparative factors of safety, performance and implementation schedule." Quoted in REC Report, p. 43.

29. In August 1995, the Army requested submissions by commercial vendors for technologies to use at the sites that store only ton containers of chemical agent. Three promising technologies were chosen and are currently being studied by the Army and the NRC: High Temperature Gas Phase Reduction (Eco-Logic), Molten Metal Catalytic Extraction Process (M4) and Electrochemical Oxidation (AEA). The companies' own conceptual designs indicate that it would take a minimum of three years to implement any of these technologies for disposal of ton containers at the Aberdeen and Newport sites, and Defendant's expert, Dr. Francis W. Holm, estimated that implementation of these methods could take longer. Each [**24] of these technologies has tested only a small amount of live nerve agent on a laboratory scale.

These technologies have not been tested using any munitions such as are present at the Tooele stockpile. Dr. Holm testified that a conservative estimate of the time required for implementation of these technologies at Tooele would be 6.5 years.

30. Plaintiffs have presented a great deal of evidence regarding the advantages, both in terms of cost and safety, of these alternative technologies. Plaintiffs disagree with defendants' [*1215] estimates regarding the readiness of these alternatives to begin processing chemical agent, questioning many of the assumptions which underlie Dr. Holm's 6.5 year estimate. Plaintiffs argue that the existing facility could be adapted to an alternative technology and that permit modifications could be obtained instead of starting the RCRA permit process from scratch. Plaintiffs also cite to the time estimates provided by the private companies promoting these technologies as evidence that, for example, M4 and Eco-Logic could be operational within about 4 years. Plaintiffs also submit evidence of recent developments which questions the Army's assumptions regarding the [**25] lack of readiness of these technologies and argue that although the alternative technologies' ability to process energetics is relatively untested, dual use of both incineration and an alternative could be implemented.

CONCLUSIONS OF LAW

1. Plaintiffs bear the burden in this case of establishing the need for injunctive relief. In making its determination regarding the necessity of the injunction, the court must consider four factors: (a) whether plaintiffs have shown a substantial probability of success on the merits; (b) whether plaintiffs are threatened with irreparable injury in the absence of an injunction; (c) whether plaintiffs' potential injury outweighs any damage to defendants; and (d) whether the injunction would be adverse to the public interest. *Potawatomi Indian Tribe v. Enterprise Management Consultants, Inc., 883 F.2d 886, 888-89 (10th Cir. 1989); Lundgrin v. Claytor, 619 F.2d 61, 63 (10th Cir. 1980).* If plaintiffs are able to show that they will suffer irreparable injury and that "the balance of hardships tips decidedly in [their] favor," the requirement of showing a substantial probability of success on the merits is satisfied by raising "questions [**26] going to the merits so serious, substantial, difficult and doubtful as to make them a fair ground for litigation and thus for more deliberate inquiry." *Lundgrin, 619 F.2d at 63* (quoting *Continental Oil Co. v. Frontier Refining Co., 338 F.2d 780, 781-82 (10th Cir. 1964)).*

Irreparable Injury

2. Mere threatened, speculative harm, without more, does not amount to irreparable injury for purposes of justifying preliminary injunctive relief such as that sought by plaintiffs. E.g., *Mullis v. United States Bankruptcy Court, 828 F.2d 1385 (9th Cir. 1987),* appeal dismissed, cert. denied, *486 U.S. 1040, 100 L. Ed. 2d 616, 108 S. Ct. 2031 (1988); Wisconsin Gas Co. v. FERC, 244 U.S. App. D.C. 349, 758 F.2d 669, 674 (D.C. Cir. 1985)* (movant must show that irreparable injury is "both certain and great; it must be actual and not theoretical"). Unlike most cases alleging violations of NEPA, plaintiffs in this case do not assert the sort of environmental harm due to construction which is usually seen as irreparable. TOCDEF is already fully constructed, so all of Plaintiffs' asserted irreparable harm in this case is related to the alleged health risks of incineration, due [**27] to either emissions from normal operations, or agent releases due to accidents.

Dioxin exposure risks.

3. The harm cited by plaintiffs resulting from increased dioxin exposure is based on extrapolations from conservative hypothetical scenarios used by the Utah DEQ in compiling their health risk assessment. As noted above, the methodology used for determining the nature of the risks by Utah DEQ is able to calculate safe levels of exposure, but does not determine levels at which harm is likely to occur. Although plaintiffs are able to put forward a scenario in which a breast-feeding infant would be exposed at levels significantly higher than levels determined by Utah DEQ to be safe, they have not submitted evidence that any plaintiff, or any person at all, would in fact be placed at risk by the projected dioxin emissions from TOCDF. The court finds that the asserted risks of harm due to dioxin exposure are too speculative to qualify as irreparable harm to plaintiffs.

Operational Risks.

4. Defendants assert that the operation of TOCDF will result in immediate risks to workers and the public from accidental releases of agent. Plaintiffs have a difficult [*1216] case to make [**28] on this issue in light of the safety record at JACADS and the independent evaluations of JACADS, as noted above, which found no significant risks associated with JACADS. Plaintiffs' experts testified that the risks associated with the agent processing at JACADS and TOCDF have been underestimated or improperly evaluated for various reasons, including a lack of adequate monitoring equipment and failure to evaluate true worst-case scenarios. However, the fact remains that during its entire operation, only one minor worker

injury due to agent processing was reported. Although three releases of live agent were reported, these did not result in any injury. Plaintiffs may be correct that the risks associated with operating TOCDF have been underestimated to some unspecified degree. However, there is no evidence that human injury is inevitable or even likely pending the court's final resolution of this case. Accordingly, the court finds that operational risks cited are too speculative to support a finding of irreparable injury to plaintiffs.

NEPA Harm.

5. The purpose of NEPA is to ensure that the agency and the public are aware of the environmental consequences of a project before [**29] beginning the project. *Sierra Club v. Hodel, 848 F.2d 1068, 1097 (10th Cir. 1988).* Courts have noted that the harm from proceeding with a project without completing the necessary NEPA evaluation is irreparable in that once a decision has been made and implemented, NEPA's purpose of making certain that decision makers have all relevant information prior to making final decisions would be thwarted. Id.; *Sierra Club v. Marsh, 872 F.2d 497, 503-04 (1st Cir. 1989).* This is not an injury arising out of the substance of the decision that has been made or its effects; it is a procedural interest in protecting the processes established by NEPA and providing the decision-maker with all the relevant information. In this case, the alleged NEPA harm does not arise out of the decision to construct TOCDF, a decision that was made and implemented long ago. Rather, the decision which plaintiffs seek to enjoin is the Army's decision to operate the incinerator during the approximately one year before a final trial on the merits. During this period, the Army will be conducting the remaining trial burns, carried out with live agent. The court finds that, pending final resolution of this case, [**30] such injury will occur during only a small portion of the expected operating lifetime of TOCDF, and is therefore relatively minimal.

Balancing of Harms

6. Even if the court assumes that the risks cited by plaintiffs are sufficiently likely so as to qualify as irreparable harm, the court must balance those risks against the risks and harms asserted by defendants. *Weinberger v. Romero-Barcelo, 456 U.S. 305, 312, 72 L. Ed. 2d 91, 102 S. Ct. 1798 (1982).* In 1987, the Army completed a comprehensive quantitative risk analysis that evaluated the risks of accidents and catastrophic events as they relate to the proposed alternatives The report concluded that the risk of continued storage was greater than the risk of processing. In 1995, the quantitative risk assessment was updated to address information specific to TOCDF. The updated analysis confirmed the Army's earlier conclusion that the risks of fatalities associated with one estimate of the entire period of TOCDF operations (6.2 years) were equaled by the same risks associated with only eleven days of storage. For individuals living closest to TOCDF, the risks resulting from continued storage are one-hundred times greater [**31] than the risks resulting from disposal operations. It is true that this quantitative risk assessment does not include calculations for non-catastrophic long-term exposures to pollutants, but it is also true that the significance of those risks (whatever they might be) must only be considered in the context of the time required for a final decision in this case.

7. This is not a case in which the harm to the environment and the public posed by a proposed government action is definite; the Army is not seeking to divert a river or level a forest. Rather, the harm plaintiffs seek to prevent pending final disposition of this case is speculative and subject to conflicting expert testimony. The Army and other independent consultants have evaluated the relative risks and have concluded that the risks [*1217] of storage outweigh the risks associated with operation of TOCDF. The court is left, then, with the issue of whether harm to the NEPA process itself is a sufficient allegation of harm to support the injunction. As noted above, the action plaintiffs are seeking to enjoin is the daily operation of TOCDEF for approximately one year pending a final decision in this case, a period of time during which [**32] the test burns with live agent will be carried out. If, after trial, it is determined that supplementation of the EIS is necessary, this supplementation can still take place and be just as effective as it would be now, since the NEPA harm would be minimal. In fact, it appears that the test burns will themselves provide information useful to the evaluation of the environmental impact resulting from the operation of TOCDEF. Plaintiffs are challenging the operation of this facility, which is, in effect, a daily decision to burn chemical agent which can always be stopped and reevaluated in light of information presented in a supplemental EIS if the court finds that such is required after a trial on the merits. The court finds that the balancing of harms favors denial of the preliminary injunction.

Likelihood of Success on the Merits

NEPA Claims

8. NEPA requires that an EIS be prepared for "major Federal actions significantly affecting the

quality of the human environment." *42 U.S.C. § 4332*(2)(C). The duty to make certain that decision makers are presented with all relevant information is an ongoing one which does not end when an initial EIS is prepared. Regulations [**33] promulgated by the Council on Environmental Quality require that an EIS be supplemented when an agency makes substantial changes to the project or when there are significant new circumstances or information relevant to the project and its impacts. 40 C.F.R. § § 1502.9(c)(1)(i) and (ii). In this case, although the facility which was the subject of the original EIS has already been constructed, the daily operation of TOCDF will itself constitute a "major federal action" that would require a supplemental EIS if "new information is sufficient to show that the remaining action will 'affect the quality of the human environment' in a significant manner or to a significant extent not already considered." *Marsh, 490 U.S. 360 at 374, 104 L. Ed. 2d 377, 109 S. Ct. 1851.* In order to provide a means for documenting the agency's evaluation of the significance of new information or changes made to a project in situations where such information or changes have been "adequately assessed in existing documents and determined not to be environmentally significant," the Army has promulgated regulations which provide for the preparation of a REC. 32 C.F.R. § 651.14(a).

9. Plaintiffs challenge the weight to be given to the Army's July 13, [**34] 1996 REC, questioning both the adequacy and the sincerity of the review found in the REC. According to plaintiffs, the timing of the REC makes it suspect. The REC is based on an attached report which was apparently completed one day before its adoption in the REC and was first made public as an exhibit to defendants' memorandum in opposition to this motion for a preliminary injunction. The REC is obviously directed to making findings regarding the precise claims raised by plaintiffs in this case, and plaintiffs argue that the court should not give the usual deference to the factual findings in the REC because it was prepared in the course of litigation. However, although the court is not blind to the adversarial context in which this document was prepared, the REC represents the considered position of the public official charged with making the decisions regarding TOCDF operations and determining the significance of any new information brought forward. The REC is based on a lengthy report which evaluates the facts plaintiffs claim should affect the decision. There is no evidence that the experts whose opinions underlie the REC were merely advocates preparing litigation documents. The [**35] court also notes that in Marsh, the Supreme Court, without discussion of the timing, gave deference to a Supplemental Information Report (a document similar to a REC) which had been prepared by the Army Corps of Engineers in January 1986, several months after the plaintiffs had filed suit. See *490 U.S. at 379-80.* The [*1218] Army's decision, as stated in the REC, that a supplemental EIS is not required before operations begin at TOCDEF, is subject to a only a limited review by this court. The Marsh Court held that under the provisions of the Administrative Procedures Act, *5 U.S.C. § 706,* a challenge to an agency decision regarding the significance of alleged changes is "a classic example of a factual dispute the resolution of which implicates substantial agency expertise." *Id. at 376.* "Accordingly, as long as the [agency] decision not to supplement the [EIS] was not 'arbitrary or capricious,' it should not be set aside." *Id. at 377.* The court's responsibility in this case is to review the record and satisfy itself that "the agency has made a reasoned decision based on its evaluation of the significance--or lack of significance--of the new information [or circumstances]." [**36] *Id. at 378.* It is clear that "an agency need not supplement an EIS every time new information comes to light after the EIS is finalized. To require otherwise would render agency decision making intractable, always awaiting updated information only to find the new information outdated by the time a decision is made." *Id. at 373.*

New information regarding safety of TOCDF based on JACADS experience.

10. Plaintiffs argue that the documentation of the performance of the incineration facility at JACADS and the testimony of Steve Jones constitutes new information which should be evaluated in a supplemental EIS. However, the court finds that these allegations do not constitute new information not already considered. It is true that perfection was not achieved at JACADS and that various problems were encountered there with both equipment and personnel. However, such problems were anticipated and planned for; JACADS was meant to expose such problems in order to implement solutions at TOCDF. To the extent that JACADS operations revealed problems with the baseline incineration technology, measures were taken to correct the problems. The ROD for the FPEIS contemplated that problems [**37] would occur at JACADS which could then be remedied at the stockpile incineration sites in the Continental United States, including TOCDEF. In addition, most of the allegations raised by Mr. Jones (if assumed to be true) appear to be relatively minor issues that, in the context of overall operations at TOCDF, would not constitute significant new information, even in the aggregate. In any event, the REC indicates that the Army has investigated the more serious operational allegations

raised in this case and found that they were not significant, or that the problems cited have been adequately mitigated. The Army's analysis of these problems appears to be thorough and reasonable.

11. In addition, plaintiffs allege that defendants have failed to evaluate the significance of changes made to the plans for operation of TOCDF; specifically, that defendants have not analyzed the dangers associated with "co-processing" both explosive munitions and ton containers at the same time. However, defendants presented evidence that co-processing risks have in fact been considered and that the quantitative risk analysis (currently in draft form) has indicated that any increase in risks associated with [**38] co-processing is negligible. The Army's experts have concluded that the TOCDF quantitative risk analysis shows that "the storage risk is significantly larger than that posed by the disposal process (greater than 10 fold)." REC Report at 12.

New information regarding dioxin harms.

12. Plaintiffs point to recent information regarding the effects of dioxin and the 1994 EPA draft dioxin reassessment as constituting new information which must be considered through in a supplemental EIS. However, the EPA 1994 dioxin reassessment's analysis is at best an indication that the debates regarding the effects of dioxin are still ongoing. The wide range of expert testimony presented to the court during the hearing on plaintiff's motion makes clear that the seriousness of the dioxin threat is far from settled. In considering the likelihood of plaintiff's success on the merits of this claim, this court is guided by the Supreme Court's observation in Marsh that a determination of whether new information is significant is an [*1219] issue that the agency is to resolve. As in Marsh, "because analysis of the relevant documents 'requires a high level of technical expertise,' we must defer to [**39] 'the informed discretion of the responsible federal agencies.'" *490 U.S. at 377* (quoting *Kleppe v. Sierra Club, 427 U.S. 390, 412, 49 L. Ed. 2d 576, 96 S. Ct. 2718 (1976)).* Defendants presented expert testimony characterizing the dioxin risks as minimal, and although plaintiff's experts, who sounded a strong warning regarding dioxin risks at even low doses, were also highly qualified, "when specialists express conflicting views, an agency must have discretion to rely on the reasonable opinions of its own qualified experts even if as an original matter, a court might find contrary views more persuasive." *490 U.S. at 378; Holy Cross Wilderness Fund v. Madigan, 960 F.2d 1515, 1527 (10th Cir. 1992).* Although plaintiffs challenge the certainty with which the defendants' experts were able to support their opinions regarding the low level of the dioxin risks, the court finds that the effect of the arguments raised is simply to emphasize the lack of definitive information available. See REC Report at 66-64 ("Large uncertainties exist in estimates of exposure, dose, background, and hazard or risk. ... The general knowledge of hazardous waste incinerators as a source of dioxins [**40] has changed little since the early 1980s."). The court finds that the Army has carefully reviewed the dioxin issue and its current uncertainties, and that the Army's evaluation of the significance of the asserted new information is not arbitrary or capricious.

Existence of alternative technologies.

13. Plaintiff's argument that the Army must prepare a supplemental EIS to consider recent developments in alternative technologies would also require the court to accept a controversial factual position. The court would have to accept plaintiffs' factual argument that these technologies present a reasonable alternative that can be implemented immediately, even though the Army's experts have explicitly found otherwise. As with the dioxin issue, the readiness of these technologies is an issue that is not definitively resolved, and the expert testimony is contradictory. Because of the inherent time pressures in disposing of the chemical weapons stockpile, these technologies would have to be an immediate option in order to be significant. At the very least, even assuming the most optimistic schedules, implementation of the most promising of these alternatives will take several years, [**41] and the court cannot say that the Army is wrong in deciding that the risks of additional storage time outweigh the possible advantages that alternative technologies offer. In light of the deference to be given to the agency's evaluation of the issue, both through the testimony of its experts at the hearing and in the REC, the court holds that the Army's decision that these alternative technologies have not progressed sufficiently to require a supplemental EIS is not arbitrary and capricious.

Compliance with TSCA.

14. Under EPA regulations promulgated under TSCA, all incinerators are required to destroy PCBs and PCB-containing materials so that no more than one part in a million leaves the incinerator stack. 40 C.F.R. § 761.70(b)(1). This is the equivalent of the RCRA requirement of a 99.9999% DRE. Plaintiffs claim that defendants have failed to show that they are able to meet this standard for the DFS incinerator at TOCDF which will destroy the rocket tubes which contain PCBs.

15. As noted above, TOCDF has completed a test burn of PCB-containing rocket tubes and met the regulatory standard. Because the PCB characteristics of the agent-containing rockets to be processed [**42] will be similar to those previously incinerated, defendants claim that the proposed operation of TOCDF will meet the 99.9999% DRE required under TSCA.

16. While acknowledging that TOCDF is able to meet the required DRE for PCBs in concentrations of over 1,000 parts per million (ppm), plaintiffs argue that many of the PCBs to be incinerated are in lower concentrations, and that defendants have not shown that the 99.9999% DRE can be achieved for such. Plaintiffs have pointed to studies which indicate that it is impossible for any incinerator to achieve a 99.9999% DRE for [*1220] concentrations below 100 ppm. However, Mr. Rick Holmes, the associate project manager for TOCDEF, testified that he had calculated that the TOCDF furnace could meet the required DRE even if feed concentrations were as low as 300 ppm. Accordingly, the court finds that plaintiffs have not shown a likelihood of success on the merits of their claim that there is an existing or threatened future violation of TSCA.

Nuisance.

17. The court has previously granted the Federal defendants' motion to dismiss this claim on the basis of immunity. Defendant EG&G has also moved to dismiss this count. The court finds that [**43] plaintiffs' allegations with regard to their nuisance claim are inadequate. "Under Utah law, [plaintiffs] must suffer some substantial injury or damage not inflicted on the community at large in order to recover on a public nuisance theory." *Hardy Salt Co. v. Southern Pacific Transportation Co., 501 F.2d 1156, 1164 (10th Cir. 1974).* n4 The complaint fails to specify the nature of the particularized in jury that individual plaintiffs will suffer as a result of the proposed operation of TOCDF by EG&G. Indeed, based on the general environment-related complaints which form the basis of plaintiffs' suit, it does not appear likely that plaintiffs will be able to allege injury which would be different in nature from that would be suffered by the public in general. To the extent that plaintiffs' assertion of likely injury is based upon alleged increases in pollutant levels, the court finds that such injury, if it exists, would not be different from that which is suffered by the general public. Accordingly the court will grant defendant EG&G's motion to dismiss the nuisance claim, although the court will allow plaintiffs to amend their complaint to reassert this claim should particular [**44] plaintiffs be able to allege individualized injury due to the operation of TOCDF.

n4 To the extent that plaintiffs are asserting a private nuisance theory, they have failed to specify how the operations of TOCDF would affect individual plaintiffs' interest in land. See *Turnbaugh v. Anderson, 793 P.2d 939, 942-43 (Utah Ct. App. 1990).*

Conclusion

In light of the above analysis, the court finds that plaintiffs have failed to show that they will be irreparably harmed during the pendency of this action and that the relatively minor interest in preserving an opportunity for NEPA documents to be prepared pending a final ruling in this case is insufficient to justify injunctive relief. The court also finds that plaintiffs have failed to show a sufficient likelihood of success on the merits to support a preliminary injunction. Plaintiffs' motion for a preliminary injunction is therefore DENIED. In addition, the court finds that defendant EG&G's motion to dismiss plaintiffs' nuisance claim is granted without [**45] prejudice.

IT IS SO ORDERED.

DATED this 13 day of August, 1996.

BY THE COURT:

TENA CAMPBELL

United States District Judge

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CHEMICAL WEAPONS WORKING GROUP (CWWG); SIERRA CLUB and VIETNAM VETERANS OF AMERICA FOUNDATION, Plaintiffs-Appellants, v. DEPARTMENT OF THE ARMY, UNITED STATES DEPARTMENT OF DEFENSE and EG&G DEFENSE MATERIAL, Defendants-Appellees.

No. 96-4166

UNITED STATES COURT OF APPEALS FOR THE TENTH CIRCUIT

101 F.3d 1360; 1996 U.S. App. LEXIS 31336; 36 Fed. R. Serv. 3d (Callaghan) 35; 27 ELR 20569

December 6, 1996, Filed

PRIOR HISTORY:
[**1] D.C. Judge Campell.

DISPOSITION:
Appellants' motion for stay pending appeal DENIED. Motion to expedite appeal GRANTED.

JUDGES:
Before BALDOCK, LUCERO, and MURPHY, Circuit Judges. Lucero, J., Dissenting.

OPINIONBY:
MICHAEL R. MURPHY

OPINION:

[*1361] **ORDER**

Appellants have filed a motion for stay pending appeal requesting that this court enjoin all incineration activities at the Tooele Chemical Agent Disposal Facility (TOCDF) during the pendency of their appeal. They also have requested that their appeal be expedited. Appellees do not object to the request to expedite. Upon consideration, we deny the motion for stay pending appeal and grant the request to expedite.

Requests for stay pending appeal are governed by Fed. R. App. P. 8(a), which provides that an application for stay "must ordinarily be made in the first instance in the district court." A motion for relief may be made to this court, but the movant must show "that application to the district court for the relief sought is not practicable, or that the district court has denied an application, or has failed to afford the relief which the applicant requested." *Id.* Appellants concede that they have failed to seek a stay in the district court. Citing [**2] *Populist Party v. Herschler, 746 F.2d 656, 657 n.1 (10th Cir. 1984)*, however, they contend that temporal urgency made it impracticable to first seek a stay in the district court.

The chronology of events in this case belies appellants' claim that resolution of the stay issue by this court is a matter of extreme urgency needing immediate resolution. The district court denied appellants' motion for preliminary injunction on August 13, 1996. Incineration began at the TOCDF on August 22, 1996. Appellants waited until October 11, 1996, to appeal from the district court's order and until October 18, 1996, to seek a stay pending appeal even though the events upon which they primarily premise the need for Rule 8 relief occurred on August 16 and 24, 1996, and appellants were aware of these events at least by August 30, 1996.

[*1362] Appellants also contend that it was impracticable to present an application for stay to the district court because, in denying their motion for preliminary injunction, it had prejudged the issues. When the district court's order demonstrates commitment to a particular resolution, application for a stay from that same district court may be futile and hence impracticable. [**3] *See McClendon v. City of Albuquerque, 79 F.3d 1014, 1020 (10th Cir. 1996); see also, e.g., Walker v. Lockhart, 678 F.2d 68, 70 (8th Cir. 1982)* (district court's finding, in inmate civil rights action, that prisoner would be "safe" in Arkansas prison system obviated need for requesting stay of transfer order from same district court).

The futility theory, however, is inapplicable in this case. A careful review of appellants' motion for stay reveals that relief is sought predominantly on the basis of new evidence concerning events which occurred

after the district court denied the motion for a preliminary injunction. This evidence has not yet been considered by the district court. It does not necessarily follow from the refusal to grant a preliminary injunction that the district court would also refuse injunctive relief pending appeal. *See Bayless v. Martine, 430 F.2d 873, 879 n.4 (5th Cir. 1970).* This is particularly so when the relief sought pending appeal is premised primarily on new evidence which the district court has not yet had a chance to consider. We will not assume that the district court would not properly consider the new evidence if a motion for stay or other [**4] appropriate motion were presented to it in the first instance.

Beyond the inapplicability of the futility theory, the fundamentally different roles of appellate and trial courts mandate consideration of the new evidence by the district court under Fed. R. Civ. P. 62(c) before Rule 8 proceedings in this court. The district court is the proper forum for presentation, testing and confrontation of the new evidence. Only upon completion of the district court's factfinding role, should this court consider any relief pending appeal. *See In re Montes, 677 F.2d 415, 416 (5th Cir. 1982); Ruiz v. Estelle, 650 F.2d 555, 567 (5th Cir. 1981).*

The dissent primarily takes issue with the majority's failure to refer appellants' motion for an injunction pending appeal to the district court. While this difference appears insignificant, its appearance is deceiving; the difference is fundamental. The dissent would mandate consideration of an injunction pending appeal by the district court and would dictate the specific issues for that court to address. This court's Order, on the other hand, allows the appellants to choose whether or not to seek an injunction in the district court. Equally important, [**5] the Order would allow the parties, the district court and the traditional processes of litigation to control any further proceedings in the district court pending appeal.

Accordingly, after careful and thorough consideration, appellants' motion for stay pending appeal is **DENIED**. Their motion to expedite the appeal is **GRANTED**.

ENTERED FOR THE COURT

Michael R. Murphy

Circuit Judge

DISSENTBY:
LUCERO

DISSENT:

Lucero, J., Dissenting

I agree with my colleagues that this motion for stay pending appeal is based primarily upon events which occurred after the district court denied appellants' request for a preliminary injunction. Thus, at this point, this new evidence has not been analyzed by any court in order to determine whether continued incineration at the Tooele Chemical Agent Disposal Facility ("TOCDF") presents an imminent threat of irreparable harm to the public and to the environment, as appellants tell us it does.

Appellants' claims appear facially substantial. They assert that since August 13, 1996, the date of the district court's denial of the preliminary injunction, nerve agent has leaked into non-agent areas at Johnson Atoll Chemical Agent Destruction System (a prototype [**6] facility upon which TOCDF is modeled), and has been discovered in non-airtight filter vestibules at TOCDF; decontamination fluid has leaked through cracks in a concrete floor above an electrical wiring and equipment room at TOCDF; and the slag removal system in the liquid nerve agent incinerator malfunctioned at TOCDF, leading to operation shutdown. This list is non-exhaustive.

Given the district court's previous examination of the factual and legal questions presented [*1363] by this action, I agree that this new evidence would best be considered by that court. My disagreement with the majority is that they do not refer appellants' request for a stay to the district court; instead, without evaluating this new evidence at all, they simply deny the request, without requiring the district court to consider the evidence. The majority opinion implies that the district court would consider the new evidence. Were the majority to hold that the district court has no discretion but to hear that new evidence, there would be no disagreement between us. However, given the posture in which the majority leaves this case, it is unclear whether the district court must consider the recent developments, [**7] and thus whether the new evidence could escape judicial consideration. In my mind, the issues presented for our consideration and their potential effect upon the public and the environment are far too important to dispose of them by summary denial. Pursuant to our broad authority under *28 U.S.C. § 1651*(a) and Fed. R. Civ. P. 62(g), I would refer appellants' request for a stay to the district court for its consideration. n1

n1 *28 U.S.C. § 1651*(a), the All Writs Act, provides that "the Supreme Court and all courts established by Act of Congress may issue all writs necessary or appropriate in aid of their

respective jurisdictions and agreeable to the usages and principles of law." The Supreme Court has explained that the Act serves as a "legislatively approved source of procedural instruments designed to achieve rational ends of law." *Harris v. Nelson, 394 U.S. 286, 299, 22 L. Ed. 2d 281, 89 S. Ct. 1082 (1969)* (quotations and citations omitted). Fed. R. Civ. P. 62(g) states that "the provisions in this rule do not limit any power of an appellate court ... to stay proceedings during the pendency of an appeal ... or to make any order appropriate to preserve the status quo ...." This rule is not a grant of power, but is "a declaration that whatever power the appellate courts have, by virtue of the All Writs Act ... or other applicable provision of law is not restricted by Rule 62." 11 Charles Alan Wright et al., Federal Practice and Procedure § 2908 (2d ed. 1995).

[**8]

In so doing, I would direct the district court to consider whether the events that have occurred since its denial of appellants' motion for preliminary injunction warrant granting of the stay. I would specifically instruct the district court to address two issues: (1) whether these recent developments, considered in the context of the totality of the evidence, necessitate conducting a Supplemental Environmental Impact Statement in accordance with the legal standards set forth by the district court in its order; and (2) where the public interest lies in light of the new evidence. As to the latter issue, I would require that the public interest be expressly considered on the record under the standard set forth in *Northern Cheyenne Tribe v. Hodel, 851 F.2d 1152, 1157 (9th Cir. 1988).* Implicit consideration of the public interest, though allowed in copyright infringement cases, see *Autoskill, Inc. v. National Educ. Support Sys. Inc., 994 F.2d 1476 (10th Cir. 1993),* is inadequate for cases involving potentially grave public and environmental consequences. I would ask the district court to compare the risks associated with test-burning a relatively small amount of agent with the [**9] risks associated with storing that same small quantity. It is unclear whether the district court followed the above approach or instead compared the risk of large-scale incineration with the risk of large-scale storage.

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CHEMICAL WEAPONS WORKING GROUP INC., et al., Plaintiffs, vs. UNITED STATES DEPARTMENT OF THE ARMY, et al., Defendants.

Civil No. 2:96-CV-425C

UNITED STATES DISTRICT COURT FOR THE DISTRICT OF UTAH, CENTRAL DIVISION

963 F. Supp. 1083; 1997 U.S. Dist. LEXIS 4709; 44 ERC (BNA) 1628

March 24, 1997, Decided

March 24, 1997, filed

DISPOSITION:
[**1] Plaintiffs' second motion for a preliminary injunction DENIED.

COUNSEL:
For all three plaintiffs: Paul Van Dam, JONES, WALDO, HOLBROOK & MCDONOUGH, Salt Lake City, Utah. Randall M. Weiner, Boulder, Colorado. Mick G. Harrison, GREENLAW, INC., Berea, Kentucky. Robert Guild, Columbia, SC. Richard Condit, Washington, D.C.

For Department of the Army and United States Department of Defense: Stephen L. Roth, Assistant U.S. Attorney, U.S. Attorney's Office, District of Utah, Salt Lake City, Utah. Lisa Ann Holden, U.S. Department of Justice, Environmental & Natural Resources Division, Washington, D.C. Alan David Greenberg, Robert H. Foster, U.S. Department of Justice, Environmental Defense, Denver, CO. David Tundermann, Michael A. Zody, Craig D. Galli, PARSONS, BEHLE, & LATIMER, Salt Lake City, Utah. Laura J. Lockhart, Utah Attorney General's Office, Salt Lake City, Utah.

JUDGES:
TENA CAMPBELL, United States District Judge

OPINIONBY:
TENA CAMPBELL

OPINION:

[*1085] MEMORANDUM DECISION AND ORDER

This matter is before the court on plaintiffs' second motion for preliminary injunctive relief to enjoin defendants from incinerating chemical warfare agent at the Tooele Chemical Agent Disposal Facility (TOCDF). Plaintiffs [**2] claim that "new" evidence, that is, evidence discovered after the conclusion of hearings on plaintiffs' first motion for preliminary injunctive relief, demonstrates that continued incineration of agent at TOCDF poses a threat of irreparable harm. Plaintiffs also contend that the new evidence requires that defendants prepare a supplemental environmental impact statement (SEIS). The new evidence presented by plaintiffs falls into two general categories: (1) operation of TOCDF, and (2) stack emissions.

Procedural Background

Plaintiffs initiated this suit on May 10, 1996. The amended complaint alleges that defendants have violated the National Environmental Policy Act (NEPA), the Resource Conservation and Recovery Act (RCRA), the Toxic Substances Control Act (TSCA), the Defense Authorization Act, and the Clean Water Act (CWA) and that defendants' operation of TOCDF constitutes a nuisance under Utah law. The court granted defendants' motions to dismiss the RCRA, CWA, and nuisance counts. Subsequently, plaintiffs initiated several proceedings before the Utah Solid and Hazardous Waste Control Board ("Utah Board") to challenge various issues and decisions regarding TOCDF's hazardous [**3] waste permits. These parallel proceedings are, to date, ongoing.

Plaintiffs' first motion for preliminary injunctive relief ("first motion"), filed on June 12, 1996, sought to enjoin defendants from commencing trial burns of chemical warfare agent at TOCDF. After a nine-day

evidentiary hearing, this motion was denied on August 13, 1996. See *Chemical Weapons Working Group, Inc. v. Department of the Army, 935 F. Supp. 1206 (D. Utah 1996)* ("CWWG I").

On October 11, 1996, plaintiffs filed a notice of appeal of the court's denial of their first motion and dismissal of various claims alleged in the first amended complaint. Seven days later, on October 18, 1996, plaintiffs moved the United States Court of Appeals for the Tenth Circuit to stay TOCDF operations pending resolution of their appeal. Because plaintiffs had failed to first seek a stay in the district court, the Tenth Circuit denied plaintiffs' motion on December 6, 1996. *Chemical Weapons Working Group (CWWG) v. Department of the Army, 101 F.3d 1360 (10th Cir. 1996).* The Tenth Circuit did not address the merits of plaintiffs' appeal.

On January 11, 1997, plaintiffs filed a consolidated motion for stay and second motion [**4] for preliminary injunction. A hearing on plaintiffs' consolidated motion was held over six days from March 3, 1997 through March 10, 1996. Having considered the evidence presented at that hearing, the memoranda filed by the parties, and the arguments presented by counsel, the court denies plaintiffs' second motion for a preliminary injunction n1 and enters the following findings of fact and conclusions of law:

n1 The court entered judgment on plaintiffs' motion for a stay pending appeal by a separate Order.

FINDINGS OF FACT

Background

1. In its previous Memorandum Decision and Order, the court made detailed factual findings concerning the physical facility at TOCDF, the nature of the chemical warfare agent stockpile stored at Deseret Chemical [*1086] Depot n2 ("Depot"), the Army's nearly twenty-years of experience with large-scale incineration of agent materials, and the compliance process dictated by NEPA. *CWWG I, 935 F. Supp. at 1209-14.* The court will not repeat its prior findings here except as [**5] necessary to explain the pending consolidated motion.

n2 Formerly known as the Tooele Army Depot.

TOCDF Operations

2. On August 22, 1996, TOCDF began destroying chemical agent pursuant to Trial Burn Plans approved by the Utah Division of Solid and Hazardous Waste. n3 Two of TOCDF's five furnaces became operational -- the Deactivation Furnace System (DFS) and the first of two Liquid Incinerators (LIC-1). The DFS is used to incinerate munitions which, after being drained of agent, remain contaminated. Agent drained from munitions and ton containers is destroyed in the LIC. As of February 4, 1997, the DFS had functioned for more than 569 hours and the LIC for over 736 hours, resulting in the destruction of 11,472 rockets and 122,750 pounds of the nerve agent GB. This amount represents thirty-eight percent of the stockpile of GB-filled rockets stored at the Depot.

n3 TOCDF's RCRA Part "B" permit specifies distinct sets of conditions for the "long term" and "short term" operation of the facility. The short term period is comprised of three phases -- "shakedown," "trial burn," and "post-trial burn." The trial burn plans cover the shakedown and trial burn phases only.

[**6]

3. On January 17, 1997, TOCDF began processing ton containers n4 stored at the Depot in the Metal Parts Furnace (MPF) and GB nerve agent drained from those containers in the second LIC (LIC-2). As of February 4, 1997, fifty-one such ton containers and 76,500 pounds of GB had been destroyed.

n4 Ton containers are large steel bulk storage containers. There were approximately 5,709 GB-filled ton containers in the original stockpile.

4. All present activities at TOCDF are governed by the Trial Burn Plans. TOCDF is currently operating in the "shakedown" phase, a period designed to identify possible mechanical difficulties, ensure that the facility has reached operational readiness, and achieve steady-state operating conditions prior to conducting the trial burns.

5. A munitions processing schedule governs the order in which the various munitions stored at the Depot are to be destroyed at TOCDF. Each portion of the schedule, termed a "campaign," is devoted to the

disposal of a specific item in the stockpile inventory. [**7] Defendants submitted evidence in the form of declaration testimony by Gary J. Boyd, author of the quantitative risk assessment for TOCDF, that since the court's decision in CWWG I, the munitions processing campaigns have been reordered to provide for the destruction of higher risk munitions earlier in the processing schedule. Mr. Boyd testified that accidents involving nerve agent GB represent the majority of the risk from potential stockpile accidents; accordingly, the first campaign in the reordered munitions processing schedule provides for the disposal of GB-filled rockets and ton containers. The reorganization of the munitions processing campaigns will reduce the stockpile risks much more rapidly than would have occurred under the original processing schedule.

6. During the shakedown period, three events have occurred which have caused defendants to halt operation of TOCDF: (1) detection of low levels of agent in two filter containment vestibules; (2) leakage of a small quantity of decontamination fluid through hairline cracks in a second level cement floor to a first floor electrical room; and (3) migration of agent into an observation corridor. In addition, TOCDF has experienced [**8] other operational and personnel difficulties. Citing these events and difficulties, plaintiffs maintain that TOCDF's present-day operation is substantially different from that contemplated during the NEPA compliance process and presents a risk of irreparable harm. Specifically, plaintiffs contend that while the "lessons learned" program and the operation of prototype facilities at the Depot (CAMDAS) and at Johnson Atoll (JACADS) were designed to identify, analyze, and correct problems of this type prior to the commencement of agent operations at [*1087] TOCDF, the facility is being operated in a reactive, trial-and-error manner.

Agent Migration Into Filter Vestibules

7. The primary means of preventing an airborne agent release to the environment or the spread of agent vapor within TOCDF is the Heating, Ventilation, and Air Conditioning (HVAC) system. The HVAC maintains negative pressure throughout the facility so that air from areas least likely to be contaminated with agent flows to areas where contamination is more likely. Air from areas in which contamination is most likely is steadily removed and directed through a bank of filters designed to extract agent. Of the nine filter [**9] units in the system, seven are typically in use at any given time with the remaining two units serving as reserves. Air passing through the filters is funneled into a common exhaust stack and monitored for the presence of agent. Additional agent monitors are located between the charcoal banks that comprise the filter units.

8. The HVAC filters are enclosed within a metal structure containing sealed access doors. In March 1995, it was discovered that the gaskets surrounding similar access doors at JACADS allowed small amounts of agent to escape to the environment. It was subsequently determined that different door gaskets and clamping mechanisms would prevent future agent releases. It was also determined that secondary containment structures, not part of the original design plans for either JACADS or TOCDF, should be constructed over the access doors at both facilities. These structures, called "vestibules," were constructed at both facilities in 1996.

9. The filter vestibules are pre-fabricated wooden structures. The interiors of the vestibules are modified so that each is lined with 22-gauge stainless steel sheeting and caulked with silicon; however, the structures are not designed [**10] to be airtight. In August 1996, the vestibules were monitored for the presence of agent through the use of Depot Area Air Monitoring System (DAAMS) units. DAAMS units collect air contents onto an absorbent material inside a testing tube over an extended period of time, typically eight hours. The absorbent material is then analyzed for the presence of agent. The other monitoring system used at TOCDF, Automatic Continuous Air Monitoring System (ACAMS), is a self-contained chromatograph used to determine agent concentrations on a near real-time basis.

10. On August 23, 1996, GB nerve agent migrated into the filter vestibules attached to filter units 107 and 108. The release was detected and confirmed the next day during laboratory analysis of absorption tubes removed from DAAMS units in both vestibules. The testing revealed that between 8:00 a.m. and 4:00 p.m. on August 23, 1996, agent was present in vestibule 108 at a level of 3.62 Time Weighted Average (TWA) n5 and in vestibule 107 at a level of .25 TWA. During this eight hour period, filter unit 107 was in operation for approximately nine minutes; filter unit 108 was off-line for the entire day. On the afternoon of August 23, 1996, [**11] three TOCDF employees were present in the vestibule 107 for approximately twenty minutes. Filter 107 was off-line at the time. Medical tests of the personnel indicated that they suffered no agent exposure.

n5 TWA is an agent concentration exposure measurement established by the Office of the Surgeon General. An average individual can be exposed to one TWA for

eight hours per day, forty hours per week, for his or her lifetime without suffering adverse health effects.

11. The plant shift manger was notified of the confirmed agent levels in the filter containment vestibules at approximately 2:32 p.m. on August 24, 1996. Processing of M55 rockets was immediately suspended. An announcement made over the public address system declared the area in and around the filter units off-limits to all but essential personnel, a 200-foot clear zone was established and cordoned off with barricade tape, and ACAMS agent detection systems were placed outside the filter vestibules and at the plant boundaries. None of these ACAMS units [**12] registered the presence of chemical agent. In addition, any personnel entering the clear zone were required to wear protective masks. Richard Holmes, Associate Project Manager for TOCDF, testified that he could not recall whether a masking alarm sounded to warn TOCDF personnel in the area to don their [*1088] masks; however, the evidence suggests that the alarm was not sounded. Finally, the ambient air present in the filter vestibules was drained back into TOCDF.

12. An investigation of the incident revealed that the most probable cause of the agent migration into the filter containment vestibules was the procedure used to place the filter units off-line, a phenomenon not encountered at JACADS. After consultation with the Executive Secretary of the Utah Board, defendants altered the procedure to ensure that negative pressure was maintained within the filter units at all times. Defendants also installed additional filtered valves in all of the filter vestibules. Finally, defendants permanently installed ACAMS agent detection systems in the vestibules. All of these actions were taken before agent operations resumed on August 30, 1996.

Cracks in the Concrete

13. On September 18, 1996, [**13] TOCDF experienced a leak of approximately eight ounces of decontamination liquid through the ceiling of an electrical room located on the first floor of the Munitions Demilitarization Building from a decontamination area located above. Upon learning of the leak, the plant manager halted agent processing activities. Tests detected no chemical agent present in the liquid, and no electrical equipment was affected. An inspection of the decontamination room, used by TOCDF personnel to decontaminate their protective equipment after exiting Explosive Containment Rooms (ECRs), revealed several hairline cracks in the concrete floor which allowed fluid to leak into the electrical room. Mr. Holmes testified that the cracks were sealed by an injection of a low viscous grout.

14. Cracks in concrete have occurred in other areas at TOCDF. Donald Smith, EG&G's Senior Quality Assurance Specialist at TOCDF, testified that he noticed cracks as early as 1990 during construction of the facility. However, Timothy Thomas, the Army's TOCDF Project Manager, testified that cracks in the concrete identified during construction of the facility were repaired. John Russell Hall, an Engineering Technician for EG&G [**14] at TOCDF from February 6, 1994 to January 4, 1996, testified that he noticed cracks in the concrete floors of the Toxic Maintenance Area (TMA) and the Residue Handling Area (RHA) in 1995. Mr. Hall testified that he completed a work order for the cracks in the TMA on November 22, 1995, but he was unable to recall whether these cracks or those located in the RHA were repaired by the time he left EG&G's employ. In fact, Mr. Hall testified in his deposition that he had no knowledge of any corrective action taken by defendants to address cracks in the concrete at TOCDF since his employment was terminated. Further, the court notes that Mr. Hall's tenure at TOCDF was during systemization, a phase of operations designed to identify and correct problems in TOCDF's physical plant and equipment.

15. Defendants have established corrective measures to identify, map, evaluate, and repair cracks in the concrete at TOCDF. Cracks are identified through routine and scheduled inspections of TOCDF's structural integrity by EG&G personnel. When a crack is identified, a work order is prepared and the crack is evaluated to determine its nature and the appropriate method of repair. Minor and hairline cracks [**15] in the concrete or the floor coating are repaired by applying a filling compound resistant to decontamination fluid and re-coating the area with chemical-resistant epoxy paint. Major cracks are repaired in a similar manner after being injected with a bonding compound. When cracks are identified in a toxic area, agent operations in that area are suspended until the crack is fixed. Thomas A. Kurkjy, EG&G's Risk Management Division Director, testified that hundreds of minor cracks and three major cracks -- cracks having a discernible void -- have been identified in the concrete floor and floor coating at TOCDF and have been repaired.

Agent Migration Into Observation Corridors

16. On January 26, 1997, GB nerve agent vapors migrated into an unoccupied observation corridor

adjacent to the first floor buffer storage area. An ACAMS alarm in the corridor sounded, and TOCDF personnel donned their protective masks and evacuated the building. In addition, TOCDF operations were halted pending an investigation [*1089] into the alarm. The ACAMS monitoring system indicated that agent had been present in the observation corridor at a level of 1.04 TWA. Agent was not released to the environment and [**16] no TOCDF employees were exposed to agent. The Army notified the appropriate regulatory authorities of the event, and agent operations resumed only after state approval was received.

17. An investigation revealed that the event was triggered when, at approximately 10:30 p.m. on January 25, 1997, an interior door between an air lock and the DFS room was opened during maintenance operations. The opening of the door caused the air pressure in nearby Toxic Cubicle n6 to rise slightly, which, in turn, activated an alarm in TOCDF's control room. A control room operator responded by opening a toxic cubicle bypass damper to lower the air pressure in the Cubicle, an action that violated TOCDF's standard operating procedures. Opening the damper had a secondary effect of causing a pressure imbalance between the observation corridor and the buffer storage area. As a result, when a drained GB ton container was moved through the storage area en route to the MPF, GB vapor was permitted to migrate into the corridor.

n6 The Toxic Cubicle houses the liquid agent storage tank.

[**17]

18. Defendants have taken corrective measures to prevent such an event from recurring: operator procedures and system changes have been implemented, control room operators have received additional training on the secondary effects of opening bypass dampers, TOCDF's standard operating procedures have been modified to emphasize the appropriate use of the toxic cubicle bypass damper, and additional air pressure alarms have been installed in TOCDF's control room.

Other Operational Events at TOCDF

19. TOCDF has experienced additional operational events during the shakedown period. These include: the failure of heating elements in the slag removal system in LIC-1; incidents during rocket processing initialization, loss of electrical power, temporary HVAC imbalance during a test of the fire suppression system, malfunction of the agent quantification system, and use of a "hot cut-out" procedure to remove TOCDF personnel from their protective clothing.

Slag Removal System Operation

20. The incineration of liquid agent produces acidic by-products which condense on the walls of the secondary combustion chamber of the LICs to form a molten slag. This slag slowly flows down [**18] the walls and collects in a pool at the bottom of the chamber. The slag removal system employs sixteen heating elements to maintain the slag in a molten state so that it may be drained from the LICS. During agent operations in LIC-1, several of the elements failed, requiring defendants to halt processing in LIC-1 temporarily so that the faulty elements could be replaced. Defendants intend to modify the slag removal system by fitting protective sleeves around the heating elements to increase their useful life expectancy.

Incidents During Rocket Processing Initialization

21. On October 14, 1996, an end cap from the rear of an M55 rocket shipping and firing tube was inadvertently removed by a feed gate designed to allow rockets to pass into an ECR for disassembly. Operation of the affected rocket processing line was halted temporarily to allow TOCDF personnel to examine the tube and the rocket. Once it was determined that the rocket was intact and stable, the employees secured the end cap to the tube and processing resumed. Rocket processing procedures have since been modified to minimize the likelihood that such an event will occur in the future.

22. On two occasions -- once [**19] in November 1996 and once in December 1996 -- rocket parts have jammed in the chute feeding into the DFS. After both incidents, operations at TOCDF were halted to allow the jams to be cleared and an evaluation to be conducted. An investigation revealed that a build-up of heated materials on the feed chute prevented sheared rockets from being fed properly into the DFS. Feed chute jams experienced at JACADS had a different root cause, one not observed at TOCDF. To reduce the likelihood of future jams at TOCDF, defendants [*1090] have heightened inspection of the chute area and have modified the chute to allow for ready access, should a jam occur.

Loss of Electrical Power

23. In mid-September 1996, TOCDF experienced a loss of commercial electrical power for 38 minutes. TOCDF's emergency power supply activated and

provided power to essential equipment in the plant, including the HVAC system. During the restart of the HVAC system, only one of the two normally operating air supply handlers came on line, causing an imbalance in the HVAC system air pressure. The masking alarm sounded and notification was given to the Deseret Chemical Depot Emergency Operations Center. Within minutes of the [**20] power loss, the second air supply handler was started manually and the masking signal was withdrawn. No chemical agent migrated from the facility and no TOCDF personnel were exposed to agent.

24. Power failures are not uncommon at TOCDF. However, there has never been an occasion when the backup power system failed to properly activate upon loss of power. Because ACAMS systems operate on an independent and uninterrupted power supply, their operation is not affected by a loss of commercial power.

Temporary HVAC Imbalance During Fire Suppression System Test

25. On September 2, 1996, a temporary imbalance in the HVAC system occurred in the Unpack Area (UPA) during a test of the fire suppression system. In conducting the test, maintenance personnel shut off the water supply to the sprinkler system. This action triggered an abnormal water pressure alarm and caused the internal fire dampers in the UPA ventilation system to close automatically. This closure caused a temporary pressure imbalance in the UPA HVAC system. Negative pressure was maintained throughout TOCDF during the event and the UPA HVAC system was stabilized quickly. No agent migrated from primary containment areas [**21] and employee safety was maintained. TOCDF maintenance personnel have since received corrective training to ensure that such an incident does not recur.

Agent Quantification System Operation

26. The Agent Quantification System (AQS) is designed to measure the amount of agent drained from munitions. The measurement is made not for security purposes but to determine the amount of residual agent being fed into the DFS. This calculation is required by TOCDF's RCRA permits. During initial agent operations it was discovered that the AQS was improperly indicating the presence of agent in rockets that had been completely drained. An investigation revealed that the AQS allowed a small quantity of agent to flow into the agent holding tank before being measured. Proper operation of the AQS was restored by the installation of a metal plate vertically from the top of the AQS downward into the tank, and similar problems have not recurred.

Hot Cut-Outs

27. TOCDF personnel working in contaminated areas are required to wear demilitarization protective ensemble (DPE) suits. These plastic suits are completely sealed from the outside environment and must be physically cut to be removed [**22] from employees. When the cut-out procedure is performed in an area where agent concentration exceeds 1 TWA, the exit is termed a "hot" cut-out. Plaintiffs argue that the hot cut-out procedure exposes TOCDF employees to chemical agent. In support of their claim, plaintiffs presented documentary evidence that the number of hot cut-outs performed at TOCDF increased steadily from ten in September 1996 to a high of fifty in November 1996. The increased frequency of hot cut-outs was due to two factors. First, practices in place at the time attempted to minimize the amount of decontamination liquid utilized outside the ECRs. Second, the nature of the work performed during those months required more frequent handling of equipment bearing liquid agent. While the hot cut-out procedure requires employees to exit the DPE suit in the presence of agent, GB nerve agent is primarily an inhalation hazard and every worker is equipped with an independent breathing apparatus. Because TOCDF will process only GB nerve agent for at least one year, the court finds that the hot cut-out [*1091] procedure does not present a threat to employee safety prior to trial.

28. None of the events cited by plaintiffs or other [**23] operational difficulties experienced at TOCDF has resulted in loss of life, injury to TOCDF personnel, or harm to the environment. James J. Cudahy, an expert in the evaluation, design, operation, and permitting of hazardous waste incineration facilities, testified that the number of safety related incidents at TOCDF is not unusually high when compared to typical start-ups of modern complex systems for hazardous waste incineration.

TOCDF Management

29. Plaintiffs argue that defendants' management of TOCDF does not ensure protection of public health and the environment. In support of their assertions, plaintiffs presented documentary evidence and testimony from former TOCDF employees Gary Millar, John Hall, and James DeHaven, and current employee Donald Smith.

30. Plaintiffs rely heavily on a November 9, 1996 letter from Gary Millar, former General Manager at

TOCDF, to Fred Parks, President of EG&G, written shortly after Mr. Millar's employment with EG&G was terminated. In the letter, Mr. Millar raised several issues about TOCDF operations and management. Mr. Millar indicated that on the date agent operations began at TOCDF, August 22, 1996, the facility was at a marginally [**24] acceptable state of safety readiness. The letter also speaks of numerous safety, quality, environmental, and operational deficiencies which, in Mr. Millar's opinion, are excessive in a "high risk business like TOCDF." In addition, Mr. Millar was highly critical of management actions at TOCDF which he analogized to the those preceding the nuclear accident at Three Mile Island and the Challenger Disaster and of a corporate "mindset" which, according to Mr. Millar, presents a high risk to TOCDF employees, the public, and the environment.

31. Mr. Millar's testimony under oath belies many of the concerns raised in the November 9, 1996 letter. On December 12, 1996, Mr. Millar testified to the Utah Board that TOCDF was being operated safely and that state regulatory agencies charged with overseeing the facility were doing a "good job" keeping TOCDF operations and the public safe. Mr. Millar further testified that he never intended his letter to become public and that he considered the issues raised therein to concern EG&G's internal management, not plant safety. Mr. Millar's deposition testimony echos his testimony before the Utah Board. Mr. Millar acknowledged that when he wrote the letter, [**25] he was upset about his recent firing and that he did not intend the letter to be disseminated to the Army, the State of Utah, or the public. Further, Mr. Millar testified that he believed TOCDF to be "inherently safe" and that he did not consider the risks described in the November 9, 1996 letter to be so serious that he was required to disclose them to state regulatory authorities. The court finds Mr. Millar's testimony more credible and more probative than the contents of his November 9, 1996 letter.

32. Plaintiffs also presented evidence in the form of deposition and live testimony from John Hall. Mr. Hall testified that he had noticed and reported various problems at the facility, including cracks in concrete flooring and leaks of sulfuric acid from batteries powering the emergency power system. However, Mr. Hall also testified that his employment with EG&G ended on January 4, 1996 and that he has no knowledge of conditions or operations at TOCDF since that date. Accordingly, insofar as Mr. Hall's testimony relates to events occurring since he left EG&G's employ or the potential for future problems at the facility, the court finds his testimony to be of little probative value. [**26]

33. Plaintiffs also presented evidence in the form of testimony by James DeHaven, an emergency medical technician employed at the Tooele Health Clinic from October 1, 1996 to February 14, 1997. Mr. DeHaven testified that electrocardiograms (EKGs) he administered to several Depot personnel revealed a higher than normal incidence of bradycardia (slow heart rate) and "blocks" (interruptions of the electrical pathways to the heart), both symptoms of nerve agent exposure. Mr. DeHaven further testified that his medical supervisors, Army personnel, [*1092] and representatives from the Utah Department of Health ignored his concerns. On cross-examination, Mr. DeHaven acknowledged that he did not know the prior medical histories of those employees exhibiting bradycardia or blocking, how long they had exhibited either condition, possible other causes of the symptoms, how long the workers had been employed at the Depot, or whether they worked at TOCDF or some other area of the Depot. n7 Mr. DeHaven also testified that all EKGs administered at the Tooele Health Clinic were transmitted to an Army hospital in Texas to be read by a cardiac specialist. Mr. DeHaven was not aware of any instance in which an [**27] EKG administered at the Depot had been deemed abnormal by a cardiac specialist. Accordingly, the court finds that Mr. DeHaven's testimony did not constitute evidence that TOCDF personnel had suffered nerve agent exposure.

n7 Later testimony established that the medical clinic at TOCDF is separate from the Tooele Health Clinic.

34. Plaintiffs also relied on the testimony of Donald Smith and on entries contained in private journals in which Mr. Smith recorded concerns and frustrations he experienced as EG&G's Senior Quality Assurance Program Development Coordinator at TOCDF. Throughout his testimony, Mr. Smith made clear that his journals did not represent his professional work product, were intended to be private, and were often used to "[vent] emotional feelings at the time." Hearing Tr. at 76 (March 6, 1997). Mr. Smith also testified that the latter portions of his journal were written while he was being treated with heavy medication. Finally, Mr. Smith testified that many, if not most, of his journal entries [**28] relating to TOCDF were based not on his personal knowledge, but on hearsay evidence. Accordingly, the court finds Mr. Smith's testimony to be of little probative value.

35. Finally, plaintiffs attempted to establish that Mr. Millar and Mr. Hall were terminated from their

employment with EG&G in retaliation for raising concerns regarding safety at TOCDF. Defendants presented evidence in the form of Timothy Thomas' supplemental declaration that Mr. Millar's firing was predicated on his inability to effectively communicate his management priorities and instructions and on his management approach, which caused stress in other EG&G personnel. In his deposition testimony, Mr. Millar admitted being told that he was causing morale problems among the workforce at TOCDF and that several EG&G managers had filed written complaints about him. Defendants also presented Mr. Hall's deposition testimony in which he conceded that he had no direct evidence that his firing was retaliatory in nature. The court finds that plaintiffs have produced insufficient evidence to establish that either Mr. Millar or Mr. Hall were terminated from their employment with EG&G for raising concerns regarding safety at [**29] TOCDF.

Quantitative Risk Assessment

36. The Army's Program Manager for Chemical Demilitarization, Major General Robert D. Orton, has directed that a quantitative risk assessment (QRA) and risk management program be developed for each of the eight planned chemical demilitarization facilities in the continental United States, including TOCDF. The TOCDF QRA estimates the probabilities and public health consequences of potential accidental releases of chemical agent during chemical storage and disposal activities. Releases resulting from internal initiating events (those originating inside the facility or directly from the activity being performed) and from external events (e.g. earthquakes, aircraft accidents, and tornadoes) were included. In addition, the TOCDF QRA assesses the public risk associated with storage of the chemical munitions at the Depot absent demilitarization operations. The TOCDF QRA is based on the "as-built TOCDF design" and incorporates data derived from JACADS.

37. At the time of the court's decision in CWWG I, the QRA for TOCDF was in draft form. Since that time, the final QRA for TOCDF has been issued. The final QRA reflects several changes [**30] from the draft version. First, as discussed above, the munitions [*1093] processing campaigns have been reordered so that higher risk munitions are destroyed earlier in the processing schedule. Second, the expected duration of processing operations at TOCDF has increased from 6.2 to 7.1 years. This change reflects the final QRA's reliance on the now de-classified actual processing schedule for TOCDF rather than on an estimated schedule, as had the draft QRA. Third, the final QRA incorporates a more realistic model for measuring risks associated with agent spills in storage area igloos. The draft QRA assumed that all igloo spills would completely exit the igloos and be subject to outside evaporation rates. The final QRA assumes that smaller spills not having sufficient volume to reach the doorway will be confined to the interior of the igloo. Fourth, the final QRA more realistically predicts the number of M55 rocket igloos that would explode during an earthquake. The draft QRA assumed that the explosion of one igloo would trigger all of the remaining igloos to explode. The current model predicts the number of igloos that would explode in earthquakes of varying sizes.

38. The final QRA concludes [**31] that, on average, 34 days of continued storage of the stockpile incurs a public risk equal to that associated with the entire 7.1 years of TOCDF agent operations. If rare events such as earthquakes and aircraft accidents are removed from the assessment, the finding is stronger -- the risk to the public from the entirety of TOCDF's operations is equaled by the risk of only 2.3 days of continued storage. n8 The final QRA also concludes that a one year delay in processing will approximately double the risk to the population surrounding the stockpile.

> n8 This is so because earthquakes dominate the risks from disposal more than those associated with storage.

Stack Emissions

39. Plaintiffs allege that "the health risk from the on-going daily stack emissions of toxic chemicals [at TOCDF] including both dioxin and nerve agent is both more real and quantitatively greater than previously disclosed." Plaintiffs' Consolidated Memorandum in Support of Plaintiffs' Motion for an Injunction Pending Appeal and Plaintiffs' [**32] Second Motion for Preliminary Injunction, at 3. Plaintiffs base this claim on "new" evidence that: (1) nerve agent GB is being emitted from the stacks at TOCDF; and (2) the Utah Department of Environmental Quality (DEQ) improperly manipulated the screening health risk assessment (SRA) performed for TOCDF by reducing estimates of mustard gas emissions, deleting risk calculations associated with open burning and open detonation, and omitting risk scenarios based on dioxin exposure to breast-fed infants and subsistence farmers.

GB Emissions

40. Stack effluent gasses at TOCDF are regularly monitored for a number of analytes, including GB, by

ACAMS and DAAMS monitoring systems installed in the stacks. Stack samples are analyzed, and the results are forwarded to state regulatory authorities.

41. Plaintiffs argue that analyses of stack particulate emissions at TOCDF indicate the presence of nerve agent GB in the stack effluent. Plaintiffs also allege that defendants' testing and analysis methodologies underestimate the amount of nerve agent actually escaping the stack and overestimate the agent destruction and removal efficiencies calculated for the DFS. In support of their claims, [**33] plaintiffs presented evidence in the form of declaration and live testimony by Pat Costner and a document prepared by EG&G's subcontractor, Battelle, which reports non-zero readings for nerve agent GB in stack emissions at TOCDF. The court finds that the evidence presented by plaintiffs is insufficient to demonstrate conclusively that nerve agent GB is being emitted from the stacks at TOCDF. All of the positive results cited in the Battelle document were below the level of quantification (LOQ), that is, the sensitivity or calibration range, of the monitoring equipment, a level approximately equivalent to a GB stack concentration over 5,500 times less than the maximum allowable regulatory-based GB stack concentration. Values below the LOQ have a lower confidence that the quantity of GB detected is [*1094] accurate and could reflect machine "noise," an interferant, or a false positive. The court finds that Ms. Costner's testimony is only marginally probative in that much of the scientific data underlying her opinions was not directly applicable to the TOCDF facility.

42. Plaintiffs attempt to analogize the potential health effects of alleged GB emissions with illnesses suffered by veterans [**34] of the Persian Gulf War. In lieu of written or live testimony, the parties introduced documentary evidence, mainly in the form of articles from periodicals. The court finds that because the etiology of Gulf War illness is not known with any degree of reasonable certainty, the evidence submitted on this subject is not probative of the issues raised by plaintiffs' consolidated motion.

Screening Health Risk Assessment

43. Prior to approving trial burns of chemical agent at TOCDF, DEQ performed an SRA which analyzed the impacts of expected TOCDF emissions on human health and the environment. The SRA followed Environmental Protection Agency (EPA) guidance in adopting conservative assumptions.

44. In CWWG I, the court discussed in detail the risk assessment performed for *TOCDF. 935 F. Supp. at 1213-14.* After carefully considering the health risks associated with dioxin exposure and DEQ's decision to eliminate from its February 1996 SRA risk scenarios regarding a subsistence farmer and a breast-feeding infant, the court found that:

although plaintiffs have shown that the assumptions applied in the State's health risk assessment may indicate a higher level of risk for [**35] some hypothetical persons, this does not constitute a showing that there is an actual risk to some person or persons posed by the emissions levels predicted for the facility.

Id. 935 F. Supp. 1206 at 1214. None of the new evidence presented by plaintiffs undermines the court's prior finding.

45. As they did with their first motion, plaintiffs rely heavily on a draft chapter of the EPA's "Health Assessment Document for 2, 3, 7, 8, Tetrachlorodibenzo-p-Dioxin (TCDD) and Related Compounds" (Dioxin Reassessment). However, this document, which by its terms is not to be cited or quoted, remains subject to review by EPA's Science Advisory Board and possible public comment and does not represent the EPA's final position. The court finds that scientific knowledge regarding health risks associated with dioxin exposure and the methods to assess the health impacts of dioxin emissions at TOCDF remains unchanged since the previous hearing.

46. In CWWG I, the court addressed the omission of the subsistence farmer and breast-feeding infant scenarios from the *SRA. 935 F. Supp. at 1213-14.* The court noted that the final version of the SRA "considered three farmer scenarios based on a survey of actual [**36] farming practices in the area, and simply deleted the breast-feeding infant scenario." *Id. at 1214.* Plaintiffs argue that the final SRA erroneously omitted consumption of local dairy products from the risk calculus. In support of this contention, plaintiffs presented evidence in the form of a written summary of farming activity surrounding TOCDF drafted by Rachel Shilton, an engineer in DEQ's Division of Solid and Hazardous Waste, and an unofficial table prepared former EG&G Permitting Manager Gary Harris which, according to plaintiffs, demonstrate that such dairy consumption is, in fact, occurring. The court finds this evidence to be unreliable. While the table appears to identify a family of local dairy consumers, no names or other identifying information is provided. The summary indicates, at most, that local dairy production may have occurred in the past. The court finds more probative Ms. Shilton's testimony that she was unable to locate any persons in the area of TOCDF who presently consume locally produced dairy products.

47. Plaintiffs allege that risk calculations for open burning and open detonation (OB/OD) of chemical weapons at the Depot were improperly omitted from [**37] the SRA. However, plaintiffs presented no evidence that OB/OD operations were occurring or would occur within the next year. Ms. Shilton testified in her declaration that DEQ will allow open burning to occur at the Depot [*1095] only if agent operations at TOCDF have ceased or if emissions from OB/OD could be modeled with the other emissions considered in the RSA to produce a cancer risk no higher than 10 per million. Plaintiffs presented no evidence that either condition has occurred.

48. The SRA models stack emissions for four stacks: the combined stack for the LICs, DFS, and MPF incinerators, the HVACS (ventilation) stack, the Dunnage Incinerator stack, and the CAMDAS stack. Early screening calculations for risks associated with mustard agent (HD) stack emissions assumed that all four stacks would emit both HD and GB continuously at the minimum concentration that would trigger a waste-feed cutoff under TOCDF's operating permits. When these early calculations showed a high risk level for HD, the model was revised to assume that HD emissions from the HVACS stack would be at the detection level, 20% of the waste-feed cutoff level. The court finds that this change reflects a more realistic [**38] approximation of expected HVACS stack emissions. The court also finds that there is no evidence that HD will be processed at TOCDF within the next year. Indeed, according to the revised munitions processing schedule, TOCDF will process only GB-filled M55 rockets and ton containers for at least one year.

CONCLUSIONS OF LAW

1. Plaintiffs bear the burden of establishing that they are entitled to injunctive relief. To meet their burden, plaintiffs must establish: (1) that they will be irreparably injured unless an injunction issues; (2) that the threatened injury outweighs any damage defendants might suffer; (3) that the injunction, if issued, is not adverse to public interest; and (4) that they have shown a substantial probability of success on the merits. *Walmer v. U.S. Department of Defense, 52 F.3d 851, 854* (10th Cir.), cert. denied, *U.S. , 133 L. Ed. 2d 403, 116 S. Ct. 474 (1995).* If plaintiffs establish the first three requirements for a preliminary injunction to issue, they may establish likelihood of success by showing "questions going to the merits so serious, substantial, difficult and doubtful, as to make the issues ripe for litigation and [**39] deserving of more deliberate investigation." Id. (citing *City of Chanute v. Kansas Gas & Elec. Co., 754 F.2d 310, 314 (10th Cir. 1985)).*

Irreparable Harm

2. To constitute irreparable harm, an injury must be certain, great, and actual. *Wisconsin Gas Co. v. FERC, 244 U.S. App. D.C. 349, 758 F.2d 669, 674 (D.C. Cir. 1985).* Irreparable harm cannot be speculative; "the injury complained of [must be] of such *imminence* that there is a 'clear and present' need for equitable relief to prevent irreparable harm." Id. (emphasis in original)(citations and internal quotations omitted); see also *Regan v. Vinick & Young, 862 F.2d 896, 902 (1st Cir. 1988)* ("speculation or unsubstantiated fears about what may happen in the future cannot provide the basis for a preliminary injunction"). Plaintiffs' claims of irreparable injury relate to: (1) the alleged public health consequences of the operation of, and emissions from, TOCDF; and (2) defendants' failure to prepare a supplemental environmental impact statement (SEIS), which, according to plaintiffs, constitutes a violation of NEPA.

Operational Risks

3. Plaintiffs assert that the occurrence of several incidents [**40] at TOCDF since agent operations began demonstrates that continued operation of the facility poses immediate risks to TOCDF employees, the public, and the environment. The overall record of operations at TOCDF does not support plaintiffs' claim. Although there have been problems at the facility, some of which required the suspension of operations, none of the events caused harm to TOCDF personnel, the public, or the environment. There is no evidence that human injury or environmental harm is inevitable or likely. In fact, the record suggests that TOCDF's safety equipment and procedures are effective in preventing such harms.

4. The evidence presented through John Hall, Donald Smith, and James DeHaven does not undermine this conclusion as it lacks sufficient probative value to be of merit. Likewise, in light of Gary Millar's testimony [*1096] in his deposition and before the Utah Board that TOCDF was being operated in a safe manner, his November 9, 1996 letter cannot serve as a basis for finding that TOCDF operations pose a risk of irreparable harm.

5. The problems experienced at TOCDF do not demonstrate that the "lessons learned" program is a failure. To the contrary, the evidence indicates [**41] that events experienced at JACADS have not recurred at TOCDF and the root causes of incidents at TOCDF were not observed at JACADS.

6. The fact remains that all of the events at

TOCDF occurred during the shakedown period, a phase designed to identify and correct operational difficulties prior to full-scale operations. As testified to by defendants' expert, James Cudahy, such events are to be expected during shakedown operations for any large-scale hazardous waste incinerator. The court finds that the occurrences cited by plaintiffs are too speculative to support a finding of irreparable harm.

Risks from Stack Emissions

7. Plaintiffs argue that the presence of nerve agent GB in TOCDF's stack effluent constitutes a direct and present threat to public safety and the environment. However, there has never been a confirmed detection of agent in the stack emissions from TOCDF since agent operations began. Non-zero values for GB reported in the stack particulate analysis relied upon by plaintiffs were well-below the level of quantification of the monitoring equipment, a level that is itself more than five thousand times less than the maximum GB stack concentration permitted by the [**42] regulatory scheme. No significant degree of scientific confidence can be placed in the results of the particulate analysis; indeed, the evidence indicates that the positive readings for GB could have benign origins such as machine noise or false positives. The court finds that the asserted risks from emissions of GB from the stacks at TOCDF is too speculative to qualify as irreparable harm to plaintiffs.

8. Plaintiffs' allegations regarding mustard agent emissions cannot support a finding of irreparable harm. The evidence reflects that mustard agent will not be processed at TOCDF before trial on the merits. Thus, plaintiffs will suffer no injury justifying preliminary injunctive relief. Further, while final SRA prepared by DEQ utilized a less conservative model for mustard agent stack emissions than did earlier assessments, the court finds that the revision more accurately reflects the actual operating conditions at TOCDF.

9. Plaintiffs' allegation that the SRA underestimates the risks associated with dioxin exposure is not tantamount to irreparable harm. The elimination of the breast-feeding infant and subsistence farmer scenarios is consistent with EPA guidance for facilities like [**43] TOCDF. Further, there is simply no reliable evidence that either scenario applies to the areas surrounding the facility. At most, plaintiffs have shown that the assumptions applied in the SRA may indicate a higher level of risk for some hypothetical persons, not that there exists an actual risk to actual persons from projected emissions levels.

10. The SRA's omission of risk calculations for open burning/open detonation at TOCDF does not support a finding of irreparable harm. Neither activity currently occurs at TOCDF, and plaintiffs produced no evidence that OB/OD operations would commence before trial. The court finds that the asserted risks of harm due to dioxin exposure are too speculative to constitute irreparable harm to plaintiffs.

11. Having carefully considered all of these factors, the court concludes that neither the plaintiffs nor the public will suffer irreparable harm from TOCDF emissions.

NEPA Harm

12. The purpose of NEPA is to focus "government and public attention on the environmental effects of proposed agency action." *Marsh v. Oregon Natural Resources Council, 490 U.S. 360, 371, 104 L. Ed. 2d 377, 109 S. Ct. 1851 (1989).* To this end, NEPA requires [**44] federal agencies to consider all information prior to taking an action which might have significant environmental effects. Id. Plaintiffs contend that defendants' failure to supplement the 1989 environmental impact statement (EIS) violates NEPA and constitutes irreparable harm. As [*1097] discussed more fully in the court's examination of plaintiffs' likelihood of success on the merits, plaintiffs' "new" information did not require the preparation of a supplemental environmental impact statement. However, even if defendants' decision not to generate a SEIS did violate NEPA, "pending final resolution of this case, such injury will occur during only a small portion of the expected operating lifetime of TOCDF, and is therefore relatively minimal." *CWWG I, 935 F. Supp. at 1216.*

Balancing of Harms -- Public Interest

13. In this case, the interests of both plaintiffs and defendants coincide with different elements of public interest. Plaintiffs assert that the public interest requires a suspension of operations at TOCDF pending trial; defendants assert the public interest lies in disposing of the stockpile of lethal chemical agent and munitions stored at the Depot. It is true [**45] that halting agent operations at TOCDF could have negative consequences for defendants, including a loss of proficiency in operations and a risk to employees during decontamination of "hot" portions of the facility. However, these harms are best considered in the analysis of where the public interest lies. Indeed, the public has an interest in the safe and efficient operation of TOCDF, and TOCDF personnel are, of course, members of the public.

14. In CWWG I, the court found that the risks of

continued storage outweigh the risks of operation of TOCDF during the period before trial. *935 F. Supp. at 1216-17.* This conclusion has been strengthened by changes made by defendants in the munitions processing schedule. During the approximately one-year period before trial, the Army will continue to process the volatile GB nerve agent, the source of the majority of the risk from potential stockpile accidents. Reorganizing the munitions processing campaigns to destroy higher risk munitions earlier in the schedule, starting with GB, will reduce the overall stockpile risks faster than would have occurred under the previous schedule. Further, the risks from potential accidental releases of chemical [**46] agent are minimized by allowing agent disposal activities at TOCDF to continue. Gary Boyd, author of the QRA for TOCDF, concluded that as of February 1997, when the bulk of GB in the stockpile remained unprocessed, a one-year delay in agent operations would approximately double the risk to the population surrounding TOCDF.

15. There is no general presumption that a NEPA violation will in all cases outweigh other public interests. See *Fund for Animals, Inc. v. Lujan, 962 F.2d 1391, 1400 (9th Cir. 1992); Concerned Citizens v. Secretary of Transportation, 641 F.2d 1, 7-8 (1st Cir. 1981); Southern Utah Wilderness Alliance v. Thompson, 811 F. Supp. 635, 641 (D. Utah 1993).* Here, even if defendants' failure to prepare an SEIS violated NEPA, this harm is outweighed by the harm to the public by allowing an injunction to issue.

16. Congress has mandated that the nation's stockpile of lethal chemical weapons be destroyed and has designated the U.S. Department of the Army to carry out this directive. Pub. L. 99-145 (codified as amended at *50 U.S.C. § 1521* (1996)). The deadline for destruction of the stockpile, originally set for 1994, has been extended to December 31, 2004, less [**47] than eight years from now. Pub. L. 102-484 (1993). This Congressional mandate is further evidence of the public's interest in the prompt disposal of the stockpile.

17. Having carefully considered all of these factors, the court concludes that the harms balance in favor of defendants and that the public interest is best served by the continued destruction of chemical agent at TOCDF.

Likelihood of Success on the Merits

18. A federal agency's duties under NEPA do not end when an initial decision is made or when an EIS is prepared. *Marsh, 490 U.S. at 371-72.* Rather, there are circumstances which require an agency to supplement and EIS. According to regulations promulgated by the Council on Environmental Quality, an EIS must be supplemented if an "agency makes substantial changes in a [project] that are relevant to environmental concerns; or ... [if] there are significant new circumstances or information relevant to environmental concerns [*1098] and bearing on the [project] or its impacts." 40 C.F.R. § 1502.9(c)(1)(i) & (ii) (1996); see also *Marsh, 490 U.S. at 374* ("if there remains major Federal action to occur, and if the new information is sufficient to show that [**48] the remaining action will affect the quality of the human environment in a significant manner or to a significant extent not already considered, a supplemental EIS must be prepared" (citations and internal quotations omitted)). Not all new information requires a SEIS; information must be "significant" to trigger the need for supplementation. See *Wisconsin v. Weinberger, 745 F.2d 412, 420 (7th Cir. 1984)* (duty to supplement EIS not triggered simply because information is "worthy of further inquiry or may be considered important research").

19. The court's review of the Army's decision not to prepare a SEIS is narrow. *Marsh, 490 U.S. at 378.* "So long as the [Army's] decision not to supplement the [EIS] was not 'arbitrary and capricious,' it should not be set aside." *Id. at 377.* Because the question is a factual one that implicates the agency's technical expertise, the court must defer to the agency's informed discretion. Id. Such deference is not automatic. In this, as in every case involving an agency's decision to not prepare a SEIS, the court must review the record and satisfy itself "that the agency has made a reasoned decision based on its evaluation of the [**49] significance -- or lack of significance -- of the new information." *Id. at 378.*

20. The new evidence which plaintiffs claim mandates a SEIS is not significant information. The operational problems encountered at TOCDF caused no injury to workers or the environment, were quickly remedied, and were the type of events common to the startup of a complex industrial facility. The evidence from the EG&G employees, when closely examined, has little probative value. The evidence regarding the dangers from emissions from the stacks is either not "new," having been previously considered by the court, or is speculative and of little merit. In short, the evidence presented by plaintiffs does not present "a seriously different picture of the likely environmental consequences of TOCDF." *Weinberger, 745 F.2d 412 at 420.* Accordingly, the court finds that the Army's decision not to prepare a SEIS was not arbitrary and capricious.

Conclusion

21. In light of the above analysis, the court finds that plaintiffs have failed to show that they or the public will be irreparably harmed during the pendency of this action. The court also finds that the public interest favors continued operation [**50] of TOCDF and that plaintiffs have failed to show a sufficient likelihood of success on the merits to support a preliminary injunction. Plaintiffs' second motion for a preliminary injunction is therefore DENIED.

DATED this 24 day of March, 1997.

BY THE COURT:

TENA CAMPBELL

United States District Judge

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CHEMICAL WEAPONS WORKING GROUP, INC. (CWWG); SIERRA CLUB; and VIETNAM VETERANS OF AMERICA FOUNDATION, Plaintiffs - Appellants, v. UNITED STATES DEPARTMENT OF THE ARMY; UNITED STATES DEPARTMENT OF DEFENSE; and EG&G DEFENSE MATERIAL, INC., Defendants - Appellees.

No. 96-4166

UNITED STATES COURT OF APPEALS FOR THE TENTH CIRCUIT

111 F.3d 1485; 1997 U.S. App. LEXIS 7926; 44 ERC (BNA) 1683; 27 ELR 21130

April 22, 1997, Filed

PRIOR HISTORY:
[**1] - APPEAL FROM THE UNITED STATES DISTRICT COURT FOR THE DISTRICT OF UTAH. (D.C. No. 96-CV-425). D.C. Judge Campbell.

DISPOSITION:
AFFIRMED.

COUNSEL:
Richard E. Condit (Mick G. Harrison, GreenLaw, Berea, Kentucky; Randall M. Weiner, Ecological Consultants for the Public Interest, Boulder, Colorado; Robert Ukeiley; R. Paul Van Dam, Jones, Waldo, Holbrook & McDonough, Salt Lake City, Utah, with him on the briefs), GreenLaw, Berea, Kentucky, for Plaintiffs-Appellants.

Craig D. Galli (David W. Tundermann with him on the brief), Parsons Behle & Latimer, Salt Lake City, Utah, for the Defendant-Appellee EG&G Defense Material, Inc.

Peter A. Appel (Edward J. Shawaker, Alan D. Greenberg, Robert H. Foster, Charles W. Findlay, Lisa Ann Holden, and Robert L. Klarquist, Department of Justice, Scott M. Matheson, Jr., United States Attorney; Stephen Roth, Assistant United States Attorney; Lois J. Schiffer, Assistant Attorney General, with him on the brief), Department of Justice, Washington, D.C., for Defendants-Appellees United States Department of the Army and United States Department of Defense.

JUDGES:
Before PORFILIO, EBEL and HENRY, Circuit Judges.

OPINIONBY:
PORFILIO

OPINION:

[*1487] **PORFILIO**, Circuit Judge.

In this [**2] appeal, Appellants Chemical Weapons Working Group, Inc., Sierra Club, and Vietnam Veterans of America Foundation (Plaintiffs) argue that the district court erred in denying their request for a preliminary injunction and in dismissing their claims under the Clean Water Act, Resource Conservation and Recovery Act, 1986 Department of Defense Authorization Act, and Administrative Procedures Act. Finding none of their arguments persuasive, we affirm.

I.

In 1985, Congress directed the Department of Defense to destroy the nation's stockpile of lethal chemical weapons, which is currently located at Johnston Island in the Pacific Ocean and at eight different sites in the continental United States. One of these sites, Tooele Chemical Agent Disposal Facility near Tooele, Utah, stores just over 40% of the nation's 30,000 tons of chemical warfare agent. Tooele's stockpile consists of both nerve and blister agents contained in a variety of bulk containers and munitions, some of which contain "energetics" (explosives and propellants) that also require disposal. This appeal results from a dispute over how to best implement the 1985 mandate: by incinerating the chemical weapons immediately [**3] or by storing them pending the

development of feasible incineration alternatives.

In 1986, the Army completed and circulated a Draft Environmental Impact Statement, which considered the environmental consequences of continued storage of the nation's chemical weapons stockpile compared to different logistical arrangements for its immediate disposal. The following year, the Army completed a quantitative risk assessment, concluding that the accident risk associated with continued stockpile storage significantly outweighed that associated with disposal operations. The Army used this assessment to support its 1988 Final Programmatic Environmental Impact Statement and Record of Decision, which selected on-site incineration as the means by which chemical weapons would be destroyed nationwide. At that time, the Army rejected alternatives to incineration as either unreasonable or premature. In 1989, the Army issued a site-specific Final Environmental Impact Statement and Record of Decision for Tooele, adopting the 1988 Final Programmatic Environmental Impact Statement conclusions and choosing on-site incineration as the method of destroying the chemical weapons stored there.

Before allowing [**4] the Army to proceed with its incineration plan, Congress required it to conduct Operational Verification Testing of the Johnston Atoll Chemical Agent Disposal System, a full-scale, operational chemical weapons incineration plant on Johnston Island [*1488] that was designed to serve as the prototype for incinerators at other stockpile sites such as Tooele. In 1993, the Secretary of Defense certified to Congress that testing at Johnston Atoll was complete, verifying that the operation there had been a success. The MITRE Corporation, a private contractor, was engaged by the Army to monitor, evaluate and report its operational testing results. The National Research Council's Committee on Review and Evaluation of the Army Chemical Stockpile Disposal Program (Stockpile Committee) was also chartered to monitor the Army's testing at Johnston Atoll and to review the test results reported by the MITRE Corporation. In its 1993 report, the MITRE Corporation concluded that although improvements could be made in the incineration technology used, Johnston Atoll had "no apparent fundamental safety, environmental, or process-related problems." Similarly, the Stockpile Committee concluded in 1994 that although [**5] Johnston Atoll had some operational problems, none were "show stoppers" for other chemical incineration plants.

In 1994, the Stockpile Committee also issued a report endorsing the Army's choice of incineration as the means by which to destroy the nation's chemical weapons stockpile. In that report, the Committee found there was no feasible alternative to incineration for the destruction of energetics, although it recommended that the Army update its 1987 quantitative risk assessment and continue to evaluate alternative technologies for sites other than Tooele. The Stockpile Committee report also considered the chronic health risks associated with routine incineration operations, concluding that alternative technologies would affect only a fraction of the releases caused by incineration and that "any reduction in disposal risk afforded by an alternative technology will be more than offset by the larger cumulative risk from extended storage." The Committee therefore recommended that disposal operations proceed without delay. In response to the Stockpile Committee's report, the Army performed a site-specific quantitative risk assessment for Tooele in 1995, again concluding that the accident-associated [**6] risk of continued stockpile storage significantly outweighed that of incineration operations. n1

n1 Specifically, the 1995 assessment found that the accident risk associated with 11 days of continued stockpile storage approximated that associated with 6.2 years of incineration operations. For individuals living closest to Tooele, the fatality risk from accidents was found to be 100 times greater for continued stockpile storage versus incineration operations.

In May 1996, Plaintiffs brought this action, alleging violations of various environmental protection acts. In one of those allegations, Plaintiffs claimed that the Army violated the National Environmental Policy Act by failing to prepare a Supplemental Environmental Impact Statement on the basis of significant new information relevant to environmental concerns. The Army responded in part by preparing a Record of Environmental Consideration in July 1996, which concluded that no new, significant information had developed since its 1988 Final Programmatic Environmental [**7] Impact Statement and 1989 site-specific Final Environmental Impact Statement were issued that would require the preparation of a supplemental environmental statement. Attached to the Record of Environmental Consideration was an 84-page report evaluating new information on dioxin emissions and alternative technologies. This report also discussed the problems experienced at Johnston Atoll, concluding that although the operation there had not been perfect, it had safely and effectively disposed of chemical agent and had not resulted in significant environmental impacts not already contemplated.

Presently, the Army has all permits necessary to operate Tooele. The Utah Department of Environmental Quality has issued both Clean Air Act and Resource Conservation and Recovery Act permits under its delegated authority from the Environmental Protection Agency. The Army has thus far conducted two trial burns at Tooele without chemical agent to determine whether the facility can destroy agent and other materials without releasing a significant amount of toxins into the environment. The Utah Department of Environmental Quality has approved the results of both tests. Presumably, the Army is now [**8] in the process of conducting trial burns with live agent, the results of [*1489] which must also be approved by Utah before Tooele can become fully operational.

II.

After extensive hearings, the district court denied Plaintiffs' request for a preliminary injunction of the Army's scheduled incineration operations at Tooele because none of the requirements for injunctive relief had been met. First, the court found Plaintiffs had failed to establish irreparable harm because the health risks associated with the Army's incineration operations were too speculative, while Plaintiffs' allegation of a National Environmental Policy Act violation was, without more, insufficient to meet the irreparable harm requirement. Next, the court found Plaintiffs had failed to meet the balance of harms requirement for injunctive relief, relying principally on the Army's 1987 and 1995 quantitative risk assessment results. Finally, the district court held Plaintiffs were unlikely to prevail on the merits of their claim under the National Environmental Policy Act because the Army's 1996 Record of Environmental Consideration was entitled to deference and because the Army was entitled to rely on its own experts [**9] in determining whether a Supplemental Environmental Impact Statement was warranted.

We review a district court's denial of a preliminary injunction for abuse of discretion. *Lundgrin v. Claytor, 619 F.2d 61, 63 (10th Cir. 1980).* "An abuse of discretion occurs only when the trial court bases its decision on an erroneous conclusion of law or where there is no rational basis in the evidence for the ruling." ***In re Coordinated Pretrial Proceedings in Petro. Prod. Antitrust Litig.,*** *669 F.2d 620, 623 (10th Cir. 1982).* Because a preliminary injunction is an extraordinary remedy, "the right to relief must be clear and unequivocal." ***SCFC ILC, Inc. v. Visa USA, Inc.,*** *936 F.2d 1096, 1098 (10th Cir. 1991).*

To obtain injunctive relief, a party must establish that: (1) it will suffer irreparable injury unless an injunction is issued; (2) its threatened injury outweighs any harm the proposed injunction may cause to the opposing party; (3) it will likely prevail on the merits of the litigation; and (4) an injunction, if issued, would not be adverse to the public interest. ***Lundgrin,*** *619 F.2d at 63.* Because the district court's balance of harms analysis is dispositive [**10] on this point of appeal, we consider it first.

On appeal, Plaintiffs argue that the district court's balance of harms finding is clearly erroneous because it overestimates the accident-related risk of continued storage, while underestimating the chronic health-related risks of routine incineration operations. We disagree. Although Plaintiffs' evidence on the health-related risks of short-term dioxin exposure is significant, we cannot conclude that the district court's finding on this issue is without any rational basis. To the contrary, the court's conclusion is amply supported by the results of the Army's 1987 and 1995 quantitative risk assessments as well as the Stockpile Committee's 1994 report, which specifically considered the health-related risks associated with routine incineration operations. We therefore affirm the district court's denial of Plaintiffs' request for a preliminary injunction on the basis of its balance of harms finding, obviating the need to address Plaintiffs' other arguments justifying a preliminary injunction in this instance. Because we conclude the district court properly denied injunctive relief, we also do not address Plaintiffs' claim that a remand [**11] is necessary to consider the effect a preliminary injunction would have on the public interest. n2

n2 We note, however, that any duty the district court had to consider the public interest was discharged implicitly in its balance of harms analysis. ***See Autoskill, Inc. v. National Educ. Support Sys., Inc.,*** *994 F.2d 1476, 1499 (10th Cir. 1993)* (district court implicitly addressed public interest requirement for injunctive relief).

III.

Plaintiffs next argue the district court erred in holding § 301(f) of the Clean Water Act does not apply to Tooele's stack emissions, dismissing their count under that section for failure to state a claim upon which relief can be granted. Plaintiffs reason that § 301(f)'s ban on the discharge of chemical [*1490] warfare agent into navigable waters must apply to Tooele's stacks because the text of that provision places no limitation on the form of chemical agent discharged or on the manner in which it enters navigable waters.

Absent such limitations, Plaintiffs urge [**12] us to read § 301(f) broadly to include discharge by way of atmospheric deposition to effectuate congressional intent to keep the nation's navigable waters clean.

We review de novo a district court's dismissal of a cause of action for failure to state a claim upon which relief can be granted. *Edwards v. International Union, United Plant & Guard Workers of Am., 46 F.3d 1047, 1050 (10th Cir. 1995).* As is true when we construe any statute, the plain language of the provision controls absent an irrational result. ***Edwards v. Valdez, 789 F.2d 1477, 1481 (10th Cir. 1986).*** We must also construe apparently conflicting statutes harmoniously where possible. ***United States v. State of Colo., 990 F.2d 1565, 1575 (10th Cir. 1993).*** Because Plaintiffs' interpretation of § 301(f) of the Clean Water Act is inconsistent with congressional intent, leads to irrational results, and creates a conflict between the Clean Water Act and Clean Air Act, we decline to construe that provision in the broad manner proposed by Plaintiffs.

Section 301(f) of the Clean Water Act provides that "it shall be unlawful to discharge any radiological, chemical, or biological warfare agent, any high-level [**13] radioactive waste, or any medical waste into the navigable waters." *33 U.S.C. § 1311*(f). Because both parties agree that § 301(f)'s ban is absolute, application of this provision to Tooele's stack emissions would effectively shut down its incineration operations indefinitely. This result, however, is completely at odds with congressional knowledge, approval, and funding of incineration as the baseline technology for destroying chemical weapons since 1986, when the Army first submitted its disposal program to Congress. We therefore reject Plaintiffs' proposed construction of § 301(f) because it is clearly inconsistent with congressional intent to implement Tooele's incineration plan.

We also reject Plaintiffs' construction of § 301(f) of the Clean Water Act because it would lead to irrational results. Because Clean Water Act § 301(a) regulates the discharge of any pollutant into navigable waters, *see* § § 1311(a), 1362(12), Plaintiffs' broad construction of the phrase "discharge ... into the navigable waters" under § 301(f) would necessarily result in regulation under § 301(a) of any air emission that might possibly result in atmospheric deposition into navigable waters. [**14] While Plaintiffs argue that the Environmental Protection Agency could issue a nationwide permit "for sources of water pollution such as cars and chimneys" to the extent § 301(a) would apply, the very thought of regulating car emissions under the Clean *Water* Act exposes the absurdity of their position. Tellingly, Plaintiffs also fail to cite a single instance in which stack emissions are regulated under the Clean Water Act. We therefore conclude that under the facts of this case, they are not. Although Plaintiffs may be correct in arguing that an object may fly through the air and still be "discharged ... into the navigable waters" under the Clean Water Act, common sense dictates that Tooele's stack emissions constitute discharges into the air--not water--and are therefore beyond § 301(f)'s reach. n3

> n3 Likewise, we reject Plaintiffs' claim that Tooele's stack emissions constitute discharge into navigable waters because in other instances, this court has recognized jurisdiction under the Clean Water Act where pollutants were discharged into ground or surface water that in turn flowed into navigable water. ***See, e.g., Quivira Mining Co. v. United States Envtl. Prot. Agency, 765 F.2d 126 (10th Cir. 1985).*** Without determining the precise jurisdictional limits of the Clean Water Act, we hold only that Tooele's stack emissions, unlike other indirect discharges, lack the requisite nexus to navigable waters to render them subject to regulation under that statute.

[**15]

Finally, we reject Plaintiffs' proposed construction of § 301(f) because in this instance, it would create a regulatory conflict between the Clean Water Act and Clean Air Act. Plaintiffs do not deny that under delegated authority by the Environmental Protection Agency, Utah has issued the Army a Clean Air Act permit for Tooele to discharge limited amounts of chemical warfare agent particles into the atmosphere. Because Tooele's Clean Air Act permit specifically allows the discharges that Plaintiffs claim are barred [*1491] under Clean Water Act § 301(f), applying that provision to Tooele's stack emissions would create an irreconcilable conflict between the two regulatory regimes. n4 We decline Plaintiffs' invitation to create such a conflict, especially since the pollution effects of atmospheric deposition are expressly considered and regulated under the Clean Air Act. ***See, e.g., 42 U.S.C. § 7403***(e)(4) (requiring Environmental Protection Agency to evaluate "the effects of air pollution on water quality"); § § 7651(a)-(o) (regulating pollution sources of acid rain). We therefore hold that § 301(f) of the Clean Water Act does not apply to Tooele's stack emissions because they do [**16] not constitute discharge into navigable waters, despite the broad language and policy goals of that provision. ***See also Train v. Colorado Pub. Interest Research Group,***

Inc., 426 U.S. 1, 48 L. Ed. 2d 434, 96 S. Ct. 1938 (1976) (radioactive materials regulated under Federal Water Pollution Control Act do not include substances already subject to regulation under the Atomic Energy Act, despite the absence of limiting language in statute). As a result, we do not address the Army's alternative arguments that § 301(f) is inapplicable because Tooele does not discharge chemical warfare agent and because any discharge into navigable waters does not come from a discernable point source.

> n4 We defenestrate plaintiffs' suggestion that the Army's Clean Air Act permit is somehow inferior to the result required under the Clean Water Act because it was issued by the Utah Department of Environmental Quality, rather than the Environmental Protection Agency. Under the Clean Air Act, this distinction is without a difference because Utah had federally-delegated authority and employed permit standards no less stringent than those promulgated by the Environmental Protection Agency. § 7412(l)(1).

[**17]

IV.

Plaintiffs next argue the district court erred in dismissing their imminent hazard claim under the Resource Conservation and Recovery Act for lack of subject matter jurisdiction. The district court reasoned that Plaintiffs' claim was essentially a collateral attack on the Army's permit under the Act because it challenged Utah's finding in issuing the permit that Tooele's incineration operations would not constitute an imminent hazard to human health or the environment. As a result, the court held that Plaintiffs' claim was barred under *42 U.S.C. § 6972*(b)(2)(D), which expressly forbids citizen suits to restrain or enjoin the issuance of Resource Conservation and Recovery Act permits.

Plaintiffs argue the district court's ruling should be reversed because they are attempting to enjoin permitted activities that create an imminent hazard, not the issuance of a Resource Conservation and Recovery Act permit. According to Plaintiffs, that Act's citizen suit provision for imminent hazards must allow claims against permitted activity because another citizen suit provision already allows for claims against facilities operating in violation of permit conditions or without [**18] any permit at all. Plaintiffs additionally maintain that Tooele's permit specifically states that compliance with permit conditions does not constitute a defense to an imminent hazard claim under the citizen suit provision. Finally, Plaintiffs argue that reversing the district court in this instance would vindicate the dual-purpose of the imminent hazard citizen suit provision: to grant citizens enforcement powers equal to those enjoyed by the Environmental Protection Agency and to prevent all imminent hazards to human health and the environment.

We review a district court's dismissal of a claim for lack of subject matter jurisdiction de novo. ***Olguin v. Lucero, 87 F.3d 401, 403 (10th Cir. 1996).*** Where a statute is susceptible to two meanings, we will choose the one that gives full effect to all of its provisions. ***Negonsott v. Samuels, 933 F.2d 818, 819 (10th Cir. 1991), aff'd 507 U.S. 99, 122 L. Ed. 2d 457, 113 S. Ct. 1119 (1993).*** Because allowing Plaintiffs' imminent hazard claim to proceed in this instance would ignore the Resource Conservation and Recovery Act's ban on suits to enjoin the issuance of permits while undermining its limited provisions for judicial review of permit decisions, [**19] we affirm.

Under § 6972(a)(1)(B) of the Resource Conservation and Recovery Act, any person [*1492] may bring an action against anyone else "who has contributed or who is contributing to the past or present handling, storage, treatment, transportation, or disposal of any solid or hazardous waste which may present an imminent and substantial endangerment to health or the environment." *42 U.S.C. § 6972*(a)(1)(B). This provision is limited only by § 6972(b)'s bar on suits "to restrain or enjoin the issuance of a permit." § 6972(b)(2)(D). For individuals desiring to judicially challenge the issuance of a Resource Conservation and Recovery Act permit, § 6976(b) provides for direct appeal of Environmental Protection Agency permit decisions to the circuit court of appeals in which the individual resides within 90 days of the permit decision at issue, unless the application for review is based on information that arose after the 90-day period has expired. § 6976(b). All challenged permit decisions are considered under the "arbitrary and capricious" standard of review. *See id.; 5 U.S.C. § 706.* Thus, by its own terms, the Resource Conservation and Recovery Act does not allow collateral [**20] attacks on Environmental Protection Agency permit decisions or those of state agencies with federally-delegated authority. *See* § 6976(b) (state-issued permits under the Resource Conservation and Recovery Act have same force and effect as those issued by Environmental Protection Agency).

Because Plaintiffs' imminent hazard claim essentially attacks Utah's decision to issue the Army a Resource Conservation and Recovery Act permit, we

conclude that the district court properly refused to recognize jurisdiction under § 6972(b). The Resource Conservation and Recovery Act's implementing regulations provide that the Environmental Protection Agency may not issue a permit for trial burns without first having determined that they "will not present an imminent hazard to human health or the environment." 40 C.F.R. § 270.62(b)(5)(ii). Under Utah's parallel regulatory provisions, the Executive Secretary of the Utah Solid and Hazardous Waste Control Board, a division of the Utah Department of Environmental Quality, was required to make the exact same finding before issuing Tooele's Resource Conservation and Recovery Act permit under its federally-delegated authority. Because Plaintiffs' [**21] imminent hazard claim directly challenges this finding, we are unable to construe it as anything other than a collateral attack on the Executive Secretary's permit decision itself. Indeed, recognizing jurisdiction in this case would severely undermine the limited judicial review of agency permit decisions provided under the Resource Conservation and Recovery Act, allowing disgruntled individuals to circumvent the Act's 90-day window for directly challenging such decisions and deferential standard of review. ***See also Greenpeace, Inc. v. Waste Tech. Indus.***, *9 F.3d 1174 (6th Cir. 1993)* (imminent hazard citizen suit against facility operating within confines of Resource Conservation and Recovery Act permit constitutes impermissible collateral attack on Environmental Protection Agency permit decision); ***Palumbo v. Waste Tech. Indus.***, *989 F.2d 156 (4th Cir. 1993)* (same).

Plaintiffs' arguments to the contrary are unpersuasive. While insisting that the focus of their imminent hazard claim is not on the permit process itself, Plaintiffs concede that in this instance, the only consequence of their suit would be to enjoin the Army's operations at Tooele entirely. That being [**22] the case, Plaintiffs' claim is indistinguishable from other attempts to enjoin the issuance of the Army's Resource Conservation and Recovery Act permit, although in this case the attempt is made retroactively. Plaintiffs' statutory construction argument based on the text of the Resource Conservation and Recovery Act and Tooele's permit under that Act is equally unpersuasive. Because the Army agrees that an imminent hazard citizen suit may be brought for permitted activity so long as it is based on information not already considered in the permit process Plaintiffs' claim that they must be able to sue for permitted activity is, without more, inapposite. n5 While we [*1493] agree with Plaintiffs that any limitation on the citizen suit provision creates a disparity between the enforcement powers enjoyed by the Environmental Protection Agency and concerned individuals, we conclude that this disparity was created by Congress because only the citizen suit provision is limited by § 6972(b). The Environmental Protection Agency, by contrast, may sue for imminent hazard at any time. *See* § 6973(a).

n5 The Army's position on this issue is consistent with that espoused by the Environmental Protection Agency in ***Shell Oil Company v. Environmental Protection Agency***, *292 U.S. App. D.C. 332, 950 F.2d 741 (D.C. Cir. 1991)*. In ***Shell Oil***, the Agency represented to the D.C. Circuit that a Resource Conservation and Recovery Act permit would "narrow the opportunities" for citizen suits, though it would not preclude them entirely. *950 F.2d at 763.* As a result, Plaintiffs' reliance on this decision is misplaced.

[**23]

We therefore conclude Plaintiffs' imminent hazard claim constitutes an impermissible collateral attack on Utah's decision to issue the Army a Resource Conservation and Recovery Act permit under its federally-delegated authority. Because we hold that the district court properly refused to recognize jurisdiction over this claim under § 6972(b), we do not address the Army's alternative argument that jurisdiction was properly declined on abstention grounds.

V.

Finally, Plaintiffs argue that the district court erred in dismissing their maximum protection and Operational Verification Testing counts for failure to state a claim upon which relief could be granted. Plaintiffs first contend that the 1986 Department of Defense Authorization Act provides an implied private right of action for their maximum protection claim because it is mandatory in tone and was especially created to benefit the general public, a class to which they belong. Plaintiffs further argue that absent an implied private right of action under the 1986 Act, Congress' maximum protection mandate will have no enforcement mechanism at all. Next, Plaintiffs contend that their maximum protection and Operational Verification [**24] Testing counts state a claim under the Administrative Procedures Act because they challenge reviewable agency actions: the Army's decision to commence trial burns at Tooele and its completion and certification of operational testing at Johnston Atoll. According to Plaintiffs, the Army's decision to commence trial burns is reviewable under the Administrative Procedures Act as either an agency

order or informal agency action.

We review the district court's dismissal of Plaintiffs' maximum protection and Operational Verification Testing claims de novo. *Edwards, 46 F.3d at 1050.* In this instance, both claims arise out of language found in the 1986 Department of Defense Authorization Act, codified at *50 U.S.C. § 1521.* Section 1521(c) of the 1986 Act requires the Army to provide "maximum protection for the environment [and] the general public" in destroying the nation's chemical warfare agent stockpile. *50 U.S.C. § 1521*(c)(1)(A). Section 1521(k), which was added in 1989, requires the Army to complete operational testing at Johnston Atoll before destroying chemical weapons elsewhere and to certify to Congress through the Secretary of Defense that such testing has been successfully [**25] completed. n6 § § 1521(k)(1), (2). Because Plaintiffs fail to convince us that either of their claims present a cause of action under the 1986 Authorization Act or Administrative Procedures Act, we affirm.

n6 Plaintiffs' maximum protection claim alleges that the Army's incineration operations do not afford maximum protection to the environment and general public, while their Operational Verification Testing claim alleges that the Army's testing at Johnston Atoll is both inaccurate and incomplete.

We first consider Plaintiffs' contention that the 1986 Defense Authorization Act provides an implied private right of action for their maximum protection claim because, as discussed later, review under the Administrative Procedures Act is available only if there exists no other remedy in court. *See 5 U.S.C. § 704.* In determining whether an implied private right of action exists under a particular statute, the focus is solely on congressional intent. *Sonnenfeld v. City and County of Denver, 100 F.3d 744,* [**26] *747 (10th Cir. 1996).* Given the indications of congressional intent relied on by Plaintiffs to assert an implied private right of action under the 1986 Authorization Act, we conclude that the Supreme Court's decision in *California v. Sierra Club, 451 U.S. 287, 68 L. Ed. 2d 101, 101 S. Ct. 1775 (1981),* is sufficiently analogous to control on this point of appeal.

[*1494] In *Sierra Club*, the Court held the 1899 Rivers and Harbors Appropriation Act did not imply a private right of action, despite the fact that the plaintiffs in that action were members of the class for whom the statute was passed: the general public. *451 U.S. at 294-95.* Commenting on its earlier decision in *Cort v. Ash, 422 U.S. 66, 45 L. Ed. 2d 26, 95 S. Ct. 2080 (1975),* the Court explained, "the question is not simply who would benefit from the Act, but whether Congress intended to confer federal rights upon those beneficiaries." *Sierra Club, 451 U.S. at 294.* The Court then concluded the general proscription stated in the 1899 Act was intended to be enforced through "a general regulatory scheme" administered under the then Secretary of War, not through the vindication of private rights. *451 U.S. at 298.*

Given the decision in *Sierra* [**27] *Club*, Plaintiffs have not persuaded us the 1986 Defense Authorization Act provides an implied private right of action just because it is mandatory in tone and was passed to benefit the general public. Because Plaintiffs provide no indication that Congress intended to confer federal rights upon the beneficiaries it identified in the 1986 Act, we cannot conclude it intended for the Army's mandate to be privately enforceable.

Similarly, Plaintiffs are incorrect that absent an implied private right of action, Congress' 1986 maximum protection mandate would be completely unenforceable. Like the 1899 Act considered in *Sierra Club*, Congress' 1986 maximum protection mandate is fully enforceable through a general regulatory scheme, comprised in this instance by the myriad of environmental statutes that regulate the Army's incineration operations at Tooele. Recognizing that the Court has been "especially reluctant to imply causes of actions under statutes that create duties on the part of persons for the benefit of the public at large," *Cannon v. University of Chicago, 441 U.S. 677, 693 n.13, 60 L. Ed. 2d 560, 99 S. Ct. 1946 (1979),* we affirm the district court's determination that the 1986 Defense [**28] Authorization Act does not imply a private right of action for Plaintiffs' maximum protection claim.

We also affirm the district court's determination that it lacked jurisdiction to consider Plaintiffs' maximum protection and Operational Verification Testing claims under the Administrative Procedures Act. Judicial review under the Administrative Procedures Act is available only for "agency action made reviewable by statute and final agency action for which there is no other adequate remedy in a court." *5 U.S.C. § 704.* "Agency action" under the Act is defined as "the whole or a part of an agency rule, order, license, sanction, relief, or the equivalent or denial thereof, or failure to act." § 551(13). The term "order" is defined as "the whole or part of a final disposition, whether affirmative, negative, injunctive, or declaratory in form, of an agency in a matter other than rule making but including licensing." § 551(6).

Because Plaintiffs' maximum protection and testing claims are not reviewable by statute, they must challenge "final agency action" to confer upon the district court jurisdiction under the Administrative Procedures Act.

Given the Administrative Procedures Act's [**29] definition of the terms "agency action" and "order," we conclude Plaintiffs' maximum protection claim is not reviewable under that statute. Assuming Plaintiffs sufficiently apprised the district court of the particular agency action they challenge, we nevertheless fail to see how the Army's decision to commence trial burns at Tooele qualifies as final agency action. Plaintiffs provide no indication that the Army has ever revisited the question of how precisely it planned to destroy the chemical weapons at Tooele since its 1989 Final Environmental Impact Statement. That being the case, we have no basis upon which to conclude the Army's actions at Tooele after 1989 constitute a "final disposition ... in a matter," rather than the implementation of a "final disposition" already made. *See* § 551(6). Because Plaintiffs do not deny *28 U.S.C. § 2401*'s six-year statute of limitations applies to suits under the Administrative Procedures Act, they are also unable to challenge the Army's 1989 Final Environmental Impact Statement conclusions. ***See also Sierra Club v. Penfold, 857 F.2d 1307, 1315 (9th Cir. 1988)*** (six-year general [*1495] statute of limitations applies to actions under [**30] the Administrative Procedures Act). We therefore hold that the district court's dismissal of Plaintiffs' maximum protection claim under the Administrative Procedures Act was proper because it failed to challenge a reviewable agency order.

Plaintiffs' reliance on ***Anderson v. U.S. Department of Housing and Urban Development, 701 F.2d 112 (10th Cir. 1983),*** to argue in the alternative that the Army's incineration operations constitute "informal agency action" reviewable under the Administrative Procedures Act is misplaced. Although the court in ***Anderson*** characterized a decision by the Department of Housing and Urban Development as "informal agency action," ***id. at 113,*** it did not hold that the Department's decision was therefore something other than "agency action" as defined by the Administrative Procedures Act. To the contrary, the decision not to accept a mortgage assignment could easily be construed as a "final disposition ... in a matter," thereby qualifying as an agency order under the Administrative Procedures Act.

Plaintiffs' Operational Verification Testing claim under the Administrative Procedures Act is equally without merit because they fail [**31] to explain how the Army's operational testing at Johnston Atoll constitutes a "rule, order, license, sanction, relief, or the equivalent or denial thereof, or failure to act." *See 5 U.S.C. § 551*(13). We also fail to comprehend how the Army's completion of operational testing can qualify as final agency action under the Administrative Procedures Act. Construing the agency action challenged as the Secretary of Defense's certification to Congress that testing was complete is similarly unhelpful. ***See American Trucking Assoc. v. United States, 755 F.2d 1292, 1297 (7th Cir. 1985)*** (agency reports do not constitute "agency action" under Administrative Procedures Act because they do not change law or policy); ***Industrial Safety Equip. Ass'n, Inc. v. Environmental Protection Agency, 267 U.S. App. D.C. 112, 837 F.2d 1115, 1120 (D.C. Cir. 1988)*** (same). We therefore affirm the district court's dismissal of both claims asserted under the Administrative Procedures Act, along with its rulings on Plaintiffs' first three points of appeal.

AFFIRMED.

BEFORE THE UTAH SOLID AND HAZARDOUS
WASTE CONTROL BOARD

IN THE MATTER OF:

The Tooele Chemical Agent Disposal Facility's Permit and Permit Modifications	*	ORDER
EPA ID No. UT5210090002	*	

This matter came before the Utah Solid and Hazardous Waste Control Board (the Board) for hearing on March 18-20 and April 17, 1997 on the First and Second Requests for Agency Action by the Petitioners, Chemical Weapons Working Group, Inc., Sierra Club and the Vietnam Veterans of America Foundation. Also participating were the Respondents, U.S Department of the Army (Army) and EG&G Defense Materials, Inc. (EG&G), and the Executive Secretary. The parties were represented by counsel. A quorum of Board members was present and voted on the motions resulting in this Order. The hearing was conducted as a formal hearing under the authority of the Utah Administrative Procedures Act, Utah Code Ann. section 63-46b-1 et seq. (1953, as amended), and Utah Admin. Code R315.

The Board, having reviewed the record in this matter, and upon consideration of the pleadings, evidence and arguments of counsel, voted to deny the First and Second Requests for Agency Action, for the reasons on that day orally assigned. The Board hereby issues its written Findings of Fact, Conclusions of Law, Statement of Reasons for Decision, and Order, as required by Utah Code Ann. section 63-46b-12.

FINDINGS OF FACT

EG&G As Co-Permittee

1. When the Executive Secretary of the Utah Solid and Hazardous Waste Control Board (Executive Secretary) approved a hazardous waste facility operation plan (plan or permit) for the Tooele Chemical Agent Disposal Facility (TOCDF) in 1989, he issued the permit to the Tooele Army Depot as owner and operator. Since the Army had ultimate responsibility for ownership and operation of the facility, the Executive Secretary properly determined that EG&G need not be included in the permit as a co-permittee.

2. The Executive Secretary, at his discretion, approved a permit modification on or about June 18, 1996, adding EG&G, a contractor working for the Army at TOCDF, as co-permittee.

Falsification of Temperature Reading

3. On or about January 9, 1997, an employee of TRC Environmental Corporation, a subcontractor to EG&G, intentionally recorded false information in connection with a temperature reading during a trial burn. The incident was investigated after being discovered by a state inspector and EG&G representatives, and the trial burn data for that incident were discarded and not used. EG&G ordered its subcontractor to permanently remove the employee from TOCDF. TRC agreed and did so.

Approval of Trial Burn Plans and TOCDF Operations

4. On June 18, 1996 and June 26, 1996, respectively, the Executive Secretary approved the Deactivation Furnace and Liquid Incinerator Agent Trial Burn Plans. Prior to approval of the trial burn plans, the Executive Secretary required the successful completion of surrogate trial

burns in both the Deactivation Furnace System (DFS) and the Liquid Incinerator (LIC). The plans for these surrogate trial burns were published for a public comment period with public meetings scheduled during the comment period. After considering the public comments, the Executive Secretary approved the surrogate trial burn plans. The Board finds and concludes that the Executive Secretary properly approved the trial burns and TOCDF agent operations for the TOCDF facility.

5. In their Second Request for Agency Action, Petitioners alleged four bases for setting aside the Executive Secretary's approval of the trial burn plans. These allegations were that the TOCDF: (1) poses an imminent threat to human health and the environment; (2) that it could not prevent or minimize releases; (3) that it could not achieve the required Destruction and Removal Efficiency (DRE); and (4) that it did not meet emergency preparedness requirements.

6. Before becoming fully operational, TOCDF has scheduled four trial burns for the DFS: (1) a "shakedown burn" with no agent; (2) an "R&D burn" with no agent; (3) a "shakedown burn" with agent; and (4) a "demonstration burn" with agent. TOCDF completed the first two burns in the DFS prior to August 22, 1996. The successful completion of these burns formed a strong basis to believe that TOCDF would complete the agent trial burns successfully.

7. Before agent operations, pursuant to a permit (the "R&D Permit") issued by the U.S. Environmental Protection Agency (EPA) under the federal Toxic Substances Control Act (TSCA), TOCDF conducted a trial burn which was intended to test, and ultimately did show, that the DFS was capable of incinerating PCBs to the regulatory 99.9999% ("six nines") level.

8. TOCDF also completed surrogate trial burns (STB) in the Liquid Incinerator #1

("LIC-1") and the DFS, and a TSCA research and development test burn in the DFS. The LIC-1 STB was conducted in June-July, 1995, and the DFS STB was conducted in October, 1995. The destruction removal efficiency achieved for each test was in excess of the six-nines required. The results of the tests were summarized in reports submitted to the Executive Secretary and the Utah Division of Solid and Hazardous Waste (DSHW).

9. The Executive Secretary issued the required approvals to initiate agent shakedown operations in preparation for trial burns with GB-filled M55 rockets. This approval included, but was not limited to, finalization of the screening risk assessment and approval of the LIC and the DFS agent trial burn plans. A letter summarizing approval to start agent shakedown operations was signed by the Executive Secretary on June 26, 1996.

10. The Board finds that the facility does not pose an imminent threat to human health and the environment, that TOCDF can prevent or minimize releases, that the facility can achieve the required DRE, and that it meets emergency preparedness requirements. With proper responses to incidents or concerns, appropriate reviews and changes in or temporary suspensions of operations, the Army and EG&G have operated the facility in such a way as to minimize the release of hazardous waste and to avoid imminent hazards and mitigate any impacts to public health.

Screening Health Risk Assessment

11. Prior to approving trial burns of chemical agent at TOCDF, DEQ through its contractor, A.T. Kearney, performed a Screening Health Risk Assessment (SRA) which analyzed the impacts of the expected TOCDF emissions on human health and the environment. The SRA followed applicable EPA guidance.

12. In keeping with the EPA guidance and current risk assessment practice, the SRA used conservative assumptions to determine the resulting risk estimates, including for example: (1) DEQ used maximum JACADS emissions levels, which it increased to account for the greater capacity of TOCDF, to model TOCDF air emissions; (2) DEQ assumed that emissions at TOCDF would be twice the JACADS detection limits in the cases where compounds were not detected; and (3) DEQ calculated the risks from exposure for up to thirty years of TOCDF emissions, when in fact, the facility is planned to operate for only about seven years.

13. The SRA examined the potential exposures to a hypothetical adult and child residing at the point of maximum off-site emissions, three different farmers modeled upon site-specific data and a subsistence fisherman. Each of these individuals was modeled to live north of TOCDF, which is downwind of the facility for 350 days of the year. For each of these six individuals, assuming simultaneous and continuous operation of all five furnaces and other TOCDF and CAMDS facilities for thirty years, the overall cancer and non-cancer risks were at or below EPA risk levels.

14. With respect to cancer effects of dioxin, the risk assessment used EPA's current conservative methodology to calculate overall cancer risks from TOCDF emissions and found that the overall cancer risks do not exceed EPA guidance levels for ten, fifteen and thirty-year operating periods. The SRA did not include a calculation of non-cancer effects of dioxin exposure because EPA had not adopted a reference dose for dioxin. Respondent's expert, Dr. Finley, calculated average daily intakes of dioxin for the six risk assessment scenarios used by DEQ in the SRA, and testified that these exposures should be below the level of concern for non-cancer effects.

15. Dr. Finley also calculated the cancer and non-cancer risks for a likely one-year trial burn period and determined that conservatively estimated risks were orders of magnitude below EPA target levels. He also declared that the conservatively estimated doses of dioxin to a breast fed infant were below the level of concern.

16. Respondents' medical expert, Dr. Guzelian, testified that low level environmental exposures to dioxin are unlikely to produce adverse human health consequences. EPA's Science Advisory Board also has reported that the scientific evidence compiled by EPA does not support a conclusion that adverse effects in humans may be occurring near the current exposure levels. There is insufficient evidence to conclude that low level exposures to dioxin that may be caused by operation of the facility will cause, or are likely to cause, adverse human health effects.

Quantitative Risk Assessment

17. Using an independent contractor, the Army arranged for preparation of both a quantitative risk assessment for the first two disposal campaigns and a comprehensive quantitative risk assessment for all TOCDF operations, performed using information specific to TOCDF, as recommended by the National Research Council. These assessments quantified the actual probability of occurrence for events leading to an accidental release of chemical agent and evaluated the potential consequences of such releases in terms of fatalities. The analysis, completed in December, 1996, confirmed the Army's earlier determination that the risks of fatalities associated with storage greatly exceed those associated with TOCDF operations. The total risks of accidental fatalities for an assumed 7.1 year period of TOCDF operations are equivalent to the risks associated with only thirty-four days of continued storage. With respect to individuals living closest to TOCDF, the risks resulting from continued storage are one hundred

times greater than the risks resulting from disposal operations.

Revocation/Termination of Plan Approval: Non-Compliance Issues

18. Petitioners have challenged the Executive Secretary's issuance of the plan approval and certain modifications thereto on grounds of the permittees' non-compliance with the law and the permit, and with an allegation that the Executive Secretary's actions were unsupported by substantial evidence or were arbitrary and capricious. Petitioners did not present evidence that either the Army or EG&G has had a poor compliance history on safety and environmental issues or has failed to comply with legal or permit requirements in connection with TOCDF. The Board finds no evidence sufficient to justify revocation or termination of the Army and EG&G's permit on these grounds.

Revocation/Termination of Plan Approval: Operational Incidents

19. Petitioners allege that the permit should be revoked or otherwise terminated because of certain incidents described in the evidence presented to the Board, namely: agent migration into filter vestibules, cracks in a concrete floor, agent migration into an observation corridor, facility response to a loss of site electrical power, fire suppression system test and temporary HVAC imbalance, agent quantification anomaly, improper hot cut-outs and the question of agent emissions in the TOCDF stack effluent gases. The Board finds no evidence sufficient to justify revocation or termination of the Army and EG&G's permit on these grounds.

20. Operations at TOCDF during the shakedown period have proceeded deliberately to ensure that full-scale operations will be conducted in a manner that maximizes the protection of TOCDF workers, the public and the environment. DSHW has engaged in extensive oversight of TOCDF operations. DSHW has an office on the facility, has conducted oversight on almost a

daily basis, and has a real-time computer link which transmits data to a computer terminal at DSHW's offices in Salt Lake City.

21. During the shakedown period, three events occurred that caused Respondents to immediately shut down operations: detection of low levels of agent in two filter unit containment vestibules, leakage of a small quantity of decontamination fluid passing through hairline cracks in a second level cement floor to a first floor electrical room, and minor agent migration into an observation corridor. Two of the incidents involved trace amounts of chemical agent migrating to unintended areas. None resulted in harm to TOCDF personnel, the public or the environment. Descriptions of the events and corrective actions taken in response to each event have been adequately explained to the Board and the Executive Secretary, and were adequately addressed by the Army and EG&G.

22. With regard to the other incidents described in paragraph 19 above, the Board finds that: adequate backup generators are in place at TOCDF, and there has never been an occasion when the backup power system failed to operate upon loss of power; the fire suppression system test and temporary HVAC imbalance was properly responded to and TOCDF personnel have received corrective training; the agent quantification system anomaly has been corrected; hot cut out procedures are a normal part of facility operations, and appropriate workers are equipped with protective equipment; and stack effluent gases are appropriately monitored by ACAMS and DAAMS systems and the agent readings in the ACAMS TREND reports were challenges to the monitoring equipment and not releases of agent.

CONCLUSIONS OF LAW AND REASONS FOR DECISION

1. In approving the permit in 1989, the Executive Secretary acted in accordance with

applicable rules and statutes, and acted in a manner that was appropriate and timely. The Board recognizes that it is not unusual for a hazardous waste facility to have subcontractors or contractors participating in operating the facility. The existence of such contractors does not necessarily mean that they are "operators" of the facility within the meaning of the Utah Solid and Hazardous Waste Act and rules issued thereunder. As the Army had ultimate responsibility for ownership and operation of the facility, the Executive Secretary properly determined that EG&G, a contractor for the Army, need not be included in the permit as a co-permittee.

2. While not legally required to add the Army's contractor, EG&G, as co-permittee, the Executive Secretary acted within his discretion and in accordance with applicable rules and statutes, including RCRA section 3005, 42 U.S.C. section 6925, and the Utah Solid and Hazardous Waste Act, Utah Code Ann section 19-6-108, and acted in a manner that was appropriate and timely, in approving the permit modification adding EG&G as co-permittee in 1996. The Executive Secretary acted properly and well within his discretion regarding the timing and processing of the TOCDF permit given the generalized nature of the applicable statutory and regulatory requirements. At no time was TOCDF constructed or operated without the required permit(s).

3. The January 9, 1997 recording of false information regarding a temperature reading by an employee of TRC during a trial burn was discovered by EG&G and DSHW personnel on that same day. The temperature readings did not affect the burn itself, but related to the temperature needed to preserve a sample. EG&G quality assurance staff immediately recorded the incident and commenced preparation of a deficiency report. At that time, EG&G ordered its subcontractor to permanently remove the employee from TOCDF. TRC agreed and did so. TRC

also indicated that the employee acted alone and took full responsibility for its employee's misconduct. TRC agreed to pay for the repeat of the trial burn run, given that the results of the January 9 run were discarded. In addition, as further corrective action to avoid any repeat of the incident, TRC conducted extensive ethics training for its employees working at TOCDF. EG&G's Risk Management Department Director, Tom Kurkjy, testified that the problem has not reoccurred.

4. The Petitioners have failed to provide data or present evidence indicating that the Executive Secretary's approval of trial burns was inappropriate or not in accordance with law. The Board recognizes the importance of trial burn data relative to understanding any emissions at TOCDF and for purposes of approval of full-scale activity at TOCDF once the trial burns are completed. The Board finds and concludes that the Executive Secretary and DSHW acted properly in approving the trial burns and in the collection of data during the trial burns.

5. Rule R315-3-20 of the Utah Administrative Code establishes the standard to issue a hazardous waste incinerator plan approval (permit). Under the provisions of R315-3-20(b)(5), the Executive Secretary shall approve a plan if: (1) the trial burn is likely to determine whether the incinerator performance standard can be met; (2) the trial burn itself will not present an imminent hazard to human health or the environment; (3) the trial burn will help the Executive Secretary determine operating requirements; and the information sought in items (1) and (2) cannot reasonably be developed through other means. In their Second Request for Agency Action, Petitioners alleged four bases (listed in paragraph 5 above) for setting aside the approval of the trial burn plans. The Board concludes that Petitioners have failed to present evidence on these issues sufficient to justify revocation, termination or modification of the plans by the

Board.

6. The Board finds and concludes that the Screening Risk Assessment (SRA) was performed using applicable EPA guidance and met all requirements for a health risk assessment. The SRA indicates that TOCDF can be operated as designed within the risks established by EPA for emissions as set forth in the design and construction. With respect to open burning / open detonation (OB/OD) activities, the Executive Secretary has prohibited the Army from conducting OB/OD until such time as a combined health risk assessment for both TOCDF operations and OB/OD is completed and indicates that the combined health risk is within acceptable limits.

7. The Petitioners failed to present evidence refuting the conclusions of the SRA, and the Board finds and concludes that the Executive Secretary acted appropriately in approving operations based on information in the SRA. The SRA was not a required study but was done at the discretion of the Executive Secretary and the Army because of their concern for human health and the environment, and the SRA will continue to be revised in the future as appropriate, for example, in the event of OB/OD activities simultaneous with TOCDF incineration operations. The risks of continued storage outweigh the risks from TOCDF operations, as outlined in the QRA.

8. The Board concludes that the preponderance of the evidence supports the Executive Secretary's approval of TOCDF's trial burn plans, permit and permit modifications, and denies Petitioners' First and Second Requests for Agency Action.

9. In further support of its decision, the Board hereby incorporates into these Conclusions of Law and Reasons for Decision all of the Findings of Fact set forth above, and also incorporates by reference the transcript of the Board members' comments and deliberations

on this matter on April 17, 1997 (Transcript of Hearing, Volume No. 4).

ORDER

Based upon the foregoing Findings of Fact and Conclusions of Law, IT IS HEREBY ORDERED that the relief requested in Petitioners' First and Second Requests for Agency Action is hereby denied, and that the TOCDF permits and permit modifications approved by the Executive Secretary are upheld and shall remain in effect unless amended, revoked or otherwise affected by the Executive Secretary or by further order of the Board.

DATED this 22nd day of July, 1997.

UTAH SOLID AND HAZARDOUS WASTE
CONTROL BOARD

Richard B. White

By: Richard B. White, Board Chairman

NOTICE

Under Utah Code Ann. section 63-46b-13, any party may request that this Order be reconsidered by the Board. Any such request must be in writing, must be filed with the Board (with a copy to each party) within twenty days after the date shown on the attached mailing certificate, and must state specific grounds upon which relief is requested.

Judicial review of this Order may be sought in the Utah Court of Appeals under

applicable statutes and court rules, including Utah Code Ann. sections 63-46b-14 and -16 and 78-2a-3 and Rule 14, Utah Rules of Appellate Procedure, by the filing of a proper petition within thirty days of the date shown on the attached mailing certificate for this Order (or, if applicable, within thirty days after a request for reconsideration is denied).

CERTIFICATE OF SERVICE

I hereby certify that on the 22 day of July, 1997 a true and correct copy of the foregoing ORDER was mailed first-class, postage prepaid to:

Mick Harrison
GreenLaw, Suite 7
200 Short Street
P. O. Box 467
Berea, KY 40403

R. Paul Van Dam
Randy Skanchy
Jones, Waldo, Holbrook & McDonough
170 So. Main Street, Ste 1500
Salt Lake City, UT 84101-1644

Robert Ukeiley
Ecological Consult. for the Public Interest
1942 Broadway, Ste 206
Boulder, CO 80302

Richard E. Condit
Greenlaw, Inc.
1347 Emerald Street
P. O. Box 1078
Washington, D. C. 20013-1978

Craig D. Galli
Parsons, Behle & Latimer
201 South Main Street, Ste 1800
P. O. Box 45898
Salt Lake City, UT 84145-0898

Alan D. Greenberg
Robert H. Foster
Environmental Defense Section
U.S. Dept. Of Justice
999 18th Street, Ste 945 (North Tower)
Denver, CO 80202

Captain Michael E. Mulligan
Gerald P. Kohns
Department of the Army
U. S. Army Litigation Center
901 North Stuart St. Ste 400
Arlington, VA 22203-1837

Richard B. White, Chairman
Solid & Hazardous Waste Control Bd.
EarthFax Engineering, Inc.
7324 S. Union Park Avenue, Ste 100
Midvale, UT 84047

Laura J. Lockhart
Assistant Attorney General
160 East 300 South, 5th Floor
P. O. Box 140873
Salt Lake City, UT 84114-0873

Dennis Downs, Executive Secretary
Utah Solid & Hazard. Waste Board
288 No. 1460 West
P. O. Box 144880
Salt Lake City, UT 84114-4880

Terra L Petersen

CHEMICAL WEAPONS WORKING GROUP, INC., SIERRA CLUB, and VIETNAM VETERANS OF AMERICA FOUNDATION, Plaintiffs, vs. UNITED STATES DEPARTMENT OF THE ARMY, UNITED STATES DEPARTMENT OF DEFENSE, and EG&G DEFENSE MATERIALS, INC., Defendants.

Civil No. 2:96-CV-0425C

UNITED STATES DISTRICT COURT FOR THE DISTRICT OF UTAH, CENTRAL DIVISION

990 F. Supp. 1316; 1997 U.S. Dist. LEXIS 20499; 28 ELR 20246

October 10, 1997, Decided

October 14, 1997, Filed

DISPOSITION:
[**1]. Defendant's motion for summary judgment on Count 10 GRANTED.

COUNSEL:
Mick Harrison, Berea, Kentucky, for Plaintiffs.

Richard E. Condit, Esq., Greenlaw, Inc., Washington, DC, for Plaintiffs.

Robert Ukeiley, Denver, CO, for Plaintiffs.

R. Paul Van Dam, Esq., Jones, Waldo, Holbrook & McDonough, Salt Lake City, Utah, for Plaintiffs.

Alan Greenberg, Robert Foster, U.S. Department of Justice, Denver, CO, for United States, Defendant.

Lt. Col. Robert Lewis, U.S. Army Litigation Center, Arlington, VA, for Department of Army.

David W. Tundermann, Craig D. Galli, H. Douglas Owens, Parsons Behle & Latimer, Salt Lake City, Utah, for EG&G, Inc., Defendant.

JUDGES:
TENA CAMPBELL, United States District Judge.

OPINIONBY:
TENA CAMPBELL

OPINION:

[*1317] ORDER

This matter is before the court on defendant EG&G's motion to dismiss Count 10. Because the defendant has submitted matters in support of its motion that are outside the pleadings, the court shall treat this motion as one for summary judgment. F.R.C.P. 12(c). Having determined that oral argument would not materially assist in the resolution of this matter, DUCivR7-1(f), the court now enters the following order based upon the submissions of [**2] the parties and applicable legal authority:

Background

On or about June 18, 1996, the Utah Division of Solid & Hazardous Waste (the "Division") added EG&G as a co-permittee to the Department of the Army's license to operate the Tooele Chemical Demilitarization Facility ("TOCDF").

On July 18, 1996, the plaintiffs in this action petitioned the Utah Solid and Hazardous Waste Control Board (the "Board") to reverse the Division's action. Plaintiffs alleged, among other things, that EG&G had violated *42 U.S.C. § 6925* and Utah Code Ann. § 19-6-108(3)(a) by operating TOCDF from 1989 to 1996 without the necessary permits. In light of this long history of alleged noncompliance, plaintiffs argued that it was arbitrary and capricious for the Division to approve EG&G as a co-permittee in 1996.

Between March 18 and April 17 of this year, the Board heard approximately 22 hours of testimony and argument on this matter. At these hearings, plaintiffs had an opportunity to examine personnel from the Division who were responsible for the decision to add EG&G as a co-permittee on the Army's license.

[*1318] Following the hearing, plaintiffs submitted proposed findings of fact and conclusions of law. [**3] These proposed findings supported plaintiffs' contention that the Division had acted capriciously when it "added EG&G to the TOCDF permit as an operator late in the game, after EG&G had operated TOCDF without a permit for a substantial period of time." Plaintiffs also requested that "the Board ... suspend approvals for agent operations until the Army can make changes in ... [its] operator ...." (Petitioners' Post-Hearing Brief and Proposed Findings of Fact and Conclusions of Law at 1-2.)

On July 22, 1997, the Board issued its findings of fact and conclusions of law. The first finding of fact by the Board reads in relevant part as follows:

1. When the Executive Secretary ... approved a hazardous waste facility operation plan ... for the [TOCDF] in 1989, he issued the permit to the Tooele Army Depot as owner and operator. Since the army had ultimate responsibility for ownership and operation of the facility, the Executive Secretary properly determined that EG&G need not be included in the permit as a co-permittee.

The first conclusion of law reads in relevant part as follows:

1. In approving the permit in 1989, the Executive Secretary acted in [**4] accordance with applicable rules and statutes, and acted in a manner that was appropriate and timely. The Board recognizes that it is not unusual for a hazardous waste facility to have subcontractors or contractors participating in operating the facility. The existence of such contractors does not necessarily mean they are "operators" of the facility within the meaning of the Utah Solid and Hazardous Waste Act and rules issued thereunder. As the Army had ultimate responsibility for ownership and operation of the facility, the Executive Secretary properly determined that EG&G, a contractor for the Army, need not be included in the permit as co-permittee.

(Board Order at 2, 9). Based upon these findings of fact and conclusions of law, the Board determined that the Division's decision to add EG&G as a co-permittee on the Army's license in 1996 was neither arbitrary or capricious.

Discussion

The defendant, EG&G, seeks summary judgment on the ground that the legal and factual issues raised by the plaintiffs in Count 10 have already been decided by State of Utah Solid and Hazardous Waste Control Board ("Board"). According to EG&G, under the principles of collateral estoppel, [**5] the Board's decision bars litigation of Count 10 in this court. This court must give preclusive effect to the Board's decision if it would be accorded such effect by the courts of Utah, the state of its origin. *Saavedra v. City of Albuquerque, 73 F.3d 1525, 1534-35 (10th Cir. 1996).*

The Utah Supreme Court has held that the following elements must be satisfied before a party may be collaterally estopped from relitigating issues already decided in another forum:

(1) The issue decided in the prior adjudication must be identical to the one presented in the action in question; (2) there must be a final judgment on the merits, (3) the party against whom the plea is asserted must be a party in privity with a party to the prior adjudication; and (4) the issue in the first action must be completely, fully, and fairly litigated.

Career Serv. Review Bd. v. Department of Corrections, 942 P.2d 933, 322 Utah Adv. Rep. 8, 10 (Sup.Ct., July 22, 1997) (citing *Searle Bros v. Searle, 588 P.2d 689, 691 (Utah 1978)).* If those elements are satisfied, however, the Utah courts will give preclusive effect to court judgments and agency decisions alike. Id.

I. Identity [**6] of Issues.

On July 18, 1996, plaintiffs petitioned the Board to revoke EG&G's permit to operate TOCDF. As grounds therefore, plaintiffs stated that EG&G had violated the requirement of Utah Code Ann. § 19-6-108(3)(a) by operating TOCDF without the necessary Division permit from 1989 to 1996.

Count 10 of the plaintiffs' Second Amended Complaint in the present case simply renews plaintiffs' claim before the Board. Count 10 alleges that EG&G violated Utah Code Ann. § 19-6-108(3)(a) by operating TOCDF from 1989 to 1996 without a permit from the Division. (Second Amended Complaint at 53-54.)

[*1319] Despite the obvious similarity of the claims presented to the Board and to this court, plaintiffs insist that the issues are merely "related," but not identical. First, plaintiffs assert that the question before the Board was whether the Division acted capriciously in adding EG&G to the license as a co-permittee in 1996. Plaintiffs ignore, however, that the Division's decision to add EG&G as a co-permittee would have been capricious only if EG&G had operated TOCDF without the required permit from

1989 to 1996. In resolving plaintiffs' capriciousness claims, therefore, the Board necessarily determined [**7] that EG&G was not required to obtain a permit during the 1989-96 period.

Second, plaintiffs argue that even if the Board considered the same state claims that are advanced here, Count 10 also seeks redress for alleged violations of the federal statute, a matter over which the state Board had no jurisdiction. *42 U.S.C. § 6925.* With respect to these federal law violations, plaintiffs argue that they cannot be collaterally estopped by the state proceedings.

Plaintiffs are correct that exclusive jurisdiction over suits alleging violations of the federal Resource Conservation and Recovery Act is lodged in the federal district courts. *42 U.S.C. § 6972*(a). It is equally true, however, that once the Environmental Protection Agency authorized the State of Utah to administer and enforce a hazardous waste program in lieu of the federal program, *49 Fed.Reg. 39693* (Oct. 10, 1984), the federal statute was no longer applicable. See, e.g., *Murray v. Bath Iron Works Corp., 867 F. Supp. 33, 42 (D.Me. 1994)* ("a direct action under section 6972(a)(1)(A) is unavailable where the applicable federal requirements of RCRA have been superseded by an EPA-authorized state hazardous waste program pursuant [**8] to *42 U.S.C. § 6926*(b)"); *Dague v. City of Burlington, 732 F. Supp. 458, 465 (D.Vt. 1989)* ("a plaintiff seeking to challenge the operation of a hazardous waste site in an EPA authorized state may bring an action under state law, not federal law ..."). Thus, the Board considered the only claims which plaintiffs may actually advance, i.e., those based on state law.

The court therefore finds that the issues presented by Count 10 are identical to those presented to the Board.

II. Final Judgment on the Merits.

Plaintiffs argue that so long as the Board's decision may be reversed by the Utah Court of Appeals, the decision is not final for purposes of collateral estoppel. The Tenth Circuit has held to the contrary: "Utah law provides that, unless it is reversed on appeal, a judgment is final for issue preclusion purposes." *Atiya v. Salt Lake County, 988 F.2d 1013, 1020 (10th Cir. 1993).* The Tenth Circuit's determination is binding on this court. Therefore, despite the pendency of plaintiffs' appeal, the Board's decision is final for purposes of this motion.

III. Identity of Party Against Whom Plea is Asserted.

Defendant asserts that the plaintiffs in this action [**9] were also the plaintiffs in the administrative hearing before the board. Plaintiffs do not dispute this fact.

IV. Opportunity for Full and Fair Litigation.

Utah case law does "not require either a motion or a hearing for full and fair litigation but says only that 'the parties must receive notice under all the circumstances, to apprise them of the pendency of the action and afford them an opportunity to present their objections.'" *Career Serv. Review Bd. 322 Utah Adv. Rep. at 10* (quoting *Copper State Thrift & Loan v. Bruno, 735 P.2d 387, 391 (Utah.App. 1987).* See also, *Kremer v. Chemical Const. Corp., 456 U.S. 461, 481, 72 L. Ed. 2d 262, 102 S. Ct. 1883 (1982)* ("state proceedings need do no more than satisfy the minimum procedural requirements of the Fourteenth Amendment's Due Process Clause in order to qualify for the full-faith-and-credit guaranteed by federal law").

Plaintiffs received all the opportunity for full and fair litigation that Utah law or the federal constitution require. In addition to filing various pleadings, plaintiffs were allowed over twelve hours of time to present witnesses. Plaintiffs also conducted cross-examination or voir dire of several [**10] witnesses called by EG&G. Although even more time and process might have been desirable from plaintiffs' perspective, the process actually accorded them was sufficient for purposes of the collateral estoppel analysis.

[*1320] Plaintiffs also argue that they lacked the incentive to litigate fully in front of the Board because the Board could not impose fines or penalties under the federal statute. This contention is without merit. First, as explained above, no court has the power to impose penalties on EG&G under the federal statute; it has been superseded by the state regulatory scheme. Second, had plaintiffs prevailed in front of the state agency, EG&G might well have been ordered to cease its operations at TOCDF. It is hard to conceive, in light of plaintiffs' vigorous efforts to prevent operations at TOCDF (including two preliminary injunction hearings before this court), that the potential halt of test burns at TOCDF did not provide them with adequate incentives to litigate the issue. The court therefore finds that this element of the collateral estoppel test is satisfied.

Conclusion

Each of the elements necessary for collateral estoppel under Utah law has been satisfied. Plaintiffs [**11] are estopped from relitigating the issue of

EG&G's licensure in this forum when that question was already decided against them in front of the Board. The court's resolution of this matter makes consideration of defendant's Burford abstention argument unnecessary.

Defendant's motion for summary judgment on Count 10 is hereby GRANTED.

SO ORDERED this 10 day of October, 1997.

BY THE COURT:

TENA CAMPBELL

United States District Judge

Sierra Club, Chemical Weapons Working Group, and Vietnam Veterans of America Foundation, Petitioners, v. Utah Solid and Hazardous Waste Control Board, Respondent, and United States Army and EG&G Defense Materials, Inc., Intervenors.

Case No. 971313-CA

COURT OF APPEALS OF UTAH

350 Utah Adv. Rep. 13; 964 P.2d 335; 1998 Utah App. LEXIS 74

August 20, 1998, Filed

PRIOR HISTORY:
[**1] Original Proceeding in this Court.

DISPOSITION:
Declined to disturb the Board's order.

COUNSEL:
Mick G. Harrison, Berea, Kentucky, for Petitioners.

Jan Graham, Laura Lockhart, and Raymond Wixom, Salt Lake City, for Respondent.

Alan D. Greenberg and Robert H. Foster, Denver, Colorado, for Intervenor United States Army.

David W. Tunderman and Craig D. Galli, Salt Lake City, for Intervenor EG&G Defense Materials, Inc.

JUDGES:
Before Gregory K. Orme, Judge. WE CONCUR: James Z. Davis, Presiding Judge, Michael J. Wilkins, Associate Presiding Judge.

OPINIONBY:
GREGORY K. ORME

OPINION:

[*337] OPINION

ORME, Judge:

Sierra Club, Chemical Weapons Working Group, and Vietnam Veterans of America Foundation (collectively referred to herein as Sierra Club) petition this court for review of a final order of the Utah Solid and Hazardous Waste Control Board pertaining to the Tooele Chemical Agent Demilitarization Facility (referred to by the parties and herein as TOCDF) located at the Deseret Chemical Depot, formerly known as Tooele Army Depot South. We decline to disturb the Board's order.

[*338] FACTS

The Deseret Chemical Depot is one of eight sites in the continental United States housing the nation's chemical weapons [**2] stockpile. The country's entire stockpile consists of approximately 30,000 tons of chemical agent. Housed at the Depot is over two-fifths of the stockpile--more than 13,000 tons. These chemicals include the nerve agents GB (sarin) and VX, and the blister agents H, HD, and HT (mustard gas). The chemicals are contained in weapons, such as rockets, artillery shells, bombs, and mines, and in one-ton storage devices called "ton containers." The Army stores these materials at Tooele in earth-covered magazines called "igloos," in fenced storage yards, and in warehouses.

The risk from continued storage of these agents has been a matter of long-standing concern. In 1989, the Board's Executive Secretary approved the Army's hazardous waste plan for construction of a hazardous waste treatment facility to destroy the chemical weapons stockpiled at the Depot. The Executive Secretary issued the authorizing permit only to the Depot, although the United States Army, TOCDF's owner, had contracted with EG&G Defense Materials, Inc. to operate TOCDF, and EG&G began doing so in 1993.

In July 1993, the Army completed construction of TOCDF, which is comprised of five separate incinerators: two liquid incinerators [**3] used to burn liquid agent that has been drained from munitions and bulk containers; a Deactivation Furnace System used to

incinerate munitions that have been drained of agent but are still contaminated; a Metal Parts Furnace used to decontaminate metal parts that have been drained of agent; and a Dunnage Incinerator used to burn non-agent contaminated and agent contaminated dunnage, such as pallets and spent carbon filters.

Before TOCDF operations could begin, the permit and federal and state law required the Army to conduct a series of "trial burns" to ensure that the facility could operate safely. In late 1995, the Army submitted trial burn plans to the Executive Secretary for approval. After requiring the Army to conduct surrogate trial burns with surrogate chemicals, in June 1996 the Executive Secretary approved the trial burn plans for the liquid incinerators and the Deactivation Furnace System. The Army scheduled four trial burns for these incinerators: a "shakedown" burn with no chemical agent, an "R & D" burn with no agent, a shakedown burn with chemical agent, and a "demonstration" burn with chemical agent. In August 1996, TOCDF began the shakedown burn with chemical agent. [**4]

In conjunction with trial burn approval, the State Division of Environmental Quality, through a contractor, conducted a Screening Health Risk Assessment (SRA) which analyzed the expected effects of theoretically high TOCDF emissions on human health and the environment. The Division conducted the SRA to address two primary concerns: whether TOCDF emissions would cause cancer and whether they would cause other types of illness. The SRA, following United States Environmental Protection Agency (EPA) guidelines, examined the potential exposure to six hypothetical groups living downwind of TOCDF: adults and children residing at the point of maximum emissions, three types of farmers, and subsistence fishermen. The Division incorporated conservative assumptions into the SRA, such as calculating the risks from exposure for up to thirty years of TOCDF emissions even though TOCDF is expected to operate for only seven years. The Division found, inter alia, that the overall cancer risks from dioxin exposure do not exceed EPA guidance levels for ten, fifteen, and thirty year operating periods. The SRA did not calculate the noncancer effects of dioxin exposure because the EPA has not adopted a reference [**5] dose for dioxin.

AGENCY DISPOSITION

In June 1996, the Executive Secretary granted the Army's request to modify the permit by adding intervenor EG&G as a permittee and operator of TOCDF. This modification prompted Sierra Club to file its First Request for Agency Action on July 18, 1996, in which it asked the Board to withdraw its modification of the permit which [*339] authorized EG&G to be a permittee and operator of TOCDF. Sierra Club subsequently filed a Second Request for Agency Action on July 22, 1996, in which it attacked the Executive Secretary's June 1996 approval of the agent trial burn plans for the liquid incinerators and the Deactivation Control Furnace. In its second request, Sierra Club claimed that TOCDF cannot be operated safely and that respondents failed to demonstrate compliance with legal requirements for hazardous waste incineration. Sierra Club therefore sought reversal of the Executive Secretary's approval of the trial burns and a Board order enjoining respondents from beginning any chemical incineration at TOCDF.

The Board held a hearing on Sierra Club's requests on March 18-20 and April 17, 1997. The Board ordered that Sierra Club would have twelve hours to [**6] present its case, the Army and EG&G would collectively have ten hours, and the Executive Secretary would have five hours. On April 17, the Board orally denied Sierra Club's two requests and issued its written order on July 22, 1997. Sierra Club then filed with this court a petition for review of the Board's order denying its two requests for agency action. The Army and EG&G subsequently intervened in this proceeding.

ISSUES

Sierra Club raises three principal arguments. n1 First, Sierra Club contends that the Board erred in failing to terminate or revoke the TOCDF permit in the face of evidence of substantial noncompliance with the Utah Solid and Hazardous Waste Act and endangerment to human health and the environment. Second, Sierra Club argues that the Board erred in allowing EG&G to operate TOCDF because EG&G is unable to operate the facility safely and in compliance with law. Third, Sierra Club contends that the Board violated its procedural Due Process rights by unreasonably limiting Sierra Club's time to present evidence and to cross- examine witnesses at the hearing. The Board, in addition to responding to Sierra Club's allegations, argues that Sierra Club lacks standing [**7] to petition this court for review. We first address the Board's standing argument.

n1 At oral argument, counsel for Sierra Club acknowledged that he had not moved for pro hac vice admission before this court, reasoning that he had so moved before the agency below. Technically, the case here is not an appeal but an original proceeding in this court. See generally Utah Code Ann. § 63-46b-

16(1) (1997); Utah R. App. P. 3(c), 14(a). Counsel for Sierra Club should therefore have moved for pro hac vice admission in this proceeding. Rule 40(d) of the Utah Rules of Appellate Procedure provides as much: "An attorney who is licensed to practice before the bar of another state or a foreign country but who is not a member of the Bar of this state, may appear, upon motion, pro hac vice." Although counsel for Sierra Club failed to comply with this requirement, we nonetheless suspend the rule for the convenience of the opposing parties and the court. Despite this suspension, counsel is directed to comply with Rule 40(d) in the future.

[**8]

STANDING

The Board argues that, although Sierra Club's standing was not considered below, n2 Sierra Club has failed to demonstrate that it has standing to petition this court for review because it cannot meet any of the three recognized standing criteria. The Board's argument is unpersuasive, and we conclude that Sierra Club has standing to petition this court for review because it raises issues of significant public importance.

n2 "Either party, or the court on its own motion, may properly raise the issue of standing for the first time on appeal." *Wade v. Burke, 800 P.2d 1106, 1108* (Utah Ct. App.), cert. denied, *800 P.2d 1105 (Utah 1990)*. Accord *Terracor v. Utah Bd. of State Lands, 716 P.2d 796, 798 (Utah 1986)* (stating that appeals court can address standing issue sua sponte); *Sierra Club v. Department of Envtl. Quality, 857 P.2d 982, 984 (Utah Ct. App. 1993)* (same).

"[A] plaintiff may maintain a suit against governmental action in those limited circumstances in which a case raises [**9] issues that are so 'unique and of such great importance that they ought to be decided in furtherance of the public interest.'" *National Parks & Conservation Ass'n v. Board of State Lands, 869 P.2d 909, 913 (Utah 1993)* (quoting *Terracor v. Utah Bd. of State Lands, 716 P.2d 796, 799 (Utah 1986)*). Under this standard, "the dispute must (1) raise a statutory or [*340] constitutional issue of substantial public import, (2) be presented by adverse parties, and (3) otherwise be suitable for resolution by the courts." Id.

In *Sierra Club v. Department of Environmental Quality, 857 P.2d 982 (Utah Ct. App. 1993)* (Sierra Club I), a somewhat similar case involving Sierra Club's challenge to an operating permit for a Tooele County commercial hazardous waste incinerator, we raised sua sponte Sierra Club's lack of standing and dismissed its petition for review. See *id. at 983*. In Sierra Club I, Sierra Club took issue with the Executive Secretary's approval of the operation-plan application for the incinerator. See *id. at 984*. Specifically, Sierra Club alleged that the applicant failed to provide evidence that emergency response plans had been coordinated with emergency personnel [**10] and that the application was otherwise incomplete. See id. Sierra Club alleged that these two errors in the application-approval process impaired its members' enjoyment of Western Utah because the incinerator, once it began operating, would generate pollution. See *id. at 986*.

In addition to concluding that Sierra Club lacked standing on two other asserted grounds, we held that it failed to raise any issues of significant public importance:

> Sierra Club is challenging determinations by the Board that constitute internal procedural decisions preceding any public involvement in the permit process. The issues, at this stage, are not of great public importance and it is not in the public interest to seek review of the Board's internal operating procedures.

Id. at 987.

The same cannot be said of the present case. In contrast to Sierra Club I, in this case the Executive Secretary has approved trial burns with chemical agents, the Army has conducted such burns since August 1996, and the Board has fielded public comment. Sierra Club also alleges several violations of Utah law, challenges the Division's and the Army's safety assessment measures upon which burn approvals [**11] were based, and identifies specific accidents at TOCDF involving actual chemical agent. Sierra Club's arguments are therefore of great public importance and their resolution is inarguably in the public interest.

TOCDF is a matter of significantly greater public concern, both locally and nationally, than was the permit prematurely challenged in Sierra Club I. TOCDF is the first facility of its kind in the continental United States, and it processes some of the deadliest substances on earth in relatively close proximity to a major metropolitan area. Consequently, the safety of TOCDF operations, which will continue for seven years, are of undeniably significant public importance.

Our Supreme Court's ruling in *National Parks &*

Conservation Ass'n v. Board of State Lands, 869 P.2d 909 (Utah 1993), strongly supports our conclusion that the issues raised by Sierra Club are of substantial public concern. National Parks dealt with a proposed land swap and development within Capitol Reef National Park and along the Burr Trail. See *id. at 913.* The National Parks and Conservation Association (NPCA) challenged the proposal and the Utah Supreme Court ultimately held that NPCA had [**12] standing because it raised issues of significant public importance. See *id. at 913-14.* Those issues included the State's discharge of its fiduciary duties in administering school trust lands and in preserving scenic, recreational, archaeological, and paleontological values related to those lands. See id. In comparing the issues in National Parks to those Sierra Club raises in this case--namely, allegedly substantial risks to human health and safety--the issues in this case clearly qualify as issues of significant public importance.

We conclude that Sierra Club has standing to petition this court for review. Given our conclusion, we need not address the alternative bases for standing.

NONCOMPLIANCE WITH UTAH LAW & ENDANGERMENT TO HUMAN HEALTH & THE ENVIRONMENT

Sierra Club first argues that the Board erred in failing to terminate or revoke the TOCDF permit in light of evidence of substantial noncompliance with the Utah Solid and Hazardous Waste Act and evidence that [*341] TOCDF emissions endanger human health and the environment.

Standard of Review

In its opening brief, Sierra Club contends that its petition challenges the Board's factual findings and therefore [**13] its claims should be reviewed under the "substantial evidence" standard of review. The Board argues that Sierra Club failed to marshal the evidence, as is required for challenges to fact findings. In its reply brief and at oral argument, Sierra Club restated its position, claiming it is not challenging the Board's findings of fact but is instead challenging the Board's allegedly erroneous application of law to fact. In light of Sierra Club's clarification of its position, we necessarily accept the Board's factual findings as uncontested and therefore address only the Board's application of the law to the uncontested facts.

When a petitioner challenges an agency's application of law to fact, we apply a standard of review that is not static, but is instead determined on a sliding scale: "[An] agency's application of the law to the facts may, depending on the issue, be reviewed by an appellate court 'with varying degrees of strictness, falling anywhere between a review for "correctness" and a broad "abuse of discretion" standard.'" *Drake v. Industrial Comm'n, 939 P.2d 177, 181 (Utah 1997)* (quoting *Langeland v. Monarch Motors, Inc., 1996 Utah LEXIS 112, 307 Utah Adv. Rep. 3,* [**14] *4 (Utah 1996),* withdrawn, *952 P.2d 1058 (Utah 1998)).* See *State v. Pena, 869 P.2d 932, 937-939 (Utah 1994).* Thus, in deciding upon the level of discretion we accord to the agency in such situations, we consider "factors such as policy concerns and an agency's expertise." *Drake, 939 P.2d at 181 n.6.*

The present case involves highly technical, specialized scientific knowledge which is uniquely within the Board's expertise. Cf. *Professional Staff Management, Inc. v. Department of Employment Sec., 953 P.2d 76, 79 (Utah Ct. App. 1998)* (concluding that court would review agency decision with only moderate deference because applying relevant law required little specialized knowledge uniquely within agency's expertise); *Allen v. Department of Employment Sec., 781 P.2d 888, 890 n.4 (Utah Ct. App. 1989)* (same). We therefore accord the Board a relatively high degree of deference in reviewing its application of the law to the facts in this case.

Analysis

Sierra Club contends that the trial burns with agent present a hazard to human health or the environment, and therefore the Board should have revoked TOCDF's trial burn permit. The applicable rule provides:

The [**15] Executive Secretary shall approve a trial burn plan if it finds that:

(i) The trial burn is likely to determine whether the incinerator performance standard ... can be met;

(ii) The trial burn itself will not present an imminent hazard to human health or the environment;

(iii) The trial burn will help the Executive Secretary to determine operating requirements to be specified ...; and

(iv) The information sought ... cannot reasonably be developed through other means.

Utah Admin. Code R315-3-20(b)(5) (Supp. 1997). Sierra Club therefore challenges the second of the four criteria which must be satisfied before the Executive Secretary may approve a trial burn plan. More

specifically, Sierra Club uses the SRA's alleged deficiencies to attack the subsequent trial burn approvals. Sierra Club's opening brief takes a shotgun approach to this issue, an approach Sierra Club refined at oral argument by limiting its challenge to the SRA's inadequacy in four discrete areas: (1) dioxin risk to infants from TOCDF emissions; (2) effects of TOCDF emissions on consumers of locally produced dairy products; (3) effects of open burning/open detonation emissions when combined with TOCDF [**16] stack emissions; and (4) effects of mustard gas emissions from the stack that ventilates the waste handling areas (HVAC stack).

a. Dioxin Risk to Infants

Sierra Club contends that the SRA failed to address two concerns relating to the risk to infants from TOCDF dioxin emissions: the actual level of infant dioxin exposure [*342] from TOCDF emissions and the safe level of infant dioxin exposure from TOCDF emissions. Specifically, Sierra Club argues that in an early draft of the SRA, the Division calculated that the dioxin exposure risk to subsistence farmers' breast-fed infants was over fifty times greater than the acceptable dose. Sierra Club claims that after reaching this conclusion, the Division then deleted this data from the SRA, rather than further addressing this dioxin risk to subsistence farmers' breast-fed infants. Sierra Club therefore maintains that the Division violated its affirmative duty to protect the public by omitting this data from the SRA. Sierra Club asks this court, at a minimum, to remand these issues to the Board for it to determine the actual and acceptable dioxin risks to breast-fed infants.

Given the deference we owe the Board's decision, we reject Sierra [**17] Club's allegations that TOCDF trial burn operations present an unacceptable dioxin exposure risk to nursing infants and that the Division should have addressed this risk in the SRA. Several considerations support this conclusion.

First, we note that there is considerable debate in the scientific community concerning safe levels of dioxin exposure and therefore the fact that Sierra Club can point to some studies suggesting an unacceptably high dioxin risk is not determinative, especially given the conflicting testimony before the Board. Given the level of debate over safe dioxin dosage, the Division's omission of analysis concerning breast-fed infant dioxin exposure is not unreasonable. The Board was in no way misled. It heard testimony that such an analysis was not included in the SRA because no reference dose for breast-fed infants has been generally accepted and that omitting analysis in the absence of a reference dose accords with EPA guidance and is standard practice for risk assessments of the type conducted here. Moreover, the Board heard testimony that the EPA did not recommend using one of the reference doses proposed by Sierra Club and that, just as there are conservative [**18] breast-milk ingestion models, like those asserted by Sierra Club, there are also more liberal models.

Second, Sierra Club did not present the Board with credible evidence that any deficiencies in the SRA pointed up imminent hazards to human health or the environment as a result of trial burn operations. More specifically, what is at issue here is not the health risk from full long-term operation of TOCDF--the only type of operation the SRA addressed--but rather the risk from the preliminary trial burns, which must be conducted before the Executive Secretary can approve full operation of TOCDF. In other words, despite the fact that the SRA's outlook was ten, fifteen, and thirty years of operation, Sierra Club wishes to translate possible dioxin risk from such long-term operation to the relatively short-term trial burns at issue here. Moreover, Sierra Club's argument is contrary to testimony by an expert to the effect that when the SRA dioxin calculations are applied to the shorter term trial burn period, the results indicate no appreciable risk to human health.

Additionally, Sierra Club bases its dioxin arguments largely upon the SRA which, by its very nature, was never intended [**19] to provide accurate, specific numbers regarding actual TOCDF operations. The expert explained that the purpose of a screening risk assessment is to "provide a conservative estimate of the possible risk of health hazards posed by chemical emissions from a facility" and that "conservative" means the assessment includes "numerous assumptions or calculation procedures that result in a broad margin of safety between the calculated risk estimate ... and the likely risk to human health." In other words, the assessment makes assumptions that "intentionally overstate what is known to be true." Because of this broad safety margin, it is not appropriate to interpret the assessment's risk estimates as "true" or "absolute." Instead, a screening risk assessment "is a method for determining plausible upper limits of risk, not actual probability or risk of harm." If the assessment, given all the conservative worst-case assumptions, shows that there is no risk, no further study is required. Conversely, if the assessment indicates that a potential risk exists, more refined and specific analysis is conducted.

[*343] The Division's SRA incorporated a number of conservative assumptions. For example, it addressed [**20] operating periods not only much

longer than the trial burns at issue here, but also much longer than TOCDF's expected operating life; the SRA assumed that TOCDF would emit all seventeen toxic types of dioxin even though this would not be the case, see *Chemical Weapons Working Group, Inc. v. United States Dep't of the Army, 935 F. Supp. 1206, 1213 (D. Utah 1996)*, aff'd, *111 F.3d 1485 (10th Cir. 1997)*, and it assumed simultaneous full-scale operation of all the incinerators, around-the-clock, for 365 days per year.

Thus, considering the scientific debate over dioxin exposure, and the SRA's long-term focus and conservative assumptions, Sierra Club failed to present any persuasive evidence that dioxin emissions from TOCDF trial burn operations present an imminent hazard to human health or the environment. Thus, given the evidence before the Board and the deference we accord it, we see no error in the Board's decision in this regard. n3

> n3 This is not to say, of course, that the actual and acceptable levels of infant dioxin exposure are not appropriate topics of future study by the Division before the Board approves full operations at TOCDF. In fact, a Division employee testified that the Division will do future assessments and update already-conducted assessments as appropriate, thereby incorporating new data and any new EPA guidance. Thus, for instance, should the EPA arrive at a dioxin reference dose for infants, the Division would presumably incorporate the appropriate analysis in a risk assessment.

[**21]

b. Local Dairy Products

Sierra Club also contends that the Division omitted from the SRA the effects of TOCDF emissions on consumers of locally produced dairy products. Sierra Club argues that because the risk estimate for nonsubsistence farmers fell right at the State/EPA acceptable level, if the SRA risk estimate had included local dairy consumption, the cancer risk estimate would have necessarily exceeded the State and EPA standards. Sierra Club further alleges that an EG&G survey showed that a local dairy producer actually existed but wished to remain anonymous, and that the Division therefore improperly omitted any local dairy analysis from the SRA. Sierra Club contends that the Division should have subpoenaed EG&G's source, verified the existence of the local dairy producer, and included local dairy analysis in the SRA. In response, the Army argues that the Division surveyed local farming practices and did not locate anyone consuming locally produced milk.

We conclude that the Board acted within its sound discretion in rejecting Sierra Club's arguments concerning the omission of dairy products from the SRA. We note that Sierra Club presented no witnesses who engaged [**22] in, or knew of anyone who engaged in, dairy farming in TOCDF's vicinity. We therefore agree with the statement of the United States District Court for the District of Utah in rejecting a similar argument in an associated case: "Although ... the assumptions applied in the [SRA] may indicate a higher level of risk for some hypothetical persons, this does not constitute a showing that there is an actual risk to some person or persons posed by the emissions levels predicted for [TOCDF]." *Chemical Weapons Working Group, 935 F. Supp. at 1214.* Sierra Club failed to present to the Board any strong evidence that any local dairy producers existed.

While Sierra Club did not present evidence of local dairy production, the Board heard testimony that the Division could not find any individuals who were milking for 100% of their own consumption or for sale to neighbors; that some residents had milked in the past but were no longer doing so; that commercial dairy operations in the area were not feasible; and that the document which allegedly shows the Division knew of local dairy consumption was not prepared by the Division and was viewed by it as a "rough draft or a place to start as far [**23] as ... inquiry into the [local dairy] practices in Rush Valley."

Moreover, many of the same observations we made regarding infant dioxin risk also apply here, particularly the limited nexus between the short trial burn period and the SRA and the SRA's inherently conservative assumptions. In view of the foregoing, we [*344] conclude that the Board did not err in rejecting Sierra Club's dairy consumption arguments.

c. Open Burning/Open Detonation & Mustard Emissions

Sierra Club argues the Division failed to address in the SRA the effects of open burning/open detonation of chemical weapons and that the cumulative effect of open burning/open detonation and TOCDF emissions would exceed the State/EPA standard. We note that the Division has prohibited open burning/open detonation until a risk assessment modeling the risks of such activity is conducted and the risks are shown to be acceptable. Moreover, the Board heard testimony that if such an assessment indicated that the cumulative effect of open burning/open detonation and TOCDF

emissions presented a risk, the Division would not permit open burning/open detonation while TOCDF is operating. The Board therefore clearly acted [**24] within its discretion in rejecting Sierra Club's argument because any risks associated with open burning/open detonation are not yet imminent.

Sierra Club also contends that the SRA is flawed because it fails to adequately address the effect of mustard gas emissions from the stack that ventilates the waste handling areas (HVAC stack). Specifically, Sierra Club contends that the Division arbitrarily lowered the estimated mustard emissions from the HVAC stack after that estimate showed a high risk from such emissions. As is the case with open burning/open detonation, the Executive Secretary has not yet approved mustard agent incineration. Consequently, the Board did not err in rejecting Sierra Club's arguments concerning these matters.

OMISSION OF EG&G FROM PERMIT, ACCIDENTS AT TOCDF

Sierra Club contends that the Board erred in refusing to revoke EG&G's permit to operate TOCDF. Specifically, Sierra Club argues that the Board should have revoked EG&G's permit in light of EG&G's permitless operation of TOCDF for six months in violation of the Utah Solid and Hazardous Waste Act, specifically Utah Code Ann. § 19-6-108(3)(a) (Supp. 1997), n4 and in light of alleged accidents at TOCDF [**25] while the facility was under EG&G's control. Sierra Club further asserts that the Executive Secretary erred in adding EG&G to the permit in June 1996. In response, the Board and intervenors contend that the Executive Secretary reasonably interpreted section 19-6-108(3)(a) in concluding that hazardous waste facilities frequently employ contractors and subcontractors and that EG&G's status as a contractor for the Army does not mean that EG&G was an "operator" within the statute's meaning. Therefore, they argue, EG&G did not need a permit and the Executive Secretary's later decision to add EG&G to the permit, though not legally required, was a reasonable exercise of his discretion.

n4 As a convenience to the reader, and because the provisions in effect at the relevant times do not differ materially from the statutory provisions currently in effect, we cite to the most recent statutory codifications throughout this opinion, unless otherwise noted.

Standard of Review

Whether EG&G is an "operator" within [**26] the meaning of section 19-6-108(3)(a)--and therefore required to obtain a permit--is an issue of statutory construction. "We review the agency's statutory construction as a question of law under a correction-of-error standard unless the statute expressly or impliedly grants the agency discretion to interpret the statutory language." *Epperson v. Utah State Retirement Bd., 949 P.2d 779, 781 (Utah Ct. App. 1997).* See *O'Keefe v. Utah State Retirement Bd., 929 P.2d 1112, 1114 (Utah Ct. App. 1996),* aff'd on other grounds, *956 P.2d 279 (Utah 1998); Allred v. Utah State Retirement Bd., 914 P.2d 1172, 1174 (Utah Ct. App. 1996).* In this case, the Solid and Hazardous Waste Act does not grant the Board such discretion, and therefore we review its decision for correctness. See generally *Epperson, 949 P.2d at 781; O'Keefe, 929 P.2d at 1115.* "Under the correction-of-error standard, this court affords no deference to the agency's interpretation or application of statutory terms." *Allred, 914 P.2d at 1174.*

[*345] Whether the Board erred in refusing to revoke EG&G's permit in light of accidents and mishaps at TOCDF involves the Board's application of law to fact, see *Drake v.* [**27] *Industrial Comm'n, 939 P.2d 177, 181 & n.6 (Utah 1997); State v. Pena, 869 P.2d 932, 937-939 (Utah 1994),* subject to the intermediate standard of review we discussed above. For essentially the same reasons as those previously discussed, we accord the Board a relatively high degree of deference in reviewing its application of law to the facts of this case.

Analysis

The statute at issue provides: "No person may own, construct, modify, or operate any facility or site for the purpose of ... treating, storing, or disposing of hazardous waste without first submitting and receiving the approval of the executive secretary for a ... hazardous waste operation plan for that facility or site." Utah Code Ann. § 19-6-108(3)(a) (Supp. 1997). See also Utah Admin. Code R315-3-1(a) (Supp. 1997) ("No person shall own, construct, modify, or operate any facility for the purpose of treating, storing, or disposing of hazardous waste without first submitting, and receiving the approval of the Executive Secretary for, a hazardous waste operation plan for that facility."). Thus, the issue is relatively straight-forward: Did EG&G "operate" TOCDF within the statute's meaning? If so, section [**28] 19-6-108(3)(a) required EG&G to have a permit. n5

n5 We follow the parties' lead in using "permit" synonymously with the statutory

phrase "receiving the approval of the executive secretary for a ... hazardous waste operation plan."

"When interpreting statutes, [an appellate] court is guided by the long-standing rule that a statute should be construed according to its plain language. Thus, where the statutory language is plain and unambiguous, [the court] will not look beyond it to divine legislative intent." *Utah Sign, Inc. v. Utah Dep't of Transp., 896 P.2d 632, 633-34 (Utah 1995)* (citations omitted). Accord *Brinkerhoff v. Forsyth, 779 P.2d 685, 686 (Utah 1989); Epperson, 949 P.2d at 782.* See also *Johnson v. Utah State Retirement Bd., 770 P.2d 93, 95 (Utah 1988)* ("A fundamental principle of statutory construction is that unambiguous language in the statute itself may not be interpreted so as to contradict its plain meaning.").

Even though the Executive Secretary conceded that EG&G is [**29] an operator of TOCDF, and even though the intervenors refer in their brief to EG&G as an operator of TOCDF, the Board and the intervenors contend that EG&G is somehow not an operator within the statute's meaning because EG&G is a contractor hired by the Army. They further contend that the Army is the only party required to hold a permit because the Army bears "ultimate responsibility for construction and operation of the facility."

"The terms of a statute should be interpreted in accord with their usual and accepted meanings." *Clover v. Snowbird Ski Resort, 808 P.2d 1037, 1045 (Utah 1991).* Accord *Mt. Olympus Waters, Inc. v. Utah State Tax Comm'n, 877 P.2d 1271, 1273* (Utah Ct. App.) (presuming statutory terms are used in their ordinary sense and should be interpreted according to usual and commonly accepted meanings), cert. denied, *890 P.2d 1034 (Utah 1994).* Section 19-6-108(3)(a) uses the term "operate," which, as conceded by the Executive Secretary and the intervenors, encompasses the services EG&G performs at TOCDF. EG&G "operates" that facility under the common meaning of the term, regardless of whether it does so as a contractor, a partner, a joint venturer, or a volunteer. [**30] The Board and intervenors would have us construe "operate" to somehow exclude contractors hired by owners, even if they are hired--as is the case here--to "operate" the owner's facility. Such a construction does not accord with the plain meaning of the statute, nor with the "usual and accepted" meaning of the term "operate." If the Legislature intended that permits be obtained by only those "bearing ultimate responsibility for construction and operation" of hazardous waste facilities, as the intervenors assert, the statute would not require parties that "construct, modify, or operate" hazardous waste facilities to obtain a permit, in addition to those who "own" such facilities. It is inarguable, given the statute's plain [*346] language, that EG&G violated section 19-6-108(3)(a) by operating TOCDF without a permit, and the Board erred in concluding that EG&G did not need a permit.

Sierra Club contends that because EG&G violated the Solid and Hazardous Waste Act by operating TOCDF without a permit, the Board should have sanctioned EG&G by refusing to add them to the permit. However, it appears that EG&G's omission from the permit was largely due to the Executive Secretary's erroneous interpretation [**31] of the term "operate," not to any connivance or evasion by EG&G. The fact that the Executive Secretary eventually added EG&G to the permit indicates that he came to realize the potential problem and took appropriate corrective action. Because the problem has been corrected, we cannot say the Board was unreasonable in declining to punish EG&G for not being named in the permit earlier by barring it from being included in the permit now.

As a second ground for seeking revocation of EG&G's permit, Sierra Club claims that a series of "mishaps, accidents, and violations" n6 at TOCDF show that EG&G cannot operate the facility in an acceptably safe manner. The Solid and Hazardous Waste Act provides that "approval of a ... hazardous waste operation plan may be revoked, in whole or in part, if the person to whom approval of the plan has been given fails to comply with that plan." Utah Code Ann. § 19-6-108(12) (Supp. 1997) (emphasis added). Permit revocation is therefore a matter within the Board's discretion and is by no means mandatory. Here, while it found that accidents had occurred at TOCDF, the Board also found that the Army and EG&G took corrective steps after each mishap and that [**32] none of the incidents have recurred.

n6 Specifically, Sierra Club alleges that an employee of an EG&G subcontractor provided falsified trial burn data; that nerve agent leaked into permeable vestibules outside the HVAC filters; that nerve agent decontamination solution leaked through an airlock; that fires have occurred in the liquid incinerator area; and that EG&G workers are inadequately trained.

Sierra Club does not dispute that the Army and EG&G have taken such corrective measures. Moreover, these accidents occurred during what is known as the "shakedown" period--the central purpose of which is to "identify possible mechanical difficulties, ensure that [TOCDF] has reached

operational readiness and achieve steady-state operating conditions prior to conducting the trial burns." One of the purposes of this phase of TOCDF operations is therefore to shake out possible bugs before the facility begins full-scale operations. Based on the foregoing, we cannot say that the Board abused its discretion or otherwise [**33] erred in refusing to revoke EG&G's permit due to these operational mishaps.

DENIAL OF DUE PROCESS RIGHTS

In a prehearing order dated September 19, 1996, about six months before the hearing began, the Board ordered that Sierra Club would be given twelve hours to argue and conduct direct and cross-examination before the Board; EG&G and the Army would be limited to a collective total of ten hours; and the Executive Secretary would be limited to five hours.

Sierra Club argues that the Board violated its state and federal procedural Due Process rights n7 by unreasonably limiting its time to present its case and cross-examine adverse witnesses. n8 Intervenors and respondent contend that Sierra Club was afforded ample opportunity to present its case and to cross-examine witnesses, but that Sierra Club failed to efficiently use its allotted time and failed to exploit the available opportunities for otherwise getting evidence before the Board.

n7 Because "Utah's constitutional guarantee of due process is substantially the same as the due process guarantees contained in the Fifth and Fourteenth amendments to the United States Constitution," *In re Worthen, 926 P.2d 853, 876 (Utah 1996)*, we need not undertake separate federal and state analysis. [**34]

n8 During the hearing, Sierra Club also objected to the Board's decision to charge Board members' questions against the parties' allotted time.

[*347] Standard of Review

"Questions regarding whether an administrative agency has afforded a petitioner due process in its hearings are questions of law. We therefore do not give deference to the agency's actions." *Lopez v. Career Serv. Review Bd., 834 P.2d 568, 571* (Utah Ct. App.), cert. denied, *843 P.2d 1042 (Utah 1992)*.

Analysis

"The requirements of due process depend upon the specific context in which they are applied because 'unlike some legal rules due process is not a technical conception with a fixed content unrelated to time, place, and circumstances.'" *V-1 Oil Co. v. Department of Envtl. Quality, 939 P.2d 1192, 1196 (Utah 1997)* (quoting *Cafeteria Workers Union v. McElroy, 367 U.S. 886, 895, 81 S. Ct. 1743, 1748, 6 L. Ed. 2d 1230 (1961)).* Due Process is therefore "flexible and requires such procedural protections as the particular situation demands." *Worrall v. Ogden City Fire Dep't, 616 P.2d 598, 602 (Utah* [**35] *1980).*

We conclude that under the circumstances of this case, the Board did not deny Due Process to Sierra Club. The Utah Administrative Procedures Act (APA) provides that "the presiding officer [of an administrative hearing] shall regulate the course of the hearing to obtain full disclosure of relevant facts and to afford all the parties reasonable opportunity to present their positions." Utah Code Ann. § 63-46b-8(1)(a) (1997). The APA further provides that "the presiding officer shall afford to all parties the opportunity to present evidence, argue, respond, conduct cross-examination, and submit rebuttal evidence." Id. § 63-46b-8(1)(d).

While the Board's time limitations do appear somewhat parsimonious, under the APA the Board was entitled to regulate the course of the hearing, which necessarily included its duration. Here, the Board limited every party's time, with Sierra Club receiving the largest block of all. Sierra Club knew of the time limits far in advance of the actual hearing date yet failed to object until the hearing was well underway. The Board also offered the parties numerous opportunities to present their positions in forms other than through time-consuming [**36] testimony, i.e., pre- and post-hearing briefs, affidavits, deposition transcripts, transcripts from a companion case in federal court, and witness diaries.

Moreover, when it became apparent that Sierra Club had used the vast bulk of its time presenting its case and therefore had little time left for cross-examination of witnesses, the Board granted forty-five minutes of extra time to Sierra Club, and both the Army and the Executive Secretary ceded Sierra Club part of their allotted times. Finally, the Board permitted Sierra Club to take additional, unlogged time on cross-examination and voir dire of several witnesses. All told, Sierra Club used over fifteen hours by the end of the proceeding. The Executive Secretary used one hour and the Army and EG&G collectively used less than nine hours.

In support of its contention that, due to the time

limits imposed by the Board, Sierra Club was denied its Due Process right to cross-examine adverse witnesses, Sierra Club primarily relies on two Utah cases where agencies violated the right to cross-examine witnesses. See *Tolman v. Salt Lake County Attorney, 818 P.2d 23 (Utah Ct. App. 1991); D.B. v. Division of Occupational & Prof'l Licensing,* [**37] *779 P.2d 1145 (Utah Ct. App. 1989).* These cases are readily distinguishable from the one before us.

In Tolman, the petitioner argued that he was denied Due Process when the agency admitted highly prejudicial hearsay testimony, testimony which petitioner could not challenge without cross-examining the declarant, who did not testify. See *818 P.2d at 28-29.* In D.B., the administrative law judge refused to permit the petitioner to cross-examine any of the three witnesses presented against him. See *779 P.2d at 1147.* We found denials of Due Process in both cases because these petitioners were denied any right to cross-examine the witnesses at issue. Such was not the case here.

In this case, the Board subjected Sierra Club to a time limit, not an outright denial of its right to cross-examine specific witnesses. "An administrative agency has broad discretion to reasonably regulate the time periods afforded parties to present evidence." *Clark* [*348] *v. Board of Dirs., 915 S.W.2d 766, 773 (Mo. Ct. App. 1996).* See also *Childs v. Copper Valley Elec. Ass'n, 860 P.2d 1184, 1190 (Alaska 1993)* (stating review board "may place reasonable time limits on testimony in order [**38] to manage its own docket"). The fact that Sierra Club ran short on time does not mean it was denied its constitutional right to cross-examine witnesses, as occurred in Tolman and D.B. The right to Due Process in an agency hearing does not translate into an absolute right to take as much time in presenting its case as a participant desires.

A further distinction between this case and those cited by Sierra Club is that in both Tolman and D.B., the petitioners showed they suffered substantial prejudice from these outright denials of the right to cross-examine. *D.B., 779 P.2d at 1149; Tolman, 818 P.2d at 30-31.* Sierra Club does not make such a showing here. Aside from generally alleging that it lacked time to cross-examine several witnesses, Sierra Club does not state what evidence it needed to get in but did not, nor does it show that the case would have come out differently had it been given more time.

Moreover, it appears from the record that any shortfall in cross-examination time was partially due to Sierra Club's failure to budget its time. "'All parties [to an agency hearing] ... must be given opportunity to cross-examine witnesses, to inspect [**39] documents and to offer evidence in explanation or rebuttal.'" *D.B., 779 P.2d at 1146* (emphasis added) (quoting *State Dep't of Community Affairs v. Utah Merit Sys. Council, 614 P.2d 1259, 1262 (Utah 1980)).* Here Sierra Club had the opportunity to cross-examine every witness--it merely failed to make the most of that opportunity through judicious use of its allotted time.

Based on the foregoing, we conclude that the Board's time limitations were not unreasonable and that Sierra Club was not denied its constitutional rights to Due Process.

CONCLUSION

We first conclude that Sierra Club has standing to bring this appeal because the issues raised are matters of substantial public importance. Second, we conclude that the Board did not err in refusing to revoke the trial burn permit in the face of Sierra Club's allegations of hazards to human health and the environment. Third, we conclude that the Board erred in finding that EG&G was not an "operator" of TOCDF under Utah Code Ann. § 19-6-108(3)(a) (Supp. 1997), but that the Board did not abuse its discretion in refusing to revoke EG&G's permit on that basis. Additionally, we conclude the Board acted within its discretion in [**40] refusing to revoke EG&G's permit based on the accidents which have occurred at TOCDF. Fourth, we conclude that Sierra Club was not denied its federal and state Due Process rights by the time limits imposed by the Board.

Accordingly, we decline to disturb the Board's order.

Gregory K. Orme, Judge

WE CONCUR:

James Z. Davis,

Presiding Judge

Michael J. Wilkins,

Associate Presiding Judge

CHEMICAL WEAPONS WORKING GROUP, et al., Plaintiffs, v. UNITED STATES ENVIRONMENTAL PROTECTION AGENCY, Defendant.

Misc. Action No. 98-156 (AER)

UNITED STATES DISTRICT COURT FOR THE DISTRICT OF COLUMBIA

185 F.R.D. 1; 1999 U.S. Dist. LEXIS 2644

January 19, 1999, Decided

January 19, 1999, Filed

DISPOSITION:
[**1] Plaintiffs' motion to compel production of documents denied.

COUNSEL:
For CHEMICAL WEAPONS WORKING GROUP, INC (CWWG), SIERRA CLUB, VIETNAM VETERANS OF AMERICA FOUNDATION, plaintiffs: Richard E. Condit, Washington, DC.

For US ENVIRONMENT PROTECTION AGENCY, defendant: Robert Foster, U.S. DEPARTMENT OF JUSTICE, Denver, CO.

JUDGES:
Aubrey E. Robinson, Jr., United States District Judge.

OPINIONBY:
Aubrey E. Robinson, Jr.

OPINION:

[*1] MEMORANDUM OPINION

Presently before the Court is Plaintiffs' motion to compel production of documents. Upon consideration of the entire record, and for the reasons stated below, the Court will deny the motion. n1

n1 The Court finds that the affidavits submitted by Defendant are adequate to establish the privilege, making an *in camera* examination of the documents unnecessary. See *EPA v. Mink, 410 U.S. 73, 93, 93 S. Ct. 827, 35 L. Ed. 2d 119 (1973).*

Background

Plaintiffs have subpoenaed documents which represent drafts of EPA's revisions to its 1994 Review Draft of the Dioxin Reassessment. n2 The Dioxin Reassessment [**2] represents EPA's best effort to analyze and synthesize [*2] the available scientific data to provide to EPA policy makers and program officials an assessment of the risk to human health and the environment of dioxins.

n2 The subpoena requested all final versions as well, but the agency states that there are no final versions. Decl. of William H. Farland at 4.

The current reassessment began in 1991. A "Review Draft" was published in 1994 for public comment and peer review by the Science Advisory Board (SAB). As a result of the public comment and the SAB's recommendations, the agency is currently in the process of the revising the Review Draft to take account of the public comment and latest science. In addition, portions of the Review Draft are undergoing more extensive revision and will be submitted to additional peer review. n3 For at least one major component of the Review Draft, the additional peer review has been completed, and the agency is now revising the draft to address the issues raised by the review.

n3 As portions of the review draft are submitted for independent peer review, the agency releases those drafts to the public. Decl.

of William H. Farland at 8-9.

[**3]

Plaintiffs seek all of the draft revisions to the Review Draft which have not been publically released. Defendant, the United States Environmental Protection Agency (EPA), has resisted production and asserted the deliberative process privilege. n4

n4 The Court notes that Plaintiffs object to EPA's privilege log. The Court finds that EPA reasonably interpreted Plaintiffs' subpoena under the circumstances. Furthermore, EPA provided sufficient information to enable Plaintiffs and the Court to assess the applicability of the privilege as to all documents. Fed. R. Civ. P. 45(d)(2).

Analysis

To be protected by the deliberative process privilege a document must be both "predecisional" and "deliberative." *Coastal States Gas Corp. v. Department of Energy, 199 U.S. App. D.C. 272, 617 F.2d 854, 866 (D.C. Cir. 1980).* There is no contention here that the draft revisions to the Dioxin Reassessment are not predecisional. The entire purpose of the revision process is to create a final Reassessment document which the [**4] agency can use in carrying out its statutory mandates. Plaintiffs appear to contend, however, that the documents are not sufficiently "deliberative" to qualify for the privilege.

The deliberative process privilege protects "all communications which, if revealed, would expose to public view the deliberative process of an agency." *Russell v. Department of the Air Force, 221 U.S. App. D.C. 96, 682 F.2d 1045, 1049 (D.C. Cir. 1982).* Thus, factual materials are frequently ineligible for the privilege. See *EPA v. Mink, 410 U.S. 73, 87-88, 93 S. Ct. 827, 35 L. Ed. 2d 119 (1973); Russell, 682 F.2d at 1048.* Plaintiffs seize on this notion to argue that the draft revisions to the Dioxin Reassessment are not privileged because they "are summaries of scientific facts, observations, and studies and scientific analysis of those facts. While scientific inferences and conclusions are drawn in the documents ... these inferences are still scientific and factual rather than policy recommendations." Pls.'s Mem. in Support of Motion to Compel at 3.

The Court notes that it is not at all clear that the information Plaintiffs seek is "factual." See *Quarles v. Department of the Navy, 282 U.S. App. D.C. 183, 893 F.2d 390,* [**5] *392-3 (D.C. Cir. 1990)* (cost estimates for homeporting battleships opinion not fact). Like any health risk assessment, the Dioxin Reassessment "involves evaluating scientific studies, deciding what weight to give their results, making scientific judgments regarding data gaps, and applying science policy to put the whole into a meaningful framework." Decl. of William H. Farland at 11-12. The result of this process, the "inferences and conclusions," may be scientific, but they are not purely factual. Although risk estimates, like cost estimates, often "have a surface precision that may lead the unsophisticated to think of them as fixed ... estimates such as these are far from fixed ...." *893 F.2d at 393.* Rather, "they derive from a complex set of judgments ... They partake of just that elasticity that has persuaded courts to provide shelter for opinions generally." Id.

While much of the information sought by Plaintiffs may not be "factual," the ultimate question in deciding whether the deliberative process privilege applies is not whether the material is "factual" or not. [*3] Courts have found the privilege applicable to information which is heavily factual. See *Russell, 682* [**6] *F.2d at 1049* (privilege protects twenty pages of Air Force history not included in final draft); *Montrose Chemical Corp. v. Train, 160 U.S. App. D.C. 270, 491 F.2d 63, 71 (D.C. Cir. 1974)* (privilege protects agency summaries of facts in public hearing record).

Instead, the critical question is whether "disclosure of the materials would expose an agency's decision-making process in such a way as to discourage candid discussion within the agency and thereby undermine the agency's ability to perform its functions." *Dudman Communications v. Department of the Air Force, 259 U.S. App. D.C. 364, 815 F.2d 1565, 1568 (D.C. Cir. 1987).*

In deciding whether the deliberative process privilege applies, courts consider the facts of the case in light of the policies behind the privilege. *Wolfe v. Department of Health and Human Servs., 268 U.S. App. D.C. 89, 839 F.2d 768, 774 (D.C. Cir 1988).*

There are essentially three policy bases for this privilege. First, it protects creative debate and candid consideration of alternatives within an agency, and, thereby, improves the quality of agency policy. Second, it protects the public from the confusion that would result from premature [**7] exposure to discussions occurring before the policies affecting it had already been settled upon. And third, it protects the integrity of the decision-making process itself by confirming that "officials should be judged by what they decided(,) not for matters they considered before

making up their own minds."

Russell, 682 F.2d at 1048 (quoting *Jordan v. United States Department of Justice, 192 U.S. App. D.C. 144, 591 F.2d 753, 772-3 (D.C. Cir. 1978))*. The Court finds that all three of these policies justify the application of this privilege to the documents sought by Plaintiffs.

First, the Court finds creditable the agency's assertion that the release of draft information would be likely to chill the free exchange of ideas within the agency. See Decl. of William H. Farland at 12; *Coastal States, 617 F.2d at 866* (privilege applies if "public disclosure is likely in the future to stifle honest and frank communication within the agency").

Risk assessments, and in particular the Dioxin Reassessment, may be very controversial. Thus, EPA has "much at stake in the [final product], and documents like it, being the product of 'candid debate and creative consideration [**8] of the alternatives'" within the agency. *Russell, 682 F.2d at 1048.* Just as the Air Force in Russell was entitled to protect the work of individual authors in order to encourage them "to provide the best, most honest, and scholarly products they are capable of producing[,]" so the EPA is entitled to protect the draft work of its individual authors. If anything, the case for protection is even stronger here than it was in Russell, because the agency has not completed its revisions. Thus, as EPA points out, any release of draft information might have the unfortunate effect of encouraging interested parties to pressure the agency to change its position even before the agency has adopted one.

Likewise, the Court finds highly creditable the agency's assertion that release of draft information could mislead the public. Decl. of William H. Farland at 12-13. "The public may misinterpret information in the drafts as the most up-to-date information on dioxin toxicity available from the Agency, even though the documents do not reflect official EPA views, but only the preliminary views of the primary authors." Id. at 13. In fact, it appears that Plaintiffs seek the documents [**9] precisely because they believe it is the latest EPA information on the health effect of dioxins. See Pls.'s Motion to Compel at 2-3. Again, the situation is very like the one in Russell, where the court said,

> We recognize the tendency of the public to assume that a memorandum generated within an agency of the government reflects the position of the agency, regardless of whether the memorandum is designated as an "official" document. Therefore [the deliberative process privilege] acts in this case to prevent the public from misconstruing the views of an individual [agency official] to be the views of [the agency].

Russell, 682 F.2d at 1049.

Finally, the Court finds that disclosure of the draft material would "violate the integrity [*4] of the decision-making process." Id. Release of draft revisions now would inevitably enable parties to learn which preliminary ideas and findings the Agency had accepted, which it had refined, and which it had rejected. "But such disclosures of the internal workings of the agency is exactly what the law forbids." Id. (quoting *Lead Indus. Ass'n v. OSHA, 610 F.2d 70, 86 (2d Cir. 1979))*.

Conclusion

The Court [**10] finds that the documents sought by the Plaintiffs are protected by the deliberative process privilege. Release of the documents would likely stifle candid communication within the agency, lead to public confusion, and violate the integrity of the decision-making process. Accordingly, the Court will deny the motion to compel. An appropriate order issues this same day.

Aubrey E. Robinson, Jr.

United States District Judge

Dated: January 19, 1999

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IN THE UNITED STATES COURT FOR THE DISTRICT OF UTAH
CENTRAL DIVISION

CHEMICAL WEAPONS WORKING GROUP, INC., et al., Plaintiffs, vs. UNITED STATES DEPARTMENT OF THE ARMY, et al., Defendants.	FINDINGS OF FACT AND CONCLUSIONS OF LAW Case No. 2:96-CV-425C

Plaintiffs Chemical Weapons Working Group, Inc., Sierra Club, and Vietnam Veterans of America filed this suit in May 1996, challenging the operation of the Tooele Chemical Agent Disposal Facility ("TOCDF") by the defendants United States Department of the Army, Department of Defense, and EG&G.[1] According to plaintiffs, the defendants' past operation of TOCDF violated various environmental statutes and its continued operation presents an imminent and substantial endangerment to human health and the environment. A trial was held to the court, sitting without a jury, in June 1999. The court now enters its Findings of Fact and Conclusions of Law, as required by Fed. R. Civ. P. 52(a), and directs that judgment be entered in

[1]For convenience, all defendants will be referred to collectively as "defendants" although the court recognizes that the responsibilities and actions of the federal defendants and the private defendant were often not the same.

favor of the defendants on all claims against them.

FINDINGS OF FACT

In 1996, destruction of chemical agent began at TOCDF.[2] Since the process began, 21% of the chemical agent stockpile has been destroyed. As explained below, the evidence at trial established that no agent-related injuries have been sustained and no agent has been released into the environment outside TOCDF.

Generally, plaintiffs' claims fall into two categories: incidents that have occurred during the operation of TOCDF and emissions from the TOCDF common stack that have entered the outside environment.[3] The court also discusses plaintiffs' allegations that defendants concealed certain information.[4]

A. Operational Incidents

1. March 30, 1998

On this date, an MC-1 bomb was incompletely drained of chemical agent GB. The placement of the incompletely-drained bomb into the metal parts furnace ("MPF") caused an overfeed of the MPF. The facts leading up to this occurrence are not seriously in dispute.

The MPF is a two-chambered furnace: combustion takes place in the primary chamber,

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[2]In several previous decisions by this court and the Tenth Circuit Court of Appeals, the background of the chemical warfare agent stockpile stored at Deseret Chemical Depot (formerly known as the Tooele Army Depot) and the physical facility at TOCDF, including various safety systems and features, are extensively discussed. The court will not repeat this information except as necessary to explain its decision here.

[3]The common stack releases emissions from TOCDF to the outside environment.

[4]As discussed below, the concealment allegations are relevant to plaintiffs' claims brought under the National Environmental Protection Act.

and gasses from the primary chamber flow into an afterburner chamber. When the gasses leave the afterburner, they pass through a pollution abatement system. The procedure for feeding an MC-1 bomb to the MPF begins when a bomb is brought on a conveyer to the bulk drain station ("BDS"), located in the munitions processing bay above the MPF. At the BDS, two holes are punched in the bomb. A drain tube is then placed in the bomb, and agent is drained from the bomb. The system is designed so that all but 11 pounds of agent, or 5% of the agent, is drained from the bomb.[5] Once a bomb is drained, it is sent on a tray to the MPF.

Shortly before midnight on March 29, 1998, a bomb was sent to the BDS, holes were punched in the bomb, and draining of GB began. After 15 seconds, draining was stopped so that workers could take a sample of the agent and perform maintenance. During the maintenance operations, one of the workers noted problems with the drain probe and suggested to the control room operator that the drain probe might be out of adjustment.

The BDS operator, directed by the control room supervisor, made several more attempts to drain the bomb. Following these attempts, the BDS operator received conflicting data concerning the amount of agent that had been drained from the bomb: certain measurements indicated that the required 95% of agent had been drained, other measurements indicated that it had not. A decision was then made to "bypass" the repeat drain cycle and send the bomb to the MPF. At approximately 3:25a.m. on the morning of March 30, the bomb was fed to the MPF. The bomb contained approximately 75-80 pounds of GB.

Once inside the MPF, the undrained GB in the bomb quickly vaporized, causing a rapid

[5]Before draining, the bombs contain 220 pounds of agent.

increase in the temperature of the MPF. At 3:39a.m., an alarm sounded, indicating that the temperature in the afterburner was above the extreme temperature limit. The burners and the afterburner automatically shutdown, and a quench water spray was applied to the primary chamber. However, within minutes, TOCDF personnel decided that the best course of action was to continue incinerating the bomb, and the quench water spray was stopped. At 3:44a.m., the temperature in the afterburner had dropped below the extreme temperature limit and shortly thereafter, the afterburner was relighted.

The Automatic Continuous Air Monitoring System ("ACAMS") and the Depot Area Agent Monitoring System ("DAAMS") are monitoring systems used throughout TOCDF to detect the presence of chemical agent. The ACAMS consists of self-contained chromatographs which collect samples of gasses at various locations throughout TOCDF. The ACAMS are numbered to identify their location. At the time of the March 30th incident, ACAMS 703 was located in the duct leading from the MPF to the common stack. ACAMS 701A, ACAMS 701B, and ACAMS 701C were the three ACAMS located in the common stack.

Each ACAMS operates on a three minute cycle with 110 seconds of the cycle spent collecting air samples and 70 seconds analyzing the samples. In the common stack, the cycles of the ACAMS are required to be set so that one ACAMS is always collecting a sample. This is called "staggering the ACAMS."

When an ACAMS detects the presence of agent above a certain concentration, it will "go into alarm," that is, it will trigger an audible alarm in the control room. (Because the ACAMS operate in "near realtime," the machine will not alarm until it has completed its cycle). On March 30, at 3:45a.m., ACAMS 703 went into alarm. However, the three ACAMS in the stack

did not go into alarm.

The second monitoring system in place at TOCDF is the DAAMS. The DAAMS units collect air onto an absorbent material inside a testing tube over an extended period of time. The DAAMS tubes are periodically collected and the contents analyzed for the presence of chemical agent. Sometime after 4a.m. on March 30, after ACAMS 703 had gone into alarm, a TOCDF employee collected the DAAMS tubes from the common stack. These were the DAAMS tubes that had been in place, or "on line" during the incident. Unfortunately, following the general practice, the common stack DAAMS tubes were not kept separate from the DAAMS tubes collected from other locations in TOCDF. In order to determine whether any agent had migrated through the common stack, therefore, workers had to examine all the DAAMS tubes. When all of the DAAMS tubes were analyzed, no agent was detected.

At 3:46a.m., immediately after ACAMS 703 went into alarm, Clayton Hall, the plant shift manager, directed that the site masking alarm, which signals all TOCDF personnel to don their gas masks, be triggered. When Hall observed that the ACAMS in the common stack had not gone into alarm, he gave the direction that gas masks could be removed.

At trial, defendants' expert, James Cudahy, an environmental engineer specializing in high temperature equipment for the treatment of wastes, gave his opinion that no GB was released from the common stack. Cudahy explained that during a one-minute period, from 3:39a.m. until 3:40a.m., there was no oxygen, and consequently, no combustion in the MPF. However, Cudahy concluded that the temperature in the MPF never dropped below 1,965 degrees Fahrenheit (a temperature of 1,350 degrees is needed to destroy GB). Cudahy's review of the data collected from the MPF led him to the conclusion that during this one-minute period,

the conditions in MPF were such that the agent would have been destroyed. It was also Cudahy's opinion that during this one-minute period, an unknown material was formed ("an interferent") and caused ACAMS 703 to go into alarm.

Cudahy opined that if any of the GB had survived the high temperatures of the MPF, which he believed highly unlikely, it would have passed into the pollution abatement system, reacted with the hot caustic brine in the system, and been chemically neutralized.

Defendants have made changes to ensure that there will not be a repeat of the March 30 incident. Drain probes have been marked to allow the BDS operator to visually determine whether the probes are in the correct position. Procedures have been implemented so that when questions arise about whether a bomb has been sufficiently drained of agent, several supervisors must evaluate the problem before the questioned bomb will be fed to the MPF. In addition, defendants have revised and improved the DAAMS tracking system and made modifications to the ACAMS to guarantee continuous, staggered monitoring in the common stack.

2. December 1998

As a result of a maintenance error, 140 gallons of chemical agent leaked into a sump. Because of another, unrelated error, the ACAMS did not alarm. When a control room operator discovered the spill, the system was shut down and no injury resulted. Changes have been made in various procedures to prevent reoccurrences.

3. May 21, 1999

TOCDF employees were working in the explosive containment room, a Level A area.[6]

[6]Areas in TOCDF are designated as either Level A, B, or C, according to whether chemical agent is expected to be present. An area is designated Level A or B if chemical agent is expected to be present. Level C areas are those where chemical agent is not expected to be present. Protective clothing must be worn in A and B

Simultaneously, in another area known as the "unpack area," other employees were feeding ton containers through an airlock into the explosive containment vestibule. Agent migrated from the explosive containment room, through the airlock, and into the unpack area.

Following the incident, the employees from the unpack area were examined at the TOCDF medical clinic, and given blood tests. There was no indication that the workers had suffered "exposure"[7] or injury.

4. May 24, 1999

TOCDF employees, dressed in Level B protective clothing, were removing nose plugs or closures from projectiles. Beneath the nose closure of each projectile is a hollow area know as the "burster well." The burster well is usually sealed to prevent leaks of agent from the surrounding agent cavity into the burster well.

On this date, one of the nose closures was removed and chemical agent migrated from the burster well. The employees immediately left the area and were taken to the TOCDF clinic. There was no indication of injury to the employees.

5. June 4, 1999

TOCDF has an emergency power system for use if the local power company experiences a power outage. The emergency system has two components: first, a battery backup system, called the "uninterruptible power supply," which supplies power for control systems and agent monitors; second, emergency generators that provide power for critical operating systems, such

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areas. TOCDF personnel working in A areas wear the highest degree of protective clothing.

[7]The Army definition of "exposure to chemical agent" is a measurable reduction of cholinesterase, an enzyme found in blood plasma.

as the heating, ventilation, and air-conditioning system ("HVAC").[8]

TOCDF has experienced problems with the emergency power system. The most significant took place on June 4, 1999, when a thunderstorm caused an outage. The emergency system failed to come online automatically and had to be manually started, resulting in an eight to twelve minute period when TOCDF was without electrical power. During this period, various safety and monitoring systems were out of operation, including the HVAC system, thereby allowing chemical agent to migrate into a Level C unpack area. No injury resulted from the failure of the emergency system.

Defendants have taken measures to improve the emergency power system, including the addition of a third generator.

6. **Waste Characterization**

Defendants are required by their Utah State permits to analyze and characterize the agent waste before it is incinerated. In January 1997, analysis of the brine from the pollution abatement system showed that the brine contained 12.3 parts per million of arsenic, far in excess of the 5 parts per million allowed by TOCDF's permit. Plaintiffs claim that the presence of this amount of arsenic shows that the defendants have been incinerating chemical agent lewisite, which TOCDF's permit does not allow.

In 1997, in an effort to discover the source of the arsenic in the brine, the Army began investigating the history of the ton containers being used at TOCDF. The investigation showed that certain ton containers had contained Freon and mustard, before being used by the Army at

[8]TOCDF's HVAC is designed, through the use of negative air pressure, to prevent agent migration.

TOCDF.

Defendants, in conjunction with the State of Utah, created a program to take samples of a representative number of the ton containers to determine if any of the containers were now contaminated with lewisite. The analysis revealed no lewisite contamination. The waste tracking forms now indicate, and have since 1998, that the waste contains arsenic.

Through the sampling program, defendants discovered that the agent in some of the ton containers had a low pH value, and was therefore highly acidic. The defendants have partially incinerated the contents of one of these ton containers in the MPF, not the liquid incinerator. The State of Utah granted defendants a temporary emergency permit to incinerate the low pH agent, which allows defendants to incinerate the contents of seventeen pressurized ton containers. Defendants do not know for sure, but they believe that no other ton containers contain low pH agent.

7. Miscellaneous Operational Claims

a. Hot Cut-Outs

Plaintiffs claim, as a general matter, that decontamination procedures, including "hot cut-outs," are inadequate and expose TOCDF employees to chemical agent.

TOCDF personnel working in Level A areas wear demilitarization protective ensemble ("DPE") suits. These plastic suits are completely sealed from the outside environment and must be physically cut to be removed. A normal cut-out occurs when a suit is removed in an area where the Time Weighted Average ("TWA") is 40 units[9] or less. Removal of a DPE suit in an

[9]TWA is an agent concentration exposure measurement established by the Office of the Surgeon General. An average individual can be exposed to one TWA for eight hours per day, forty hours per week, for his or her lifetime, without suffering adverse health effects

area where agent concentration is higher than 40 TWA, is described as a "hot cut-out." Following a hot cut-out, the person is examined at the TOCDF medical clinic. There was no evidence that any employee has been injured as a result of a hot cut-out.

b. Bags Containing Hazardous Waste

Twice, shortly before trial, TOCDF employees were working in the vicinity of bags containing hazardous waste. Apparently, on each occasion, one or more of the bags was torn, allowing agent vapor to escape and causing the ACAMS to alarm. There was no indication that the employees were injured. Employees working in the vicinity of bags containing contaminated waste now wear the highest level of protective clothing.

c. Visitors to TOCDF

On May 25, 1997, a group of visitors toured TOCDF. During the tour, the visitors entered an area where MC-1 bomb casing were stored. Due to an error in the documentation that had accompanied the bomb casings when they were delivered to TOCDF from Deseret Chemical Depot, one of the casings was not completely decontaminated.

The evidence indicated that the visitors were not exposed to agent. No ACAMS alarm was triggered in the area and a later blood test of an employee who had spent a far greater amount of time than the visitors in the vicinity of the contaminated MC-1 bomb showed no evidence of exposure. The defendants now exclude visitors from entering areas where possibly contaminated materials are stored.

d. Staggered ACAMS

As discussed previously, to ensure continuous monitoring, the ACAMS in the common stack must be staggered. There have been at least five times when the ACAMS were not

staggered. No evidence was presented of injury resulting because of these five failures.

Since April 1998, at the direction of the State of Utah, the ACAMS are monitored to ensure that they remain staggered. If the ACAMS are not staggered, an alarm sounds in the control room, the waste feed to the furnaces automatically shuts down, and no agent is fed to the furnaces.

e. Agent Gelling

Defendants have discovered that in the remaining stockpile, agent is gelling or crystallizing in the rockets and is less easily drained. Defendants have asked the State of Utah for permission to feed rockets that contain more than a 5% heel (the "heel" is the amount of agent remaining in a munition after it has been drained). To ensure that the total amount of agent fed to the furnace does not exceed the amount demonstrated as part of the TOCDF trial burns (and therefore be within the limits of the TOCDF permits), defendants have proposed to the State that they be allowed to feed one rocket with a greater than 5% heel per hour to the MPF rather than 42 rockets with a 5% heel per hour as currently allowed.

B. Emissions from the Common Stack

1. Risk from Dioxin

Defendants' expert witness, James Cudahy, explained that the term "dioxin" refers to a family of 210 compounds that can be dangerous to human health, including causing an increased risk of cancer. Each of the 210 members of the dioxin family is called a "congener." The molecular structure of each congener is unique. The Environmental Protection Agency ("EPA") has identified seventeen of the congeners as toxic, although the level of toxicity among the seventeen congeners varies. The EPA assesses the toxicity of the seventeen congeners by a

method known as "toxic equivalent factors." (June 16 Tr. at 22-23).

Under its permits with the State of Utah, TOCDF was required to conduct a series of trial burns to determine whether it can destroy agent and other materials without releasing, above specified limits, toxic materials into the air. The defendants have conducted trial burns on the four furnaces that now operate at TOCDF. Cudahy testified that he had examined the results of the trial burns from the four TOCDF furnaces that are in operation and found that most of the seventeen toxic congeners were not found in concentrations above the detection limit. The most toxic—2,3,7,8 tetrachloro dibenzo-p-dioxin—was not found above the detection limit.

In 1996, the State of Utah Department of Environmental Quality prepared a Screening Health Risk Assessment ("Assessment").[10] The Assessment evaluated the risks, cancerous and non-cancerous, that emissions from TOCDF would pose to human health. Because the Assessment was prepared before TOCDF began incineration of chemical agent, the Assessment modeled TOCDF emissions by using maximum levels taken from the data drawn from JACADS, the prototype facility located at Johnston Atoll in the South Pacific. The Assessment concluded that

> [a]ssuming simultaneous operation of all five furnaces at TOCDF [only four furnaces are in operation at TOCDF], the overall cancer and non-cancer risks were at or below EPA screening risk levels. As far as the cancer effects of dioxin, the risk assessment found that EPA guidance levels were not exceeded for 10, 15, and 30 year operating periods. The risk assessment did not calculate non-cancer effects of the dioxin exposure because there is currently no applicable reference dose for dioxin . . . .

Chemical Weapons Working Group, Inc. v. United States Dep't of the Army, 935 F.Supp 1206,

[10]In an earlier order, the court discussed the Assessment at length. See Chemical Weapons Working Group, Inc. v. United States Dep't of the Army, 935 F.Supp. 1206, 1213–14 (D. Utah 1996).

1213 (D. Utah 1996).

At trial, the defendants called Dr. Brent Kerger, an expert witness in toxicology and risk assessment. Dr. Kerger had updated the Assessment with data from the TOCDF trial burns and new EPA toxicity criteria. The trial burn data used by Dr. Kerger were more comprehensive than the JACADS data: approximately 235 individual chemicals were analyzed in the trial data compared to 69 in the JACADS. In addition, the trial burn data produced congener-specific dioxin levels, while the JACADS data did not. With the congener-specific dioxin levels, Dr. Kerger was able to focus on the congeners which, because of their toxicity, can be dangerous to health.

Using the updated information, Dr. Kerger concluded that the Assessment substantially overstated the degree of risk that would be caused by the TOCDF emissions. In Dr. Kerger's opinion, the low level of emissions resulting from operation of TOCDF was several orders of magnitude below levels known to be harmful to human health.

Plaintiffs presented no credible evidence in support of their contention that dioxin emissions from TOCDF would cause adverse health effects in humans. In support of their argument, plaintiffs heavily relied on a draft document entitled "Health Assessment Document for 2,3,7,8 Tetrachloro dibenzo-p-dioxin," issued by the EPA in 1994. That document, however, clearly states that it is just a draft, and therefore is not a final conclusion by the EPA.

2. **Destruction of PCBs**

The M-55 rocket shipping and firing tubes incinerated in the Deactivation Furnace System ("DFS") at TOCDF contain polychlorinated biphenyls ("PCBs"). Under the terms of its Toxic Substances Control Act Permit, Defendants must demonstrate that the DFS will destroy

PCBs to a one part in one million, or 99.9999 %, destruction removal efficiency (commonly referred to as "6-9s DRE").

To date, the DRE has been measured in two demonstration burns. The second demonstration burn demonstrated that the DFS met the 6-9s DRE. The results were not so clear in the first demonstration burn. The first demonstration burn consisted of three runs or trials. While the first two runs were successful, the data from the third run showed that the 6-9s DRE was not met. The EPA, therefore, did not approve the first burn. However, the evidence indicated that an interferent caused the failure to meet the 6-9s standard and the DFS furnace performed properly.

Cudahy testified that he had examined the structure and design of the DFS, and in light of his familiarity of PCB test burns conducted at other facilities, it was his opinion that the DFS would meet the 6-9s DRE.

Based on the above evidence, the court concludes that the DFS will meet the 6-9s DRE.

C. Concealment of Information

Plaintiffs have asserted claims under the National Environmental Policy Act ("NEPA"), 42 U.S.C. § 4332 et seq."[11] By previous order, the court dismissed plaintiffs' allegation that the failure to prepare a supplemental Environment Impact Statement ("EIS") violated NEPA. The only issue remaining at trial on plaintiffs' NEPA claims was whether plaintiffs' challenge to the

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[11]Plaintiffs' NEPA claims are directed at two environmental impact statements. In 1988, the Department of the Army completed a three-volume final programmatic environmental impact statement ("1988 FPEIS") on the disposal of stockpiled munitions and chemical agent. A Record of Decision ("ROD") was signed on February 23, 1988. On-site incineration was selected as the process to dispose of the stockpiled chemical weapons.

The following year, the Army prepared a site-specific environmental impact statement ("1989 EIS") for the Tooele facility. On August 30, 1989, a ROD was signed, and on-site incineration was selected. The 1989 EIS incorporated the 1988 FPEIS.

1988 and 1989 EISs is barred by the statute of limitations. The plaintiffs contend that defendants actively concealed relevant information that should have been included in the 1988 and 1989 documents and that, therefore, the doctrine of equitable tolling allowed plaintiffs' NEPA claims to go forward.

According to the plaintiffs, the defendants concealed information about three subjects: the cause of sheep deaths in Skull Valley, Utah; the synergistic effects of pesticides; and the existence of a dioxin reference dose.[12]

1. **Sheep Deaths**

On March 13, 1968, as part of an overflight spray test, an Airforce F-4E aircraft released approximately 2500 pounds of chemical agent VX over the Dugway Proving Grounds, near Skull Valley, Utah. Almost immediately, thousands of sheep that had been grazing near the Dugway Proving Grounds fell ill and died.

News articles reflected the suspicion that chemical agent was the cause of the deaths. For example, the headline of an article in the Washington Post read: "Did U.S. Army Nerve Gas Kill the 6400 Sheep in Utah?" (Article of Mar. 23, 1968, cited in Defendants' Ex. A-1136 at 571). Similarly, the Los Angeles Times reported that "Army Chemical Suspected" in the sheep deaths. (Article of Mar. 21, 1968, cited in Defendants' Ex. A-1136 at 540). The Army initially denied any link between the release of chemical agent and the sheep deaths.

Despite their initial denial of responsibility, however, federal authorities, including the Army, soon began an investigation into the cause of the sheep deaths. In April 1968, under the

[12]The evidence presented at trial consisted solely of documents, most of which were presented by defendants.

direction of Brigadier General William Stone, the Army released a two-volume report ("the Stone Report") which detailed the results of the investigation. The Stone Report was initially classified and not available to the public, but declassified in January 1976. Reference to the Stone Report appears in the Army's administrative record for the 1988 FPEIS.

In 1969 and 1970, the Journal of American Veterinary Medical Association published articles on the sheep deaths. Material from both articles appeared in the FPEIS. ("[S]heep were poisoned at Skull Valley, Utah from eating VX-contaminated forage . . . ." App. O at 26, Defendants' Ex. A-1143). Other reports of investigations and studies of the sheep deaths were referred to in the FPEIS.

2. Synergistic Effects of Pesticides

During the investigation into the sheep deaths, an experiment was conducted to determine if pesticides that had been used for aerial crop spraying in the vicinity of Skull Valley might have interacted with the chemical agent that had been released. The 1988 FPEIS disclosed the details and the results of this experiment, concluding that "[t]he animals [four sheep] were observed continuously for effects, but no toxic signs or indications of synergism were produced. The sheep were completely normal during the 48-hour observation period." (Defendants' Ex. A-1140 at 35). The investigation also explored the effects of other insecticides on sheep. (Id. at 36-37). This material was referred to in the 1988 FPEIS.

3. Dioxin Reference Dose

Plaintiffs contend that the defendants concealed information that the EPA had, before 1988, calculated a reference dose of 1 pg/kg/day for dioxin exposure and that this information was not disclosed in the NEPA documents. Although plaintiffs are apparently correct that this

information was not disclosed in the NEPA documents, it is undisputed that the information on a possible reference dose was known and available to the public in 1984.

CONCLUSIONS OF LAW

The court has jurisdiction over this action pursuant to 42 U.S.C. § 6972(a), 15 U.S.C. § 2619(a), and 28 U.S.C. § 1331. Venue is not disputed.

Remaining for resolution at trial were plaintiffs' claims brought under the Resource Conservation and Recovery Act ("RCRA"), 42 U.S.C. § 6941 et seq.; the Toxic Substances Control Act ("TSCA"), 15 U.S.C. § 2601 et seq.; and NEPA.

A. RCRA Claims

RCRA's citizen suit provisions are found at 42 U.S.C. § 6972. Under § 6972(a)(1)(A), any person may bring suit "against any person (including . . . the United States . . .) who is alleged to be in violation of any permit, standard, regulation, condition, requirement, prohibition, or order which has become effective pursuant to this chapter . . . ." 42 U.S.C. §6972(a)(1)(A).

Section 6972(a)(1)(B) authorizes suit "against any person, including the United States . . . who has contributed or who is contributing to the past or present handling, storage, treatment, transportation, or disposal of any solid or hazardous waste which may present an imminent and substantial endangerment to health or the environment . . . ." 42 U.S.C. § 6972(a)(1)(B).

1. Section 6972(a)(1)(A) claims

Plaintiffs have pointed to a number of incidents and events that they claim show that defendants have violated their RCRA permits, and therefore have violated § 6972(a)(1)(A). The court concludes that plaintiffs have not prevailed on any of their claims under this subsection because either the claim is barred by the Gwaltney Doctrine or the evidence at trial did not

establish the claimed violation.

a. Claims barred by the Gwaltney Doctrine

In Gwaltney of Smithfield, Ltd., of Chesapeake Bay Foundation, Inc., et al., 484 U.S. 49 (1987), the Court held that while citizens may bring suit against dischargers whom they believe to be violating the Clean Water Act, a district court does not have subject matter jurisdiction over a citizen suit for wholly past violations. In arriving at this conclusion, the Court focused its attention on the language of the citizen suit provision of the Clean Water Act, 33 U.S.C. § 1365(a), which permits a private cause of action only against persons who are "alleged to be in violation" of the Act. The Court held that the "prospective orientation" of the phrase indicated that Congress had authorized only prospective relief. Gwaltney, 484 U.S. at 57. The Court observed that Congress has used identical language in the citizen suit provisions of several other environmental statutes, including § 6972(a)(1)(A), "that authorize only prospective relief." Id. The Court pointed out, citing § 6972(a)(1)(B) as an example, that Congress knows how to draft a statute that "explicitly targets wholly past violations." Id. n.2.

Although the Tenth Circuit has not addressed the question of whether claims based on wholly past violations can be brought under § 6972(a)(1)(A), other courts have found that the Supreme Court's language in Gwaltney prohibits suits under § 6972(a)(1)(A) for wholly past violations. See, e.g., Carroll v. Litton Systems, Inc., 47 F.3d 1164, 1995 WL 56862 (4th Cir. 1995); Ascon Properties v. Mobil Oil Co., 866 F.2d 1149, 1159 (9th Cir. 1989); Raymond K. Hoxsie Real Estate Trust v. Exxon Education Foundation, 81 F.Supp.2d 359, 363 (D. R.I. 2000); Aurora National Bank v. Tri Star Marketing, Inc., 990 F.Supp. 1020, 1024 (N.D. Ill. 1998). Pennsylvania Real Estate Investment Trust v. SPS Technologies, Inc., 1995 WL 687003, *6

(E.D. Pa. 1995); Murray v. Bath Iron Works Corp., et al., 867 F.Supp. 33, 42 (D. Me.1994); Chartrand v. Chrysler Corporation, 785 F.Supp. 666, 670 (E.D. Mich. 1992).[11] Accordingly, because plaintiffs have failed to establish that the following violations were on-going or likely to reoccur, judgment is granted on plaintiffs' § 6972(a)(1)(A) claims:

i The March 30, 1998, overfeed of agent to the MPF;

ii. The failure to stagger the common stack ACAMS on five occasions between November 1996 and April 1997;

iii. The operation of TOCDF by EG&G without a license. (EG&G was added to the operating permit on June 18, 1996).

iv. The failure to file a hazardous waste minimization plan and obtain the corresponding certification during the first year of operation at TOCDF. (Defendants have been properly certified since August 1996).

b. Claims not supported by evidence

The court further concludes that the evidence presented at trial was not sufficient to establish the following:

i that chemical agent has been released into the environment outside TOCDF;

ii. that any TOCDF personnel or visitors have been injured through exposure to chemical agent;

iii. that the safety practices of TOCDF violate the terms of the TOCDF permits;

iv. that the gelling of agent in rockets and defendants' proposal to the State of Utah to incinerate rockets containing more than a 5% heel is in violation of defendants'

[11]The court has found no courts that have permitted suits under this subsection for wholly past violations.

permits or poses a threat to health and the environment;

v. that the low pH factor of some of the chemical agents and defendants' means of incinerating it violates defendants' permits or poses a threat to health and the environment;

vi. that defendants have failed to properly categorize agent waste; and

vii. that defendants have failed to comply with the terms and the requirements of their permits from the State of Utah.

2. Section 6972(a)(1)(B) claims

In order to prevail under this subsection, plaintiffs must show that defendants' actions "present an imminent and substantial endangerment to health or the environment." 42 U.S.C. § 6972(a)(1)(B).

Plaintiffs allege that the various operational events and incidents at TOCDF and the emissions from the common stack described above satisfy the requirements of this subsection. The court holds that the evidence at trial does not support such a conclusion.

Although there have been problems in the operation of TOCDF, there was no evidence that TOCDEF personnel, the public, or the environment have been harmed by these operations. Further, the evidence at trial indicated that when an operational incident occurred, defendants took steps to improve procedures and implement additional safety measures to prevent similar incidents from occurring. There was no evidence at trial that chemical agent has ever been released from the common stack into the environment and the evidence demonstrated that the release of non-agent emissions from the common stack have been, and continue to be, well within regulatory guidelines.

Since plaintiffs failed to demonstrate that defendants' actions present an imminent and substantial endangerment to health or the environment, their claims under § 6972(a)(1)(B) must fail.

B. TSCA claims

Plaintiffs brought suit under the citizens' suit provision of TSCA, 15 U.S.C. § 2619, claiming that defendants had violated TSCA by failing to meet the 6-9s DRE required for the destruction of PCBs. The evidence at trial demonstrated that TOCDF has, and continues to, meet the 6-9s DRE. Therefore, plaintiffs have not prevailed on their TSCA claim.

C. NEPA Claims

NEPA does not have a private right of action. Challenges to NEPA decisions are governed by the Administrative Procedures Act ("APA"). See Chemical Weapons Working Group v. Dep't of the Army, 111 F.3d 1485, 1494 (10th Cir. 1997). Plaintiffs' NEPA claims must fall within the six-year statute of limitations of 28 U.S.C. § 2401, which applies to suits under the APA. See id. As the court has previously held, unless plaintiffs can demonstrate that the limitations periods should be equitably tolled, plaintiffs' challenges to the 1988 FPEIS and the 1989 EIS are time-barred. Plaintiffs contend that the statutes of limitations have been tolled by the defendants' concealment of information concerning the sheep deaths in Skull Valley, Utah, the synergistic effect of pesticides, and a possible reference dose for dioxin. To prevail on these claims, plaintiffs must demonstrate that the defendants "engaged in 'active deception' which caused [their] filing to be untimely." Purrington v. Univ. of Utah, 996 F.2d 1025, 1030 (10th Cir. 1993) (internal citations omitted).

Plaintiffs acknowledge that the defendants "did disclose selected other portions of the

available information regarding the sheep kill." (Plaintiffs' Proposed Findings of Fact and Conclusions of Law on NEPA Issues at 3). Plaintiffs assert that equitable tolling should apply because "these disclosures are only peace-meal [sic], bits and pieces of a puzzle that are disclosed without the existence of the puzzle itself being known to the public." (Id. at 4). Plaintiffs' equitable tolling argument, then, is based on the adequacy of the discussion of the sheep deaths and the information in the NEPA documents. Plaintiff's allegations simply do not rise to the level of active deception, particularly in view of the fact that the Stone Report, which extensively discussed the sheep deaths, was available in 1976.

Similarly, plaintiffs' arguments regarding a possible dioxin reference dose and the synergistic effects of pesticides fall short of establishing active deception by the defendants. Plaintiffs admit that as early as 1988, information was available from the EPA concerning a possible reference dose for dioxin. (Id. at 5). In addition, the synergistic effects of pesticides was contained in the FPEIS.

Accordingly, plaintiffs' NEPA claims are time-barred.

For the above reasons, judgment is granted for the defendants on all claims against them brought by plaintiffs.

DATED this 14 day of April, 2000.

BY THE COURT:

Tena Campbell

TENA CAMPBELL
United States District Judge

ATTACHMENT T

"Evaluation of Demonstration Test Results of Alternative Technologies for Demilitarization of Assembled Chemical Weapons: A Supplemental Review," National Research Council, 2000

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Evaluation of Demonstration Test Results of Alternative Technologies for Demilitarization of Assembled Chemical Weapons

A Supplemental Review

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NATIONAL RESEARCH COUNCIL

Evaluation of Demonstration Test Results of Alternative Technologies for Demilitarization of Assembled Chemical Weapons

A Supplemental Review

Committee on Review and Evaluation of Alternative Technologies
for Demilitarization of Assembled Chemical Weapons

Board on Army Science and Technology

Commission on Engineering and Technical Systems
National Research Council

NATIONAL ACADEMY PRESS
Washington, DC

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MICHAEL A. CLARKE, Associate Director
MARGO L. FRANCESCO, Staff Associate
CHRIS JONES, Financial Associate
DEANNA SPARGER, Senior Project Assistant

Preface

The United States has been in the process of destroying its chemical munitions for over a decade. The U.S. Army, with expertise from numerous bodies including the National Research Council (NRC), originally decided to use incineration as the method of destruction at all storage sites. However, citizens in states with storage sites have opposed incineration on the grounds that it is impossible to determine the exact nature of the effluents, in particular, effluents from the stacks. Nevertheless, the Army has continued to pursue incineration at most sites. In the last few years, influenced by growing public opposition to incineration and after numerous studies, including a 1996 study by the NRC entitled *Review and Evaluation of Alternative Chemical Disposal Technologies*, the Army is developing a chemical neutralization process to destroy chemical agents stored only in bulk ton containers at two sites: VX at Newport, Indiana, and mustard (HD) at Aberdeen Maryland.

Pursuaded by public opposition to incineration at the Lexington, Kentucky, and Pueblo, Colorado, sites, Congress in 1996 enacted Public Law 104-201 instructing the Department of Defense (DOD) to "conduct an assessment of the chemical demilitarization program for destruction of assembled chemical munitions and of the alternative demilitarization technologies and processes (other than incineration) that could be used for the destruction of the lethal chemical agents that are associated with these munitions." The Army established a Program Manager for Assembled Chemical Munitions Assessment (PMACWA) to respond to this instruction. Unlike prior activities, the PMACWA involved the public in every aspect of the program including the procurement process. A nonprofit organization, the Keystone Center, was hired to facilitate public involvement.

After requesting and receiving proposals from industry for complete technology packages to destroy stored assembled chemical weapons, the Army initially selected seven industry teams, denoted as technology providers in this report. In later selections, these seven were reduced to six, and then three to proceed to the demonstration phase of the assessment program. When the NRC's Committee on Review and Evaluation of Alternative Technologies for Demilitarization of Assembled Chemical Weapons (ACW Committee) first report was written, the committee did not have the benefit of evaluating the results of the demonstrations.

Subsequently, the PMACWA requested that the committee evaluate both the technology providers' test reports and the Army's evaluations to determine if the demonstrations changed the committee's earlier findings or recommendations. This report is a supplemental review evaluating the impact of the three demonstration tests on the committee's original findings and recommendations.

I wish to acknowledge with great gratitude the members of the ACW Committee who have continued to serve as volunteers throughout this extended study and who completed this supplemental study in the relatively short time allocated by the PMACWA. They provided the necessary expertise in chemical processing, permitting and regulations, energetic materials and public acceptance to continue this task. I remain, by far, the least capable of this group.

The committee recognizes and appreciates the assistance of the Army ACWA team, which provided support and the necessary reports. We also appreciate the openness and the cordiality of the technology providers.

A study such as this requires extensive support. We are all indebted to the NRC staff for their logistic support. I would particularly like to acknowledge the close working relationship between the committee and Bruce Braun, who undertook the task of acting study director along with his other duties as director of the NRC Board on Army Science and Technology. Mr. Braun also provided the resources and staff to complete this study in record time for an NRC report. The efforts of Harrison Pannella, who acted as assistant study director, were invaluable. He put in long hours on evenings and weekends to prepare, edit, and format this report. In addition, Rebecca Lucchese and Jacqueline Johnson

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provided logistic support to the committee, allowing us to concentrate on our task. Also, an acknowledgement is due for Carol Arenberg, who edited the final draft of the report. Everyone worked under a short deadline and great stress during a period that included a holiday season.

I gratefully acknowledge the support of my colleagues in the Chemistry Department at the University of Southern California, who willingly assumed my teaching duties while I traveled on behalf of this study.

Robert A. Beaudet, *chair*
Committee on Review and Evaluation of
Alternative Technologies for Demilitarization
of Assembled Chemical Weapons

Acknowledgment

This report has been reviewed by individuals chosen for their diverse perspectives and technical expertise, in accordance with procedures approved by the National Research Council's Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the authors and the NRC in making the published report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The contents of the review comments and draft manuscript remain confidential to protect the integrity of the deliberative process. We wish to thank the following individuals for their participation in the review of this report:

Richard Magee, New Jersey Institute of Technology
Raymond McGuire, Lawrence Livermore National Laboratory
Royce Murray, University of North Carolina
Robert Olson, consultant
George Parshall, E.I. DuPont de Nemours & Company
Janice Phillips, Lehigh University
Martin Sherwin, ChemVen Group, Inc.

While the individuals listed above have provided many constructive comments and suggestions, responsibility for the final content of this report rests solely with the authoring committee and the NRC.

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Acronyms

ACWA	Assembled Chemical Weapons Assessment (program)
ARAR	appropriate, relevant, and applicable rule
BOD	biological oxygen demand
CAA	Clean Air Act
CAMDS	Chemical Agent Munitions Disposal System
CATOX	catalytic oxidation
CFM	cubic feet per minute
COD	chemical oxygen demand
CSTR	continuously stirred tank reactor
DAAMS	depot area air monitoring system
DMMP	dimethyl methyl phosphonate
DOD	U.S. Department of Defense
DPE	demilitarization protective ensemble (suit)
DRE	destruction and removal efficiency
DSHS	dunnage shredding/hydropulping system
EDC	energetics deactivation chamber
EMPA	ethyl methylphosphonic acid
EPA	Environmental Protection Agency
ERH	energetics rotary hydrolyzer
GB	type of nerve agent
GC	gas chromatography
GC/MS	gas chromatography/mass spectrometry
HD	distilled mustard agent
HEPA	high-efficiency particulate air
HRA	health risk assessment
ICB	immobilized cell biotreatment
IMPA	isopropyl methylphosphonic acid

M	molar concentration
MPT	metal parts treater
NRC	National Research Council
PCG	plasma converted gas
PMACWA	Program Manager for Assembled Chemical Weapons Assessment
ppm_v	parts per million (volumetric)
PWC	plasma waste converter
RCRA	Resource Conservation and Recovery Act
RDX	cyclotrimethylenetrinitramine
RFP	request for proposal
scf	standard cubic feet
SCWO	supercritical water oxidation
TCLP	toxicity characteristic leachate procedure
TNT	trinitrotoluene
TWA	time weighted average
UV	ultraviolet
VOC	volatile organic compound
VX	type of nerve agent
WHEAT	water hydrolysis of explosives and agent technology
3X	level of decontamination (suitable for transport for further processing)
5X	level of decontamination (suitable for commercial release)

Executive Summary

In 1996, the U.S. Congress enacted two laws, Public Law 104-201 (authorization legislation) and Public Law 104-208 (appropriation legislation), mandating that the U.S. Department of Defense (DOD) conduct an assessment of alternative technologies to the baseline incineration process for the demilitarization of assembled chemical munitions. In December 1996, DOD appointed Mr. Michael Parker, Technical Director of the Soldier Biological Chemical Command, to be the program manager for assembled chemical weapons assessment (PMACWA). The program manager published a request for proposals for the complete destruction of assembled chemical weapons. On July 29, 1998, three technology packages were selected for the demonstration phase of the ACWA program. Constrained by both time and resources, the PMACWA selected the unit operations deemed "most critical [and] least proven" for demonstration testing.

The PMACWA had previously requested that the National Research Council (NRC) perform and publish an independent evaluation of the seven technologies packages that had been selected during earlier phases of the Assembled Chemical Weapons Assessment (ACWA) program and deliver a report by September 1, 1999. However, to meet that deadline, the NRC Committee on Review and Evaluation of Alternative Technologies for Demilitarization of Assembled Chemical Weapons (ACW Committee) had to terminate its data-gathering activities on March 15, 1999, prior to the completion of demonstration tests. In September 1999, the PMACWA requested that the ACW Committee examine the reports of the demonstration tests and determine if the results changed the committee's original findings, recommendations, and comments. This report documents the committee's reassessment of the findings and recommendations in the original report, *Review and Evaluation of Alternative Technologies for Demilitarization of Assembled Chemical Weapons*.

In this supplemental report, the committee limited its review to the demonstration test reports prepared by the technology providers and the PMACWA's *Supplemental Report to Congress,* which included the PMACWA's technical evaluation of the tests as a separate appendix. The committee limited its evaluation to the effects of the demonstration test results on the earlier report.

The three technology demonstrations are reviewed in separate chapters in this report; in each chapter, the demonstrated unit operations are considered one at a time. Following a short description of the demonstration tests and commentary by the committee, the findings and recommendations from the original report that bear on the demonstrations are then evaluated. In general, very few of the original findings and recommendations were influenced by the demonstrations. In some cases, the original findings and recommendations were confirmed. A number of new findings and recommendations resulted from the demonstrations, however, and these are presented below.

SUPPLEMENTAL FINDINGS AND RECOMMENDATIONS

Burns and Roe Demonstration Tests

Finding BR-1. The plasma torch apparatus, as demonstrated by the Burns and Roe team, is not qualified for further consideration for the demilitarization of assembled chemical weapons. The torch design appears to be unreliable for extended use. Furthermore, the design increases the possibility of a catastrophic water leak, which could produce a significant increase in pressure in the plasma waste converter (PWC), and possibly cause an explosion, which, in turn, could expose personnel to chemical agent. Moreover, the effectiveness of the monitoring and control sensors was not demonstrated.

Finding BR-2. Even after more than a year of research and development, the technology provider has not been able to

TABLE ES-1 Summary Evaluation of the Maturity of Demonstrated Unit Operations and Processes[a]

	Hydrolysates			Agent Munitions			
Unit Operation/Process	VX/GB	HD	Energetics	VX/GB	HD	Energetics	Other
Burns and Roe							
Plasma waste converter[b]	C	C	D	D	D	E	C[c, d, e]
General Atomics							
Hydrolysis				A	A		
Rotary hydrolyzer						C	
Shredding/hydropulping							A[c]
SCWO	B	B	C				C[e]
Parsons-AlliedSignal							
Munitions accessing				B	B	B	
Hydrolysis				A	A	C	
Biotreatment	D	A	A				
Catalytic oxidation							B[e]
Metal parts treater				B	B	D	B[d]

Note: Environmental and safety issues were considered in assigning maturity categorizations. Schedule and cost issues were not considered.

[a] The letter designations are defined as follows (a blank space indicates categorization was not applicable for that material).
- A Demonstration provides sufficient information to allow moving forward to full-scale design with reasonable probability of success.
- B Demonstration provides sufficient information to allow moving forward to the pilot stage with reasonable probability of success.
- C Demonstration indicates that unit operation or process requires additional refinement and additional demonstration before moving forward to pilot stage.
- D Not demonstrated; more R&D required.
- E Demonstrated unit operation or process is inappropriate for treatment.

[b] Includes integrated gas polishing system to support demonstration
[c] Dunnage
[d] Metal parts
[e] Effluents

show that its small PWC can adequately destroy agent simulants or that nitrogen is the best gas to use for the plasma feed. If oxygen leaks into the reactor, it could react violently with hydrogen. If air were used for the plasma feed gas, regulatory compliance issues would arise, as well as questions of public acceptance.

Finding BR-3. In the absence of any data for processing effluents from agent runs, the committee could not validate the ability of the proposed system to handle and stabilize effluent products arising from agent processing.

General Atomics Demonstration Tests

Finding GA-1. Testing on the hydrolysis of energetic materials contaminated with agent will be necessary before a full-scale system is built and operated.

Finding GA-2. Testing will be required to verify that the larger diameter supercritical water oxidation (SCWO) reactor feed nozzles will be capable of accepting the dunnage material as shredded (i.e., without additional classification and segregation) and that the reactor will perform reliably under these conditions.

Recommendation GA-1. Operation of the size reduction and slurrying system, and long-term operation of the supercritical water oxidation (SCWO) reactor with slurry, should be conducted before proceeding with a full-scale system.

Recommendation GA-2. Before construction of a full-scale supercritical water oxidation (SCWO) system, additional evaluations of construction materials and fabrication techniques will be necessary because corrosion and plugging prevent continuous operation with the present design. If the new construction materials do not solve these problems, then alternative SCWO reactor designs should be investigated.

Recommendation GA-3. To determine the operability of the supercritical water oxidation (SCWO) reactor and the reliability of the materials of construction, long duration runs of a SCWO reactor should be conducted with slurry, with energetics hydrolysate, and with agent hydrolysate before full-scale implementation proceeds.

Recommendation GA-4. The efficacy and safety of the additional step to remove aluminum hydroxide from the hydrolysate produced from rocket propellants should be evaluated prior to construction of a full-scale supercritical water oxidation (SCWO) system.

Recommendation GA-5. Decontamination of solid munitions materials by flushing and immersion should be demonstrated prior to full-scale implementation.

Recommendation GA-6. The air emissions data from the demonstration tests should be used in a screening risk assessment. The results of the air effluent samples should be subject to (1) a human health risk assessment following the Human Health Risk Assessment Protocol (HHRAP) for Hazardous Waste Combustion Facilities from the Environmental Protection Agency (EPA) [EPA530-D-98-001(A,B,C)], and (2) an ecological risk assessment following a protocol that will be released by EPA in the very near future.

Parsons-AlliedSignal Demonstration Tests

Finding PA-1. The mustard demonstration tests were very encouraging and showed that the process is ready for the next scale-up.

Finding PA-2. The nerve agent demonstration tests had serious problems. However, if the previous tests at the technology provider's laboratory and the results of the demonstration tests are combined, the aggregate results are inconclusive. The reason for the poor demonstration results might be as simple as poor aeration in the bioreactor (see Recommendation PA-1).

Recommendation PA-1. Before proceeding to a further scale-up of GB and VX biotreatment processing, the committee recommends that the following steps be taken:

- The biotreatment process should be examined carefully at bench scale to determine the factors that are critical to success.
- An investigation of analytical techniques should be undertaken to provide more reliable process information.

Supplemental General Findings

The results of the demonstration tests did not significantly affect the committee's original general findings and recommendations and, in some cases, confirmed them. The committee's review of the results of the demonstration tests, however, led to the following new general findings.

General Finding 1. Based on the committee's assessment of the maturity of the various unit operations (as summarized in Table ES-1), none of the three technology packages is ready for *integrated* pilot programming, although certain unit operations are sufficiently mature to bypass pilot testing (e.g., hydrolysis of agent).

General Finding 2. The demonstration tests were not operated long enough to demonstrate reliability and long-term operation.

General Finding 3. The committee reiterates that none of the unit operations has been integrated into a complete system. The lack of integration remains a major concern as a significant obstacle to full-scale implementation.

1

Introduction

BACKGROUND

In 1996, the U.S. Congress enacted two laws, Public Law 104-201 (authorization) and Public Law 104-208 (appropriation), mandating that the U.S. Department of Defense (DOD) conduct an assessment of alternative technologies to the baseline incineration process for the demilitarization of assembled chemical weapons and that not less than two technologies be demonstrated. The law included the following stipulations:

- All funds for the construction of destruction facilities at Blue Grass Depot in Richmond, Kentucky, and at Pueblo Chemical Depot in Pueblo, Colorado, should be frozen.
- DOD should select a program manager who was not and had never been associated with the ongoing incineration destruction.
- DOD should "coordinate" with the National Research Council.

In December 1996, DOD appointed Michael Parker, technical director of the Soldier Biological Chemical Command, to be the program manager for the Assembled Chemical Weapons Assessment (ACWA) Program (PMACWA). On July 28, 1997, after organizing a staff and establishing a program plan, the PMACWA published a Request for Proposals (RFP) for a "total system solution" for the destruction of assembled chemical weapons without using incineration. Twelve proposals were submitted in September 1997. Of these, seven were found to have proposed total system solutions and to have passed the threshold requirements stipulated in the RFP. On July 29, 1998, after an elaborate multitiered selection process, three technology packages were selected for demonstration testing. Detailed descriptions of the selection process and all seven technologies are available in the PMACWA's two annual reports to Congress (DOD, 1997, 1998).

Constrained by both time and budgetary resources, the PMACWA identified unit operations for the three technology packages that were "most critical [and] least proven" for the demonstration tests. These unit operations had not previously used in the disposal of chemical munitions or had they been integrated into a complete system for application. Two of the three technology packages use hydrolysis as the primary treatment step to destroy agent and energetic materials. Because most of the uncertainties concerning these technology packages pertain to the secondary treatment of products from the primary treatment the PMACWA provided hydrolysates for nerve agent and VX and mustard agent HD for testing. Approximately 1,100 gallons of GB hydrolysate and 400 gallons of VX hydrolysate were produced at the Army's Chemical Agent Munitions Disposal System (CAMDS) experimental facility at the Deseret Chemical Depot in Utah. Approximately 4,200 gallons of HD hydrolysate were produced at the Army's Aberdeen Proving Ground in Maryland. The agent hydrolysates provided a representative feedstock for the demonstration tests and enabled characterization of the intermediate product stream for residual agent, including Schedule 2 compounds (agent precursor compounds defined by the international Chemical Weapons Convention).

Various types and amounts of energetic materials contained in the weapons were reacted with caustic solutions similar to those specified in the technology packages proposals of the respective providers. These materials were made available for the demonstrations. Unit operations of the three technology packages were set up, and systemization (operational testing) was conducted from January to March 1999. The actual demonstrations began in March 1999 and were completed in May 1999. The technology providers submitted their reports on the demonstration tests to the PMACWA on June 30, 1999 (Burns and Roe, 1999a; General Atomics, 1999a; Parsons-AlliedSignal, 1999a). The PMACWA used these reports and other information to prepare a *Supplemental Report to Congress*, which was submitted on September 30, 1999 (DOD, 1999a).

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The committee commends the PMACWA and his staff, as well as the support contractors and technology providers, for completing the demonstrations within the very tight time schedule. The committee recognizes that everyone involved worked long hours, including weekends, to fulfill their tasks.

ROLE OF THE NATIONAL RESEARCH COUNCIL

The PMACWA requested that the National Research Council (NRC) perform and publish an independent evaluation of the technologies by September 1, 1999, a month before the Army's report to Congress was due. The NRC and DOD reached agreement on the Statement of Task in March 1997, and the study was officially begun on May 27, 1997. The committee chose to evaluate all seven technology packages that had passed the threshold requirements stipulated in the RFP. The Statement of Task did not require that the NRC recommend a best technology or compare any of the technologies to the baseline incineration process in use at some storage sites. Although members of the committee visited the demonstration sites prior to systemization of the unit operations in January 1999, in order to produce its final report by September 1, 1999, data-gathering activities had to be terminated on March 15, 1999, prior to receiving the results of the demonstration tests. The committee's report was submitted for peer review on May 1, 1999, and was released to the sponsor and the public on August 25, 1999 (NRC, 1999).

In September 1999, the PMACWA requested that the tenure of the committee be extended to review the results of the demonstrations. The committee was asked to determine if and how the demonstration results affected the committee's commentary, findings, and recommendations, as well as the steps required for implementation (NRC, 1999). In October 1999, the committee began its evaluation of the results of the demonstrations and a determination of the impact of these results on its initial report. The present report is an addendum to the initial report documenting the committee's review of the demonstration test results and the impact of those results on its initial report.

STATEMENT OF TASK

The Statement of Task for this report is as follows:

> At the request of the DOD's Program Manager for Assembled Chemical Weapons Assessment (PMACWA), the NRC Committee on Review and Evaluation of Alternative Technologies for Demilitarization of Assembled Chemical Weapons will continue its independent scientific and technical assessment of the three demonstrated alternative technologies for assembled chemical weapons located at the U.S. chemical weapons storage sites. The continuation of the NRC study will involve the review and evaluation of the demonstration results from the Burns and Roe, General Atomics, and Parsons-AlliedSignal tests performed by the PMACWA. The specific tasks to be performed are:
>
> - use the following as the basis of information:
>   - — PMACWA's *Supplemental Report to Congress* issued September 30, 1999, and the "Technical Evaluation Report" (an appendix to the former report)
>   - — the demonstration test reports produced by the ACWA technology providers and the associated required responses of the providers to questions from the PMACWA
>   - — the PMACWA's demonstration testing database (CD-ROM);
> - perform an in-depth review of the data, analyses, and results of the unit operation demonstration tests contained in the above and update as necessary the committee's 1999 NRC report, *Review and Evaluation of Alternative Technologies for Demilitarization of Assembled Chemical Weapons* (the ACW report);
> - determine if the Burns and Roe, General Atomics, and Parsons-AlliedSignal technologies are viable to proceed with implementation of a pilot-scale program that would employ any of these technologies;
> - produce a supplemental report for delivery to the Program Manager for Assembled Chemical Weapons Assessment.

SCOPE OF THIS STUDY

The committee limited its review to assessing the reports mentioned in the Statement of Task. For each technology package, the committee commented on findings from the initial report that were impacted by the demonstrations (technology-specific findings not related to a demonstrated unit operation are merely noted). This report also includes new findings that may not have been apparent before the demonstration data became available. The committee did not evaluate the extent to which the demonstration tests fulfilled all of the test objectives set by the PMACWA. However, the committee commented on these objectives when they were related to the findings in the initial report (NRC, 1999).

ORGANIZATION OF THIS REPORT

This report consists of five chapters. This chapter has presented background information on the ACWA program and the NRC's involvement in that program. Chapters 2, 3, and 4 discuss the results of the demonstrations for each of the three technology packages. In each chapter, demonstration test objectives are quoted for each unit operation that was demonstrated. (The demonstration objectives are intended to provide contextual technical background [analogous to the Description of the Technology Package sections in the committee's initial report]). Pertinent original findings are discussed, and a concise rationale is given for each of the committee's conclusions on the basis of its review of the documents listed in the Statement of Task. Chapter 5 provides a discussion of the impact of demonstration test results on the original general findings and recommendations. Some new general findings based on the demonstration test results are also provided.

2

Burns and Roe Plasma Arc Process

The plasma arc process proposed by the Burns and Roe team uses modified baseline disassembly for munitions access. Agent, energetics, metal parts, and shredded dunnage are all treated in plasma waste converters (PWCs). The PWCs use plasma arc technology—electrically driven torches with various gases that produce an intense field of radiant energy and high temperature ions and electrons that cause the dissociation of chemical compounds. Materials are processed with steam in the absence of air to produce a plasma converted gas (PCG) that could be used as a synthetic fuel after cleanup and testing.

The integrated PWC system used for the demonstration tests consisted of a PWC—a 300-kW unit capable of operating with a variety of gases (Ar, N_2, CO_2, etc.) in either of two modes: a nontransferred mode (arcing from electrode to electrode on the torch) and a transferred mode (arcing from torch electrode to the melt) (DOD, 1999b). A steam injection system was used for feeding liquids, and a box feed module with a horizontal ram feed was used for feeding solids via a conveyor to the PWC. The gas polishing system, a pollution abatement system, consisted of a quench, a venturi scrubber, a caustic (NaOH) scrubber, a demister, and a high-efficiency particulate air (HEPA) filter.

The PWC system was the only unit operation that was tested. Other components used in the demonstration but not intended to demonstrate a specific unit operation are listed below (DOD, 1999b):

- a liquid feed module
- thermal oxidizers to characterize the effluent from burning PCG
- an energetics deactivation chamber (EDC) for generating and supplying the expected energetics off-gas feed to the PWC

PLASMA WASTE CONVERTER

Demonstration test campaigns of the PWC were planned for treatment of (1) energetics, (2) dunnage and secondary waste, (3) agent, and (4) projectile agent heels.

Energetics Campaign

The energetics campaign was required to validate that the PWC can destroy off-gas from a proposed EDC, which is used for thermal initiation of high explosive components (bursters and fuzes). The following test objectives were established for this campaign (DOD, 1999b):

- Demonstrate the feasibility of the proposed energetics destruction strategy using the integrated EDC demonstration unit and PWC system for high explosives and the PWC system for M28 propellant.
- Validate that the integrated EDC and PWC unit operations can achieve a destruction and removal efficiency (DRE) of 99.999 percent for energetics Comp B and tetrytol.
- Validate that the PWC unit operations can achieve a DRE of 99.999 percent for M28 propellant.
- Characterize the detonation gases and residues from Comp B and tetrytol from the EDC demonstration unit for suitability for processing in the PWC.
- Characterize the deflagration gases from the M28 propellant feed to the PWC system.
- Compare the detonation gases from the EDC demonstration unit to the deflagration gases from the M28 propellant in the PWC system.

The energetics campaign was only designed to show that the PWC could destroy off-gas from the EDC. During the

onstration, 16 grams each of tetrytol and Comp B were ated in four test runs. Because the design of the detonation chamber was not the one intended for full-scale use, no attempt was made to evaluate its efficacy. Detonation gases were fed to the PWC. (Detonation usually efficiently destroys materials such as tetryl, TNT, and RDX.) The off-gases generated from the EDC were shown to be suitable for feeding to the PWC.

In the opinion of the committee, the use of the EDC would be a poor solution for the destruction of a large volume of energetic materials. During the demonstration tests, M28 propellant was not completely ignited, which was attributed to poor propagation from the initiator. The technology provider explains that initiation at full scale will be accomplished by heating the energetic to 1,100°F. Although a small amount of M28 propellant was introduced directly into the PWC during the demonstration tests, the committee concluded that the test results did not demonstrate conclusively that the direct introduction of propellants would be safe.

Dunnage and Secondary Waste Campaign

The dunnage and secondary waste campaign was required to validate the destruction of solid and liquid secondary wastes and the decontamination of dunnage to a 5X level.[1] acterization of gaseous, liquid, and solid effluents was ired, as was verification of operating parameters. The monstration tests had the following objectives (DOD, 1999b):

- Demonstrate that the PWC unit operation can process carbon filter media, demilitarization protective ensembles (DPEs), wooden pallets spiked with 4,000 parts per million pentachlorophenol, decontamination solution with carbon filter media, and M55 rocket shipping and firing containers.
- Characterize the process gases, liquids, and solids.
- Validate the ability of the PWC unit operation to meet a 5X condition for solid residues from these feeds.

The demonstration test runs were designed to evaluate the treatment of a variety of dunnage materials, including oak pallets, activated charcoal, fiberglass shipping and firing containers, and DPE materials. Although the test plan originally called for separate testing with each material, the plan was subsequently modified to using a mix of materials. The tests demonstrated the PWC could treat these materials as a mixture, could achieve 5X temperature conditions, and could destroy the pentachlorophenol that had been spiked into the pallets.

The mixed dunnage tests were the only demonstration runs in which sufficient carbon, oxygen, and hydrogen were available in the feed to generate synfuel with appreciable fuel value. The average fuel value of the PCG exceeded 100 Btu/scf in only one of the six mixed dunnage test runs. In several runs, the measurement technique for fuel value failed; in others, the measured average fuel value was very low. In all runs, the oxygen content of the PCG ranged from 5 to 7 percent. This was attributed either to air leakage into the PWC or downstream components or to a lack of control of the oxygen content in the feed materials and gases. The presence of a combustible gas premixed with oxygen clearly represents an unsafe condition susceptible to ignition. Full-scale operation would require design features and/or procedures that would preclude these conditions.

The process did not produce PCG with an acceptable synfuel quality when a steady feed of carbon/hydrogen-containing material was used. Thus, the committee is concerned about the appropriateness, reliability, and robustness of the measurement and control systems. In addition, unless careful control of the steam-to-carbon ratio is maintained, excessive soot may form. Because the system does not include on-line monitoring of the carbon and hydrogen in the feed, the monitoring and control system must reliably measure fuel value and adjust parameters, such as-steam flow, to achieve acceptable fuel quality. Such monitoring and control systems were not demonstrated during the test runs, and, therefore, must be developed to ensure the reliable operation of the system with variable feedstocks.

Agent Campaign

The agent campaign was required to validate the destruction of chemical agents. Characterization of gaseous, liquid, and solid effluents was required, as was verification of operating parameters. The test objectives for this campaign are listed below (DOD, 1999b):

- Validate that the PWC process can achieve a DRE of 99.9999 percent for chemical agents HD, GB, and VX.
- Characterize the process gases, liquids, and solids.
- Balance the elemental carbon and heteroatoms from each agent, to the extent possible.

For various reasons, the equipment was not deemed ready for agent tests during the demonstration tests. Therefore, there was no direct demonstration of the ability of the proposed plasma technology to destroy chemical agents. The committee concluded that the variety of equipment problems encountered in the demonstration were due to the immaturity of the proposed integrated process and the particular demonstration equipment, and not due to a fundamental inability of plasma-based technologies to achieve acceptable

[1] Treatment of solids to a 5X decontamination level is accomplished by ing the material at 1,000°F for 15 minutes. This treatment results in npletely decontaminated material that can be released for general use or old to the general public in accordance with applicable federal, state, and local regulations.

results. The history of plasma-based systems for waste treatment indicates that they can destroy chemical agents. Nevertheless, the operability, reliability, and repeatability of the integrated plasma system have not been demonstrated due to equipment failures, system redesigns, and operational modifications. Also, the committee was concerned that some of the agent could bypass the reaction zone (see the discussion below of Finding BR-1 under Review of Previous Committee Findings).

Tests were conducted on the agent-surrogate, dimethyl methyl phosphonate (DMMP), and hydrolysates of HD and VX. In these tests, high DREs of both DMMP and hydrolysate compounds were achieved, increasing the confidence level that the proposed plasma-based process would be capable of destroying chemical agents. However, demonstration tests with neat chemical agents will be required to determine specific operational conditions, such as proper control of oxygen and steam, before pilot-scale evaluations can proceed. These tests will be particularly important for determining the formation of by-products, which is dictated by the materials processed, the stoichiometry for oxygen, steam, and carbon, and temperature conditions. The data on the by-products generated in the demonstration tests are of limited value because the tests were not run with agents.

Projectile Heel Campaign

The projectile heel campaign was required to validate the destruction of chemical agent that had adhered to metal parts and to demonstrate removal of the melt from the PWC. Characterization of gaseous, liquid, and solid effluents was required, as was verification of operating parameters. The test objectives for this campaign are listed below (DOD, 1999b):

- Validate that the PWC process can achieve a DRE of 99.9999 percent for chemical agent GB heels in simulated projectile shells.
- Demonstrate that the PWC can process simulated projectile shell heels using chemical agent in pipe nipples.
- Demonstrate melting of uncontaminated 4.2-inch mortar shells.
- Validate that the PWC unit operation can meet a 5X condition for solid residues from this feed.
- Characterize the gases, liquids, and solids.
- Demonstrate that the melt from the PWC can be removed.

The first five objectives were not met because agent was not injected into the PWC. In addition, the sixth objective was not met because samples were manually removed.

REVIEW OF PREVIOUS COMMITTEE FINDINGS

The committee's earlier findings concerning the Burns and Roe PWC technology package are quoted below and their status following demonstration tests is examined (NRC, 1999):

> **Finding BR-1.** No tests have been done involving actual chemical agent or propellant destruction in a PWC. Tests with agent and M28 propellant were planned for the demonstrations being conducted between February and May of 1999, but no data were available to the committee at the time of this writing.

The demonstration tests conducted on the agent surrogate DMMP (a GB simulant), HD hydrolysate, and VX hydrolysate provided only limited data. The DMMP was 99.99997 percent destroyed; trace levels of thiodiglycol were detected in two of the six HD hydrolysate tests; and the levels of ethyl methyl phosphonic acid and methyl phosphonic acid in the VX hydrolysate tests were very low.

Energetic materials (Comp B and tetrytol) were reported to be 99.9998 percent destroyed, but trace levels of RDX and TNT were detected. Components of M28 propellant were 99.97 percent destroyed (nitrocellulose) and 99.99998 percent destroyed (nitroglycerin). The detection of RDX and TNT in the PWC effluents is indicative that feedstocks can bypass the reaction zone and exit without complete reaction. Thus, if chemical agents were fed to the PWC, they could potentially also bypass the reaction zone and be found in the effluents. Solving this problem will require ensuring thorough mixing in the PWC.

> **Finding BR-2** Scale-up from the small PWC units in existence to the very large units proposed is likely to present significant scientific and engineering challenges.

The numerous problems encountered in the demonstration described above confirmed this finding.

> **Finding BR-3.** Tests performed with one plasma feed gas may not be indicative of PWC performance with a different gas. Because different plasma feed gases have different thermodynamic and chemical properties, the choice of the plasma feed gas could have a significant impact on the performance of the system. For example, the electrical power requirements will be determined, in part, by the plasma feed gas. Electrode wear may also depend on the type of gas, and product gas composition will vary.

Initially, the technology package proposal indicated that argon would be used as the plasma feed gas. This would distinguish the PWC from an incinerator because the inert gas is not an oxidizing agent. Citing the expense of argon, the technology provider subsequently shifted to carbon dioxide (CO_2), which is cheaper, but introduces a source of oxygen. Computer calculations for various chemical agents introduced into a CO_2 plasma at ~ 3,000 K predicted that agents would undoubtedly be destroyed but also indicated that large amounts of carbon soot would be formed as the hot gaseous mixture cooled. The presence of particulates of high surface area (that are probably pyrophoric) in the product creates a new problem. Also, electrical power requirements for CO_2-plasma operation would be greater than for argon-plasma operation.

In the actual demonstration tests, nitrogen (N_2) was used he plasma gas. Although N_2 is a nonoxidizing species, eaction products of environmental concern (C_2N_2, HCN, metal cyanides, etc.) were predicted and were detected in the demonstration tests. The power requirements for N_2-plasmas are acceptable.

In summary, the technology provider has explored a few alternatives for plasma gases but may not have found the best choice. Also, the problem of torch failure could be minimized by a better choice of metals or by alternative designs. For water-cooled plasma torches, the metals must not react with the plasma gases and must still have high melting points to prevent a sudden release of water into the PWC (see the discussion following Finding BR-5).

> **Finding BR-4.** The technology provider's proposal for recycling the liquid-scrubber effluent through the PWC to vitrify the salts may not be practical. If scrubber liquor is fed to a PWC, some of the contaminants may simply revolatilize. In addition, NaCl and NaF salts could react with SiO_2 at high temperatures to form gaseous $SiCl_4$ and SiF_4, respectively (both hazardous materials).

The demonstration tests did not address the ability of the PWC to vitrify salts from recycled scrubber liquor. Finding BR-4 remains unchanged.

> **Finding BR-5.** The maintenance of negative pressure within the PWC has not been demonstrated under munition-processing conditions. Pressure excursions that produce positive pressure in the PWC vessel could release product gas to the surrounding room. Some upsets that could result in moderate to severe pressure excursions included:
>
> - A leak in the torch-cooling system to release water into the PWC, and rapid steam formation could pressurize the vessel.
> - Energetic material that remained in a mortar or projectile introduced into a PWC could detonate upon heating, which would generate a pressure pulse.
> - An improper cut of the rocket motor could allow a larger-than-design piece of propellant to be introduced into the PWC. If the gas production rate from the propellant exceeds the capacity of the downstream PAS, the vessel could overpressurize.

The primary safety problem apparent from the demonstration tests is an inability to maintain negative pressure. Overpressurization occurred several times during the tests due both to plasma torch failure and poor engineering system design (e.g., ram feeder blow-back and leaks in the gas polishing system). The failure of the plasma torch caused cooling water to be released into the PWC, which could have resulted in catastrophic overpressure that could have released agent, if any had been present. Thus, substantial further engineering development will be necessary, along with design l administrative controls to ensure the safe use of this sma torch technology.

According to the technology provider's proposal, rocket propellant would be sent directly to the PWC, whereas explosives would be sent first to the EDC. Although a small amount of the propellant was tested in the PWC, the committee was concerned that larger amounts of propellant might detonate rather than deflagrate. The resolution of this issue has not been successfully demonstrated.

> **Finding BR-6.** Combustion of plasma-converted gas in a boiler faces three major hurdles: (1) to avoid being permitted under RCRA as a boiler burning hazardous wastes, the gas may have to be delisted; (2) the gas may require significant scrubbing to remove compounds that are unsuitable as boiler feedstock; and (3) the boiler will have to be configured to burn gas that has a low heating value efficiently in order to avoid generating unacceptable emissions.

The Environmental Protection Agency (EPA) has recently established an exemption for synfuel produced from hazardous waste. Under the Comparable/Syngas Fuel Exclusion (40 CFR 261.38), synfuels that meet certain specifications are not classified as hazardous wastes and, therefore, could be burned without Resource Conservation and Recovery Act (RCRA) permits in boilers and industrial furnaces (a Clean Air Act [CAA] permit would still be necessary). The synthesis gas fuel specification has the following criteria:

- a minimum Btu value of 100 Btu/scf
- less than 1 ppm_v of total halogen
- less than 300 ppm_v of total nitrogen other than diatomic nitrogen (N_2)
- less than 200 ppm_v of hydrogen sulfide
- less than 1 ppm_v of each hazardous constituent on a target list of 40 CFR 261 Appendix VIII constituents

These stringent requirements were not met in any of the demonstration tests. It was not clear that the tests were designed to evaluate this specification, even though it would be critical to the development of an alternative disposal technology using PCG. Without this exemption, the PCG synfuel could not be used in boilers without a RCRA/CAA hazardous waste combustor permit subject to boiler and industrial furnace rules (the so-called "BIF rules").

The demonstration tests revealed several potential problems with PCG meeting the Comparable/Syngas Fuel Exclusion. Only one material tested in the demonstration (mixed dunnage) was converted to synfuel with an appreciable fuel value. Even for this material, the minimum Btu value (> 100 Btu/scf) was only demonstrated in one test (out of six). For all other tested materials, the Btu value of the synfuel was very low (generally close to zero).

Furthermore, both the generation of hazardous air emissions and the conversion of carbon are strongly affected by carbon/oxygen stoichiometry. The generation of synfuel of insignificant Btu value in nearly all of the demonstration test runs casts doubt on the relevance of the emissions data to full-scale operation for most of the materials tested in the demonstration. The Comparable/Syngas Fuel Exclusion

specification for hazardous constituents would have to be demonstrated for the specific conditions that would yield a PCG with acceptable Btu value. In addition, a more complete profile of all 40 CFR 261 Appendix VIII compounds would have to be evaluated. Finally, the demonstration tests did not confirm that predictable control of the PCG heat content could be achieved, even when higher hydrocarbon feedstocks (such as mixed dunnage) are treated.

Another challenge to meeting the Comparable/Syngas Fuel Exclusion requirements for PCG is maintaining low levels of nitrogen and halogen compounds. The NO_x-level for every PCG material tested in the demonstration unit exceeded the criterion of less than 300 ppm_v (~388 mg/m^3) of total nitrogen other than diatomic nitrogen (N_2). The removal of nitrogen compounds from the PCG synfuel is a critical process capability that was not demonstrated but is necessary for full-scale operation.

The PCG synfuel generated from all of the test materials (except tetrytol) exceeded the total halogen requirement of 1 ppm_v (~1,500 $\mu g/m^3$) for chlorine despite the use of an acid scrubber. For example, PCG generated from DMMP in the demonstration tests had 26,980 $\mu g/m^3$ (approximately 18 ppm_v) of chlorine, which is 18 times the Comparable / Syngas Fuel Exclusion of 1 ppm total halogens. Thus, the demonstration unit also failed to demonstrate that it could generate synfuel that meets these critical synfuel exclusion criteria.

> **Finding BR-7.** Although a PWC may not be considered to be an incinerator by permitting authorities, the most likely permitting procedures for a PWC would be similar to those used for incinerators.

A key component of the Burns and Roe demonstration tests was to determine the characteristics of the flue gas when the synfuel is burned in the thermal oxidizer. These characteristics can suggest the emissions from a boiler or industrial furnace burning the PCG. In other permitting actions relating to plasma units that generate gas burned in catalytic oxidizers (e.g., the ATG facility in Richland, Washington, EPA Region 10), the EPA and state regulators used appropriate, relevant, and applicable rules (ARARs) based on the hazardous waste combustion rules.

A comparison of the thermal oxidizer emission levels with the Hazardous Waste Combustion ARARs indicates that either additional cleanup of the PCG would be required or the emissions of the boiler/industrial furnace would require more rigorous scrubbing. This comparison is complicated by the highly dilute conditions in some of the thermal oxidizer exhaust (i.e., 12 to 20 percent oxygen). It is also worth noting that the thermal oxidizer used would not generally meet the carbon monoxide standard of 100 ppm_v. A comparison of the hazardous waste combustion rules with the thermal oxidizer emissions data indicates that the combustion of PCG would not meet some standards, when corrected to the standard 7 percent oxygen, (e.g., the cadmium-plus-lead emission for the system configuration used in the demonstration tests for M28 propellants, mixed dunnage, and VX hydrolysate). Mercury emission could be a problem for M28 propellants, and particulate matter would be a problem for the treatment of mixed dunnage. Chlorinated dioxin/furan was not found to be problematic for the configuration demonstrated when compared to the hazardous waste combustion standard. In summary, the demonstration tests did not show that the PWC system could adequately control emissions for the direct combustion of PCG in a boiler or industrial furnace.

SAFETY ISSUES

In the earlier report, the committee made the following observation (NRC, 1999):

> Cooling water is circulated through the plasma torch to keep it from melting at the high plasma temperatures. A leak in the cooling system could spray water into the plasma. If the leak is sudden, rapid vaporization could cause a pressure pulse that might overload the downstream gas-handling equipment. Then, untreated agent could be released into the surrounding room through the torch opening in the top of the PWC. Similar "puffing" has been observed in combustion equipment when excessive back pressure occurs. If the leak is gradual, the resulting steam would dissociate in the plasma forming hydrogen and oxygen gas that could recombine and explode if the mixture is in the flammable range above its autoignition temperature. The effect of liquid water introduced into a plasma in the presence of other species present in PWCs must be determined before larger scale experiments are performed. . . .
>
> The technology provider is aware that torch failure is a concern, and the potential for an explosion has been reduced by the torch design and by redundant flow and pressure controls that would actuate fast-closing valves on the water feed as well as the waste feed in the event of a failure.

The committee reiterates its earlier observation that appropriate design and administrative controls can ensure the safety of plasma arc technology (NRC, 1999).

The technology provider proposes sending rocket propellant directly to the PWC, whereas, explosives will be sent first to the EDC. Although a small amount of the propellant was demonstrated to deflagrate in the PWC, the committee is concerned that larger amounts of propellant may detonate rather than deflagrate. The committee does not believe this issue has been successfully demonstrated.

The addition of nickel to the melt to form a conductive bed for the transferred arc operation constitutes another issue regarding worker safety (Burns and Roe, 1999a). Airborne nickel particulate is very hazardous and should be assessed further with respect to worker exposure during normal operations, anticipated transient conditions, maintenance, and accidents.

The recovery of molten metal may require more access

h·· workers during operations, as well as increased maintenance. Increased access would also increase worker exposure to hazards over predemonstration estimates.

REEVALUATION OF STEPS REQUIRED FOR IMPLEMENTATION

The committee's earlier report identified the following five steps required for implementation (NRC, 1999):

1. Determine the effect of sudden water injection into the plasma torch in the presence of argon, nitrogen, carbon dioxide, and other species present in the plasma system. Include an evaluation of the effect of gases present in the PWC on the flammability range of hydrogen gas.

2. Determine the likelihood of the release of untreated agent and other hazardous contaminants from the PWC if the gas generation rate is unexpectedly high (e.g., due to a cooling-water leak, the inadvertent introduction of explosive material into the chamber, or a rapid deflagration of propellant).

3. Conduct a thorough analysis of the product gas generated from each PWC using the plasma feed gas proposed for full-scale operation. This analysis should include the identification of organic intermediates that would be of concern in an HRA [health risk assessment].

4. Establish the efficacy of pollution-control equipment in removing hazardous compounds (e.g., NO_x, SO_x, HCl, and metals) from the product gas.

5. Perform a larger-scale demonstration of PWC operation that includes the hold-test-release step.

None of these steps was completed in the demonstration tests. Furthermore, the test results do not readily indicate how the concerns raised by the committee could be addressed.

Clearly, extensive testing with chemical agents will be necessary if PWCs as currently proposed by the technology provider are to be used. As discussed in Finding BR-5, serious doubts have been raised about the reliability of the torch design and the maintenance of negative pressure in the system, and, hence, about the safety/efficacy of this system.

The committee believes a properly configured and operated plasma arc process would be a robust, indiscriminant thermal process capable of destroying chemical agents. However, on the basis of observations during two site visits to plasma arc installations (Ontario Hydro Technologies, Toronto, Ontario, and Aberdeen Providing Ground, Maryland), the results of the demonstration tests, and a review of the available demonstration data, the committee concurs with the Army's conclusion that the Burns and Roe process is too immature to be considered as a viable solution for the destruction of assembled chemical weapons at this time.

SUPPLEMENTAL FINDINGS

Finding BR-1. The plasma torch apparatus, as demonstrated by the Burns and Roe team, is not qualified for further consideration for the demilitarization of assembled chemical weapons. The torch design appears to be unreliable for extended use. Furthermore, the design increases the possibility of a catastrophic water leak, which could produce a significant increase in pressure in the PWC, and possibly cause an explosion, which, in turn, could expose personnel to chemical agent. Moreover, the effectiveness of the monitoring and control sensors was not demonstrated.

Finding BR-2. Even after more than a year of research and development, the technology provider has not been able to show that its small PWC can adequately destroy agent simulants or that nitrogen is the best gas to use for the plasma feed. If oxygen leaks into the reactor, it could react violently with hydrogen. If air were used for the plasma feed gas, regulatory compliance issues would arise, as well as questions of public acceptance.

Finding BR-3. In the absence of any data for processing effluents from agent runs, the committee could not validate the ability of the proposed system to handle and stabilize effluent products from agent processing.

3

General Atomics Technology Package

The General Atomics process uses a modified version of the baseline disassembly process and cryofracture of projectiles for munitions access. The agent and energetics are destroyed by hydrolysis. The hydrolysate is then treated by supercritical water oxidation (SCWO). Metal parts are subjected to caustic hydrolysis processing followed by 5X thermal treatment. Dunnage is shredded, mixed with caustic, and destroyed by SCWO.

Demonstration tests were conducted for the following operations:

- energetics rotary hydrolyzer (ERH)
- dunnage shredding and hydropulping
- SCWO

ENERGETICS ROTARY HYDROLYZER

The objectives of the demonstration tests of the ERH are listed below (DOD, 1999b):

- Demonstrate the effective dissolution of aluminum and energetics in fuzes and bursters, as well as propellant in rocket motors, to allow downstream processing in the continuously stirred tank reactor, SCWO reactor, and heated discharge conveyor.
- Determine the deactivation of the energetics in fuzes and bursters and the propellant in rocket motors.
- Validate the retention times for aluminum and energetics in fuzes and bursters and propellant in rocket motors
- Characterize the gas, liquid, and solid process streams.

The General Atomics demonstration tests involved several different munition items and energetic materials. Complete destruction, (i.e., below the detection limit) was achieved for tetryl in M557 fuzes and M14 bursters and for tetrytol (tetryl/TNT) in M6 bursters. However, the following problems arose during the handling of other energetics (General Atomics, 1999a):

- Small quantities of fuze-train components remained unhydrolyzed; these were destroyed in the hot muffle furnace.
- Unhydrolyzed energetic material adhered to a flight drum during an M83 burster (RDX/TNT) validation test and burst into flame.[1] (The technology provider claims that this was an artifact of the test; the flights in the ERH were designed to hold solids and liquids for sampling rather than to drop them into the hydrolyzing solution. An appropriate flight design will be used in the full-scale ERH).
- Excessive boiling and foaming was reported with the M83 burster, which could cause difficulties in processing.
- RDX and HMX were above the detection limit in the liquid analyte.
- Hydrolysis of M28 propellant in the motor casing was slower than anticipated; the NaOH solution concentration had to be raised to 12M. (The technology provider has suggested cutting the propellant into smaller pieces).
- During the processing of M28 rocket propellant, a yellow substance (identified as N-nitrosodiphenylamine) was generated and coated much of the interior of the explosive containment cubicle. The technology provider indicated that the coating was caused by the ventilation flow in that particular ERH test unit. The ventilation was sized to dilute hydrogen to below the lower explosive limit and was clearly inadequate to prevent

[1]The term "flight" refers to plates attached to the drum that hold the energetic pieces as the drum rotates. The entire apparatus is called a flight drum.

fugitive emissions from the ERH. The technology provider reported that in the full-scale system, sufficient ventilation flow would be provided to prevent fugitive emissions (General Atomics, 1999b). The yellow material would be scrubbed from the ERH ventilation flow, and the scrubber solution would be combined with energetics hydrolysate and processed through the SCWO reactor. The committee was concerned that the proposed solution to the problem could result in the accumulation of similar energetic by-products in other parts of a full-scale system.

The committee's earlier report contained the following finding concerning hydrolysis of energetics (NRC, 1999):

> Finding GA-2. Hydrolysis of energetics at the scales proposed by the technology provider is a relatively new operation. Chemically, it is possible to hydrolyze all of the energetic materials; however, the rate of hydrolysis is limited by the surface area and, therefore, depends on particle size. (Smaller particles are more desirable because they have a higher surface-to-volume ratio.) The proposed method of removing and hydrolyzing the energetics appears to be reasonable, but further testing is required to determine the hydrolysis rates and to confirm that throughput rates can be achieved.

The demonstration tests substantively confirmed this ling. The test results demonstrated that the ERH could ctivate and dissolve the energetics and aluminum found M557 fuzes and M83 bursters and could deactivate the energetics found in M6 and M14 bursters in two to four hours. Test data on the M28 rocket motor sections show that a residence time of 10 hours at 12M caustic concentration and 230°F were required for complete hydrolysis of the M28 propellant.

The demonstration program did not include the treatment of agent-contaminated solids. In the opinion of the committee, the ability of the ERH system to hydrolyze solid pieces of propellant supports the conclusion that similar treatment could successfully clean contaminated solids to a 3X condition.[2] However, the demonstration results cannot be considered conclusive evidence that the required processing rates could be consistently achieved.

The committee's earlier report included the following finding (NRC, 1999):

> Finding GA-3. The rotary hydrolyzer appears to be a mature reactor configuration that is well suited for this application.

Although no test data on the reaction rate were provided, the tests did qualitatively demonstrate that the ERH could destroy energetic materials. However, some results indicate that the ERH did not completely wet the energetics with hydrolysis solution, which allowed some solid energetic material to exit the ERH before hydrolysis was complete. The explanation given by the technology provider (i.e., the shape of the flights) and the design modification proposed by the provider to address this problem (i.e., modification of the pitch and shape of the flights) should, in the committee's opinion, decrease the amount of unexposed solid material that passes through the ERH.

No tests were conducted on the hydrolysis of energetics contaminated with agent; however, because of the long residence time in the ERH, the committee believes that chemical agent exposed to the caustic hydrolysis solution in the ERH would be hydrolyzed. Nevertheless, because the exact manner in which agent might penetrate energetic materials is not known, there is still some question as to whether chunks of unhydrolyzed energetic material, such as those that were found in the residue from the ERH, would be truly agent free. Agent embedded in the energetic solids might not have been exposed to the caustic solution and, hence, might not have reacted.

DUNNAGE SHREDDING/HYDROPULPING SYSTEM

The purpose of the demonstration tests of the dunnage shredding/hydropulping system (DSHS) was to show that solid wastes (wooden dunnage, DPE suits, and butyl rubber) could be adequately reduced in size and pulped to a pumpable mixture. The objectives of the demonstration testing are listed below (DOD, 1999b):

- Validate that the shredders and hydropulper can adequately prepare the dunnage for downstream processing in the SCWO reactor.
- Qualitatively evaluate the operability (especially material handling) of the shredder/hydropulper unit operations.
- Validate that the shredders can process 1,000 lb/hr of pallets and, separately, 250 lb/hr of plastics.

Several commercial shredders identical in size to the units proposed for the full-scale system were used to achieve the size reduction of the solid materials of interest. In the initial report, the committee had stated the following (NRC, 1999):

> Finding GA-4. Shredding of dunnage and injection of the slurry directly into a SCWO system is a new and unproven process. While General Atomics claims to have developed a proprietary pump capable of pumping the slurry at high pressures, it has not been tested under the

[2] At the 3X decontamination level, solids are decontaminated to the point that agent concentration in the headspace above the encapsulated solid does not exceed the health-based, eight-hour, time-weighted average limit for worker exposure. The levels for HD, VX, and GB are, respectively, 3.0, 0.01, and 0.1 μg per cubic meter in air. Materials classified as 3X may be led by qualified plant workers using appropriate procedures but are not sable to the environment or for general public reuse. In specific cases which approval has been granted, a 3X material may be shipped to an approved hazardous waste treatment facility for disposal in a landfill or for further treatment.

intense solids loading anticipated. Furthermore, the injection of large amounts of solid material, including wood shreds, cut-up nails, and complex organic materials, such as pentachlorophenol and other wood preservatives, into the SCWO system has not been demonstrated. Considering the difficulty SCWO reactors have encountered with deposition of solids when liquids are treated, the committee believes that this application of SCWO may encounter significant difficulties. (At the time of this writing, processing of solids with SCWO was being performed as part of the ACWA demonstrations.)

The individual components of the DSHS had been tested previously in their respective applications but had not been used collectively in the configuration used for the demonstration test program. Consequently, numerous, albeit surmountable, problems were encountered (e.g., wood "nesting" in the hammer mill and micronizer feed chutes and inadequate magnetic separation of metal from the shredded DPE suits prior to processing in the granulator). The technology provider was able to control both system and feed variables well enough to achieve the targeted feed processing rates and obtain the proposed objective for size reduction (< 1 mm for wood and < 3 mm for plastics). The 3-mm plastic material product was processed through a sieve to separate material that was less than 1 mm that could be fed to the SCWO reactor. The full-scale SCWO system will have larger feed nozzle diameters that should be capable of accepting the plastic dunnage material as shredded (i.e., without the need for sizing to less than 1 mm) (General Atomics, 1999b).

The demonstration tests did not validate that the hydropulper could consistently produce material that was smaller in diameter than the goal objective of 1-mm; however, the tests did determine that the hydropulper could blend energetics hydrolysates with size-reduced wood to yield a uniform, pumpable slurry for processing in the SCWO reactor.

The mass balance reported for the two validation test runs of the micronizer while processing wood pallets showed a 5.4 and 6.3 percent deficit (General Atomics, 1999a). The deficit was attributed to "Presumably . . . the loss of water due to heatup in the micronizer." This loss is not a problem for pallets that are not contaminated with agent. When contaminated wood is processed, however, the water vapor released could contain vaporized agent, and the gas stream will have to be managed accordingly.

The duration of the shredding tests was too short to allow for an evaluation of the long-term efficacy of this process. The demonstration was highly labor intensive and, because it was performed on uncontaminated material, did not require that the operators work in full protective clothing. Therefore, it cannot be concluded that a full-scale system would provide similar levels of materials segregation without further development of the process. For example, one of the technology provider's conclusions is that the metal parts in DPE suits would have to be manually cut out in glove boxes prior to processing and then decontaminated to a 5X condition in the metal parts furnace (General Atomics, 1999a). Because this step (which is necessary for successful processing) was not performed during the demonstration tests, the committee could not assess its efficacy.

SUPERCRITICAL WATER OXIDATION SYSTEM

The hydrolysates of energetic materials provided by the PMACWA were prepared using 12 percent sodium hydroxide (as specified in the technology provider's proposal). The DREs from hydrolysis of energetic constituents of Comp B, tetrytol, and M28 propellant all exceeded 99.999 percent, except for the nitrocellulose component of the M28 propellant. The latter was set to measure a DRE of no greater than 99.988 because the analytical method has a high detection limit.

The SCWO system was demonstrated to validate its capability to destroy Schedule 2 and other organic compounds produced from agent hydrolysis. The objectives of the demonstration testing of the SCWO reactor concerning agent hydrolysate products are listed below (DOD, 1999b):

- Validate that the SCWO reactor can eliminate the Schedule 2 compounds present in the agent hydrolysate feed.
- Validate that the agent hydrolysis process and the SCWO reactor can achieve a DRE of 99.9999 percent for HD, GB, and VX.
- Demonstrate the long-term operability of the SCWO reactor with respect to salt plugging and corrosion.
- Characterize the gas, liquid, and solid process streams from the SCWO reactor.

The SCWO system was also demonstrated to validate its capability to destroy organic compounds from energetic hydrolysis products and to demonstrate the feasibility of destroying shredded dunnage. The demonstration tests included the following objectives (DOD, 1999b):

- Validate that the ERH, continuously stirred tank reactor (CSTR), and SCWO can achieve a DRE of 99.999 percent for tetrytol, Comp B, and M28 propellant.
- Determine the impact of the aluminum from the ERH process on SCWO operation.
- Determine how well organics in the shredded dunnage are oxidized in the SCWO reactor.
- Characterize the gas, liquid, and solid process streams from the SCWO system.

The committee's initial report contained the following finding concerning General Atomic's use of SCWO (NRC, 1999):

> **Finding GA-5.** All of the findings in the [1998] NRC report, *Using Supercritical Water Oxidation to Treat*

Hydrolysate from VX Neutralization, apply to the General Atomics system.

The demonstration confirmed this finding (see Appendix A). Although the SCWO system successfully destroyed organic compounds in the liquids, the results did not demonstrate that the system is capable of operating without frequent shutdowns for repair or cleaning. This uncertainty could affect the system's ability to treat the numbers of munitions located at a storage site within a reasonable length of time. For the destruction of agent and energetics hydrolysates and dunnage, the SCWO system performed reasonably well. However, corrosion and salt plugging both raised concerns about reliable long-term operation.

Operationally, the validation test runs for agent hydrolysate (all liquid feeds) proceeded smoothly, except for inconsequential leaks at some joints. Validation test runs for the energetic hydrolysates and dunnage feeds showed that these can be processed successfully, provided that aluminum hydroxide is removed from the feed (it caused severe plugging). Safety issues pertaining to the removal of aluminum hydroxide are noted later in the chapter.

Thus, the demonstration confirmed the concerns of the committee (and of another NRC committee that had previously evaluated the use of SCWO to treat VX hydrolysate) about the durability of components and the materials of construction in the highly corrosive SCWO system environment (NRC, 1998, 1999). Although the demonstration plan had called for the use of a platinum-lined reactor, because of problems encountered in fabricating the platinum liner, an unlined Inconel™ 718 SCWO reactor was used. This contributed to the corrosion and plugging of the downstream components with corrosion products (DOD, 1999b).

SCWO processing of the dunnage slurry was not demonstrated beyond a simple proof of concept. As described in the technology provider's report, a mixture of tetryl hydrolysate, aluminum hydrolysate, deionized water, phosphoric acid, micronized wood, granulated plastic (< 1 mm), ground activated carbon, and a stabilizing additive proprietary to the technology provider was fed to the SCWO reactor at an approximate rate of 6 kg/hr (General Atomics, 1999a). The committee concluded that this brief test constituted a proof of concept only and could not be considered a validation of the method.

The demonstrated treatment of shredded and slurried dunnage using SCWO resolved one of the committee's concerns but raised new ones. The demonstration tests showed that the SCWO system's pump can pressurize the slurry to the high pressure required for the SCWO reactor and that the SCWO reactor is capable of oxidizing the slurried dunnage. However, the testing did not demonstrate that tramp metal[3] would not prove to be a problem in extended operation. Furthermore, the demonstration tests of the SCWO system with dunnage feed was too short to demonstrate the long-term reliability of the system.

Finally, the demonstration tests used slurried solids of dunnage shredded to less than 1 mm (rather than less than 3 mm as proposed in the full-scale process), and the feed nozzles were smaller than those proposed for full-scale operation. Thus, the efficacy of the process with particles sized to full-scale specifications and larger nozzles was not demonstrated.

SAFETY CONCERNS

The demonstration tests revealed that additional processing steps to remove aluminum from energetics hydrolysate would be necessary to prevent plugging of the SCWO reactor. The technology provider has proposed using a neutralization and filtration process to remove aluminum hydroxide from the hydrolysate, with subsequent 5X treatment of the precipitated aluminum filter cake in an inductively heated metal parts furnace (General Atomics, 1999b). Aluminum hydroxide forms a very flocculent precipitate, however. Because this compound is also amphoteric, the pH will have to be carefully controlled and the precipitate carefully filtered. If other hazardous metal salts precipitate with the aluminum hydroxide, they may have to be treated under RCRA specifications.

The removal of aluminum hydroxide would require additional processing equipment, which would add to the maintenance and reliability burden of the plant and would increase worker maintenance time in DPE suits and opportunities for worker exposure to agent. This concern was raised in the committee's initial report (NRC, 1999). It is repeated here to emphasize that modifications used in the demonstration tests would increase the potential of exposure.

The demonstration tests showed that condensable organics, such as nitroglycerine, will be evolved from the ERH and will be subsequently condensed and returned to the CSTR for hydrolysis. The committee notes that considerable care will be required to ensure that these condensable explosive materials are not initiated, thereby increasing the possibility of worker exposure to agent and damage to process equipment. The ERH demonstration tests using propellant feed also resulted in the release of volatile organic compounds (VOCs) into the explosive containment cubicle for the ERH. The walls of the cubicle were coated with this material as it condensed. As the technology provider noted, this experience reveals that the ERH design will have to control fugitive emissions (General Atomics, 1999b). The committee believes that the potential for worker exposure to agent would be increased during the maintenance of currently undefined control systems for fugitive emissions.

The technology provider also indicated that, to preclude dust explosions (which are extremely unlikely) in the micronizer component of the DSHS, additional safety

[3]In this instance, tramp metal consists of metal pieces and fragments originating from dunnage components entrained in the dunnage slurry.

features will be required for the full-scale design of the system (General Atomics, 1999b). These features, too, would increase the opportunities for worker exposure to agent during maintenance.

In general, the demonstration tests revealed that more maintenance in DPE suits would be required, and, thus, the opportunities of exposure to agent by workers would be increased. At the baseline incineration disposal facilities operating on Johnston Island (in the Pacific Ocean) and at Tooele, Utah, workers in DPE suits are only allowed to remain in contaminated areas for two hours at a time and can only enter if another worker is present. In case of emergency, two more workers wearing protective clothing must be prepared to provide assistance (PMCD, 1998). Thus, an increase in maintenance in DPE suits can have a significant impact on productivity. Process design and the selection of reliable process equipment and materials, in conjunction with suitable training and procedures, should be used to minimize requirements for activities in DPE suits.

EFFLUENT CHARACTERIZATION

In the initial report, the committee concluded that the liquid effluent from the General Atomics process consists of pure water from the evaporator/crystallizer used to produce the solid filter cake (NRC, 1999). This effluent is essentially distilled water and should not pose a significant hazard to human health or the environment. The solid waste from the process, consisting of dried filter cake, was reasonably well characterized. The gaseous effluent from the SCWO process was not well characterized, however, and as a result, its hazardous characteristics could not be determined.

Tables 3.4-10 through 3.4-19 in the demonstration test report by General Atomics present some analytical results on the liquid and gaseous effluents from the SCWO reactors (General Atomics, 1999a). However, the reported characterizations are inadequate to determine if the solid filter cake could be stabilized adequately or to estimate the degree of risk to human health or the environment posed by the gaseous effluent from the SCWO process.

A further concern relates to the presence of sodium and other solid materials in the gaseous emissions from the SCWO reactor. The mechanism whereby solids are released into the gaseous effluents is not clear. One would expect that these inorganic materials would be found in the solid and liquid phases, but not in the gaseous phase. Small quantities of chromium in the gaseous emissions from the SCWO reactor are of potential concern for two reasons. First, it reinforces the importance of demonstrating the reliable operation of the platinum-lined reactor; second, it illustrates the need to test gaseous emissions from the SCWO system for particulates, as well as for gaseous contaminants. Chromium emissions reported in Table 3.5-11 of the technology provider's demonstration test report were at 3.1, 12.3. and 10.5 micrograms, respectively, during a five-hour test period for each of three test runs (General Atomics, 1999a). If the reported emissions pertain to chromium in the hexavalent form, the committee has serious concerns.

Table 3.4-8 of the demonstration test report by General Atomics shows that chemical analyses on VOCs and semi-VOCs were conducted on samples from the off-gas duct of the SCWO system during tests with HD hydrolysate tests (General Atomics, 1999a). The results of these measurements, however, do not appear to be adequate for evaluating the environmental impact of the process. Standard EPA methods for analysis of gaseous effluent samples generally produce full scans that can indicate the quantities of a large number of compounds of environmental concern.[4] These results, along with the results for emissions of metals (including chromium valency), can then be used to assess the environmental impact of a facility through accepted risk assessment methods (EPA, 1998a).

REEVALUATION OF STEPS REQUIRED FOR IMPLEMENTATION

The committee's earlier report included six required steps for implementation of the General Atomics overall technology package (NRC, 1999). These steps are reprinted below, followed by a description of the effects of the demonstration tests on them.

1. Conduct tests of the cryofracture process to ascertain if it provides better access to the agent cavity in projectiles and mortars then the baseline disassembly process.

Cryofracture was not part of the demonstration.

2. Sample and analyze air emissions from the demonstration system. The air emissions will have to be measured to a level of detail and accuracy that can be used for HRAs and environmental risk assessments required by EPA (1998a).

Some sampling and analyses of air emissions were conducted during the demonstration. However, additional data will be required to evaluate HRA and EPA emissions requirements.

3. Verify that energetic materials encased in metal (e.g., rocket or other munitions fragments) will be hydrolyzed.

The demonstration tests did verify that energetic materials encased in metal can be hydrolyzed. They also confirmed that the chemical reaction of the aluminum casings with the caustic solution is sufficient to gain access to and hydrolyze the contained energetic materials in the design residence time of the ERH.

[4]8000 Series Methods, especially those using gas chromatography/mass spectrometry scans (e.g., Methods 8260B, "VOCs by GC/MS," and 8270C, "Semi-VOCs by GC/MS").

4. Ascertain how well the SCWO process can handle high-solids materials (shredded dunnage).

The demonstration indicated that the SCWO process can handle materials with a high solids content (e.g., shredded dunnage). However, the SCWO system was not operated long enough to demonstrate reliable continuous operation.

5. Ascertain how well the SCWO system can treat hydrolysate containing large amounts of chlorides, sulfur, and phosphates on a continuing basis.

The ability of the SCWO system to treat hydrolysate containing large amounts of chlorides, sulfur, and phosphates on a continuous basis was not demonstrated.

6. Determine erosion and corrosion behavior of the components of the SCWO system.

General Atomics provided data on the types and quantities of metals found in the precipitates. Both the types and relative quantities matched those of Inconel™ 718. These data provide a strong indication that Inconel™ 718 was the source of the precipitates during the demonstration tests; they do not prove that other materials would not also form precipitates. In addition, the results do not confirm that a platinum-lined reactor could withstand the SCWO conditions and protect the underlying reactor wall during sustained operation.

SUPPLEMENTAL FINDINGS AND RECOMMENDATIONS

Finding GA-1. Testing on the hydrolysis of energetic materials contaminated with agent will be necessary before a full-scale system is built and operated.

Finding GA-2. Testing will be required to verify that the larger diameter supercritical water oxidation (SCWO) reactor feed nozzles will be capable of accepting the dunnage material as shredded (i.e., without additional classification and segregation) and that the reactor will perform reliably under these conditions.

Recommendation GA-1. Operation of the size reduction and slurrying system, and long-term operation of the supercritical water oxidation (SCWO) reactor with slurry, should be conducted before proceeding with a full-scale system.

Recommendation GA-2. Before construction of a full-scale supercritical water oxidation (SCWO) system, additional evaluations of construction materials and fabrication techniques will be necessary because corrosion and plugging prevent continuous operation with the present design. If the new construction materials do not solve these problems, then alternative SCWO reactor designs should be investigated.

Recommendation GA-3. To determine the operability of the supercritical water oxidation (SCWO) reactor and the reliability of the materials of construction, long duration runs of a SCWO reactor should be conducted with slurry, with energetics hydrolysate, and with agent hydrolysate before full-scale implementation proceeds.

Recommendation GA-4. The efficacy and safety of the additional step to remove aluminum hydroxide from the hydrolysate produced from rocket propellants should be evaluated prior to construction of a full-scale supercritical water oxidation (SCWO) system.

Recommendation GA-5. Decontamination of solid munitions materials by flushing and immersion should be demonstrated prior to full-scale implementation.

Recommendation GA-6. The air emissions data from the demonstration tests should be used in a screening risk assessment. The results of the air effluent samples should be subject to (1) a human health risk assessment following the Human Health Risk Assessment Protocol (HHRAP) for Hazardous Waste Combustion Facilities from the Environmental Protection Agency (EPA) [EPA530-D-98-001(A,B,C)], and (2) an ecological risk assessment following a protocol that will be released by EPA in the very near future.

4

Parsons-AlliedSignal WHEAT[1] Process

The Parsons-AlliedSignal process uses a modified baseline disassembly system to access agent and energetics. These are then hydrolyzed and subsequently biotreated. Hardware and dunnage are thermally decontaminated. The overall process consists of several technologies.

Demonstration testing was conducted for the following components:

- munitions cutting and fluid mining
- biotreatment of agent and energetics hydrolysates
- catalytic oxidation of all gases from the process
- metal parts treater for 5X treatment and dunnage treatment

MUNITIONS CUTTING AND FLUID MINING

A major modification from the standard baseline disassembly system is the use of water-jet cutting for accessing munitions, followed by fluid mining (wash out) of the energetics with high-pressure water jets. The objectives of the tests are listed below (DOD, 1999b):

- Demonstrate that circumferential cuts at required locations along the rocket length can be made.
- Demonstrate effective fluid mining and separate collection of rocket bursters, motor propellants, and residual agent simulant.
- Demonstrate that control can be maintained of rocket metal and plastic parts from cutting and fluid mining operations.
- Determine the energetic particle size of mined rocket bursters and propellant.
- Determine the requirements for separating used grit from the residual cutting solution.

Most of the objectives listed above were met:

- Rockets were cut at appropriate locations.
- Explosives were successfully washed out, yielding particles that were small enough for subsequent hydrolysis. M28 rocket propellant could not be washed out, however, because of its tough, rubbery consistency. The propellant grain was separated as a single piece several times during the demonstration tests. In the full-scale operation, the technology provider proposes that the propellant grain would be separated, sheared, and the pieces shredded.
- Operational control during the cutting operations was demonstrated, although some refinements from original plans were necessary.
- Used grit was readily separated from the water used for cutting.

During demonstration tests, the propellant grain ignited and burned while it was being forcibly fed into the low-speed shredder. The committee had noted this possibility earlier (NRC, 1999):

> Friction, shear, or heat may result from the inadvertent introduction of metal, an excessive feed rate, or some other cause and could initiate the energetic material.

The problem was resolved during the demonstration by inundating the shredding face with cooling water. In the full-scale operation, the technology provider proposes performing the entire shredding operation under water.

The separation and initial processing of the rocket components (and other major hazardous operations) are performed remotely to reduce worker exposure to safe levels. Thus, although further development is necessary in certain

[1]WHEAT is an acronym for water hydrolysis of explosives and agent technology.

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areas, the committee continues to believe that design and administrative controls will be feasible when the technology reaches the level of development at which quantitative risk assessments and hazard evaluations can be performed (NRC, 1999).

BIOTREATMENT SYSTEMS

Different biotreatment systems are used to treat HD hydrolysate and nerve agent (GB and VX) hydrolysates. Therefore, they are discussed separately below. The main objectives of the demonstration tests are listed below:

- to show a high level of destruction of Schedule 2 compounds and energetics hydrolysate compounds, yielding products acceptable for discharge
- to demonstrate a high level of destruction over an extended period of time with good operational control

The specific test objectives are listed below (DOD, 1999b):

- Validate that the immobilized cell biotreatment (ICB) process can eliminate Schedule 2 compounds present in all hydrolysate feeds.
- Confirm the absence of agent in the effluents of the ICB systems.
- Validate that the ICB systems (and the separately tested agent hydrolysis systems) can achieve a DRE of 99.9999 percent for VX, GB, and HD.
- Validate that the ICB systems (and the separately tested energetic hydrolysis systems) can achieve a DRE of 99.999 percent for energetics.
- Develop mass loading and kinetic data required for scale-up of ICB unit operations.
- Validate that the catalytic oxidation (CATOX) unit can eliminate specified VOCs, semi-VOCs, and Schedule 2 compounds from the process gas stream.
- Determine the potential impact of operating conditions on fouling and plugging of the CATOX unit.
- Characterize gas, liquid, and solid process streams from the ICB process for selected chemical constituents and physical parameters, as well as the presence or absence of agent, Schedule 2 compounds, and other toxic or hazardous compounds.

Biotreatment System for Mustard Hydrolysate

A flow diagram for the demonstration test unit used for HD hydrolysate is shown in Figure 4-1. The feed consisted

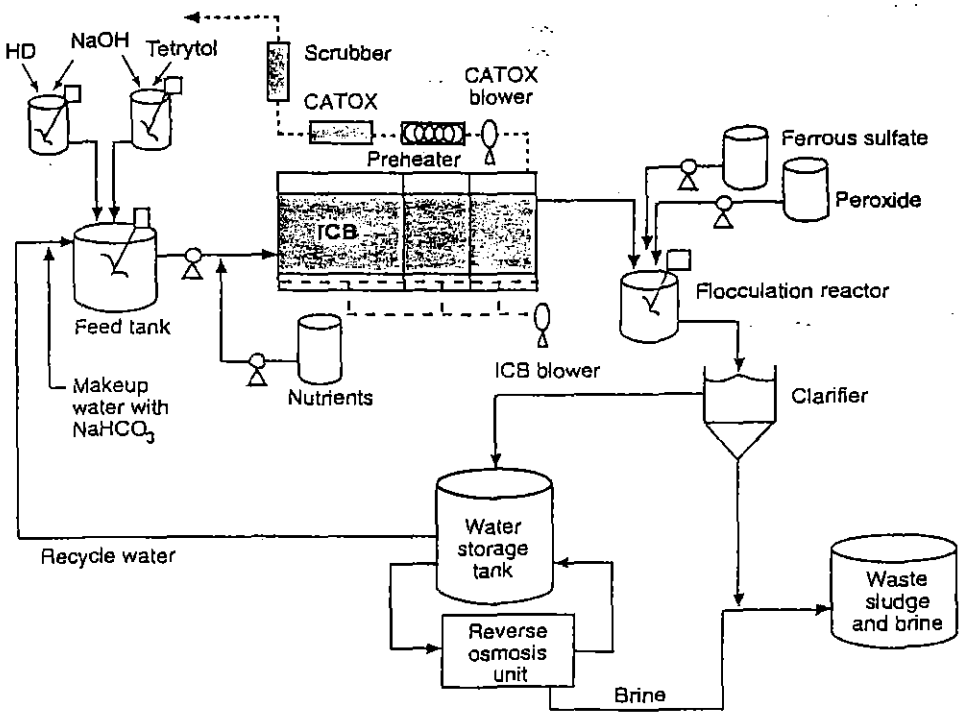


FIGURE 4-1 Demonstration test unit for treatment of HD/tetrytol hydrolysate. Source: Adapted from Parsons-AlliedSignal, 1999a.

of two streams, hydrolyzed HD and hydrolyzed tetrytol, that corresponded to the agent/energetics combination from an M60 105-mm artillery shell. Nutrients (ammonium sulfate or ammonium bicarbonate) were added to supply additional nitrogen. Fenton's reagent (30 percent H_2O_2 plus $FeSO_4$) was added to the flocculation product after biotreatment. (The amount added was small and did not contribute significantly to the overall oxidation process.)

The products of the HD biotreatment process are listed below:

- a wet sludge (biosolids plus a high percentage of brine)
- brine from the biotreatment system, concentrated by a reverse osmosis unit (which will not be included in the final plant design)
- depleted air from the bioreactors that has been treated in a CATOX unit (to oxidize organics carried over as spray or vapor) and then passed through a dry caustic scrubber and a carbon filter

The major criterion used to judge the efficacy of the bioreactor was the destruction of Schedule 2 compounds in HD hydrolysate and of tetrytol hydrolysate products in the feed. Schedule 2 compounds were not detected in the brine or sludge, and the DRE of Schedule 2 compounds from the combined agent/energetic hydrolysate feed was greater than 99.9 percent. Small amounts of 1,4-dithiane and 1,4-thioxane survived but were removed in the flocculation step, in which Fenton's reagent was added.

No energetics or their breakdown products, such as nitrotoluenes and nitrobenzenes, were detected in the brine and sludge, and samples of brine and sludge passed the EPA's toxic characteristic leaching procedure (TCLP). Low levels of several semi-VOCs were found in both sludge and brine samples. Also, some VOCs (e.g., 2-butanone and acetone) were found. Dioxins and furans were detected in some samples, but were below the levels of concern. Metals were also below the levels of concern. Analysis of the brine showed a greater than 90 percent removal of chemical oxygen demand (COD) relative to the bioreactor feed. Biological oxygen demand (BOD) in the brine was measured, but the technology provider considered the results meaningless because the microorganisms used in the BOD test were not well acclimated to the components in the agent and energetic hydrolysates.

Biotreatment System for Nerve Agent Hydrolysates

A flow diagram of the demonstration test unit used for nerve agent hydrolysate is shown in Figure 4-2. The main difference between this system and the system used for HD hydrolysate is the presence of the phosphonate form of phosphorus, which cannot be readily biodegraded. Other differences are listed below:

- A large amount of dextrose was added (about 44 lbs per pound of nerve agent products). The dextrose plus other nutrients (e.g., urea) represent about 95 percent of the total COD of the system.
- The feed rate of agent/energetics hydrolysate to the biotreatment system was scaled back to accommodate the added dextrose. The hydrolysate feed contained a concentration of about 0.1 percent Schedule 2 compounds, compared with 1.0 percent for the HD/energetics hydrolysate feed.
- The bio-oxidation process was augmented by a ultraviolet (UV)/hydrogen peroxide reactor.

The operating conditions were based on tests performed at the technology provider's laboratory that had demonstrated a DRE of more than 95 percent for Schedule 2 compounds. Energetics hydrolysate and agent hydrolysates were fed to the reactor in the following combinations:

- VX hydrolysate, Comp B hydrolysate, and M28 propellant (the products of a processed M55 rocket)
- GB hydrolysate and Comp B hydrolysate (the products of a processed M426 8-inch artillery shell)

The major criterion for judging the nerve agent process was the same as for the mustard process—destruction of the Schedule 2 compounds and energetic products in the hydrolysate feed. In general, the biotreatment of nerve agent hydrolysates was not successful. Although some of the problems were identified (described below), the reasons for the inadequate performance remain unclear.

The overall process (biotreatment plus UV/hydrogen peroxide) reduced the Schedule 2 compounds by 40 to 60 percent for GB hydrolysate, somewhat more for the VX hydrolysate (the higher DRE quoted in the demonstration report is an error [Parsons-AlliedSignal, 1999a].) As the test proceeded, there was a gradual buildup of the most biologically refractory Schedule 2 compounds: isopropyl methylphosphonic acid (IMPA) in GB hydrolysate; ethyl methylphosphonic acid (EMPA) in VX hydrolysate. The proportion of the DRE attributable to the biotreatment system and the proportion attributable to the UV/hydrogen peroxide could not be established from the available data. However, based on material balance estimates from the reported information on GB (for tests on April 13 and May 5), about 60 percent of the total IMPA conversion occurred in the bioreactor and flocculator, and about 40 percent occurred in the UV/hydrogen peroxide unit (Parsons-AlliedSignal, 1999a). The Fenton's reagent was not a major factor because the amount added corresponded to only about 3 percent of the initial feed COD.

The flow through the biotreatment process was continuous, 24 hours per day. However, the UV/hydrogen peroxide treatment was operated intermittently. A reverse osmosis

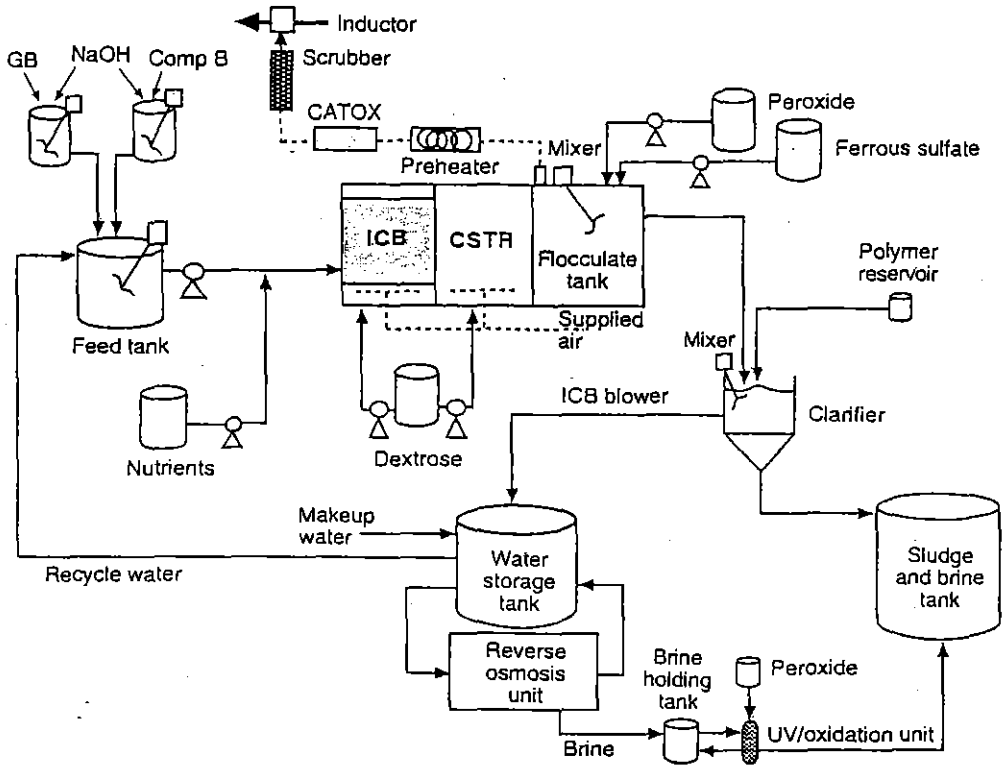


FIGURE 4-2 Demonstration test unit for treatment of GB/Comp B hydrolysate. Source: Adapted from Parsons-AlliedSignal, 1999a.

unit drawing on the recycle stream produced a small flow of concentrated brine, which accumulated in the brine holding tank. After 800 gallons had accumulated (over a period of about five days), the brine was recycled through the UV/hydrogen peroxide unit for six hours to produce one of the products leaving the plant. Although the UV/hydrogen peroxide unit was responsible for a substantial fraction of the total oxidation, a very large excess of hydrogen peroxide was used (at least 10-times the theoretical requirement). The intensity of the UV light was not reported. Therefore, the committee was unable to evaluate the efficiency of the UV/hydrogen peroxide unit.

The circulating brine was black, which suggests that the process was anaerobic in some areas. The black color-bodies were not identified, but, because of the black color, the brine was not suited for oxidation by the UV/hydrogen peroxide unit.

The air supply (116 cubic feet per minute [CFM]) was substantially less than planned (200 CFM) because of a much higher than expected pressure drop across the CATOX unit. The technology provider attributes this to an accumulation of corrosion products from the inlet line, but the CATOX ur[illegible]s not examined (Lupton, 1999). The technology pro[illegible]had obtained acceptable results with another unit when t[illegible]air supply was equivalent to 200 CFM. Although a larger air supply might have resulted in acceptable levels of destruction during the demonstration tests, this is merely conjecture. Even at the reduced level of 116 CFM, the oxygen supply was more than 10 times the stoichiometric requirement (i.e., with air in at 21 percent oxygen, air out contained 19.5 percent oxygen). The reduced air flow might have caused poor dispersion of air in the reactor or uneven mixing and stirring. Nevertheless, the technology provider should examine the CATOX unit thoroughly and reassess its design.

During demonstration, the BOD of the hydrolysate feed was unusually large (15,800 mg/L)—in fact, 85-fold larger than the BOD during prior tests (200 mg/L). No explanation was given for the very large BOD requirement, which was much larger than the calculated oxygen requirement for complete oxidation of the feed. The very small BOD in the earlier tests was much lower than the theoretical oxygen requirement and undoubtedly much lower than the oxygen actually consumed in the tests. Too low a BOD measurement may be explained as a poor BOD test with a biological culture poorly acclimated to the feed, for example. However, there is no apparent explanation for a BOD measurement higher than the BOD for total oxidation. Therefore, the committee believes the BOD measurements are questionable.

"Thiol," the major Schedule 2 compound produced from VX hydrolysis, is expected to be more than 50 percent of the

mass of Schedule 2 materials. Surprisingly, however, it is reported to be present in much smaller amounts, less than 5 percent in some cases. (To reduce the unpleasant odor, the hydrolysate may have been treated with sodium hypochlorite and the thiol oxidized, but no information on this is given. The treatment would have reduced the oxidation required of the bioreactor.)

According to the technology provider, the sludge produced in the biotreatment of nerve agents passed the TCLP tests satisfactorily. Because the treatment of these organophosphorus compounds was unsatisfactory, this sludge is not representative of the sludge that would be produced if the technology provider had developed an effective process. Thus, these TCLP tests are invalid.

The Army and its contractors have experienced problems with the analyses of the trace components in the effluents. For example, low concentrations of semi-VOCs and Schedule 2 compounds had to be measured in highly contaminated samples containing high concentrations of caustic. Many of the compounds in the effluents were never identified. Such solutions, as well as sludges, present difficult matrices in which to perform trace analyses. To lower the alkalinity, the samples were diluted extensively, thereby lowering further the concentrations of the trace components. Also, the caustic reacted with the absorbents, such as alumina, used in the chromatography columns (Arthur D. Little, Inc., 1999). In addition, the demonstration tests with the VX hydrolysate were delayed because the Army had difficulty analyzing the residual VX and certifying that the hydrolysate was safe prior to shipment.

The poor performance in the demonstration tests was attributed to the low air supply and the large BOD described above (Parsons-AlliedSignal, 1999b). However, the committee believes other factors may have been crucial:

- poor dispersion of air in the reactor leading to inadequate saturation of the liquid with oxygen
- inadequate acclimation of the biomass, particularly for handling phosphonate material

CATALYTIC OXIDATION

Catalytic Oxidation Unit for Mustard

The CATOX unit on the effluent gas from the biotreatment of HD hydrolysate appeared to work well, but because there were some difficulties in analyzing the gas for some EPA-regulated nonvolatile organic compounds, the gas composition was uncertain. The gas leaving the CATOX unit had traces of low molecular weight materials, which are considered acceptable. Chlorinated dioxins and furans were observed at very low levels in some of the analyses, but these compounds should be adsorbed from the gas by the carbon filter. No analysis of the gas discharged from the carbon filter was performed.

Catalytic Oxidation Unit for Nerve Agent

The technology provider claimed that the CATOX unit for the effluent gas from the biotreatment of GB and VX hydrolysates performed well. However, there was an unexpectedly large pressure drop across the unit (Lupton, 1999). Although both input and output streams were sampled, no data on the composition of the effluents were available.

METAL PARTS TREATER

The MPT system consisted of the following units:

- a cylindrical furnace heated electrically by induction heaters surrounding the cavity and by a flow of low-pressure superheated steam
- a furnace to generate and superheat the steam
- a heat exchanger to condense most of the outlet steam and the semi-VOCs
- a CATOX unit with a preheater and added air to treat gases leaving the condenser
- a solid caustic scrubber for the gas leaving the CATOX unit

The system was run in a batch mode. The chamber was loaded with the material to be treated, and the temperature and steam flow were ramped up to achieve a 5X decontamination condition. The chamber was cooled, opened, and the products examined. The proposed full-scale MPT system will have several batch reactors of the general type demonstrated, as well as a continuous reactor for some components (e.g., fuses and projectile burster casings). The continuous reactor will resemble the metal parts furnace of the baseline system but will be electrically and steam heated. The continuous processing unit was not included in the demonstration testing.

The MPT was tested with the following feeds:

- M60 105-mm projectile spiked with GB, VX, or HD
- dunnage of various kinds (wood, DPE suits, carbon)

To test a potential failure mode of the MPT, the CATOX unit associated with it was challenged by separately injecting 0.6 lb of each of the three neat agents over a four-hour period.

Qualitatively, the MPT system appeared to work well. Solid material remaining in the furnace was decontaminated to a 5X condition (free of agent). The condition of the material driven off in the furnace (the liquid and off-gas from the condenser) is more difficult to characterize. HD was reported to be less than 5 μg/L in the condensate; its breakdown (hydrolysis) products (thiodiglycol, 1,4-oxathiane, and dithiane) were at several hundred μg/L. In direct agent injection tests, GB was reported at 11 and 27 μg/L; VX at 60 and 220 μg/L. Their breakdown products were not reported. The volume flow of steam (and the volume of condensate) was not

-orted. Consequently, the breakdown level of the agents ıot be calculated.

A variety of VOCs were present in the condensate. The data on semi-VOCs were not available to the committee during the preparation of this report. There was some evidence of the reaction of organic materials with steam, but it was not possible to determine the extent or the weight fraction of feed material driven off in the furnace. The nature of the materials identified in the condensate suggests that they could be handled satisfactorily by recycling to the ICB reactor feed.

Neither analytical data on the gas from the condenser nor flow rates were included in the reports (DOD, 1999b; Parsons-AlliedSignal, 1999a). Some agent concentrations were reported based on analysis of depot area air monitoring system (DAAMS) tubes, which showed agent concentrations for VX from zero (i.e., not detected at the detection limit) to 25 times the time-weighted average (TWA) permissible exposure limit. (The committee assumed the TWA referred to was the stack-emission limit of 0.0003 mg/m^3).

During the direct injection tests, the CATOX unit destroyed the agent to a DRE of greater than 99.9999 percent. The very low levels of agent leaving the MPT unit should be destroyed in the CATOX (Parsons-AlliedSignal, 1999a).

The operational problems listed below must be addressed ır to the development of a final plant design:

- Some dunnage (e.g., DPE suits) generated gas too rapidly, resulting in an excessive temperature rise in the CATOX unit.
- Paint chips clogged the condenser liquid outlet.
- Some significant operational data were not reported: steam flow rate, liquid condensate rate, and vapor and air flow rates to the CATOX unit.
- The catalytic activity of the CATOX unit is expected to decline slowly with time, but this was not investigated during the demonstration tests.

It seems likely to the committee that the system performed its desired function. However, going from the batch, "unsteady-state" operation of the demonstration test unit to the proposed, "steady-state" flow operation will require further investigation by the technology provider.

SAFETY CONCERNS

The safety issues were discussed in the section on munitions-cutting and fluid-mining.

REEVALUATION OF STEPS REQUIRED FOR `LEMENTATION

The committee's earlier report identified seven steps required for implementation of the WHEAT technology (NRC, 1999).

The following steps would have to be taken to implement this technology package:

1. demonstration of the effectiveness of the biotreatment of various combinations of agent and energetics hydrolysates of sufficient length to give reasonable assurance of long-term performance

Mustard and energetics hydrolysates were effectively treated by the biotreatment process. However, nerve agent hydrolysates, which were mixed with energetic hydrolysates, were not digested by the microorganisms.

2. operation of the bioreactor at the planned salt-content

The demonstration tests were all done at very low salt contents (e.g., 0.5 weight percent). Other experience suggests that much higher salt contents could be tolerated (e.g., 2 weight percent [Lupton, 1999]).

3. characterization of the off-gas from the bioreactor to evaluate the extent of air-stripping from the reactor and the possible poisoning of the catalyst in the catalytic oxidation unit

This was not done during the demonstration tests (at least partly because of analytical difficulties). Therefore, the extent and rate of catalyst poisoning have yet to be determined. The extent of air stripping was not evaluated.

4. demonstration of the effectiveness and long-term performance of the catalytic oxidation system in destroying organic constituents in the bioreactor off-gas

Although the CATOX units appeared to perform well during the demonstration tests, their long-term performance remains to be demonstrated (see commentary on Step 3 above).

5. quantification and characterization of the sludge from the biological process to ascertain if Schedule 2 compounds or other hazardous constituents are present

The sludge from HD hydrolysates was tested and appeared to be nonhazardous. The sludge from the nerve agent hydrolysates also appeared to be acceptable, but they were the products of an operation that will require further development to perform satisfactorily and should, therefore, be retested as the system advances.

6. demonstration of unproven steps in the proposed process, including ultraviolet/peroxide oxidation and evaporation operations

Some "unproven steps" were demonstrated (e.g., high-pressure water-jet mining of explosives). Because the UV/hydrogen peroxide process was tested under very adverse conditions, its ultimate operation could not be evaluated. No brines were evaporated.

7. quantification and characterization of the salts from the evaporation operations to ascertain what organic compounds are present

Many partially oxygenated compounds were identified in the brine—some appeared in the dried salts and some evaporated in the drying operation. The compounds observed in the mustard/energetics process were materials typically observed in biotreatment plants. The nerve agent/energetics products, however, were the products of an unsatisfactory operation. Therefore, no conclusions can be drawn.

Because the demonstration test program was short, and because difficulties were encountered, few of the steps noted above were of sufficient duration to demonstrate long-term performance. However, it is reasonable to conclude that the biotreatment process will operate satisfactorily for HD hydrolysate. Because the nerve agent demonstration tests encountered many problems, further scale-up should be delayed until these problems have been resolved.

REVIEW OF PREVIOUS COMMITTEE FINDINGS

The demonstration program was responsive to some, but not all, of the committee's earlier findings.

> **Finding PA-1.** The biological treatment operation will require further demonstration to prove its ability (1) to handle a variety of feed stocks with reasonable acclimation times between changes, and (2) to achieve high levels of conversion of the Schedule 2 compounds in the hydrolysate. The demonstration will have to last long enough to give confidence in the long-term operational ability of the process.

The conversion rate of Schedule 2 compounds in the biotreatment process on mustard hydrolysate was high. Although acclimation time was longer than anticipated, this does not represent a serious problem. The results of the biotreatment of nerve agent hydrolysates, however, were discouraging. In both cases, the demonstration tests were too short in duration to demonstrate conclusively long-term operational reliability.

> **Finding PA-2.** The relative effects of biological treatment and air-stripping on the destruction of organic materials in the bioreactor have not been established. This will affect the composition of the off-gas from the bioreactor.

Air stripping was not seriously examined in the demonstration tests. However, the concentration of organics in the off-gas from the reactor was low.

> **Finding PA-3.** The effectiveness of ultraviolet/hydrogen peroxide oxidation in reducing Schedule 2 compounds to an acceptably low level has not been demonstrated. [Note: Applicable only to biotreatment of nerve agent hydrolysate.]

The UV/hydrogen peroxide process was operated under adverse conditions in the demonstration tests (i.e., the fluid was black and nontransparent).

> **Finding PA-4.** The bioreactor has been operated only at very low salt concentrations. Operation at design concentrations has not been demonstrated.

The demonstration reactions were also carried out only at low salt concentrations.

> **Finding PA-5.** Additional data should be gathered on the effectiveness of the catalytic oxidation system in destroying organic materials in the biotreatment of off-gas.

The CATOX system demonstrated high conversion of nerve agents and very low levels of materials in the off-gas. Input concentrations were very low, however, so the DRE could not be computed.

> **Finding PA-6.** The sludge from the biological process has not been completely characterized.

The sludges in the demonstration tests were extensively characterized. However, in contrast to the sludges produced from treatment of mustard hydrolysate, the sludges produced from biotreatment of nerve agent hydrolysates were not considered representative of a final acceptable process because of difficulties in processing the phosphonate form of phosphorus.

> **Finding PA-7.** Even though the evaporation operations involve conventional technologies, they have not been tested for this application.

No evaporation process was demonstrated.

> **Finding PA-8.** The dried salts from the evaporation operations have not been characterized for leachability and toxicity.

No dried salts were produced. Therefore, whether or not the dried salts will meet leachability and toxicity requirements for disposal, either with or without stabilization, was not determined.

SUPPLEMENTAL FINDINGS AND RECOMMENDATION

As a result of the demonstration tests, the committee's earlier findings (discussed above) have been supplemented by two new findings and a new recommendation:

Finding PA-1. The mustard demonstration tests were very encouraging and showed that the process is ready for the next scale-up.

Finding PA-2. The nerve agent demonstration tests had serious problems. However, if the previous tests at the technology provider's laboratory and the results of the demonstration tests are combined, the aggregate results are inconclusive. The reason for the poor demonstration results might be as simple as poor aeration in the bioreactor (see Recommendation PA-1).

Recommendation PA-1. Before proceeding to a further scale-up of GB and VX biotreatment processing, the committee recommends that the following steps be taken:

- The biotreatment process should be examined carefully at bench scale to determine the factors that are critical to success.
- An investigation of analytical techniques should be undertaken to provide more reliable process information.

5

Update of General Findings and Recommendations

Chapter 11 of the committee's initial report, *Review and Evaluation of Alternative Technologies for Demilitarization of Assembled Chemical Weapons*, included 16 general findings and seven general recommendations (NRC, 1999). For the most part, these findings and recommendations remain unaffected by the results of the demonstration tests of the three technology packages. Each of these findings and recommendations is quoted below followed by a discussion of the effect of the demonstration tests results. New findings are then presented.

REVIEW OF EARLIER FINDINGS AND RECOMMENDATIONS

> **General Finding 1.** The chemistries of all four of the primary technologies, (hydrolysis, SILVER II, plasma arc, and SET) as proposed, can decompose the chemical agents with destruction efficiencies of 99.9999 percent. However, each technology package raises other technical issues that must be resolved. One of the crucial issues is the identity and disposition of by-products.

Two of the three technology packages chosen for ACWA demonstration rely on hydrolysis as the primary treatment process. The third is based on plasma arc technology. Hydrolysis of agents was not a direct part of the demonstrations. However, the PMACWA produced approximately 1,100 gallons of GB hydrolysate, 400 gallons of VX hydrolysate, and 4,200 gallons of HD hydrolysate as starting materials for the demonstrations. The Army's ability to produce agent hydrolysates that show no agent above detection limits confirms the effectiveness of hydrolysis in destroying both mustard and nerve agents to a DRE of 99.9999 percent.

Although the Burns and Roe team did not conduct demonstration tests for the destruction of neat chemical agents, the committee continues to believe that a properly engineered plasma arc device could destroy both mustard and nerve agents to a DRE of 99.9999 percent.

General Finding 2. The technology base for the hydrolysis of energetic materials is not as mature as it is for chemical agents. Chemical methods of destroying energetics have only been considered recently. Therefore, there has been relatively little experience with the alkaline decomposition of ACWA-specific energetic materials (compared to experience with chemical agents). The following significant issues should be resolved to reduce uncertainties about the effectiveness and safety of using hydrolysis operations for destroying energetic materials:

- the particle size reduction of energetics that must be achieved for proper operation
- the solubility of energetics in specific alkaline solutions
- process design of the unit operation and the identification of processing parameters (such as the degree of agitation and reactor residence time) necessary for complete hydrolysis
- the characterization of actual products and by-products of hydrolysis as a function of the extent of reaction
- the selection of chemical sensors and process control strategies to ensure that the unit operation following hydrolysis can accept the products of hydrolysis
- development of a preventative maintenance program that minimizes the possibility of incidents during the cleanup of accumulated precipitates

General Finding 3. The conditions under which aromatic nitro compounds, such as trinitrotoluene (TNT) or picric acid, will emulsify in the aqueous phase and not be completely hydrolyzed are not well understood. Therefore, this type of material could be present in the output stream from an energetic hydrolysis step.

General Finding 4. The products of hydrolysis of some energetic materials have not been characterized well enough to support simultaneous hydrolysis of different kinds of energetic materials in the same batch reactor.

General Recommendation 5. Whatever unit operation immediately follows the hydrolysis of energetic materials should be designed to accept emulsified aromatic

nitro compounds, such as TNT or picric acid, as contaminants in the aqueous feed stream. (See General Finding 3.)

General Recommendation 6. Simultaneous processing of different types of energetic materials should not be performed until there is substantial evidence that the intermediates formed from the hydrolysis of aromatic nitro compounds will not combine with M28 propellant additives or ordnance fuze components to form extremely sensitive explosives, such as lead picrate. (See General Finding 4.)

The hydrolysis of energetics performed during the ACWA demonstrations substantiates the findings and recommendations cited above. The committee is concerned that the technology for the hydrolysis of energetic materials may be even more immature than was originally anticipated. Problems were experienced in scale-up test runs for Comp B and tetrytol that were not apparent during laboratory-scale tests. Because the hydrolysis of lead stearate produces lead hydroxide, toxicity is a potential problem, justifying the committee's concern about the possible formation of lead picrate if M28 propellant is simultaneously hydrolyzed with Comp B or tetrytol bursters.

The Army and General Atomics have acknowledged that more work needs to be done before the hydrolysis of energetics can be considered safe and effective at production-le levels (DOD, 1999c, 1999d; General Atomics, 1999a). e demonstration tests provided a large body of data. The Army has assembled a team of agencies to analyze the preliminary results, assess the efficacy of the processes, and identify problems and their causes and effects. Further experimentation is also being planned.

General Finding 5. The primary chemical decomposition process in all of the technology packages produces environmentally unacceptable reaction products. Therefore, all of the packages are complicated processes that include subsequent treatment step(s) to modify these products.

The General Atomics and the Parsons-AlliedSignal technology packages use hydrolysis for primary chemical decomposition, whereas the primary treatment process in the Burns and Roe package is the PWC. Analyses of the agent hydrolysates produced by the PMACWA for the demonstration tests confirmed General Finding 5. In other words, the hydrolysates contained Schedule 2 compounds and other products that are not suitable for direct discharge to the environment. The PWC used for the demonstration was not tested on agents or under conditions that produced acceptable synfuel. Consequently, PWC by-products produced from agents must still be characterized.

General Finding 6. The waste streams of all of the ACWA technology packages could contain very small amounts of hazardous substances (besides any residual chemical agent). These substances were not fully characterized at the time of this report; therefore, all waste streams must be characterized to ensure that human health and the environment are protected. If more than one phase (gas, liquid, or solid) is present in a waste stream, each phase should be characterized separately.

Although a large body of data was gathered, the tests of unit operations from the three technology packages during the demonstrations were of short duration and were conducted with undersized reactors. In addition, the operating conditions were not optimized. Thus, the effluents that were produced may not be completely representative of the effluents that would be produced in units operating at different conditions (e.g., temperature, pressure, etc.).

General Finding 7. None of the proposed technology packages complies completely with the hold-test-release concept for all gaseous effluents (both process and ventilation effluents).

General Finding 8. Hold-test-release of gaseous effluents may not ensure against a release of agent or other hazardous material to the atmosphere. No evidence shows that hold-test-release provides a higher level of safety than current continuous monitoring methods for gaseous streams with low levels of contamination. Furthermore, none of the technologies provides for hold-test-release of effluents from ventilation systems that handle large volumes of gases from contaminated process areas.

Because the basic configurations of the three demonstrated technology packages have not changed, General Findings 7 and 8 remain unchanged. Hold-test-release was not included in the demonstration tests.

General Finding 9. Solid salts will be hazardous waste, either because they are derived from hazardous waste...or because they leach heavy metals above the levels allowed by the Resource Conservation and Recovery Act Toxicity Characteristic Leaching Procedure. Stabilization—mixing waste with a reagent or reagents to reduce the leachability of heavy metals—will probably be required before the salts can be sent to a landfill. The potentially high chloride and nitrate content of these salts will make the waste difficult to stabilize, and treatability studies will be necessary to determine a proper stabilization formula.

General Finding 9 remains unchanged because the demonstrations did not test the ability of unit operations to produce dried salts.

General Finding 10. Testing, verification, and integration beyond the 1999 demonstration phase will be necessary because the scale-up of a process can present many unexpected challenges, and the ACWA demonstrations were limited in nature.

The committee considers the demonstration tests as "proof-of-concept" tests of the demonstrated unit operations. In nearly all cases, the conditions during the tests had to be modified in some respects, and, in many cases, significant alterations had to be made to the procedures. Finally, the critical step of integrating the unit operations has not yet been addressed by the technology providers for any of the demonstrated technology packages.

The committee believes that the following general findings and recommendations from the committee's original report were not affected in any way by the demonstration tests of the three technology packages.

General Finding 11. Although a comprehensive quantitative risk assessment (QRA), health risk assessment (HRA), and ecological risk assessment (similar to assessments performed for the baseline process) cannot be completed at this stage of process development, these assessments will have to be performed and refined as process development continues.

General Finding 12. The "optimum" system for a particular chemical weapons storage depot might include a combination of unit operations from the technology packages considered in this report.

General Finding 13. Some of the ACWA technology providers propose that some effluent streams be used commercially. New or modified regulations may have to be developed to determine if these effluent streams can be recovered or reused.

General Finding 14. An extraordinary commitment of resources will be necessary to complete the destruction of the assembled chemical weapons stockpile in time to meet the current deadline using any of the ACWA technology packages. This would demand a concerted national effort. It is unlikely that any of the technology packages could meet this deadline.

General Finding 15. The Dialogue process for identifying an alternative technology is likely to reduce the level of public opposition to that technology. The committee believes that the Dialogue has been and continues to be a positive force for public acceptance of alternatives to incineration. Although the Dialogue process requires a significant commitment of time and resources, it has been a critical component of the ACWA program to date.

General Finding 16. Although the committee did not have access to scientific data on the attributes of a technology that would be most acceptable to the public, input from members of the active publics and previous research indicates that technologies with the following characteristics are likely to stimulate less public opposition:

- minimal emissions, particularly gaseous
- continuous monitoring of effluents to verify that the process is operating as designed (process assurance measurement)
- provisions for representatives of the local community to observe and participate in the process assurance measurement

General Recommendation 1. If a decision is made to move forward with any of the ACWA technology packages, substantial additional testing, verification, and integration should be performed prior to full-scale implementation (see General Finding 10).

General Recommendation 2. The sampling and analysis programs at each phase of development should be carefully reviewed to ensure that the characterization of trace components is as comprehensive as possible to avoid surprises in the implementation of the selected technology (see General Finding 6).

General Recommendation 3. If a decision is made to move forward with any of these technology packages, health and safety evaluations should progress from qualitative assessments to more quantitative assessments as the process design matures. Quantitative (QRA), health (HRA), and ecological risk assessments should be conducted as soon as is practical. Early initiation of these assessments will allow findings to be implemented with minimal cost and schedule impact (see General Finding 11).

General Recommendation 4. Any of these technology packages, or any component of these technology packages, should be selected on a site-specific basis (see General Finding 12).

General Recommendation 7. The Department of Defense should continue to support the Dialogue throughout the current ACWA program and should seriously consider the participation of the Dialogue in follow-on programs.

SUPPLEMENTAL GENERAL FINDINGS

In the Statement of Task for this report, the committee was asked to determine if any of the technology packages chosen for demonstrations was "viable to proceed with implementation of a pilot-scale program that would employ any of these technologies." The committee has evaluated the maturity of each unit operation in the proceeding chapters of this report. Table 5-1 provides a summary of the committee's assessments.

General Finding 1. Based on the committee's assessment of the maturity of the various unit operations (as summarized in Table 5-1), none of the three technology packages is ready for *integrated* pilot programming, although certain unit operations are sufficiently mature to bypass pilot testing (e.g., hydrolysis of agent).

The demonstrated PWC system of the Burns and Roe technology package does not appear to be ready for pilot testing for any assembled chemical weapons materials. The demonstrated components of the General Atomics technology package are close to achieving an overall acceptable level of maturity. However, certain key demonstration tests were not performed or the results were inconclusive. The demonstrated components of the Parsons-AlliedSignal technology package are also close

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TABLE 5-1 Summary Evaluation of the Maturity of Demonstrated Unit Operations and Processes[a]

	Hydrolysates			Agent Munitions			
Unit Operation/Process	VX/GB	HD	Energetics	VX/GB	HD	Energetics	Other
Burns and Roe							
Plasma waste converter[b]	C	C	D	D	D	E	C[c, d, e]
General Atomics							
Hydrolysis				A	A		
Rotary hydrolyzer						C	
Shredding/hydropulping							A[c]
SCWO	B	B	C				C[c]
Parsons-AlliedSignal							
Munitions accessing				B	B	B	
Hydrolysis				A	A	C	
Biotreatment	D	A	A				
Catalytic oxidation							B[c]
Metal parts treater				B	B	D	B[d]

Note: Environmental and safety issues were considered in assigning maturity categorizations. Schedule and cost issues were not considered.

[a] The letter designations are defined as follows (a blank space indicates categorization was not applicable for that material).
- A Demonstration provides sufficient information to allow moving forward to full-scale design with reasonable probability of success.
- B Demonstration provides sufficient information to allow moving forward to the pilot stage with reasonable probability of success.
- C Demonstration indicates that unit operation or process requires additional refinement and additional demonstration before moving forward to pilot stage.
- D Not demonstrated; more R&D required.
- E Demonstrated unit operation or process is inappropriate for treatment.

[b] ludes integrated gas polishing system to support demonstration
[c] unnage
[d] Metal parts
[e] Effluents

to being ready for pilot testing, but only for mustard-bearing munitions. Hydrolysis of agent (used in the General Atomics and Parsons-AlliedSignal technology packages) appears sufficiently mature to consider full scale application to any assembled chemical weapons. Similarly, biotreatment of hydrolysate (Parsons-AlliedSignal technology package) appears sufficiently mature for full scale application to mustard munitions.

General Finding 2. The demonstration tests were not operated long enough to demonstrate reliability and long-term operation.

The PMACWA's demonstration plan was severely constrained by both scheduling deadlines and available budget resources. The technology providers did not have enough time for systemization (preoperational testing). Consequently, the committee maintains that these tests were simply "proof-of-concept" demonstrations that indicate whether or not a particular unit operation (with more development) might be applicable to the disposal of assembled chemical munitions.

General Finding 3. The committee reiterates that none of the unit operations has yet been integrated into a complete system. The lack of integration is a major concern and a significant obstacle to full-scale implementation.

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Appendix A

Findings and Recommendations from the 1998 Report on Supercritical Water Oxidation

The following paragraph and the subsequent findings and recommendations are taken directly from *Using Supercritical Water Oxidation to Treat Hydrolysate from VX Neutralization* (NRC, 1998). They are reproduced here because the committee considers them applicable to the supercritical water oxidation (SCWO) technology evaluated in this study.

EXCERPT

Chemical neutralization of VX nerve agent results in the production of a liquid hydrolysate stream that has greatly reduced toxicity compared to the original nerve agent but requires further treatment to meet the requirements of the Chemical Weapons Convention and to be suitable for disposal. After considering several approaches, the U.S. Army has selected SCWO (supercritical water oxidation) as the primary process for treating the hydrolysate from VX neutralization prior to ultimate disposition. The integration of SCWO into the complete process for the destruction of VX stored at Newport, Indiana, also requires an evaporator system after SCWO treatment to allow water to be recycled back into the neutralization process. The evaporation system also produces a dry solid waste stream consisting of salts produced during the neutralization and SCWO treatment steps. Excess condensed water from the evaporator is expected to be of relatively high purity and suitable for discharge. The technology selected for the evaporation process step is mature with considerable full-scale design and operations experience. In contrast, treatment of the hydrolysate will be a new application for SCWO. Thus, the findings and recommendations presented here focus on the use of SCWO for the treatment of VX hydrolysate.

FINDINGS

Finding 1. Limited pilot-scale testing has demonstrated the ability of SCWO to achieve high destruction efficiencies for the organic constituents of VX hydrolysate. Effluent from SCWO treatment of VX hydrolysate has been shown to have negligible acute toxicity in intravenous testing in mice, gavage testing in rats, and dermal testing in rabbits. The separation of salts in the effluents from SCWO through an evaporator system should produce relatively pure water suitable for discharge and solid salts suitable for disposal. Treatment requirements for VX hydrolysate are less stringent than they are for VX because the hydrolysate has low toxicity relative to the agent. However, criteria for process destruction efficiency and final disposal standards have not been established.

Finding 2. Using SCWO to treat VX hydrolysate is significantly different and more complex than previous applications. SCWO systems on a pilot scale have been used to treat several other types of wastes, but SCWO is in commercial operation at only one site. There has been only limited pilot-scale or operational-scale experience with wastes that are similar to VX hydrolysate in being highly corrosive and salt-laden. Operation with VX hydrolysate or appropriate surrogates at design conditions, equipment configuration, or approximate scale for full-scale operations has not been demonstrated. A vertical cylindrical reactor is the only reactor configuration that has been successfully demonstrated to date at pilot scale for the treatment of VX hydrolysate and similar waste streams. Additional development and pilot-scale testing of SCWO technology will be necessary to ensure sustained, reliable operation of a full-scale integrated treatment system. Sufficient time appears to be available in the Army's implementation schedule for the Army to carry out development and testing for using SCWO at the Newport site, provided they are carried out expeditiously.

Finding 3. Pilot-scale operation of SCWO in a vertical cylindrical reactor at the temperature and pressure necessary for the effective destruction of hydrolysate constituents has been limited to one eight-hour and two less than two-hour tests. During pilot-scale testing with hydrolysate, the following factors were identified that could create difficulties in sustaining system performance:

- Large quantities of insoluble salts were produced, which must be effectively managed within, and downstream of, the SCWO reactor.

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- Unexpected fluctuations were observed in temperature, pressure, and salt expulsion from the SCWO reactor.
- High levels of corrosion and erosion of materials of construction were observed in the reactor liner and pressure let-down valves.
- The sustained performance and reliability of the pressure let-down system was not demonstrated.

Although at this point in development the Stockpile Committee cannot be certain, it believes that a SCWO system for the treatment of VX hydrolysate with sufficient sustained performance can be achieved with additional development and testing.

Finding 4. Limited bench-scale and pilot-scale tests have demonstrated operating regimes under which SCWO can effectively destroy carbon-phosphorus bonds and oxidize the organic constituents present in VX hydrolysate. The demonstrated conditions for high levels of destruction (> 99 percent) include temperatures between 640°C (1184°F) and 730°C (1346°F) and pressures between 231 and 258 atm (3395 to 3792 psi). At temperatures and pressures below this regime, effluent from SCWO processing may contain significant concentrations of residual organic species that are difficult to destroy, including constituents with carbon-phosphorus bonds.

A basis for the reliable scale-up and operation of SCWO technology for the treatment of VX hydrolysate has not yet been demonstrated. Fundamental knowledge about the following processes within the SCWO reactor is still not available:

- the number and characteristics of the physical phases, including large quantities of entrained and adhered solids and potentially liquid, gas, and supercritical fluid phases
- fluid dynamics and mixing processes complicated by relatively high loadings of insoluble salts
- heterogeneous and homogeneous reaction mechanisms and kinetics
- salt nucleation, particle growth, agglomeration and adhesion mechanisms, and kinetics

Because the understanding of fundamental processes is limited and the process operational data and experience are sparse, empirical design and engineering judgment will be required for the selection of a prudent scale for development prior to full-scale demonstration. This is common engineering practice.

Finding 5. Alkaline VX hydrolysate and its destruction products under SCWO reaction conditions create an extremely corrosive and erosive environment that requires the careful selection of materials of construction. Although preliminary data indicate that certain noble metals, such as platinum and gold, may have acceptable properties, the data currently available are insufficient for the selection of materials of construction. The Army has initiated further testing of materials of construction.

Finding 6. Process monitoring and control strategies for the management of salts within the SCWO reactor and the destruction of the organic constituents of the hydrolysate have not been demonstrated.

RECOMMENDATIONS

Recommendation 1. A pilot-scale SCWO process facility with the critical characteristics of the full-scale design should be constructed and operated to further define operating characteristics and demonstrate sustained continuous operation of the process. Objectives for process development and demonstration should include:

- operation with either hydrolysate or a suitable surrogate to demonstrate reliable operation for periods similar to full-scale design operating cycles
- the development and validation of process monitoring and control strategies for salt management and the destruction of organic constituents
- the definition of stable operating regimes, including the temperature, pressure, and the use of the oxidant (liquid oxygen or compressed air) selected for full-scale operation
- the definition of a basis for process scale-up, operation, and maintenance of a full-scale system
- the development and demonstration of a reliable pressure let-down system

Because the understanding of the fundamental process mechanisms and operating characteristics is limited, the committee recommends that the pilot-scale system be within an order of magnitude of the total mass and heating throughput of a full-scale design unit. Based on testing and reactor scale-ups to date, a vertical cylindrical reactor configuration is recommended as the system that will probably require the least amount of additional development. Other reactor configurations may perform at required levels but would require significant additional development.

Recommendation 2. Testing of materials of construction should be carried out as necessary to finalize the selection of materials for critical components, including the SCWO reactor and the pressure let-down system. Additional pilot-scale testing indicated in Recommendation 1 should include fabrication with the materials of construction selected from testing smaller samples and evaluation of corrosion and erosion rates for critical components.

Recommendation 3. Flexibility and redundancy of critical components should be incorporated into the design of the full-scale system to allow for uncertainties about the basis for scale-up and operation. Trade-offs should be evaluated to establish an appropriate balance between two 100-percent capacity SCWO reactors or a greater number of smaller reactors. The analysis should consider performance uncertainties associated with process scale-up and complexity, as well as the reliability of operating several reactors in parallel.

Recommendation 4. The Army should make provisions for targeted research and development to resolve

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problems identified during pilot-scale testing and the full-scale implementation of SCWO technology.

Recommendation 5. Requirements for process destruction efficiencies and final disposal standards for all effluent streams from SCWO treatment should be clearly defined to ensure that the final design meets regulatory standards.

REFERENCE

NRC (National Research Council). 1998. Using Supercritical Water Oxidation to Treat Hydrolysate from VX Neutralization. Committee on Review and Evaluation of the Army Chemical Stockpile Disposal Program, Board on Army Science and Technology. Washington, D.C.: National Academy Press.

Appendix B

Biographical Sketches of the Committee Members

Robert A. Beaudet, *chair,* received his Ph.D. in physical chemistry from Harvard University. He joined the faculty of the University of Southern California in 1962 as an assistant professor and is now a full professor in the Chemistry Department. He has extensive knowledge of chemical-agent monitoring and detection technologies and has served on several Department of Defense committees on chemical-warfare agents.

Richard J. Ayen received his Ph.D. in chemical engineering from the University of Illinois. Dr. Ayen is currently an independent consultant and was formerly the director of technology for Waste Management, Inc. He has extensive experience in the evaluation and development of new technologies for the treatment of hazardous, radioactive, industrial, and municipal waste.

Joan B. Berkowitz graduated from the University of Illinois with a Ph.D. in physical chemistry. Dr. Berkowitz is currently managing director of Farkas Berkowitz and Company. She has extensive experience in the area of environmental and hazardous-waste management, a comprehensive knowledge of available technologies for the cleanup of contaminated soils and groundwater, and a strong background in physical and electrochemistry.

Nosa O. Egiebor graduated from Queens University in Kingston, Ontario, with a Ph.D. in mineral process and reaction engineering. Dr. Egiebor currently holds the Department of Energy Samuel P. Massie Chair of Excellence in Environmental Engineering at Tuskegee University. His areas of expertise span a broad range of topics in environmental engineering; his specific focus is on the biotreatment of hazardous wastes and supercritical-fluid technology.

Willard C. Gekler graduated from the Colorado School of Mines with a degree in petroleum-refining engineering. Mr. Gekler, formerly vice president, chief engineer at PLG, Inc., is currently an independent consultant. His extensive experience includes design and safety analysis of hazardous-materials handling, storage, and waste-treatment systems. He specializes in hazard evaluation, quantitative risk analysis, reliability assessment, and database development for risk and reliability.

Hank C. Jenkins-Smith received his Ph.D. in political science from the University of Rochester. Dr. Jenkins-Smith is currently a professor in the Department of Political Science at the University of New Mexico, where he is also the director of the Institute for Public Policy. His areas of expertise include statistical analysis, measurement of public opinion, politics of risk perception, environmental policy, and public policy.

John L. Margrave, a member of the National Academy of Sciences, graduated from the University of Kansas with a B.S. in engineering physics and a Ph.D. in physical chemistry. Dr. Margrave is currently the chief scientific officer at the Houston Advanced Research Center and the E.D. Butcher Professor of Chemistry at Rice University. His expertise is in high-temperature chemistry, materials science, and environmental chemistry.

Walter G. May, a member of the National Academy of Engineering (NAE), graduated with a Sc.D. in chemical engineering from the Massachusetts Institute of Technology. He was the senior science advisor for Exxon Research and Engineering Company from 1976 to 1983 and professor of chemical engineering at the University of Illinois from 1983 until his retirement in 1991. His expertise is in process design, thermodynamics, chemical-reactor design, separation processes, industrial chemistry and stoichiometry, and chemical-weapons disposal.

Kirk E. Newman received a B.S. in chemistry from the

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College of William and Mary and an M.S. in chemical engineering from the University of Virginia. Mr. Newman is currently technology group leader for the Yorktown Detachment of the Naval Surface Warfare Center, Indian Head Division. He has extensive experience in the development, processing, and characterization of energetic materials used in military applications.

Jimmie C. Oxley received her Ph.D. in chemistry from the University of British Columbia in Vancouver and is currently an associate professor of chemistry at the University of Rhode Island. Her expertise is in thermal decomposition of energetic materials, explosives chemistry, and explosives safety.

William R. Rhyne received a B.S. in nuclear engineering from the University of Tennessee and an M.S. and D.Sc. in nuclear engineering from the University of Virginia. Dr. Rhyne is cofounder and director of H&R Technical Associates, Inc. He has extensive experience in risk and safety analysis associated with the processing and transport of hazardous nuclear materials and chemicals.

Stanley I. Sandler, a member of the NAE, graduated from the University of Minnesota with a Ph.D. in chemical engineering. Currently, he is the Henry Belin du Pont Professor and director of the Center for Molecular and Engineering Thermodynamics at the University of Delaware. His extensive research interests include applied thermodynamics and phase equilibrium, environmental engineering, and separations and purification.

William Randall Seeker, who received his Ph.D. in nuclear and chemical engineering from Kansas State University, is senior vice president of GE Energy and Environmental Research Corporation. Dr. Seeker has extensive experience in the use of treatment technologies and environmental-control systems for managing solid waste and controlling air pollution emissions. He is a member of the Executive Committee of the Environmental Protection Agency's Science Advisory Board.

Leo Weitzman received his Ph.D. in chemical engineering from Purdue University. He is a consultant with 28 years of experience in the development, design, permitting, and operation of equipment and facilities for treating hazardous wastes and remediation debris. Dr. Weitzman has extensive experience in the disposal of hazardous waste and contaminated materials by thermal treatment, chemical reaction, solvent extraction, biological treatment, and stabilization.

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ATTACHMENT U

Additional Transcript Excerpts and Expert Witness Declaration from various Utah-related proceedings (State and Federal Courts and USHW Board)

TITLE OF DOCUMENT	RELATED EXHIBIT NUMBER	PAGE
Testimony of Dr. Brent L. Finley; March 20, 1997 in the matter of "The Tooele Chemical Agent Disposal Facility's Permit and Permit Modifications" in a hearing before the Utah Solid and Hazardous Waste Control Board, Volume III of Transcript, pp. 836-887.	47	U-1
Deposition of Timothy W. Thomas, February 5, 1998, for the U.S. District Court for the District of Utah, CWWG, et al., Plaintiffs, *vs.* U.S. Department of Army, et al.; Defendants, Case No. 2:96CV-0425C, **pp. 19-34.**	25	U-15
Deposition of Timothy W. Thomas, February 5, 1998, for the U.S. District Court for the District of Utah, CWWG, et al., Plaintiffs, *vs.* U.S. Department of Army, et al.; Defendants, Case No. 2:96CV-0425C, **pp. 134-161.**	25	U-24
Deposition of Timothy W. Thomas, February 5, 1998, for the U.S. District Court for the District of Utah, CWWG, et al., Plaintiffs, *vs.* U.S. Department of Army, et al.; Defendants, Case No. 2:96CV-0425C, **pp. 203-215.**	25	U-39
Declaration of James J. Cudahy, July 15 1996	30	U-47
Declarations of James J. Cudahy, October, 1996	30	U-70
Declaration of James J. Cudahy, February 4, 1997	30	U-76
Declaration of James J. Cudahy, December 1, 1997	30	U-83
Professional Qualifications of James J. Cudahy	30	U-91
Deposition of Richard Holmes, April 14, 1998, for the U.S. District Court for the District of Utah, CWWG, et al., Plaintiffs, *vs.* U.S. Department of Army, et al.; Defendants, Case No. 2:96CV-0425C, **pp. 170-175.**	33 & 34	U-101

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STATE OF UTAH

DEPARTMENT OF ENVIRONMENTAL QUALITY

SOLID AND HAZARDOUS WASTE CONTROL BOARD

IN THE MATTER OF: The Tooele Chemical Agent Disposal Facility's Permit and Permit Modifications	))))	TRANSCRIPT OF HEARING Volume III EPA ID #UT5210090002

DATE: March 20, 1997

TIME: 7:00 a.m.

PLACE: Department of Environmental Quality
Office of the Executive Director
168 North 1950 West
Conference Room 101
Salt Lake City, Utah

CERTIFIED COPY

ANGIE L. KIRK
CSR No. 271

INDEPENDENT REPORTING SERVICE
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1710 Beneficial Life Tower
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(801) 538-2333

MR. KOHNS: We'll call Dr. Brent Finley.

BRENT FINLEY, M.D.
was called as a witness, having been first duly sworn, was examined and testified on his oath as follows:

DIRECT EXAMINATION

BY MR. KOHNS:

Q: For the record, would you please state your full name current employment.

A: Full name is Brent Leonard Finley. My current employment is McClaran Heart Environmental Engineering.

Q: Dr. Finley, could you give the board an idea of your educational background.

A: I have a Bachelor's Degree in Biochemistry from Cornell University which I obtained in 1982; a Ph.D. in toxicology, pharmacology which I obtained in 1986 from Washington State University. I did a year of post-op research after receiving my Ph.D. and then have been a consultant since 1988 in risk assessment. I'm also board certified in toxicology.

Q: What does that mean to be board certified in toxicology?

A: Well, it basically means that you have passed a written exam, a three-part written exam which requires you to pass each part. There is a recertification that is

approximated every five years, also, a written exam. I also have to pass all three parts. I think there's probably between 250 and 300 what are called DABT's. Three hundred DABT's or so in the United States.

Q: What other boards do require recertification like that?

A: I'm thinking of medical boards. I think this is getting beyond my area of expertise. I'm not aware of other boards that require passing a written exam every five years.

Q: Have you passed that written exam every five years?

A: Yes.

Q: Let me focus in a little bit on your risk assessment experience. Have you ever authored, designed or overseen performance of risk assessment?

A: Sure. Probably somewhere between maybe 200 and 300 risk assessments in the last ten years.

Q: And how many of those have involved incineration facilities?

A: Probably between five and ten.

Q: Does EPA provide guidance on performing these risk assessments for incinerators?

A: Sure.

Q: And what's the date of the applicable version of

the guidance?

A: My recollection is it's April 1994 Exposure Assessment Guidance for RCRA.

Q: What is the purpose of a screening of a risk assessment?

A: I don't know how much detail you've gone into that already.

Q: None so far. Feel free to answer.

A: The purpose of a screening level risk assessment is to try to ascertain using limited amounts of resources, which means using very conservative uncertain assumptions about whether or not a risk truly exists, using, again, a short time frame, limited information on site specifics. Basically, what you do in a screening level risk assessment is pile on the conservatisms and at the end look at your results and make a conclusion of yes, no, or do these results indicate a potentially significant risk or not.

Q: You use the word "conservative." What does that term mean in risk assessment?

A: In the screening mobile risk assessment world, in the risk assessment universe, conservative means an assumption that is intentionally overstating what is known to be true. Maybe using a maximum value when we know most of the values are going to be less than that or

overstating an expose or something like that, using something that's known to be close to implausible.

Q: And what does the use of these conservative assumption mean for a risk assessment's ultimate results?

A: Well, it will depend on the assessment. As you have more pathways and more exposure factors, what happens is you accumulate conservatism throughout the assessment, and basically the final result of such an assessment will manifest that conservatism and the final result is a number that is understood contains a healthy degree of conservatism. It shouldn't be taken as being a real number, not a real accurate estimate, but something that contains some measure of built-in conservatism.

Q: Does this implement in '94 Risk Assessment require risk assessors to stop after the first incineration a Screening Risk Assessment is done?

A: Required to stop?

Q: Right. In other words, how does it deal with use of drafts and iterations and that sort of thing?

A: You're not required to stop. Basically you do your screening level assessment. If at that point it's clear that there's no risk, even under these implausible worse case assumptions, you're done. There's no point in continuing. You've proven beyond a shadow of a doubt there can't be a risk there.

If the results indicate that under these conservative assumptions there is potentially – if the results are such that they exceed some criteria of what's considered an assumable risk, then the risk assessor is required to go back and conduct a more refined analysis. Sometimes a sensitivity analysis is conducted where you go back and look at the individual factors and try to decide which one is influencing the risk and, if possible, incorporate some refinements into those factors if you can.

Q: Let's focus in now on the 1996 version of the Risk Assessment that was done by AT Kearney. Have you reviewed that document?

A: Yes.

Q: Can you please describe for the board again, briefly, how AT Kearney went about its process, how that document reaches its conclusions.

MR. HARRISON: Excuse me, Mr. Chairman. There's no foundation for this witness who did not offer this Risk Assessment knowing how it was prepared or how they reached their conclusions other than from the face of the document.

MR. KOHNS: That's exactly what I would like this witness to describe to the board, form the perspective of a public risk assessor to give how this complex document logically goes through its process and

reaches its conclusions.

MR. HARRISON: Mr. Chairman, just to clarify. If the witness is going to answer how this document came to be, we have another witness later today, Mrs. Sellers, who authored it. We also have a series of documents showing its history. If the witness is simply describing a risk assessment process in general, that's fine. But it is not for this witness to describe how this risk assessment was done.

MR. KOHNS: Mr. Chairman, I have no idea of what the examination Mr. Harrison has planned for Mrs. Sellers.

We have this witness right here right now who is prepared, in less time than this exchange has taken, to explain how the logic of it pulls together.

MR. HARRISON: I'll retain my objection for lack of foundation.

THE CHAIRMAN: Go ahead and answer his question to the best of your ability.

THE WITNESS: I'll give you the 60-second version. It's a pretty standard risk assessment. They basically start with the emission rates that they took from another facility because no emission data existed at the time. Then they went through an emission scenario and used the exposure scenarios that were dictated in the guidance for farmers, residents, et cetera; calculated

uptake of the chemicals via inhalation, ingestion, what have you.

Then based on that dose, how much chemical gets in the body, they then characterize the risk by using EPA toxicity criteria. I think those were discussed a little bit already. Those are basically the numbers the EPA publishes that said this is the value you would use for this chemical for this pathway. Then they characterize non-cancer and cancer risk for the various scenarios and discuss some of the uncertainty.

MR. KOHNS: Mr. Utley, I'm afraid I overlooked a bit of administrative paperwork.

Q: (BY MR. KOHNS) Dr. Finley, did you submit a declaration in with this proceeding?

A: Yes.

MR. KOHNS: And, again, for the record, that's already been attached and admitted. I guess we will be referring to this document. I'll hand Mr. Finley a copy of this document now.

THE CHAIRMAN: For the record, this has been admitted into evidence.

Q: (BY MR. KOHNS) Dr. Finley, did the February '96 version of the Kearney Risk Assessment use conservative assumptions?

A: Certainly.

Q: Can you give the board some examples of those?

A: Well, again, I'll give you this brief version, because that could take some time, in my mind, I divide it up into the emissions and the exposure segments. In the emissions they certainly overestimated the emissions of chemicals. I won't go into a lot of detail. I believe it's explained in some detail in my declaration. For detecting chemicals they use the maximum measured value; for non-detected chemicals they use the limited detection, which is a very conservative assumption. In some cases I believe they use five times the detection of chemicals.

For dioxin, in particular, they assume that all of the dioxin, whether it was even detected or not, was in the potent form. That's something I could go into detail if you would like. Basically, there's only a handful of the 210 dioxin and furan congeners that actually possess any toxicity. Basically the consultant assumed that all the congeners possessed toxicity. And there are some other factors in emission that contributed to the conservatism.

As far as exposure is concerned, they then used worse case assumption regarding exposure duration, how much we breathe and how much we eat. I somewhere in my declaration I give an estimate of what the overestimate might be or the level of conservatism. As I sit here, I

think I said the factor of ten or more, or at least a factor of ten.

Q: Again, you may have just answered my next question. What effect would the use of these conservative assumptions that's were used by AT Kearney have on the overall risk assessment calculations?

A: Well, again, you have to understand as you look at the results that there is a healthy degree of conservatism built into those numbers. Be aware of that as you're interpreting that information. There is a lot of conservatism in there.

Q: Does the February 1996 AT Kearney Risk Assessment, in your opinion, comply with the applicable guidance and accepted risk assessment practice?

A: Yes.

Q: Let's talk about some specific issues that have arisen over the course of the past few days. What is your opinion about the February '96 Risk Assessment's exclusion of a breast feeding infant?

A: Basically, that was consistent with the applicable guidance, the April '94 guidance, which does not include a breast fed infant.

Q: And how about the Risk Assessments's evaluation of the health impact of dioxin, both cancer and non-cancer?

A: Again, that was done in a standard method. Cancer risks were assessed using the USCPA cancer slope factor. Non-cancer risks were not quantitative because EPA has not come forth with a reference dose.

Q: Dr. Finley, I'm going to show you a series of document to try to help put this Risk Assessment in perspective. These have been previously marked and provided by counsel, and I'll have you identify them.

Dr. Finley, do you see the Exhibit that's marked Army 5A?

A: Okay.

Q: Have you ever seen this document before?

A: Yes.

Q: If you just read the subject line on the first page.

A: Preliminary Summary Report for the DFSTSCA Demonstration Burn.

Q: And for the record, this document is an excerpt from the document Army Exhibit 5 which as admitted yesterday.

Secondly, if you would look to Army Exhibit A6. Can you identify that?

A: Yes. This is appendix R1 from the Kearney Risk Assessment, February '96.

Q: Is this the entire document or just excerpts.

A: This is just an excerpt.

Q: Again, Army A7, if you would look at that.

A: This is an excerpt from the draft June 1994 EPA. The title of the document is Estimating Exposure to Dioxin-Like Compounds.

Q: Then finally Army A8.

A: This is Part 2 of EPA's 40 CFR Part 60 of the Hazardous Waste Combustors Rule?

Q: And how much pages does this exhibit comprise?

A: This is two pages, plus the cover sheet is three.

MR. KOHNS: Okay. Mr. Utley, at this time I would like to move the admission of these four documents. These documents were on our exhibit list. I forget how long ago. We have not received objection to these.

THE CHAIRMAN: Counsel?

MS. LOCKHART: No objection.

THE CHAIRMAN: Mr. Harrison?

MR. HARRISON: No objection.

THE CHAIRMAN: To clarify, according to my records we have not received A6, A7, A8 into evidence yet, the board will receive those exhibits. I thought we did accept A5.

MR. KOHNS: You did accept A5. This is 5a.

THE CHAIRMAN: The board will accept Army

Exhibit 5a into evidence.

Q: (BY MR. KOHNS) Dr. Finley, if you would, please take a look at Army Exhibit A5a. Again, if you could, identify this document?

A: This is the Preliminary Summary Report for the DFS demonstration burn.

Q: All right. If you turn to the next page, which is labeled Table 14 DFSDTB Dioxin Summary. Doctor, can you describe real briefly to the board what this table is saying?

A: This table reports the results of three trial burns for the DFS for dioxin and furans. The dioxin and furans are reported as emission rates in grams per second, and the dioxins and furans are reported in terms of total congener class, et cetera.

Q: Doctor, I would like to address your attention to the column that says HRA Maximum – do know what that is?

A: Yes.

Q: Could you tell the board.

A: Those are the emission rates in the Kearney Risk Assessment.

Q: What is the number on the bottom of that column?

A: The number on the bottom of that column is 5.6 times 10 minus 9, total dioxins and furans grams per

second.
Q: Okay. Then the three numbers immediately to the let of that column.
A: Those are the results of the individual runs, again in the same units.
Q: Okay. Doctor, do you have any opinions about what the implications of these results are for the Risk Assessment results as pertains to dioxin?
A: Yeah. Basically, the results of these three runs – I guess it was January of this year – indicate that the actual – at least the date in this – the actual emissions of dioxin and furans are one to two and is some case – one to two orders of magnitude lower than the emission rates used by Kearney in their February '96 Risk Assessment.
Q: And in risk assessment is exposure proportional to the emissions?
A: Yeah. It's not an exact linear correlation, but I can tell you that if you were to input the actual emission rates listed here in the Kearney Risk Assessment the dioxin exposure and risk would drop one to two orders of magnitude.
Q: Doctor, if you turn to the next page it says Table 3 on the top. Look at the middle and bottom blocks of information on this page. Can you tell the board what

these are?
A: These are the individual – this is more detail on the results of the emission testing, same three runs. They looked at in this case the individual 2378 substituted and dioxin furan congeners in addition to the total groups we saw on the previous page.
Q: Okay. Doctor, I see that 2378 TCDD in picogram has a list there on the side and back in all three cases. What does that mean?
A: It means it was not detected. In fact, if you look at – what's striking about this is a majority – I'm guessing 90 percent or more – of the individual congeners or congener classes were not detected in any of the three runs. If you look just at the furans, you can basically conclude that there were no furans detected associated with the emissions.
When you go to the dioxins above that, you can see that, what, 10 out of the 11 congeners there were no detects in any of the three runs. In two runs total TCDD was detected. But, as you can see in the row underneath that 2378 TCDD was not detected. 2378 TCDD is the only TCDD that has any potency.
So basically what this table indicates is that during these three runs there were no detections of any dioxin or furan congeners associated with the emissions that possess

any toxicity.
Q: Doctor, there's a column here that says TEF. What does that mean?
A: TEF stands for toxicity equivalency factor and that is a value we assign to the various dioxin and furan congeners. As I indicated earlier there are 210, I believe, different dioxin and furans. Only a handful of these possess any potency. What we do in risk assessment is we set 2378 TCDD as a the benchmark. It has a TEF of 1. It's the most potent of all congeners. Then all the other 2378 substituted dioxins and furans get assigned a TEF of less than one. They are a fraction as potent as 2378.
Q: Again, as a risk assessor, was the significance of this data fort risk assessment?
A: Well, again, what it says to me is that, number one, the emissions were far less than what was assumed to be present in the February of '96 Kearney Risk Assessment; and, number two, the most potent dioxin congener, 2378, was never detected; and, number three, again, there isn't a single measurable concentration reported here of any dioxin or furan that has any potency that could be associated with the emissions, the burning of the material.
Q: I would like you to turn now Army Exhibit A6.

Again, if you could just briefly look through that and tell the board what it is.
A: Oh, these are dioxin furan emission rates from the JACADS incinerator. This is for VX. The first page is for the LIC and the second page is for the DFS.
Q: Okay. Did you review the entirety of appendix R1 in conjunction with this case?
A: I may have.
Q: I'm not going to ask terribly specific questions about it. I'm just curious. I notice it says JACADS VX LIC versus JACADS DFS. Now, the trial results are for BG. Why would these be selected?
A: Can you say the last part the question again?
Q: Sure. I notice these are JACADS VX LIC and JACADS VX GB – I'm sorry – JACADS BX for the DFS – is there a reason why these would be useful comparisons?
A: Well, yeah. You can compare the DFS rates to the DFS rates in JACADS an see that – well, actually I'm not sure.
Q: I'll tell you what. Since there appears to be a commonality here, let's talk about these numbers. In your review of these numbers, did you find any relationship between the numbers for dioxin and the JACADS LIC versus the JACADS DFS?
A: Yeah the JACADS LIC was consistently lower than

the JACADS DFS.
Q: So then taking that fact –
A: You could conclude that the LIC, which I'm not sure has been tested at DFS – you can conclude – let's see. What could you conclude? You could conclude that the LIC emissions from the Tooele incinerator would be lower than the ones that are reported here from the DFS. You could make that conclusion assuming that the commonality exist here as it does at JACADS.
Q: Doctor, I would like you to turn to Kearney Exhibit A7. Then turn to page 3-144 of that document.
A: Okay.
Q: I want you to help put these dioxin emissions into some ever-day perspective. Do you see the first full paragraph?
A: Yes.
Q: Would you read that sentence, please.
A: Based on above studies, the 1 nanogram T per Q per kilogram appears to be a reasonable average emission factor for residential wood burning.
Q: Doctor, let me give you kind of a hypothetical now. Let's say if one took – if 13 pounds of EPA is hypothetical wood year burned off completely in four hours, on average how much dioxin is emitted per second?
A: You would be emitting about a half a picogram.

Q: Okay. Then if you would turn back, please, to –
A: Per second.
Q: – Exhibit A5a and look at Table 14. Again, there's a line here that says TEQ emission rates grams per second.
A: Right.
Q: What's the highest emission rate you see there?
A: The highest emission rate in TEQ is 2.48 x 10 to the -12 grams, which if you convert that to picograms per second is 2.48, 2.48 picograms per second.
Q: So, basically, if say six of these panel members were to go home tonight and throw one of EPA's hypothetical logs on the fire and it burned off in four hours, they would actually be emitting more dioxins per second than the DFS.
A: If six people went home and burned six pounds of wood in four hours, that's right.
Q: I will have you refer to the next exhibit. That's Army A8. Doctor, I realize you may not be an expert in the laws regarding air pollution. Do you know what a MACT standard is?
A: Do I know what a MACT standard is?
Q: Just offhand.
A: MACT stands for maximum achievable control

technology. It's basically – it's a technology that one arrives at in considering, obviously, technology and cost and efficiency, et cetera.
Q: And what does it stand for?
A: Maximum achievable control technology.
Q: Doctor, if you turn this to the next page, 172081, do you see that little chart in the middle?
A: Yes.
Q: Okay. Can you read the heading on that table?
A: The heading of this table is proposed MACT Standards or Existing Incinerators.
Q: And what's the EPA's proposed MACT standards for existing incinerators for dioxin and furan?
A: The proposed standard is .20 nanograms per DSCM, which, if I recall, stands for dry square cubic meters. That's in terms of TEQ.
Q: Might it be dry standard?
A: Yeah, you're right.
Q: And .2 nanograms is how many picograms.
A: That would be 200.
Q: Okay. If you would turn back to Table 14 on Army Exhibit A5a. Look at the very bottom. You'll see column that says TEQ Concentration Standard Cubic Meter.
A: Right.
Q: What's the highest value there that you see of

those three?
A: The highest value is the one in the middle, which is .00064 nanograms DSCM, which to convert to picogram, again, would be .64.
Q: Okay. So how – how many times lower is this emission rate than the proposed MACT standard by the EPA for dioxins?
A: The – well, the measured emission rate would be about 300 times less than what EPA is proposing as a MACT standard for existing incinerators.
Q: Okay. I would like to cover just one last area. Focusing on the trial burns that are at issued for this board, have you had any risk calculations performed that would, say, address what might be possible risks and doses within, say, the next year?
A: Yeah. That's summarized on Table 10.
Q: Could you please describe for the board how you came about those numbers and what they mean?
A: Sure. We basically use the Kearney Risk Assessment; that is, the Kearney emission rates exposure assumptions, et cetera. But we added some more exposure groups into some of the scenarios. If you look on Table 10 you can see we have the residents which was considered by Kearney, but we've added in the infant. We've also added in a child and infant and farmer C and

basically assumed that the incinerator was going to have its trial burn for a year using some assumption regarding when it would be burning. That's summarized on Table 5. Basically plug the emissions into the Kearney Risk Assessment and calculated the cancer risks you see here, the hazard and disease and the dioxin dose for each of these groups for those scenarios.

Q: And, again, what kind of results do we see?

A: These results – let me just go across the column. The cancer risks are in the range of 10 to the -7 to 10 to the -9; obviously, below the 10 to the -5 criteria that's being implied here. The hazard and disease are .1 or less, which, again, is well within the .25 benchmark that's being applied here. The dioxin doses range from .2 to – I'll just say very low doses of dioxin. The TEQ and all of these doses are below the range of doses that have been suggested by some agencies to be health effective.

Q: One last thing. I see NC here under hazard and disease for infants. Why is that?

A: We didn't calculate hazard and disease for infants. The reference doses that are set by EPA to be used in the calculation on the hazard index are set to be protective of daily exposure for 70 years of a lifetime. Nobody, EPA or anybody else that I know of, has thought

about setting reference doses that would be applicable for very short-term exposures like this, like an infant for a year. So the toxicity criteria basically don't exist for this kind of calculation. You would have to derive from the raw data, basically, all new reference doses to do this calculation. We just simply didn't do that.

Q: Has EPA done that?

A: No.

MR. KOHNS: I have no further questions.

MR. WIXOM: We have no questions.

MR. HARRISON: Yes, Mr. Chairman. I had the pleasure of examining Dr. Finley in the Federal proceeding, and I think about 95 percent of my questions would be covered by that examination. If the board would entertain the submission of my examination for Dr. Finley in the Federal proceeding I would offer it, but I have a few clarifying questions from this Table 10 that is apparently very recent based on the trial burn results. So if I could do that and offer the transcript for the rest.

THE CHAIRMAN: We accept the transcript from the Federal proceeding.

MR. HARRISON: Thank you.

THE CHAIRMAN: Counsel, do you agree with that.

MR. GALLI: We don't object to it. In fact, we

have the transcripts right here that we're happy to provide the board members immediately.

MR. WIXOM: No objection.

MR. HARRISON: We appreciate knowing that we won't have to call a copy shop now. We appreciate it.

THE CHAIRMAN: Is that agreeable to you?

MR. HARRISON: It is agreeable.

THE CHAIRMAN: Go ahead.

MR. HARRISON: Thank you.

CROSS-EXAMINATION

BY MR. HARRISON:

Q: Now, Dr. Finely, let me just clarify this Table 10 that you've been asked about. I understand this was prepared by you by plugging in trial burn results into the AT Kearney Risk Assessment with a modification or two for the infant.

A: This doesn't have the trial burn data. This is still the Kearney February '96 information.

Q: So why does it have Summary of Trial Burn at the top?

A: That could be better worded. We were basically trying to use the Kearney Risk Assessment and ask the question, What would the risks be using those assumptions for a one-year trial burn, but it still has the Kearney emission rate estimates.

A: I appreciate that clarification. Now, you've indicated that no agency had ever set a standard for short-term exposures to dioxin. Is that correct?

A: Set a standard.

Q: Or suggested what might be a protective or dangerous level for short-term exposure.

A: I don't know if I said that, but I know it's been discussed. The EPA has not set a reference dose that's been verified yet.

Q: I'm not talking EPA. I'm talking about any agency. You made a broad statement?

A: There's a table in my declaration that summarizes some doses that have been suggested by some agencies as being safe, yeah.

Q: Do you recall ATSDR, the Federal Agency for Toxic Substances, setting such a level?

A: They have an MRL of 1 to 10, I believe.

Q: 1 to 10?

A: Picogram kilogram day.

Q: Isn't it 1 picogram rather than 1 to 10?

A: Let me look.

Q: Okay. I take it you're looking at your affidavit rather than the ATSDR document.

A: No. I'm looking at my affidavit. It's one,

correct.
Q: Thank you. Now, the infant you've talked about adding here in your Table 10, that's not a breast feeding infant; is it?
A: Yes.
Q: So you calculated dose from breast feeding?
A: Yes.
Q: And where is that reflected?
A: Where does it reflect?
Q: Where does it calculate you showed a dose from breast feeding?
A: We haven't presented any of the populations in the affidavit.
Q: Where are those calculations?
A: Those are on a spread sheets in a computer.
Q: Would you be prepared to make them available so we can put them in this record?
MR. KOHNS: Subject to the time lines that this board might set.
MR. HARRISON: Mr. Chairman, I believe we have a right under the Rules of Evidence to obtain the underlying calculations that this expert relied upon in offering this opinion. That's all we're asking for.
MR. KOHNS: As I said, I'm not sure exactly when this board wants this record to close. I don't know if

physically we can get them here in that time.
Mr. Harrison has known about Dr. Finley being on the witness list since of last year. He has had ample opportunity to depose what have you. I'm not trying to hide the calculations. It's more a logistical concern.
MR. HARRISON: Mr. Chairman, the Petitioner didn't know that Dr. Finley was going to be giving testimony that appears to be inconsistent with his Table 10. I'll explore that. Let me explain to Dr. Finley, and you can rule after the explanation.
Q: (BY MR. HARRISON) If you would look at footnote C on your table. You see there it says, "Dioxin TEQ dose to the infant is assumed as a worse case to be equal to the daily uptake for an adult and then modified for body weight"?
A: That's correct.
Q: Now, adults don't breast feed; do they?
A: None that I know of.
Q: You're not assuming this in this case; are you?
A: I believe breast feeding is actually in the calculation in addition to taking the adult dose and squeezing it into an infant.
Q: And why doesn't this footnote say that?
A: Good question.
Q: Thank you. We would like to see the

calculations?
MR. KOHNS: Again, Mr. Utley, if this board decides to rule this afternoon, no doubt, Mr. Harrison, once he sees these calculations, will want an opportunity to examine Dr. Finley or will present some type of analysis or response. And, frankly, I don't know if we can get those things here in whatever time remains today, much less have to reopen the record to consider that type of thing. On a substantive basis it's no problem. It's more of a logistical timing concern.
MR. HARRISON: Mr. Chairman, if I could.
THE CHAIRMAN: Can I just ask, did you ask for this document in discovery?
MR. HARRISON: Asked for underlying calculations?
THE CHAIRMAN: Yes.
MR. HARRISON: No, we didn't, because we didn't anticipate he would give testimony inconsistent with his footnote.
MR. KOHNS: Mr. Utley, I apologize. A momentary clarification. We have nothing to add.
THE CHAIRMAN: It seems to me the breast feeding infant has been a high profile topic in this hearing. I think the board would sort of appreciate that information to be included in the record if at all possible.

MS. NIELSON: Mr. Chairman, could I ask a question?
I think what the Petitioner is asking for is the underlying data. The board doesn't necessarily have the capability to interpret that data, but we probably are interested in confirming the question that's the basis for that request, which is whether the infant scenario in Table 10 was calculated in the underlying data as a breast-feeding infant or a non-breast-feeding infant. I think what we have heard the witness say is the calculations for a breast feeding infant.
Is it possible for us to get some – or for the witness to give some clarification on that point today short of supplying the data?
MR. HARRISON: Mr. Chairman, it wouldn't satisfy us. We believe we have a right to it under the Rules of Evidence. We have a right to establish where this calculation supports his document on this issue, so we would object to that. The alternative, if this data is not made available before your record closes, we would move the strike the affidavit in the table.
MR. KOHNS: Mr. Utley, again, Plaintiff's had ample opportunity to approach this witness, find out whatever type of analysis he was going to perform in conjunction with this. He was not deposed. He has known

about Dr. Finley since –
MR. HARRISON: Mr. Chairman, I just explained it's based on his testimony. He's using my time now.
THE CHAIRMAN: Go ahead and finish.
MR. KOHNS: Consequently, this is why you do discovery, is to find out things like this.
MR. HARRISON: Objection. That's a mischaracterization.
THE CHAIRMAN: Let him finish, please.
MR. KOHNS: Nonetheless, I think with respect to the question raised by Commissioner Nielsen, can we find out, yes or no, did this include breast feeding, Dr. Finley may know or he can make a quick phone call and before this afternoon is out give you an oral answer. Now, getting the spread sheet here, I'm not sure if that's going to be logistically possible. If the board desires, we'll attempt that immediately. But if he doesn't have it here, it's back in California some place, so we'll have to see what we can do.
THE CHAIRMAN: Do you have another comment, Mr. Harrison.
MR. HARRISON: That proposal is totally unsatisfactory. We're not willing to accept the witness' word for it. We want the evidence. It may be impeaching.
MR. KOHNS: Well, a clarification, Mr. Utley.

I'm just curious as to whether Mr. Harrison intends upon receiving this spreadsheet, or however many spreadsheets it is, to reopen cross-examination of Dr. Finley.
MR. HARRISON: It depends on what it says, I guess. I would at least like to offer it into evidence.
THE CHAIRMAN: Mr. Kohns, what do you think the chances are of obtaining that information this afternoon.
MR. KOHNS: Honestly, I'm not sure. We have another proposal that may solve this; that is we redact it, to black it out and will not be considered part of the record.
THE WITNESS: It's in the text of the affidavit on Page 13. It does say that breast milk was included in the calculations of Table 10.
THE CHAIRMAN: Which paragraph? Page 13 did you say?
THE WITNESS: Yeah. The first full paragraph, about halfway, third sentence – I'm sorry – fourth sentence. Maximum dose for the TOCDF intake by infant to be of breast milk, et cetera.
MR. KOHNS: Mr. Utley, if I may. The significance of that sentence is – I'm glad the witness is far more familiar with this declaration than I. This declaration was provided in conjunction with the pre-hearing brief. If the Petitioners had a concern about

this type of calculation, it certainly put them on notice. Table 10, of this underlying analysis.
THE CHAIRMAN: If you can get the information to the Petitioners so we can accept it, that would be great; if not, we'll redact it.
MR. KOHNS: I think just to bring this to close right now we'll agree the to the redaction.
MR. HARRISON: We don't accede to that offer, and we would object to redaction in lieu of providing the date. We now have a credibility question regarding this witness and this entire calculation, which I'm not sure we can answer until we see the calculation. The board is not going to have the benefit of whether there's an integrity problem with this document until we review that. If that's the board's decision, so be it.
We object to it as a due process violation. We have a right in the Rules of Evidence to receive the underlying calculations, and in particular when a discrepancy is noted in testimony.
THE CHAIRMAN: Well, your answer Mr. Harrison – We're on page 13. That includes up to the breast milk.
MR. HARRISON: Can I have the reference in particular that you're referring to?
THE CHAIRMAN: Well on page 13.

MR. HARRISON: Which paragraph?
THE CHAIRMAN: It's the first full paragraph.
MR. HARRISON: It's not clear to me that this reference to a maximum dose for TOCDF for infants eating breast milk when he says, Suggests no appreciable health risk. It doesn't reference this table. It doesn't reference this number. He could have been referring to the January '96 Risk Assessment that we do have a calculation for infants in. I don't know. I mean, this is near the conclusion of the document. It doesn't reference this table or this number.
THE WITNESS: Table 10 is –
THE CHAIRMAN: It doesn't reference Table 10.
MR. HARRISON: Before that statement. It doesn't reference it in that statement. I mean, maybe that's what he means. But I took this footnote which is much more precise. This footnote is footnoted to these particular figures. I took it at face value. I do have another question for the witness if you could hold your ruling here just a moment.
MR. KOHNS: I do not agree there's any type of inconsistency between this declaration and tables and testimony, but maybe you'll ask the witness what he meant by this sentence and consequently gain insight.
MR. HARRISON: Mr. Chairman, I'm examining the

questions at the moment.
MR. KOHNS: I don't believe that has been resolved.
MR. HARRISON: I would a potential way of helping the resolution, but I would like to ask the questions if counsel wouldn't mind.
MR. KOHNS: Feel free.
THE CHAIRMAN: I'm not sure when we're going to close the record. Myself, I would like to see at least some verification that this information does pertain to a breast-feeding infant.
MS. NIELSON: Mr. Chairman, I realize that my solution to your question isn't acceptable to the Petitioner, but what I suggested is that we have an expert witness who is the individual who prepared this or who gave the statements in this Affidavit and who was responsible for Table 10. It seem to me that if that witness were able to verify to the board by the end of the day that that is what the calculations show. The Petitioner may still want the data and has a right to it, and that may be a legal argument. At least we would have had verification on the part of the witness for verification of the information that he provided.
From my perspective as a member of this board, that would answer me questions. I think that's a good

question. I would at least like to have that piece of information before we either redact or extract or disregard something that may be valuable for our consideration.
MR. KOHNS: Mr. Utley, we can try to make that happen at the conclusion of this cross-examination. Additionally, if the board so desires, we'll try to get that spreadsheet or spreadsheets or volume or whatever it is here. As I said, the concern that arises is Mr. Harrison may want to cross examine in light of the fact we think has had notice or opportunity. We'll try to get that here.
MR. HARRISON: If I might, in response to the statement just made. We are uncomfortable with an attempt to verify an apparent inconsistent statement by the witness with their document by asking the witness. Our concern is that there may be a credibility problem with this witness on this issue, so asking the witness to resolve it doesn't satisfy our concerns.
MRS. FARRELL-POE: I have a question on how it could be resolved. So if it's his table, his spreadsheet, that he's going to bring to you, how else is it going to be resolved.
MR. HARRISON: I can help you out with that Mrs. Farrel-Poe. If the calculations show intakes were

from a breast feeding rather than for an adult – and we can tell by the numbers – I expect that the calculations would also indicate that in the text. It answers the question.
So all I want to know is, was the procedure used to take an adult intake and then adjust for body weight – which those numbers will show – or was it an infant intake with the proper body weight for an infant? Now, there's no way those numbers can be ambiguous about that. They're going to be one way or the other.
MRS. FARRELL-POE: So it was my understanding you just said if he supplied the spreadsheet that that would not be acceptable. Did I misunderstand that?
MR. HARRISON: I'm sorry. You did. What I'm saying is his testimony would not be acceptable. His calculations would be.
MR. KOHNS: We may have a solution, then. Were proposing that we endeavor to get the spreadsheet or spreadsheets as quickly as possible. They can go into the record, and then parties are able to comment on their weight or lack thereafter in whatever post-hearing briefs may be allowed, if, in fact, the board decides to allow post-hearing briefs.
THE CHAIRMAN: I would like to defer on the ruling hoping we can get that information here to the

satisfaction of the Petitioner.
MR. HARRISON: Thank you, Mr. Chairman.
THE CHAIRMAN: Dr. Nielson wanted to ask a question.
MS. NIELSON: Do you believe, based on the information that you've provided in your Affidavit, including Table 10, that the information in Table 10 for the infants scenarios are based on breast feeding?
THE WITNESS: Yes.
MS. NIELSON: Thank you.
MR. HARRISON: Mr. Chairman, if I could proceed with my examination.
THE CHAIRMAN: Go ahead.
CROSS-EXAMINATION (Continued)
BY MR. HARRISON"
Q: Dr. Finley, did you type this table yourself?
A: No.
Q: Who typed it?
A: You want the name of the person? Probably David Dodge.
Q: And what's his role?
A: He's assistant in the company.
Q: All right. Who performed the calculations, selected numbers, and did the mathematics to determine the dose for the infant represented in the table?

A: The actual crunching of the numbers would have been done by David Dodge and Brent Kuringer.
Q: You didn't do those calculations or select those numbers yourself; did you?
A: I didn't sit down and do this by hand or punch the computer keyboard, no.
Q: Did you go and verify the numbers they selected and determine where they selected them from and their mathematics
A: Again, I didn't hand check their calculation, but we discussed what scenarios we were going to put together in this table.
Q: Did you hand check their data to see what numbers they were inputting?
A: That I believe I did, yeah.
Q: What data were they inputting? What was it from?
A: Again, the February '96 Kearney –
Q: The data that – I beg your pardon. The February 1996 Kearney Risk Assessment didn't include an infant; did it?
A: No.
Q: You realize we're talking about the infant data at the moment?
A: That's right.

Q: You do realize that.
A: We're talking about infant exposure to emissions.
Q: So what I'm trying to figure out is, the dioxin dose for the infant, the numbers that were the basis for determining that dose, didn't come Kearney Risk Assessment; did it?
A: What we used for the Kearney Risk Assessment was the emission data. We had to add in an infant scenario of our own because Kearney didn't have one.
Q: So the answer is no, it didn't come from the Kearney Risk Assessment. The infant dioxin dose date, it wasn't in there.
A: No, because there isn't one.
Q: Thank you. So where did it come from?
A: This is the infant dose that we calculated from the Kearney emission.
Q: When you say "we," you mean David Dodge.
A: My colleagues I, sure.
Q: You didn't do those calculation you just testified. So where did the numbers come from they inputted in their calculations?
A: We used Kearney emission rates from October of '96.
Q: For the infant dioxin dose.

A: We input the Kearney emission rates. The emissions land on an infant that's living at a fence line or Farmer C.
Q: Land on the soil.
A: On the soil, in the food. That infant breast feeds, and we calculate the dioxin dose for that infant?
Q: How do you know that those numbers represented breast feeding exposures?
A: We're relying on the same infant scenario we've used in this proceeding and the last one.
Q: You say "we." How do you know that your colleagues in doing this calculation were using numbers representing breast feeding exposure rather than adult exposure? Did you verify that yourself?
A: Yeah.
Q: How did you do that?
A: I walked through the calculations verbally. What assumption are were going to use as far as how much breast milk a kid ingests for a year? What emission rates are we going to use? How are we going to adjust an adult dioxin dose to an infant body weight? Again, I didn't sit down and hand check the calculations with them.
Q: This was conversations before they did the calculations.
A: That's right.

Q: All right. Now did you ask anyone, David, who typed this why this footnote indicated an adult exposure rather than a breast feeding expose?
A: Well, what the footnote is saying is that we took an adult dose, dioxin dose –
Q: Excuse me. If you could answer my question. Did you ask Mr. Dodge about that footnote?
A: There was – I didn't see any need to, no.
Q: Do you think this footnote reflects a breast feeding dose for the infant?
A: That footnote doesn't discuss breast feeding.
Q: Does it reflect information to the contrary that it's an adult dose being adjusted for body weight only?
A: No, it's not to the contrary.
Q: Does this footnote reflect that your dose is calculated by taking an adult dose and adjusted for body weight only?
A: For the non-breast-feeding pathways, so the adult dose, we basically just squeeze it into an infant.
Q: Dr. Finley, do you see the word "infant" in your footnote there, footnote C?
A: That's right.
Q: Do you see that?
A: Correct.
Q: Doesn't this footnote in its entirety with the

word infant indicate that the dose for the infant was calculated by taking an adult dose and adjusting for body weight only?
A: That's what it says.
Q: All right. Now, if you'll turn to your Affidavit on Page 12. You note in the second full paragraph, first sentence, "As shown in Table 2, all of the dioxin dose estimates calculated in the Kearney Risk Assessment are well below the acceptable intake range of 1 to 10 picograms per kilogram per day." Do you see that?
A: Right.
Q: You're familiar, are you not, that the State through AT Kearney in January '96 calculated a 50 picograms per kilogram dose per day dose for the infant?
A: My recollection is they calculate a 50 picogram/kilogram day dose for the infant for the subsistence farmer.
Q: I appreciate that clarification. That is correct. That number is outside your range here?
A: That number is outside the range, yes.
Q: All right. Now, go back to your Table 10. You have a .2 figure in the farmer C in the TEX dioxin dose column.
A: Right.
Q: For the infant?

A: That's right.
Q: Now, are you aware that – first let me ask you: Have you read EPA's September '94 Dioxin Reassessment?
A: Which part?
Q: Chapter 9, the final chapter in Volume 3?
A: Yes, some of it.
Q: Already. Are you aware on approximately 9-84 that the agency states that the current background exposures are 10 to 100 times higher than any reference dose they might calculate?
A: I'm aware that they make that statement, yeah.
Q: All right. Now, if you could do a small calculation for me on your paper or if you prefer to use the flip chart, which ever. You're aware, are you not, about the background exposure for dioxin is as reflected in EPA's Dioxin Reassessment?
A: I believe background exposure they discuss in that document is 1 to 3 picogram/kilogram day for adults and 50 to 60 picogram/kilogram day for infant.
Q: Now, if you take – well, let me just ask you. I assume – you tell me if I'm wrong – when they said the background exposure is 10 to 100 times higher than any reference dose, they were talking about adults, weren't they, not infants?
A: I'm sure they were.

Q: So the background level you indicated for adults is 1 to 3 picograms per kilogram per day?
A: For adults, right.
Q: If you could, tell me what 10 to 100 times lower than that range would be just as matter of mathematics.
A: 1 to 3 would be .1 to .3
Q: .1 to .03?
A: .1 to .3 would be 10 times lower.
Q: What about 100 lower?
A: Or .01. to .03.
Q: Okay. Now, the number in your table there for the infant for Farmer C, .2, is considerably larger than the .01 to .03 if one were to divide by 100.
A: That's correct.
MR. HARRISON: Nothing further, Mr. Chairman.
THE CHAIRMAN: Anything else? Anything from the board?
MR. WHITE: Good morning, Mr. Finley.
THE WITNESS: Good morning.
MR. WHITE: There was some discussion of Army Exhibit 5a. Just explain to me – in those right two columns one was labeled "without multiplier" and one was labeled "with multiplier." What are the multipliers?
THE WITNESS: The multipliers – again, this is adjustments that Kearney made – has to do – it's either

with the upset start conditions or a TOC adjustment. I'm not sure. I believe it's something on that order.
MR. WHITE: With the multiplier the number is higher.
THE WITNESS: It's higher, right.
MR. WHITE: I assume that's taking, then, some kind of extra risk into account that may occur on occasion.
THE WITNESS: Right.
MR. WHITE: And on Table 3 of that same exhibit, Army Exhibit 5a, there were the numbers that were provided for the dioxins and the furans. Can you put those into some kind of perspective as to how the magnitude of those numbers can be interpreted? Are those – let me back up just a second. On Table 14 of that you put it into perspective of comparing it against the – you put the trial burn data into the perspective of the Health Risk Assessment, and we're able to make a comparison with the trial burn data. We're lower than the what the Health Risk Assess assumed.
Is there anything similar to that that we could do with the data in Table 3 of that exhibit?
THE WITNESS: Not really. Not that I can see, other than to say these are low detection limits. I can't draw from these numbers right here.

MR. WHITE: Are these data that – the Table 3 data, is that what's used to input into the calculations to generate the numbers that are on Table 14?
THE WITNESS: Right.
MR. WHITE: Okay. Then with respect to the 50 picogram per kilogram day number, did I understand you right to say that an EPA guidance document indicates that the background exposure of infants to dioxins is 50 to 60 picograms per kilogram day?
THE WITNESS: It's either 50 to 60 or 60 to 70. I think it's 50 to 60.
MR. WHITE: It's something in excess equal to or greater than 50.
THE WITNESS: Yes.
MR. WHITE: And I assume that background number for infants is higher than it is for adults because of the lower infant weight, lower body weight of the infant.
THE WITNESS: That's part of it, right.
MR. WHITE: So you're dividing by a smaller number, smaller weight.
THE WITNESS: Right.
MR. WHITE: Thank you.
THE CHAIRMAN: Anything else? Counsel, anything else?
MR. HARRISON: Just a clarification.

Dr. Finley, when the board member asked you whether the higher level for the infant was due to the different body weight, you said that's part of it. What's the rest of it?
THE WITNESS: The rest of it is that an infant's diet is made up, obviously, more of breast milk than an adult diet, and there's dioxin in breast milk to some degree.
MR. HARRISON: Is it your opinion that an exposure is acceptable merely because it is equal to or nearer to current exposures?
THE WITNESS: I don't think you can make that broad conclusion, no.
MR. HARRISON: That's because at some point current exposures might impose a danger themselves.
THE WITNESS: That's correct.
MR. HARRISON: Nothing further.
THE CHAIRMAN: Thank you very much. Call your next witness.
MR. MULLIGAN: Mr. Utley, can we have a five-minute conference break? I drank quite a bit of coffee.
THE CHAIRMAN: Reconvene at twenty-five to.
(Recess.)
THE CHAIRMAN: Let's go ahead and reconvene.

The documents you have from the transcripts from the Federal hearing, do you have transcripts for Dr. Guzelian and Dr. Finley?
MR. GALLI: Yes. I have those right now, and I'm happy to pass them out.
THE CHAIRMAN: Can we do that?
MR. HARRISON: Absolutely.
MR. MULLIGAN: While we're doing that, can we get a time pact. I'm cognizant of running out of time.
THE CHAIRMAN: Yes.
MR. MULLIGAN: With the board's permission, I'll have our next witness, Mr. Cudahy, sit in the chair.
MR. RATHBUN: I just checked with the time keeper, Shelly Milligan, who indicated that by her calculation the Army has used 6 hours and 49 minutes of their allocated 10 hours. Of the additional time that was given to the Petitioners, our calculation is that there's 20 minutes remaining of the Petitioners time. I had calculated 22.
MS. LOCKHART: Does that include the time we gave them?
MR. RATHBUN: That's all the additional time the Petition has. It's 11:40 right now.
THE CHAIRMAN: Okay.

DR. CUDAHY
was called as a witness, having been first duly sworn, was examined and testified on his oath as follows:
EXAMINATION
BY MR. MULLIGAN:
Q: Mr. Cudahy, have you been provided since the submission of your Affidavit in this case Petitioner's Exhibit 2, which was an extract of documents from the DEQ files?
A: Yes, I have.
Q: And having reviewed those documents, is there anything in your Affidavit which you wish to change or amend?
A: No, sir. This would not change any of my opinions.
Q: Mr. Chairman, I submit Mr. Cudahy for examination by the board.
MR. WIXOM: We have no questions.
MR. HARRISON: We're in the same predicament, even more so, Mr. Chairman, so we'll waive cross in the sense that we have no time for it. We would appreciate the chance to offer our examination of Mr. Cudahy in the Federal proceeding by transcript.
THE CHAIRMAN: Any objections to that?
MR. GALLI: We have no objection, and at this

time I would like to provide the board with copies of that testimony.

THE CHAIRMAN: Any objection?

MR. HARRISON: No objection, unless they're sending us a bill.

MR. WIXOM: No objections from the state.

THE CHAIRMAN: Board members, any questions? Rich, go ahead.

MR. WHITE: Could you just very briefly summaries what your involvement was in the TOCDF project for the record?

THE WITNESS: I have been involved since the first Federal hearing, submitted a declaration for that, two declarations for the second hearing that just finished up and have visited the facility twice since that process.

MR. WHITE: My question went more to what it was that you reviewed and what you were asked to do.

THE WITNESS: Well, I was asked to look at the operation of the facility, the design, permitting process, the safety and overall operation of the facility.

MR. WHITE: No other questions.

THE CHAIRMAN: I just have a couple of questions, sir. From your Affidavit you looked at some alternative technologies. You made a statement that these three alternative technologies have potential of agent

with a high degree of development work necessary. Could you give us an idea of how much time would be involved for these alternative treatments to be commercially available, if available, to use?

THE WITNESS: I would say for the type of waste that we're talking, the type of emissions and agent that we're talking about at Tooele, in the range of five to ten years. There's a National Research Counsel Report that was done recently that looked at commercialization of some of these technologies for ton containers only, and those periods of time were consistent with what I just said, because the time necessary would be extended because of the fact that you would have to be treating the rockets now and other things besides just the liquids from the ton containers thank.

THE CHAIRMAN: Thank you. The other comment you made you is didn't think these three technologies were good. Can you expand on that, why you think they're good alternatives?

THE WITNESS: There has been no research done on that. The ecologic technology is working with SAIC to see if it can take munitions and process explosive munitions. But it has not, to my knowledge, started that project yet. The use of these technologies, for example the molten metal technology, is a bath full of molten, hot metal, at

about 2,600 to 3,000 degrees, so an accident with munitions could be a problem, for example.

THE CHAIRMAN: Thank you.

MS. NIELSON: I have a question about the context of using alternative technologies. You indicated, I think, six to ten years in terms of bringing that on line. What sort of tests do you envision having to go on during that period of time? Assuming all the answers are go based on that, what sort of –

THE WITNESS: Well, I believe that the Army would require pilot scale testing first at a small scale to show, like they did at CAMDS, to show that the technologies were viable and that they would be workable. There would be process designs involved in that, and then the pilot studies would show certain problems that would have to solved on a full-scale basis. So all of those activities would result in the five to ten years.

MS. NIELSON: Would that also include quantitative risk assessments of the operation of screening health risk assessments, shakedown, trial –

THE WITNESS: Yes, ma'am.

MS. NIELSON: – activities?

THE WITNESS: All of those things would have to be done just as they were with the incineration systems.

MS. NIELSON: Thank you.

MR. HARDY: Mr. Cudahy, in your declaration, could I direct your attention to Page 8?

THE WITNESS: Dated which one?

MR. HARDY: It was one that was prefiled.

THE CHAIRMAN: The one we have is July 15th, 1996.

THE WITNESS: Yes, sir, I have that. Page 8?

MR. HARDY: I'm not sure. On my Page 8 there's a number 46 at the bottom of the page. Do you have one of those on yours?

THE WITNESS: Yes, sir.

MR. HARDY: Thank you.

THE CHAIRMAN: Tom, I don't think we are with you. Paragraph 46?

MR. HARDY: Yes.

THE CHAIRMAN: Thank you. You expressed an opinion in paragraph 46 about dioxins and a proposed hazardous waste maximum standard?

THE WITNESS: Yes, sir.

MR. HARDY: In your opinion, is that standard conservative, or how would you character characterize it?

THE WITNESS: Well, I can't speak to whether it's conservative or not because I'm not a health professional. What I can say is that the proposed MACT standard of .2 nanograms per dry standard square cubic

93-1727

IN THE UNITED STATES DISTRICT COURT

FOR THE DISTRICT OF UTAH, CENTRAL DIVISION

* * *

CHEMICAL WEAPONS WORKING GROUP (CWWG), INC., SIERRA CLUB and VIETNAM VETERANS OF AMERICA FOUNDATION,	CERTIFIED COPY
Plaintiffs,	Civil No. 2:96CV 425 C
vs.	Deposition of:
UNITED STATES DEPARTMENT OF THE ARMY, UNITED STATES DEPARTMENT OF DEFENSE and EG&G DEFENSE MATERIAL, INC.,	TIMOTHY W. THOMAS
Defendants.	

* * *

BE IT REMEMBERED that on the 5th day of February, 1998, the deposition of TIMOTHY W. THOMAS was taken before Sharon R. Morgan, Registered Professional Reporter and Notary Public in and for the State of Utah, at the hour of 9:00 a.m. at the offices of Jones, Waldo, Holbrook & McDonough, 170 South Main Street, Suite 1500, Salt Lake City, Utah.

* * *

Sharon R. Morgan

Registered Professional Reporter

MERIT REPORTERS
5 DAY DELIVERY
(801) 322-3742
185 South State Street #920
Salt Lake City, Utah 84111
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EQC Meeting May 18, 2000
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A P P E A R A N C E S

For the Plaintiff: (Telephonically)	Mick G. Harrison GreenLaw P.O. Box 467 Berea, Kentucky 40403
For the Defendant United States:	Robert H. Foster U.S. DEPARTMENT OF JUSTICE Environmental Defense Section 999 - 18th Street, Suite 945 Denver, Colorado 80202
	Major David A. Mayfield Major Peter Zolper UNITED STATES DEPT. OF THE ARMY OFFICE OF THE JUDGE ADVOCATE 901 North Stuart Arlington, Virginia 22203
For the Defendant EG&G:	H. Douglas Owens PARSONS, BEHLE & LATIMER 201 South Main Street, Suite 1800 Salt Lake City, Utah 84111-0898

* * *

I N D E X

EXAMINATION	PAGE
By Mr. Harrison	3

TMA area, the toxic maintenance area?

A I have no knowledge of transporting vials to the TMA area.

Q All right. Do you have knowledge of transporting vials to any area where they would not normally be transported to?

A No. I have no knowledge of that.

Q Do you have any knowledge that an incident occurred in which a control room operator contacted your toxic maintenance area crew or TMA crew, including one of your staff members by the name of Brenda Moore, and asked one or more of them to search the TMA area or some other area for misplaced vials of chemical warfare agent?

A I have no knowledge of that.

Q Now, Mr. Thomas, do you recall testifying in a prior proceeding before the Utah Solid and Hazardous Waste Board?

A Do I recall it?

Q Yes.

A I do vaguely recall that.

Q Is it slipping from your memory at the moment?

A Well, it's been a long time, but I do recall it. Yes, I do.

Q All right. Do you recall that I asked you a question during that proceeding regarding how many ACAMS alarms had occurred at the Tooele facility site?

A Yes.

Q Do you recall saying that you could not recall the number?

A That's correct.

Q All right. Do you recall my asking even if you couldn't recall the specific number, whether the number was a large one in any case? Do you recall my asking you that?

A Yes.

Q Sitting here today, is your information any fresher in your mind regarding the number of ACAMS alarms at the Tooele facility site right up to this date?

A As far as the number?

Q Do you know the number?

A I do not know the number.

Q Do you know whether it's a large number?

A Define large.

Q More than 100?

A Over what period of time?

Q Since August 22nd, 1996.

A It could be.

Q You know that it is, don't you?

A I don't know. I haven't gone back to look at the number of ACAMS alarms that we have had. I know we have had a number of them. I don't know if it's above 100 or not.

Q Would you know whether it was less than 1,000?

A Again, I don't know the number of the ACAMS alarms we've had.

Q Have you not consulted with anyone regarding the number of such alarms since I interviewed you in the state proceeding?

A No, I have not. It is not relevant to --

Q Not relevant to what?

A To me in performing my duties.

Q So you are not really concerned with ACAMS alarms?

A Oh, definitely I am.

Q But not the number?

A Right.

Q Now, do you recall in that same state proceeding before the board that you volunteered a number in response to my questions that there had been six confirmed stack alarms at the facility? Do you

recall saying that?

MAJOR ZOLPER: Objection to assuming facts as to what your question was at that hearing.

MR. HARRISON: Well, I am assuming nothing. I am simply telling you that in response to some question I asked, and the question I asked is irrelevant at the moment. You gave an answer.

MAJOR ZOLPER: The question at the time -- of course you are not reading the testimony from the hearing, but the question was the number of ACAMS alarms, whether confirmed or unconfirmed.

MR. HARRISON: I am not concerned about the question, Counsel, and I will object to your coaching the witness in the form of restating my question when it's irrelevant. The relevancy is the answer.

Q Mr. Thomas, you understand, don't you, in that hearing that you gave a very clear answer that there had been six confirmed stack alarms at the Tooele facility? Do you recall saying that?

A It was not a clear answer, no.

Q Do you recall saying those words?

A As part of an effort to clarify some information.

Q Do you recall saying those words, sir?

A Yes, I do.

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Q Now, when you said there were six confirmed stack alarms at Tooele, were you not telling the truth?

A What I was referring to were -- that was a misstatement and what I was talking about was an issue relative to the fact that somebody had said that there were six. I was trying to clarify what they were.

Q Somebody said there were six confirmed stack alarms; is that correct?

A Yes. Somebody outside, not related to our activity said that.

Q Who said that?

A I think Cindy King said that.

Q Is that who you were referring to?

A Yes.

Q Now, Mr. Thomas, you understand that when I was asking you to give testimony in the state proceeding that I wanted to know the number of alarms, as you understood them, as the chief official for that facility for the Army. I wasn't asking you to tell me what my client said.

A I understand.

MR. OWENS: I object. The witness can't know what you had in mind.

MR. HARRISON: Of course he knows that. He

just said he did. I don't need to know what my client says because I can ask my client.

Q Now, Mr. Thomas, what basis did you have at the time of that hearing for stating there were six confirmed stack alarms beyond Ms. King maybe having mentioned it?

A As I mentioned, it was a misstatement and I was trying to provide some clarifying information. It was a misstatement on my part.

Q So you're telling me that there have not been six confirmed stack alarms at Tooele?

A There has not been six confirmed stack alarms at Tooele.

Q There have been six stack alarms, haven't there?

A Yes. At that point there were six alarms, but they were not confirmed.

Q So there had been more than six stack alarms at that point, weren't there, more than six ACAMS alarms?

A On the stack, that's all I have knowledge of.

Q At that time?

A At that time.

Q So the number six would have reflected every

ACAMS alarm, whether confirmed in any manner or not, at that time?

A On the stack.

Q On the stack.

A During that period of operations.

Q Why did you use the word confirmed?

A Like I say, it was a misstatement.

Q Well, it may have been, but I want to know why. Why did you use the word confirmed?

A Because it was a misstatement. I was trying to clarify some information and it was a misstatement.

Q You are saying there was no reason for using the word confirmed?

A There was no reason.

Q Isn't it true that the six incidents you were thinking about were instances in which not only an ACAMS alarmed, but at least one DAAMS tube indicated the presence of agent?

A No.

Q You are saying that in these six incidents, that in none of those cases did any DAAMS tube show the presence of agent?

A Not to my knowledge.

Q Really? What do you understand the

definition of confirmed stack alarm to be as you or your colleagues use it at the Tooele facility?

A Confirmed means validation through alternate means, that when an ACAMS goes into alarm, there's a parallel method of validating that agent was truly seen.

Q What is the parallel method you are referring to?

A DAAMS tubes that are run parallel with the ACAMS.

Q All right.

A Which are then analyzed in a laboratory.

Q Now, the DAAMS tubes have the capability of having more than one tube analyzed for the same sample period; is that correct?

A We have an A and B to be run, yes.

Q Now, for a stack alarm to be confirmed by your definition for agent, is it required that one tube show the presence of agent or that both tubes show the presence of agent?

A Both tubes.

Q Now, isn't it true that in some of the six instances you were referring to, that one of the DAAMS tubes showed the presence of agent even if the other one did not?

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A I don't recall.
Q Are you sure, Mr. Thomas, that that isn't what you were thinking about when you said six confirmed stack alarms?
A No, absolutely not.
Q You are sure it wasn't?
A Uh-huh (affirmative).
Q After that hearing before the state board, did you talk with anyone soon thereafter about your testimony that there were six confirmed stack alarms?
A Oh, yeah.
Q Who did you talk with about your stating that?
A My lawyers.
Q Pardon me?
A My lawyers.
Q Your lawyers. Anyone else?
A We went back and researched it.
Q Who else did you talk with besides your lawyers about this statement?
A There probably were a few people I talked to on that. I can't remember everybody's name.
Q Give me one.
A Rick Holmes.
Q And what did you and Mr. Holmes say about

your statement in the state proceeding that there had been six confirmed stack alarms?
A That I misstated what happened.
Q And who first made the statement that you had misstated, you or Mr. Holmes?
A I think I recognized it as part of the -- when I received the minutes from the deposition or the --
Q The transcript?
A The transcript, yes.
Q You may have recognized it, but that's not my question. In your conversation with Mr. Holmes, who first stated that your statement that there were six confirmed stack alarms was a misstatement? Was it you or Mr. Holmes?
A It was a conversation. I can't tell you exactly who. He indicated that I stated that. I said, gees, I did not want to provide that -- that is not the information I wanted to convey.
Q Now, Mr. Thomas, it's true, isn't it, that it did not occur to you you had made a misstatement until Mr. Holmes brought it to your attention?
A Again, I was trying to clarify an issue that I felt was important at the time and I misstated that fact.

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Q Mr. Thomas, you can say that as many times as you want, but you still need to answer my question.

A Would you repeat the question?

Q Isn't it true that it had not occurred to you that your statement that there were six confirmed stack alarms at Tooele was a misstatement until Mr. Holmes bought it to your attention?

A No, I was well aware of that when I was making my statement.

Q You knew it was a misstatement when you were saying it?

A It was a misstatement. I did not have an opportunity to clarify my statement at that time.

Q Really?

A That's correct.

Q Okay. Now, it's true, is it not, that in your conversation with Mr. Holmes, that he is the first one who mentioned that this statement was a misstatement?

MR. OWENS: Objection, asked and answered.

MR. HARRISON: We are still trying to get the answer.

THE WITNESS: I realized I made a mistake directly after that hearing at that point.

Q BY MR. HARRISON: Mr. Thomas, I am not going to get off this question until you give me a direct statement. Save us some time.

A Please repeat the question.

Q Mr. Holmes, in his conversation with you regarding your statement in the state proceeding that there were six confirmed stack alarms at Tooele, Mr. Holmes was the first one who mentioned that that was a misstatement and you were not. That's true, isn't it?

A True.

Q Was that true?

A Yes.

Q Okay. Thank you. Now, Mr. Thomas, do you have any information at your disposal that since the time of that state hearing that there have been any confirmed stack alarms for agent at the Tooele facility?

A Would you repeat the question, please?

Q Sure. Since the hearing, the state hearing we have been talking about, since that time has any information been brought to your attention regarding stack alarms at Tooele, whether they occurred before or subsequent to that hearing, that indicates to you that confirmed stack alarms have occurred at the

Tooele facility?

A No information has been provided.

Q Were you aware that any such information exists?

A I am not aware of any information.

Q To that effect, I take it?

A That's correct.

Q Now, there have been a number of stack alarms at the Tooele facility beyond the six you referenced in the state hearing. That's true, isn't it?

A Would you give me a time frame on that?

Q Yes. Since August 22nd, 1996.

A Up to that point where we had the hearing, the only ones I knew of were six.

Q That's your complete answer to my question?

A Well, I don't understand your question. Please repeat it.

Q All right. You know, don't you, that there have been stack alarms -- notice I am not using the word confirmed at the moment -- that there have been stack alarms at the Tooele facility beyond the six you were referencing during the state hearing? You know that, don't you?

A Yes, I do know that.

Q All right. Now, do you know at this moment whether there were stack alarms at the Tooele facility beyond the six you were referencing in that hearing that had occurred prior to that hearing?

A No.

Q So those six were the only ones you were aware of and are aware of today that have occurred prior to that hearing?

A Correct.

Q So the additional stack alarms that you acknowledge knowing about today would have occurred after that hearing?

A That's correct.

Q How many stack alarms have there been at the Tooele facility since the time of that hearing?

A I don't have an exact number.

Q I am not too concerned with precision. Give me a ballpark.

A 10, 12, in that range.

Q All right. And would there be Army records reflecting the dates on which these stack alarms occurred?

A Yes, there would be.

Q And do you know whether those records are among those records either physically produced or

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offered for inspection to the Plaintiffs?

A I believe they have been, yes.

Q So I take it you would have no objection to Plaintiffs inspecting those records?

A I have none.

Q Do you happen to know sitting here today the date of any of those stack alarms?

A I do not.

Q Did you make a determination regarding any or all of those stack alarms as to whether they were confirmed or not or did someone else make that determination?

A I reviewed those and none were confirmed.

Q Did any of those 10 to 12 or so stack alarms that have occurred since the hearing we have been discussing, the state hearing, in any of those cases was there one DAAMS tube that indicated the presence of agent?

A I have no knowledge of that occurring.

Q Are you saying that didn't happen?

A To my knowledge, yes.

Q Now, when a stack alarm occurs at the Tooele facility, is there a masking alarm that goes along with it or are the personnel required to put on their respirators?

A Yes.

Q And that's true in every incident of a stack alarm?

A Yes.

Q And do you know whether in fact the masking alarm was sounded in each of those incidents, the 12 you referenced?

A My understanding is it was.

Q Do you have any uncertainty about that?

A No.

Q Now, during these incidents where a stack alarm, meaning an ACAMS alarm, for agent in the stack was occurring -- and you're telling me, I take it, today that in none of those cases did your DAAMS tube confirm agent being present -- did the DAAMS tube indicate that some chemical other than agent was present?

A I have no knowledge of that.

Q Really? Well, how do you determine whether the DAAMS tube shows agent or not? Isn't it by looking at a readout showing a retention time?

A Pardon? Would you repeat that?

Q Do you ever look at a DAAMS tube data to see whether agent is present or not?

A I do not.

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99-1727

IN THE UNITED STATES DISTRICT COURT

FOR THE DISTRICT OF UTAH, CENTRAL DIVISION

* * *

CHEMICAL WEAPONS WORKING GROUP (CWWG), INC., SIERRA CLUB and VIETNAM VETERANS OF AMERICA FOUNDATION,	**CERTIFIED COPY**
Plaintiffs,	Civil No. 2:96CV 425 C
vs.	Deposition of:
UNITED STATES DEPARTMENT OF THE ARMY, UNITED STATES DEPARTMENT OF DEFENSE and EG&G DEFENSE MATERIAL, INC.,	TIMOTHY W. THOMAS
Defendants.	

* * *

BE IT REMEMBERED that on the 5th day of February, 1998, the deposition of TIMOTHY W. THOMAS was taken before Sharon R. Morgan, Registered Professional Reporter and Notary Public in and for the State of Utah, at the hour of 9:00 a.m. at the offices of Jones, Waldo, Holbrook & McDonough, 170 South Main Street, Suite 1500, Salt Lake City, Utah.

* * *

Sharon R. Morgan

Registered Professional Reporter

MERIT REPORTERS
UTAH'S MOST CERTIFIED REPORTING FIRM
5 DAY DELIVERY
(801) 322-3742
185 South State Street #920
Salt Lake City, Utah 84111

A P P E A R A N C E S

For the Plaintiff: (Telephonically)	Mick G. Harrison GreenLaw P.O. Box 467 Berea, Kentucky 40403
For the Defendant United States:	Robert H. Foster U.S. DEPARTMENT OF JUSTICE Environmental Defense Section 999 - 18th Street, Suite 945 Denver, Colorado 80202
	Major David A. Mayfield Major Peter Zolper UNITED STATES DEPT. OF THE ARMY OFFICE OF THE JUDGE ADVOCATE 901 North Stuart Arlington, Virginia 22203
For the Defendant EG&G:	H. Douglas Owens PARSONS, BEHLE & LATIMER 201 South Main Street, Suite 1800 Salt Lake City, Utah 84111-0898

* * *

I N D E X

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A The best I can tell you is it covered a year's operation. I don't know the period, when it started and when it ended.

Q It's a 12-month period?

A That's my understanding, yes.

Q Did the Army dispute every violation indicated in that notice?

A No.

Q Has the Army given written response to the state on its position regarding each of the violations in that notice?

A Yes.

Q Now, Mr. Thomas, I chatted with Mr. Gray yesterday about a new sampling plan or program that's in progress at the moment that involves testing ton containers that were and are, I assume, intended to be burned at your TOCDF facility. Are you familiar with that sampling program?

A Yes, I am.

Q And does it involve sampling of any material other than ton containers?

A No.

Q All right. What is the purpose of this sampling program as you understand it?

A To assure that we have properly

characterized the agent we are feeding into our incinerator.

Q All right. And was it your idea to do this sampling program?

A No, it was not.

Q Was it the Army's idea?

A No, it was not.

Q Was it EG&G's idea?

A No, it was not.

Q Was it the State of Utah's idea?

A Yes.

Q All right. Had the state not directed the sampling program, would the Army or EG&G have performed it voluntarily?

MAJOR ZOLPER: I would object, it calls for speculation.

MR. HARRISON: I'll note your objection. I think being the director of the Army's program he can tell us whether they would have performed such testing on their own initiative.

MAJOR ZOLPER: He's not the director of the Army's program.

MR. HARRISON: Director of the TOCDF for the Army.

THE WITNESS: As information came to light,

we probably would have wanted to confirm what we already knew about the agent.

Q BY MR. HARRISON: So had the state not insisted at some point in time, you may have taken that initiative yourself?

A We may have.

Q But in this case it was the state's initiative?

A Yes.

Q Mr. Thomas, has there been processing of ton containers at TOCDF that you now know or have reason to believe previously contained the chemical warfare agent lewisite?

A Yes.

Q Do you know how many such ton containers have been processed to date?

A My understanding is three.

Q And have there been, to your knowledge, ton containers processed to date at TOCDF that, according to your records, previously contained some form of mustard agent?

A The answer is yes.

Q Do you know the numbers of such containers that have been processed?

A Not offhand.

Q Mr. Gray indicated yesterday that there would be, based on his spread sheets, about 135 such containers that previously contained mustard agent. Does that sound like the ballpark is correct?

A I would assume so if Marty said that.

Q Now, Mr. Thomas, have you acknowledged that some containers have been processed at the TOCDF facility that your records indicate previously contained the substance called freon?

A The question is, did the containers previously contain freon?

Q Yes, sir.

A That may have happened. I don't know the specific number.

Q Do you know whether it happened at least on one occasion?

A It may have. I haven't looked closely at freon, but it's possible.

Q Are you aware that some containers that have been processed at TOCDF appear from a review of your records to have at this time an unknown history?

A That's correct.

Q All right. Do you know how many such containers fall in that category?

A I could not give you a number.

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Q All right. Do you understand that the circumstances we have just discussed is one of the bases for the state's requiring the new sampling program?

A I understand that.

Q Now, regarding the containers that have already been processed at TOCDF, the ton containers, do you have any way of knowing at this time the quantity of actual lewisite that may have been processed at TOCDF?

MAJOR ZOLPER: Objection, you're assuming facts not in evidence. There's been no testimony here that there has been lewisite processed.

MR. HARRISON: I didn't say that there was and my question doesn't assume it. It's asking for a quantity, if Mr. Thomas knows a quantity. Of course it could be zero. It could be something considerably above zero. So I am assuming nothing, sir.

Q Mr. Thomas, do you remember the question?

A Repeat that, please, if you would.

Q Do you have information that would allow you to determine or your staff to determine the amount of lewisite that has been processed at TOCDF at this point?

A We have processed no lewisite through our

facility.

Q Zero?

A Zero.

Q Do you know that with certainty?

A Based on all the information I have.

Q Is the information sufficient for you to be certain?

A I believe it is.

Q So you are telling me that you processed three containers that are previously known to have contained lewisite, but you are certain that there was no lewisite left in them at the time they were processed at your facility?

A Based on the information I have, that's a conclusion I have reached.

Q What information do you have to that effect, sir?

A Just a knowledge of what happened and based on information that has been given to me about that.

Q I want to know what information that is.

A There is nothing that would lead me to believe we have burned any residual amounts of lewisite.

Q Nothing at all?

A Nothing at all.

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Q Are you aware that arsenic has been found in the brine from the pollution abatement system?

A I am aware of that.

Q And arsenic is a primary component of lewisite, is it not?

A Yes.

Q And can you explain the quantities of arsenic found other than from lewisite left in a container?

A Yes.

Q And what is the source of the arsenic as you understand it?

A There could be several sources, but the source that I believe it could be was due to the manufacturing process related to GB.

Q That's a very general answer, sir. How is it arsenic comes to fall into a container with GB when GB as it's manufactured has no arsenic component?

A Because of -- I don't know. I do know that the GB that we looked at in the past does have a residual amount or small amount of arsenic in it.

Q I understand that. But might that be because it has come in contact with lewisite?

A My belief is it is not as a result of that.

Q And what is the source of the arsenic if not

lewisite?

A I don't know.

Q That doesn't create any uncertainty in your mind about the potential for having burned lewisite?

A No, it doesn't.

Q All right. I take it you would agree with me that arsenic is not a component of agent GB?

A Not a planned component.

Q I understand you find it in the GB containers, but it's not by design manufactured as part of the GB compound?

A Right, not as a planned component.

Q I understand. Nor do you know the source of its presence with GB?

A Correct.

Q All right. Now, do you have any information that would allow you to determine the quantity of any mustard agent that may have been processed at TOCDF up to this date?

A I am sorry, would you repeat that?

Q Yes, sir. Do you have any information that would allow you to determine the quantity of any mustard agent that has been processed at TOCDF up to this date?

A To my knowledge, no mustard has been

processed through our facility up to this date.

Q And are you certain about that?

A Yes.

Q Now, you recognize that several containers, ton containers, that previously contained mustard agent have been processed at TOCDF?

A I understand that.

Q Now, did you test those containers for residual mustard agent before you processed them?

A No, we did not.

Q Do you have a history of documentation that shows the extent to which mustard agent was removed c cleaned from these containers before GB was added?

A We do have a plan that defines how the ton containers were reconditioned back in the early days when they were used.

Q In the 1950s?

A Yes.

Q And this would be the protocol for how the containers should have been reconditioned for use for another agent?

A Right.

Q Have you interviewed workers that might still be alive who were present at that time to determine whether the cleaning was 100 percent

effective?

A No, I have not.

Q Have any of your staff made an attempt to do that?

A No.

Q Do you have any reason to believe that the reconditioning protocol was not followed to the letter in some cases?

MAJOR ZOLPER: Objection as to calling for speculation.

MR. HARRISON: I am asking if he had any reason to believe it. That's hardly calling for speculation.

THE WITNESS: Right now I have no reason to believe that they did not follow the protocol.

Q BY MR. HARRISON: Okay. Have you ever heard from any of your staff that they have reason to believe that some of these containers were not completely emptied or cleaned prior to being filled with GB?

A No.

Q You have not heard that?

A It has been discussed, but there was nothing that would lead me to believe that the protocol was not followed.

Q And who was this issue discussed with, as you recall?

A One of my employees, Steve O'Neil.

Q Steve O'Neil?

A Uh-huh (affirmative).

Q All right. And why would you be talking about this issue with Steve O'Neil?

A Steve has a good history and did a lot of research on the history of those ton containers.

Q All right. Is that because you assigned him that task?

A Yes.

Q So Mr. O'Neil and you discussed the possibility, or the questions, at least, of whether these containers were completely cleaned before they were filled with GB?

A Uh-huh (affirmative).

Q And what did Mr. O'Neil tell you regarding that question?

A He doesn't have enough knowledge to dispute the cleaning method.

Q All right. So he's not in a position to prove that they weren't cleaned completely. Is he in a position to believe they were cleaned completely?

A I believe that to be correct.

Q Do you know what his basis of knowledge would be for having that level of certainty?

MAJOR ZOLPER: Object to your request for speculation as to another person's basis for opinion.

MR. HARRISON: Really, I think we would be better off not making this type of objection in terms of speeding up the deposition. I think it's clear that Mr. Thomas assigned one of his staff members to this task. The staff member apparently conducted some inquiry and reported back to Mr. Thomas and he would have a basis for what he reported back. I am just exploring what that basis is.

MAJOR ZOLPER: My objection would stand. I think it's a valid objection. If this witness can testify as to the basis of someone else's evaluation of an assigned task and conclusion, fine, but --

MR. HARRISON: Well, he's asked this person to report back to him, so I think we are about to find out what that report was.

Q So, Mr. Thomas, what would be Mr. O'Neil's basis for drawing this conclusion that the ton containers were cleaned completely?

A I don't know.

Q He didn't tell you that?

A No.

Q But you have confidence in his conclusion without knowing his basis?

A His basis probably is the same as mine. This occurred a long time ago and we know that a protocol existed at the time and we would assume that the people during that period of time followed that protocol.

Q He didn't tell you that, though?

A Right, he did not tell me that.

Q You're assuming that's his basis?

A That's correct.

Q Did he identify any other basis for you for his conclusion?

A No.

Q Did you or he decide to not interview workers who might have been involved in the reconditioning of ton containers or the failure to do so in order to avoid collecting evidence?

A No.

Q Do you know, Mr. Thomas, the containers that were processed at TOCDF, according to Mr. Gray, some 11 of them that previously contained freon, what the freon would have been used for and why it was stored in ton containers?

A I have no idea.

Q Are you aware that ton containers have been processed at TOCDF that previously contained chlorine?

A I am aware of that, yes.

Q Do you know the number?

A I do not.

Q Do you know the content of chlorine that may have been processed at TOCDF in any of these containers?

A The content?

Q The quantity.

A I would assume zero.

Q Did you test the ton containers for chlorine before processing them?

A Those specific tons? I don't know if we processed those tons that had chlorine. It depends on when we processed them, I guess.

Q You don't know if the tons have been tested for chlorine systematically before processing at TOCDF?

A No, not specifically, no.

Q When did you first discover or come to know that ton containers containing GB intended to be processed at TOCDF had in some cases previously contained lewisite, mustard agent or other compounds?

A It was less than a year ago.

Q All right. And what prompted you to come to know this?

A Based on a complaint by an individual.

Q Anyone that I might recognize?

A I think so. Trina Allen.

Q All right. Yes. And what was it about Ms. Allen's complaint that brought this information to your attention that ton containers had been reused?

A Ms. Allen made a direct correlation between arsenic in the brine to the potential of lewisite being in the ton containers.

Q All right. And who brought this information directly to your attention?

A I think I was first apprised of that when I was made aware of the complaint that was filed by Ms. Allen.

Q In her Department of Labor case?

A Yes.

Q Do you know who it was that informed you of that?

A No, I don't recall.

Q So no one from Batelle, your contractor, had informed you of the issue of arsenic in the brine prior to your being told of Ms. Allen's complaint?

A I think that I heard about it -- once I heard about it as part of the complaint, I asked Mr. Ray Bills to provide additional information to me.

Q All right. So Mr. Bills had not told you of this issue prior to Ms. Allen's complaint coming to your attention?

A As I recall, that's correct.

Q And what additional information did Mr. Bills provide you at that time?

A He basically told me that Ms. Allen made the connection between the arsenic in the brine to lewisite, and Mr. Bills did not agree with that conclusion until they had an opportunity to investigate what the source of that arsenic was.

Q All right. Now, apart from the connection or the conclusion that there was a connection between arsenic in the brine and lewisite in the tons, had Mr. Bills or anyone at Batelle ever informed you that arsenic itself, totally apart from the lewisite question, that arsenic itself had been detected in the brine?

A No.

Q So that matter as well came to your attention only after Ms. Allen's complaint?

A Right.

Q Were you aware prior to Ms. Allen's complaint that Mr. Bills and/or one of his Batelle associates or staff who work under him had told Ms. Allen to not talk about the potential lewisite contamination?

A I was only informed of that after the complaint.

Q Have you ever discussed that issue with Mr. Bills?

A I asked him to provide a report to me as to what happened.

Q Did you ever ask him if he instructed Ms. Allen not to talk about this, the lewisite potential?

A Yes, and he explained to me that there was not enough evidence to make a direct correlation between arsenic and lewisite.

Q Did he admit to you that he had communicated to Ms. Allen that she should not speak about the lewisite issue?

A No, he did not.

Q Did you ask him point-blank if he had told this to Ms. Allen?

A No, I did not.

Q Mr. Thomas, do you have any information that would lead you to conclude that there are mixtures of

chemical warfare agent present in some of the ton containers that are intended to be processed at TOCDF?

A There is nothing that would lead me to believe that there's a mixture of chemical warfare agents in those tons.

Q All right. And is the answer the same for the tons you already processed?

A That's correct.

Q Would the answer be the same for the other munitions that have already been processed at TOCDF, including the rockets?

A That's correct.

Q And would the answer be the same for those remaining munitions other than tons that are intended to be processed at TOCDF?

A That's correct.

Q Has there been any discussion of the issue of mixtures of chemical warfare agents and the possibility that they might exist in any of these weapons or containers?

A No, there has not been.

Q You never talked about that possibility with anyone?

A Only to absolutely rule that out.

Q Who did you talk about it with?
A Probably Dave Jackson.
Q And what was the substance of your conversation with Mr. Jackson regarding this issue?
A Basically we both concluded that there's nothing that would lead us to believe that there's any kind of mixing of chemical agents in the munitions processing.
Q Have you made any inquiries with the depot or with Aberdeen or Edgewood as to whether such mixtures were produced by the Army?
A No, not directly. There's nothing that led me to believe that we need to ask that question.
Q So you haven't asked it?
A No.
Q Are you familiar with the incident that happened, and I have forgotten the year now, for some reason 1968 rings a bell, where approximately 2,000 sheep were killed that at about the same time a live agent spraying occurred at Dugway?
MAJOR ZOLPER: Objection to the characterization of that incident. I think that assumes facts not known.
Q BY MR. HARRISON: Well, Mr. Thomas, you are aware that 2,000 sheep were killed near Dugway at some

time in the past?
A Only through the news.
Q You have read it in the news?
A Yes.
Q All right. And you're also familiar with at least the alleged connection to spraying of chemical warfare agent at Dugway?
A I have heard it discussed, yes.
Q Have you ever asked anyone questions regarding that incident?
A No.
Q So do you know what agent was involved or what agents were involved in that incident?
A Only secondhand information is all I have received on that.
Q All right. What secondhand information did you receive?
A I have heard that it was VX.
Q Did anyone who gave you this information also indicate that it may have been a mixture of two agents?
A No.
Q Are you aware, Mr. Thomas, that the Army has done a study in the past, approximately 1972, examining the toxicity of a -- I wouldn't call it a

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mixture but of combined exposure to a chemical warfare agent and a pesticide?

A No, I am not familiar with that.

Q Mr. Thomas, are you aware of the data indicating that the agent in the ton containers weapons that is being processed or intended to be processed at TOCDF is less than 100 percent pure?

A I am aware of that, yes.

Q Are you aware of the ranges of purity that have been found in the testing performed so far?

A Yes, I am somewhat aware of that.

Q All right. What ranges do you recall for the purity measurements?

A I could just give you the best information I have. From the range of 60 to 100 percent.

Q The purity testing that's been done, when it identifies a purity less than 100 percent, do you know whether the testing goes on to fully characterize the remaining components that would make up 100 percent of the mixture?

A If we are conducting a purity test, then the answer is no.

Q So it might identify perhaps some degradation components and possibly some preservatives, but not everything else that might be

in the mixture?

A The purity tests are not designed to do that.

Q Do they routinely identify anything other than agent?

A We do have -- as I recall, we do on certain occasions look at metals as part of our information that we are providing the State of Utah.

Q All right.

A And on some samples we do look at major components of the constituents of the GB and its breakdown products.

Q All right. Would this be a testing other than the routine purity testing or is it the routine purity testing you are talking about?

A No, I am talking about in special tests that were requested by the State of Utah.

Q To your knowledge, has there been any test performed to date on an agent sample that has completely identified each of the constituents that make up 100 percent of the quantity of the containers?

A To my knowledge, no.

Q All right. Do you know whether the Army has been reluctant to do that for any reason?

A No.

Q So if the state or EPA or some other party, government party, requested that that be done, the Army would have no reason to object?

A Only from the technical basis as to whether or not we can achieve that level of clarification or understanding of what is there.

Q I understand.

A We are just limited by our testing techniques.

Q Do you know, Mr. Thomas, whether the Army has ever intentionally placed metals into an agent container or weapon for military purposes?

A I have no knowledge of anything like that.

Q So you would presume the metal to be an unintended contaminant?

A Or from the container that's holding those.

Q I understand. But the Army still would not put the metals in the agent?

A Correct.

MAJOR ZOLPER: Mr. Harrison, I've got just about 10 after 3:00 now. We have been going almost an hour. I suggest we take a comfort break.

MR. HARRISON: I don't have a problem with that. How long would you suggest?

MAJOR ZOLPER: Why don't we just make it five minutes.

MR. HARRISON: That's fine.

(Recess.)

Q BY MR. HARRISON: Now, Mr. Thomas, I take i the state has issued some restriction on which ton containers you can process at this time; is that correct?

A That's correct.

Q All right. How many ton containers are available for processing in the absence of this state restriction? How many are intended for processing?

A I don't know. I couldn't give you the number.

Q Do you have a ballpark?

A Several hundred.

Q Isn't it several thousand?

A Did you say -- would you repeat your question?

Q Sure. I am looking for the total pool or population of ton containers that have yet to be processed, that were intended to be processed at TOCDF.

A Yes, you're correct, several thousand.

Q And the number that the state is currently

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authorizing TOCDF to resume processing would be a few hundred?

A Several hundred.

Q And why is it that the state is distinguishing between those which it is allowed to process and those that it is not allowed to process?

MAJOR ZOLPER: Objection as to calling for speculation.

Q BY MR. HARRISON: If you know, Mr. Thomas, as to why the state has imposed this restriction. I expect they told you?

A Yes. Looking at the records on those ton containers that are allowed to be processed, there's no history indicating that they had prior use.

Q All right. And this, I believe, is what the state is referring to as first-time use containers?

A Yes.

Q Now, do you know, Mr. Thomas, whether the containers that the state is allowing the Army to process at this time, the ones that the state considers first-time use, are containers that had GB put into them when they were essentially new?

A That's my understanding.

Q Do you know what basis there is for that conclusion in your records?

A It was based on a historical search of the records.

Q Who did that search?

A Mr. O'Neil.

Q Steve O'Neil?

A Yes.

Q Has anyone besides Mr. O'Neil reviewed those records?

A Yes, Mr. Kevin Dolan.

Q All right. Is he an Army person?

A He's an Army employee.

Q Anyone else besides Kevin and Steve?

A And I know the State of Utah employees have reviewed it.

Q Okay. You didn't review those yourself, I take it?

A I did not.

Q Now, to your knowledge, have any of these containers that had GB placed into them when the containers were new subsequent to that time had their contents changed in any way?

A Not to my knowledge.

Q Has Mr. O'Neil or Mr. Dolan investigated that question for you?

A No, they have not.

Q Is that because it hadn't occurred to them?
A Because the data cards that they are reviewing do not indicate any change in use of these tons.
Q Should the data card indicate a change had a change occurred?
A I would imagine it would have.
Q Is that required that the data card would reflect such a change?
A It has -- my understanding is it would.
Q You don't know if it's a requirement or not?
A I do not know.
Q So I take it if Mr. O'Neil or Mr. Dolan hasn't made an inquiry into this based on review of the data cards, that you would have no other basis for believing that the contents of any of these containers has changed?
A That's correct.
Q Does the Army have any results back from any of the sampling of the ton containers that has occurred so far?
A Not yet.
Q Are any of these containers being sampled and analyzed for dioxins or PCBs?

A Possibly.
Q Do you know whether or not they are?
A I do not.
Q Who would know that?
A Ray Davis.
Q Is Mr. Davis in charge of the sampling or analytical procedures?
A Yes.
Q Do you have any reason to believe that dioxins or PCBs would be present or would not be present in the tons?
A I have no reason to believe that they would be present.
Q Has anyone ever discussed the topic of whether dioxins or PCBs would be present in the ton containers?
A No.
Q Do you know whether the -- let me just ask you first, what is the most recent date at TOCDF during which brine from the pollution abatement system has been created? I am talking about brine to be disposed of.
A From the pollution abatement system, you are saying?
Q Yes, sir.

99-1727

IN THE UNITED STATES DISTRICT COURT

FOR THE DISTRICT OF UTAH, CENTRAL DIVISION

* * *

CHEMICAL WEAPONS WORKING GROUP (CWWG), INC., SIERRA CLUB and VIETNAM VETERANS OF AMERICA FOUNDATION,	CERTIFIED COPY
Plaintiffs,	Civil No. 2:96CV 425 C
vs.	Deposition of:
UNITED STATES DEPARTMENT OF THE ARMY, UNITED STATES DEPARTMENT OF DEFENSE and EG&G DEFENSE MATERIAL, INC.,	TIMOTHY W. THOMAS
Defendants.	

* * *

BE IT REMEMBERED that on the 5th day of February, 1998, the deposition of TIMOTHY W. THOMAS was taken before Sharon R. Morgan, Registered Professional Reporter and Notary Public in and for the State of Utah, at the hour of 9:00 a.m. at the offices of Jones, Waldo, Holbrook & McDonough, 170 South Main Street, Suite 1500, Salt Lake City, Utah.

* * *

Sharon R. Morgan

Registered Professional Reporter

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(801) 322-3742
185 South State Street #920
Salt Lake City, Utah 84111

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A P P E A R A N C E S

For the Plaintiff: (Telephonically)	Mick G. Harrison GreenLaw P.O. Box 467 Berea, Kentucky 40403
For the Defendant United States:	Robert H. Foster U.S. DEPARTMENT OF JUSTICE Environmental Defense Section 999 - 18th Street, Suite 945 Denver, Colorado 80202
	Major David A. Mayfield Major Peter Zolper UNITED STATES DEPT. OF THE ARMY OFFICE OF THE JUDGE ADVOCATE 901 North Stuart Arlington, Virginia 22203
For the Defendant EG&G:	H. Douglas Owens PARSONS, BEHLE & LATIMER 201 South Main Street, Suite 1800 Salt Lake City, Utah 84111-0898

* * *

I N D E X

EXAMINATION	PAGE
By Mr. Harrison	3

A I think it was part of the NOV. It was discussed in that and then it was related to method 23 versus 0023A or something like that. But I don't have the details on that.

Q This is an EPA method for analyzing or sampling contaminants?

A It could be. I don't recall exactly what it was for.

Q You don't recall any particular contaminants it may have been regarding?

A No.

Q But you are aware that is one issue the state has raised regarding departure of the trial burn plans?

A That's correct.

Q Have there been any others the state has raised?

A Not that I recall offhand.

Q Has the state approved any of the trial burns for the metal parts furnace, the deactivation furnace, either LIC 1 or LIC 2 at this point?

A No, they have not. START OF DUN

Q Have you operated the dunnage incinerator at TOCDF?

A Yes.

Q During what time period?

A During systemization.

Q Have you ever operated the dunnage incinerator with agent waste?

A No, we have not.

Q Do you ever intend to?

A I am not sure.

Q There are written communications from Army personnel at this point indicating a plan to move to alternative methods for dunnage disposal and to abandon use of the dunnage incinerator, correct?

A That's probably correct, yes.

Q Do you know who created these documents?

MAJOR ZOLPER: Objection. If you are referring to documents, the documents need to be identified.

MR. HARRISON: I don't need to identify them.

MAJOR ZOLPER: Well, you're questioning on documents and you haven't identified what documents you are talking about.

MR. HARRISON: I don't need to identify them.

Q Mr. Thomas, you are aware that such written communications exist. You have already testified to

that. I am asking you who created the written communications. I don't need to tell you the name of the documents to ask you that question.

A No, I am not sure who the specific authors were.

Q I take it you were not one of them?

A I may have been. I don't know. I am one of the ones that's working to evaluate the use of the dunnage furnace in the future.

Q I understand. So I take it whether you authored the documents or not, you certainly are aware that they were written with your approval?

A Yes.

Q Do you know the basis for your decision or the Army's decision to move to alternative methods for dunnage disposal?

A Do I know the rationale behind that?

Q The basis, the rationale, yes.

MR. OWENS: Objection to the characterization of his testimony that there has been a decision to change the disposal method.

Q BY MR. HARRISON: Well, basically I am talking to Mr. Thomas about the documents we referenced where that decision was communicated. You may or may not be considering it still. But there was

some basis for writing these documents. I just want to know what it was.

A The basis for writing the documents was whether or not there was alternative methods to disposing of the waste that was planned to be processed in the dunnage incinerator.

Q All right. Has there been a determination made that such alternatives exist?

A We are still looking at that issue. It has not been finalized.

Q Okay. Has there been a tentative determination that alternatives exist?

A Yes. We are still looking at that issue, however.

Q Okay. What alternatives have you identified at this point?

A There's options. Carbon micronization in the deactivation furnace is one option. Commercial disposition is another option.

Q Does that mean disposal at a licensed hazardous waste facility?

A That's correct.

Q Would you have considered landfill incinerators or some other category?

A Only as long as it meets the destruction

requirements imposed by RCRA permit.

Q Well, destruction suggests a treatment technology rather than landfilling.

A Right. Well, if it requires any kind of treatment, we would go and meet the regulatory requirements imposed by our permit.

Q Have you ruled out landfilling of the dunnage?

A Again, it's dependent on the type of waste that we are talking about. If it requires treatment, we would provide it. There were a variety of wastes that were scheduled for the dunnage incinerator.

Q I understand that. So I am trying to determine in your tentative inclusion so far, have you identified landfilling as one option for some aspects of dunnage disposal?

A Yes.

Q And have you identified incineration off site as another option?

A That's correct.

Q Have you identified any methods other than those two for some aspects of dunnage disposal?

A Let me think. No, I think that's generally what we would be looking at.

Q All right. And what categories of waste

would fall into your term dunnage as it was intended for the dunnage incinerator?

A Contaminated charcoal, contaminated wood products, hepa and prefilter elements, and other miscellaneous wastes in lower quantities.

Q All right. Would it also include protective suits of one kind or another?

A Yes, as one time early on that was scheduled for the dunnage incinerator.

Q In your current plans for alternative dunnage disposal, are you contemplating methods for the disposal of protection suits?

A Yes.

Q Is there any reason you are aware of why you would not want to continue to dispose or plan to dispose of these items in the dunnage incinerator at this point?

A We haven't ruled that out yet.

Q I understand, but obviously you are looking at other options. What has motivated looking at other options?

A Safety and environmental compliance and cost effectiveness.

Q In terms of the safety issue, what specifically were you considering that was involved in

this decision?

A Generally the fact that our furnace does require additional resources and attention to operate that in light of the operations of the facility.

Q We are talking about safety now.

A Yeah, I understand. And it's another furnace that we would have to monitor and control, that we would have to feed, so it would require additional resources. We want to minimize the amount of complexity in the plant operations.

Q You are saying that operation of the dunnage incinerator might increase the complexity of operations to the extent of posing a safety problem?

A No, I don't think it would extend to a safety problem, but we feel it would probably be better to in some cases process this off site. It would add less complexity.

Q Right. But I asked you about the safety component, which you yourself had identified as part of your decision. I wasn't talking about operational complexity or convenience or cost, because you had mentioned the word safety. I am just asking you what you were referring to when you said safety.

MAJOR ZOLPER: Mr. Harrison, I would like to make an objection in terms of the vagueness of your

question.

MR. HARRISON: Give me a break.

MAJOR ZOLPER: What type of break would you like?

MR. HARRISON: I would like you to not object when you don't have a basis.

MAJOR ZOLPER: I will tell you the basis. My basis is you are characterizing his testimony as you have decided on safety. I think his testimony has consistently been that there are a number of people that are involved in the decision making process, including PMCD and others. So for a point of clarification, that is my objection. If you are speaking of you meaning Mr. Thomas making that decision, that's an inaccurate characterization of his testimony. So you'll receive no break.

MR. HARRISON: Thanks. I really don't understand the logic to your objection, but we'll note it.

Q Mr. Thomas, am I mistaken that you yourself moments ago used the word safety?

A Yes, I did.

Q And do you find it ambiguous for me to ask you what you were referring to in the word safety?

A In every decision we make out there --

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Q Mr. Thomas --
A I am trying -- yes?
Q Do you remember my question now?
A Yes. I am trying to answer your question.
Q You are answering a prior question. I am asking you a new question now.
A Okay.
Q Please listen. I am asking you if you consider my asking what you were referring to when you used the word safety to be an ambiguous question.
A Would you repeat that, please?
Q I asked you what you were referring to when you used the word safety. Do you find that to be an ambiguous question?
A No. Let me --
Q Go ahead and answer.
A If I can answer. We go through a risk management process to identify all risks associated with that of concern relative to the operations of the facility. We consider safety, environmental compliance as part of that risk decision making process. So safety is always a consideration in making decisions like that. I don't have a specific because we haven't reached the decision as to whether or not to abandon the dunnage incinerator or to

continue to operate it.
Q Was there a safety concern identified by you or your staff during these deliberations regarding the dunnage incinerator?
A Not specifically, but, again, we haven't gone through the total process of evaluating all risks associated with it and the benefits associated with the use of the dunnage incinerator.
Q All right. Now, have you or your staff or your contractors identified a concern with the risk posed by emissions from the dunnage incinerator? Has that been one factor in your deliberations?
A That's a consideration that will be taken into -- we will consider when we go through that process.
Q You are saying that has not been completed yet?
A It has not.
Q You identified compliance as one of your bases for considering alternatives for dunnage along with safety and cost, I believe. What specific compliance issues have you identified?
A None in particular. Again, that's part of our risk evaluation process that we go through when we make a final determination.

Q All right. Have you had communications with the State of Utah that suggest to you that there would be compliance or safety issues if you operated the dunnage incinerator as you had initially planned?

A Not that I recall.

Q So as far as you know, the state would have no concerns about full-scale operation of the dunnage incinerator at this time?

A Not to my knowledge.

Q So this really is an Army issue?

A Yes.

Q Do you know who in the Army has taken the lead in initiating this analysis of alternatives for dunnage, or was that somebody else?

A I have been one of the primaries on it. Maybe I am not the only one, but I think -- I may be, as I said, one of the primaries.

Q Would Mr. Rick Holmes be another?

A He may be involved, yes. We have had discussions with Rick on this.

Q Do you know who made the first initiative in this direction? Was it you, Mr. Holmes or someone lse?

A No, I don't.

Q The charcoal you were referring to as being

part of the dunnage disposal issue, what would be the source of that charcoal?

A From the agent filters.

Q The HVAC agent filters?

A That's correct.

Q What is the current status of any charcoal that's been removed from those filters at this point?

A It's in storage.

Q And where is it being stored at the moment?

A In permitted storage on the installation.

Q Which installation might that be?

A Deseret Chemical Depot.

Q Is it in area 10?

A I don't recall where precisely it's stored.

Q You don't know whether it's in area 10 in CAMDS or TOCDF?

A It's not at TOCDF. I think CAMDS has a permitted storage area that we are storing it in there, but I couldn't tell you precisely.

Q All right. Do you know whether it's consistent with CAMDS's permit to store TOCDF spent carbon on charcoal?

A Yes.

Q Yes, you do know that?

A Yes.

Q Has the state told you that?
A I am depending on the information that's provided by my subordinates on the storage of that.
Q So I take it that means no, the state has not told you that?
A Has not told me that, no.
Q Have there been any malfunctions of the HVAC system during your tenure at TOCDF?
A Yes.
Q All right. Do you know how many?
A I do not.
Q Do you recall any specific instances?
A One was related to a power failure test.
Q All right. And when did that occur?
A I don't recall. It's been a little bit, a little while.
Q I take it it was not 1998?
A No.
Q Do you know whether it was 1997?
A I believe it was.
Q And was there some malfunction of the HVAC system related to a power failure?
A I am not aware of failure of the HVAC
ated to the power.
Q The HVAC incident you were referring to,

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July 15, 1996

DECLARATION - James J. Cudahy

1. My name is James J. Cudahy. I am the president of Focus Environmental, Inc. We have offices in Knoxville Tennessee and La Porte Texas. Focus Environmental is an environmental engineering firm with 23 employees which specializes in the design, permitting and technical evaluation of hazardous waste incineration and other thermal treatment systems. The total environmental and incineration related experience of our technical staff is close to 200 years. We have consulted on over 450 projects for 175 clients in the United States, Canada, Croatia, Saudi Arabia and Ukraine. These projects have included 95 test programs for hazardous waste incineration, boiler and industrial furnace certification of compliance and contaminated soil incineration projects. Our clients have included industry, hazardous waste services companies, the U.S. Environmental Protection Agency, the Department of Energy, the Department of Defense, and the Agency for Toxic Substances and Disease Registry.

2 GENERAL BACKGROUND AND EXPERTISE

3 My educational background includes a Bachelor of Science in Chemical Engineering from Newark College of Engineering, a Masters of Science in Chemical Engineering from the University of Delaware and a Masters in Business Administration from Michigan State University. I am a registered professional engineer in Michigan, Louisiana and Delaware.

4 My background and expertise includes 30 years of experience in the chemical industry and in environmental engineering consulting. My chemical industry experience includes 5 years in research and manufacturing. My environmental engineering experience includes almost 25 years specializing in the technical evaluation, design and permitting of incineration and thermal treatment systems for hazardous wastes, contaminated soils and contaminated air from industrial process vents. I have been involved in the preparation or consulting on over 25 trial burn programs for hazardous wastes, polychlorinated biphenyls and contaminated soils. One of the Trial Burn Plans that I prepared was for a Rotary Deactivation Furnace designed to thermally treat military munitions at the Hawthorne Army Ammunition Depot in Hawthorne Nevada.

5. During my professional career I have written numerous papers and book chapters and made many presentations at technical conferences and seminars in the areas of incineration, thermal treatment and alternative technologies. I contributed a chapter to the Thermal Destruction volume of the American Academy of Environmental Engineers series on Innovative Site Remediation Technology

OPPOSITION OF APPELLEES TO PLAINTIFFS' MOTION FOR STAY EXHIBIT D

published in 1994 and have written another chapter for the next Thermal Destruction volume to be published in 1997.

6. I have served on national committees involved with incineration and thermal treatment. I was a member of the American Society of Mechanical Engineers committee which peer reviewed the Environmental Protection Agency Guidance on setting permit conditions and reporting trial burn results (Volume II of the Hazardous Waste Guidance Series). I also have been involved recently on technical review panels for the Department of Defense on Alternative Technologies for Chemical Demilitarization and the Department of Energy for Alternative Thermal Technologies for Mixed Waste.

7. I have chaired seven technical sessions at national meetings which involved hazardous waste incineration and test burns, alternative thermal treatment technologies, boilers and industrial furnaces, thermal treatment of contaminated soils and Mixed Waste permitting for Department of Energy radioactive and hazardous wastes. On June 26, 1996, I chaired a session on polychlorinated dibenzodioxin and furan (dioxin) emissions from hazardous waste incineration systems at the annual meeting of the Air and Waste Management meeting. A copy of my resume is included as Attachment 1 to my Declaration.

8 As part of my activities for the preparation of this Declaration, I have reviewed various documents which are generally used by experts in the areas of incinerator design and permitting. I have also based the conclusions in this Declaration on the experience that I have obtained over my career. I have visited the Tooele Chemical Demilitarization Facility at the Tooele Army Ammunition Depot in Tooele Utah. As part of this visit I talked with site personnel who are specialists in the demilitarization and incineration of agent and had an in-depth tour of the demilitarization equipment and incineration equipment. I have reviewed the Part B permit application for the Tooele Chemical Demilitarization Facility, Trial Burn test results for the incinerators and other documents that are relevant to the permitting, testing and operation of the facility.

9 GENERAL INCINERATION

10 Incineration is a mature and thoroughly proven technology which has been successfully used for the treatment of chemical wastes since the 1930's (Dow, no date).

11. There are 190 permitted hazardous waste incinerators in the U.S. at 162 locations. These units are incinerating approximately 1.5 million tons per year of hazardous waste (EPA, 1996).

12. PERMITTING

13. All of the 190 hazardous waste incinerators have been through a rigorous permitting process administered by the U.S. EPA and the states. The same

rigorous permitting process that the five incinerators at the Tooele Chemical Demilitarization Facility have undergone.

14. Hazardous waste incinerators are permitted by state agencies and the Environmental Protection Agency under the Resource Conservation and Recovery Act regulations for the treatment, storage and disposal of hazardous wastes.

15 One of the important ways to measure incinerator performance is the Destruction and Removal Efficiency. The Destruction and Removal Efficiency is a measure of the amount of a specific organic that exits an incinerator stack relative to the amount of that organic in the feed to the incinerator. For example, a Destruction and Removal Efficiency of 99.9999% for trichlorobenzene means that one pound of trichlorobenzene will exit the incinerator stack for every 1,000,000 pounds of trichlorobenzene fed to the incinerator.

16 An important incinerator operational consideration is the Automatic Waste Feed Cutoff system. The state regulatory agency and the operator of the incinerator develop a set of operating permit conditions which are limits on the operation of the incinerator. These operating permit conditions are parameters such as a minimum combustion chamber temperature or a maximum waste feed rate, which are developed based on operation during the Trial Burn. When these permit conditions are exceeded, the waste feeds to the incinerator are automatically shut off. This is important because operation of an incinerator for example, at too low a temperature, can result in increased emissions.

17 Another important incinerator operational consideration is the use of a continuous emission monitoring system on the stack of the incinerator. The most common continuous emission monitoring system on the nation's 190 hazardous waste incinerators is a carbon monoxide monitor. The carbon monoxide concentration is used by the Environmental Protection Agency as a surrogate for good combustion and therefore low organic emissions in the incinerator's stack gas. Because the technology is not available, none of the nation's 190 incinerators have a continuous emission monitoring system for specific organic emissions. The automatic continuous air monitoring system that is used by the Tooele Chemical Demilitarization Facility for low concentration agent monitoring is the only continuous emission monitoring system in the country that is being used for continuous monitoring of incinerator stack specific organic emissions. The automatic continuous air monitoring system in use at the Johnston Atoll Chemical Agent Disposal System and the Tooele Chemical Demilitarization Facility, has the capability for continuous incinerator stack analysis of specific agents in the parts per trillion concentration range. This results in a significant level of safety to the public and the operators of the Tooele Chemical Demilitarization Facility.

18 The Utah Department of Environmental Quality has significant previous experience in permitting hazardous waste incinerators. Two of the biggest

commercial hazardous waste incinerators in the nation are located in Utah. The Rollins-Aptus facility in Aragonite is permitted and the Laidlaw facility in Clive is in the final stages of obtaining a final permit

19. DOD CHEMICAL DEMILITARIZATION AND INCINERATION EXPERIENCE

20. The Tooele Chemical Demilitarization Facility will be used to incinerate three chemical warfare agents, agent HD (Mustard), agent GB (Sarin) and agent VX, and various energetics contained in the munitions, bombs and rockets. Energetics are explosive materials such trinitrotoluene and rocket propellants which, if ignited, can cause fires and the generation of large volumes of hot gases.

21. The Department of Defense has been using incineration to dispose of chemical agent and energetics since 1972. Over 6 million pounds of Mustard was destroyed in a Liquid Incinerator at the Rocky Mountain Arsenal in Denver, Colorado. In addition, over 86,000 Mustard and GB ton containers were also thermally decontaminated in Hearth Furnaces at the Rocky Mountain Arsenal. This incineration occurred between August 1972 and October 1976. From May 1981 through December 1982, 36,600 pounds of HD, GB, Chloropicrin, Lewisite, Phosgene, and Cyanogen Chloride were incinerated at Rocky Mountain Arsenal using a rotary kiln and the Hearth Furnaces (Flamm, 1989).

22. Following the incineration work at the Rocky Mountain Arsenal, the Army continued the development of its program to ensure maximum protection of the environment and the safety of the general public and the workers involved in the Chemical Demilitarization program. This program involved the development of a test facility to verify the equipment, processes and procedures which were being considered for use in future chemical agent and munition disposal facilities (Onuveros, 1993). This test facility is a first generation design called the Chemical Agent Munitions Disposal System.

23. The types of incinerators at the Chemical Agent Munitions Disposal System are identical to the types of incinerators at Johnston Atoll Chemical Agent Disposal System and the Tooele Chemical Demilitarization Facility.

24. Because the Chemical Agent Munitions Disposal System is a pilot test facility however, the size of the incinerators is smaller. The Liquid Incinerator for example, is a one-third scale pilot unit of the full size Liquid Incinerator at the Johnston Atoll Chemical Agent Disposal System and the Tooele Chemical Demilitarization Facility (Flamm, 1990)

25. Through 1992, the Chemical Agent Munitions Disposal System facility had successfully incinerated over 300,000 pounds of agent (Ali, 1993).

26. Based on the design and operational data generated at the Chemical Agent Munitions Disposal System facility, the second generation of Chemical

Demilitarization incinerators were designed, constructed and operated at the Johnston Atoll Chemical Agent Disposal System facility.

27. This second generation design is operational and located on Johnston Atoll in the Pacific about 700 miles from Honolulu, Hawaii (Rife, 1989). This facility has four types of incinerators which except for design improvements, are essentially identical in design and size to the Tooele Chemical Demilitarization Facility incinerators.

28. The Johnston Atoll Chemical Agent Disposal System facility has operated since July 1990 and through June of 1996 had successfully incinerated over 1,850,000 pounds of GB, over 141,000 pounds of VX, almost 250,000 pounds of HD, over 6,000,000 pounds of agent decontamination solutions, almost 1,700,000 pounds of energetics and has incinerated or thermally treated over 9,000,000 pounds of drained rocket bodies and rocket firing tubes, metal munition bodies, drained ton containers, drained bombs, and contaminated and non-contaminated dunnage.

29 Over the last 24 years, at Rocky Mountain Arsenal, the Chemical Agent Munitions Disposal System, and the Johnston Atoll Chemical Agent Disposal System, the Army has safely and effectively incinerated over 1,900,000 pounds of GB, almost 150,000 pounds of VX, over 6,300,000 pounds of distilled and Levinstein mustard and almost 37,000 pounds of other agent. Over 8,500,000 total pounds of agents have been successfully incinerated at these Army facilities.

30. TOOELE CHEMICAL DEMILITARIZATION FACILITY INCINERATOR TYPES

31. The third generation design is called the Tooele Chemical Demilitarization Facility and is located at the Tooele Army Ammunition Depot. The Tooele Chemical Demilitarization Facility includes the following types of incinerators. A Liquid Incinerator will be used to incinerate liquid agent which will be drained from ton containers, rockets, other agent containing items and agent decontamination solutions. There are two identical Liquid Incinerators. A Deactivation Furnace System will be used for materials containing explosives and propellants such as rockets which have been drained, but are still wet with agent. A Metal Parts Furnace will be used to decontaminate metal parts such as ton containers, which have been drained of agent A Dunnage Incinerator will be used to burn non-contaminated and agent contaminated dunnage (wood, plastic protective equipment, etc.) as well as contaminated carbon from the carbon filters. A more detailed description of the Tooele Chemical Demilitarization Facility incinerators can be found in Attachment 2 to my Declaration.

32. All of the Tooele Chemical Demilitarization Facility incinerators include two combustion chambers. The first or primary combustion chamber, destroys most of the agent present in the incinerator feed. The combustion gas from the primary chamber, which may contain small amounts of unburned agent, is sent to a

secondary combustion chamber, which is used to complete the agent destruction process.

33. The combustion gas from the secondary combustion chambers of the Tooele Chemical Demilitarization Facility incinerators contains particulates and hydrogen chloride which are regulated by the Resource Conservation and Recovery Act regulations and must be controlled. Control of these is achieved by the Pollution Abatement Systems. The two Liquid Incinerators, the Deactivation Furnace System and the Metal Parts Furnace all have identical Pollution Abatement Systems for control of dioxin, particulate, metals and hydrogen chloride (Ali, 1993). Because the Dunnage Incinerator is expected to have very low uncontrolled hydrogen chloride emissions, it has a different dry Pollution Abatement System which is specifically designed for particulate and metals removal (Ali, 1993). Diagrams of the four types of incinerators and the two types of Pollution Abatement Systems are shown in Attachment 2 to my Declaration.

34. In my opinion, the Tooele Chemical Demilitarization Facility incinerators have a state of the art design. In general, the instrumentation, computer controls, materials of construction, fugitive emission control, emergency diesel generator electrical back-up, uninterruptible power supply and the quality of construction are above industry standards.

35. Relative to state of the art design, the Tooele Liquid Incinerators each have two combustion chambers. The industry standard for liquid incineration is only one combustion chamber. The Tooele Liquid Incinerator primary combustion chamber operates at a temperature of 2700°F. The industry standard is 1800 to 2000°F. The Pollution Abatement System is state of the art for dioxin control because of the rapid quench system and for wet particulate and metals control because of the candle mist eliminators. A rapid quench system cools a hot combustion gas below 350°F in a fraction of a second, thereby minimizing the formation of dioxin which can occur if the combustion gas is cooled too slowly between the temperatures of 450°F and 750°F (EPA, 1991). The candle mist eliminators are excellent at removing very small (submicron) particulate and metals. The Automatic Continuous Air Monitoring System, which is used for continuous incinerator stack monitoring of agent at the parts per trillion level, is state of the art. There is no industry standard for continuous stack monitoring of specific organics. None of the other hazardous waste incinerators in the nation have this capability.

36. The basic Deactivation Furnace System design has been used safely and effectively by the Department of Defense for almost 45 years (U.S. Army, 1981). The Tooele Deactivation Furnace System is state of the art because it has 2 inch thick steel walls instead of the 0.5 inch thick walls in the Johnston Atoll Chemical Agent Disposal System design. The Tooele Deactivation Furnace System also has a state of the art secondary combustion chamber design which allows the unit to obtain

Destruction and Removal Efficiency's greater than 99.9999% for polychlorinated biphenyls as required by the Toxic Substances Control Act regulations (Onnveras, 1993) The Pollution Abatement System is state of the art for dioxin control because of the rapid quench system and for wet particulate and metals control because of the candle mist eliminators. The Automatic Continuous Air Monitoring System, which is used for continuous incinerator stack monitoring of agent at the parts per trillion level, is state of the art. There is no industry standard for continuous stack monitoring of specific organics. None of the other hazardous waste incinerators in the nation have this capability.

37. The Metal Parts Furnace is state of the art because it has a secondary combustion chamber specially designed to Resource Conservation and Recovery Act hazardous waste destruction standards. The Pollution Abatement System is state of the art for dioxin control because of the rapid quench system and for wet particulate and metals control because of the candle mist eliminators. The Automatic Continuous Air Monitoring System, which is used for continuous incinerator stack monitoring of agent at the parts per trillion level, is state of the art. There is no industry standard for continuous stack monitoring of specific organics None of the other hazardous waste incinerators in the nation have this capability.

38. Relative to industrial incinerators of contaminated trash, the Dunnage Incinerator is state of the art because it has a secondary combustion chamber specially designed to Resource Conservation and Recovery Act hazardous waste destruction standards. The Pollution Abatement System is state of the art for dry particulate and metals control because of the fabric filter. The Automatic Continuous Air Monitoring System, which is used for continuous incinerator stack monitoring of agent at the parts per trillion level, is state of the art. There is no trash incinerator industry standard for continuous stack monitoring of specific organics None of the other industrial trash incinerators in the nation have this capability.

39 The Department of Defense received a Resource Conservation and Recovery Act permit from the state of Utah on June 26, 1996 Besides the Resource Conservation and Recovery Act permit, the Department of Defense has also obtained an air permit for the five incinerators and a wastewater permit and a storm water permit for the entire facility A TSCA permit for the incineration of polychlorinated biphenyls was obtained for the Deactivation Furnace System.

40 Through July 7, 1996, the five Tooele Chemical Demilitarization Facility incinerators have been operated for a total period of 5 years and eight months in a hot shakedown period using either natural gas, non-hazardous ethylene glycol as an agent surrogate or hazardous constituents during the Resource Conservation and Recovery Act and Toxic Substances Control Act Trial Burns. Therefore, many of the equipment related operational problems that commonly occur during

the start-up of any mechanical system have all ready been discovered and corrected prior to the feeding of agent.

41. The five Tooele Chemical Demilitarization Facility incinerators are equipped with all instrumentation, controls, continuous emission monitors and automatic waste feed cutoffs that are required by the Utah Department of Environmental Quality for the state hazardous waste regulations and by Region VIII of the Environmental Protection Agency for the Toxic Substances Control Act regulations.

42. INCINERATION REGULATORY TESTING

43. Since December 1990, the Johnston Atoll Chemical Agent Disposal System agent incinerators and the Tooele Chemical Demilitarization Facility agent incineration facilities have undergone 10 test burn programs which included 35 stack tests for agent and/or other Resource Conservation and Recovery Act and Toxic Substances Control Act related emissions.

44. The most recent tests at Johnston Atoll Chemical Agent Disposal System and the Tooele Chemical Demilitarization Facility have shown the ability of these incinerators to perform at levels significantly better than required by the regulatory standards. These tests are summarized in Tables 1 through 3, which are attached to this Declaration.

45. A summary of the Destruction and Removal Efficiency testing for agent at the Johnston Atoll Chemical Agent Disposal System is shown in Table 1. As can be seen from Table 1, the Destruction and Removal Efficiencies for agent are significantly better than required by the Utah Department of Environmental Quality. No agent was detected above the analytical reporting level in any of the tests shown in Table 1. This means that during the testing shown in Table 1, that the concentration of GB in the incinerator stack before dispersion, was below 10 parts per trillion. The concentration of VX in the incinerator stack before dispersion, was below 5 parts per trillion, and that the concentration of HD in the incinerator stack before dispersion, was below 900 parts per trillion. One part per trillion is equivalent to one second in 32,000 years.

46. A summary of the most recent dioxin tests at Johnston Atoll Chemical Agent Disposal System and the Tooele Chemical Demilitarization Facility is shown in Table 2. Dioxin is the term commonly used to represent 210 polychlorinated dibenzodioxins and dibenzofurans. These compounds are typically found at very low levels in the combustion gas from incinerators, automobiles, diesel trucks, and various industrial processes. Dioxin has been found in animal studies to be extremely toxic to certain animals and dioxin emission control is considered by the Environmental Protection Agency to be a serious issue. There are currently no Environmental Protection Agency dioxin emission control regulations. On April 19, 1996 however, the Environmental Protection Agency published a proposed dioxin emission standard in the proposed Hazardous Waste Combustor Maximum

Achievable Control Technology regulations (EPA, 1996). The proposed national dioxin emission standard is 0.2 nanograms of dioxin Toxic Equivalents per dry standard cubic meter of stack gas, corrected to 7% oxygen. A nanogram is a billionth of a gram. When finalized, this proposed dioxin emission standard will likely apply to the 190 Resource Conservation and Recovery Act permitted hazardous waste incinerators in the country as well as the five incinerators at the Tooele Chemical Demilitarization Facility.

47. All of the dioxin tests summarized in Table 2 were below the Environmental Protection Agency's proposed standard. The Dunnage Incinerator dioxin emissions were about 1.3 times lower than the proposed standard. The Metal Parts Furnace dioxin emissions were about 7 times lower than the proposed standard. The Deactivation Furnace System dioxin emissions were almost 20 times lower than the proposed standard. The two Liquid Incinerator tests were 83 and 154 times lower than the proposed standard.

48. A summary of the Resource Conservation and Recovery Act and Toxic Substances Control Act testing which was done at the Tooele Chemical Demilitarization Facility is shown in Table 3. As can be seen in Table 3, the performance of the two Liquid Incinerators and the Deactivation Furnace is significantly better than required by the Utah Department of Environmental Quality and Region VIII of the Environmental Protection Agency. The Destruction and Removal Efficiencies for the hazardous organic chemicals and polychlorinated biphenyls ranged from 4 to almost 60 times better than required by the permits and by the Toxic Substances Control Act regulations. The Combustion Efficiency required by the Toxic Substances Control Act regulations was 7 times better. The particulate emissions were from 12 to 25 times lower than required by the permit. The hydrogen chloride emissions ranged from 160 to over 1300 times lower than required by the permit. The Metal Parts Furnace has also had a Resource Conservation and Recovery Act trial burn, but the trial burn report is not yet completed.

49. The concentrations of typical products of incomplete combustion from the incinerators at the Johnston Atoll Chemical Agent Disposal System facility are similar in type and concentration to products of incomplete combustion found in the stack gas of other hazardous waste incinerators.

50. I have reviewed the Tooele Chemical Demilitarization Facility Resource Conservation and Recovery Act Trial Burn plans for incinerating GB in the Liquid Incinerator and the Deactivation Furnace System. It is my opinion that these trial burn plans are complete and have been developed in sufficient detail so that the process operations, sampling, analytical, and QA/QC activities are appropriate to demonstrate the stated objectives of the tests.

51. RESPONSES TO SPECIFIC CLAIMS

52. In this section of my Declaration, I will discuss issues raised by the Plaintiffs' in the Memorandum in support of Plaintiffs' motion.

53. ALTERNATIVE TECHNOLOGIES

54 The Memorandum in support of Plaintiffs' motion discusses five alternative technologies as possible candidates to replace incineration for the treatment of chemical agent and munitions at the Tooele Chemical Demilitarization Facility and other Army facilities where agents are stored. Two of these technologies involve neutralization and three of the Alternative Technologies are being developed by private companies. The three Alternative Technologies were selected in October 1996 by a panel of eight engineers and scientists from over twenty proposals.

55. I was a member of the panel which selected the three Alternative Technologies, mentioned in the plaintiffs' Memorandum, as candidates for additional evaluation by the National Research Council

56 The three Alternative Technologies were selected as being potentially able to treat blister agent HD from ton containers at Aberdeen Proving Ground in Aberdeen MD and nerve agent VX from ton containers at the Newport Chemical Activity storage site in Newport, IN. The scope of the selection process only included processes which could potentially treat HD and VX drained from ton containers and the possible decontamination of the ton containers. Energetic materials were excluded from the scope of the selection process

57 The panel concluded that the three Alternative Technologies were the most advanced of the candidates submitted, but were still in the early stages of development. We concluded that these Alternative Technologies had the potential to be able to treat agent according to Army and Environmental Protection Agency requirements, but that further process development work would be required for all three to confirm this potential Only one of these three processes (Eco-Logic), has been operated on a full scale basis on concentrated organic feed streams. To my knowledge, this full scale work has included chlorinated organics, but not high concentrations of fluorine, phosphorus and sulfur containing organics such as are found in GB, VX and HD.

58 Recently, the Government Accounting Office published a report evaluating the use of Innovative Technologies for the treatment of polychlorinated biphenyl and dioxin contaminated Superfund sites (GAO, 1995). Environmental Protection Agency officials interviewed by the Government Accounting Office for this report said that incineration is selected for these wastes because it meets Environmental Protection Agency existing regulatory standards, can perform under a variety of conditions and has been successfully demonstrated in full-scale applications. They added that using a demonstrated technology becomes particularly important

because polychlorinated biphenyls and dioxins are highly toxic and difficult to treat.

59. In my opinion, while these three Alternative Technologies have the potential to adequately treat agent, a high degree of development work would be necessary to bring each technology to the point where safe and effective full scale treatment of agent would be possible. In addition, based on what I learned during the panel review, I believe that these three Alternative Technologies are not good candidates for the treatment of the explosive and propellant containing munitions, rockets and bombs associated with the agent weapons.

60. DESTRUCTION AND REMOVAL EFFICIENCY AT LOW ORGANIC CONCENTRATION

61. The Memorandum in support of Plaintiffs' motion, Ms. Costner's and Dr. Miller's Declarations all allege that Destruction and Removal Efficiencies of organic chemicals decrease as the concentration of the organic decreases in the incinerator feed. According to the plaintiffs', this contention is based on a 1989 Environmental Protection Agency research study by John Kramlich. The plaintiffs' interpret the Kramlich report as proof that the Tooele Chemical-Demilitarization Facility and any other incinerators will not be able to obtain appropriate Destruction and Removal Efficiencies at low organic feed concentrations. On pages 25 and 26 of the Memorandum, Dr. John Miller is quoted as saying that even at 1,000 parts per million, a waste will not be destroyed at 99.99%. Ms Costner is also quoted as saying that a Destruction and Removal Efficiency of 99.9999% could only be achieved when the waste was at a concentration of greater than 10,000 parts per million. I have read the Kramlich report and I do not agree with the Plaintiffs' allegation that the Metal Parts Furnace, Deactivation Furnace System, and Dunnage Incinerator will be unable to obtain high Destruction and Removal Efficiencies on low concentration agent or polychlorinated biphenyls. I base my conclusion on my experience with numerous Destruction and Removal Efficiency tests done on incinerators treating soils contaminated with low concentrations of organic contaminants in the Superfund program. Some examples of where Destruction and Removal Efficiencies greater than 99.9999% at low organic feed concentrations occurred are the Denney Farm site, the Times Beach site and the Swanson River site.

62. At Denney Farm in Missouri, the Environmental Protection Agency used an incinerator to remediate a site contaminated with dioxin. During four tests, the incinerator achieved an average Destruction and Removal Efficiency of 99.999986% at an average 2,3,7,8-tetrachlorodibenzo-p-dioxin concentration in the feed of 40 parts per million. The concentration range was 28 to 53 parts per million. The test with 28 parts per million had a Destruction and Removal Efficiency of 99.999995%. (Miller, 1993 and EPA, 1985)

63. At the Times Beach site in Missouri, six incinerator Trial Burn tests were run, three with trichlorobenzene and three with hexachloroethane at concentrations in the soil feed averaging about 180 parts per million. The average Destruction and Removal Efficiencies for these six tests was 99.999984%. (Foster, 1996)

64. At the Swanson River site in Alaska, six Trial Burn tests were run with polychlorinated biphenyls at concentrations in the soil feed averaging about 595 parts per million. The average Destruction and Removal Efficiencies for these six tests was 99.99994%. The concentration range was 289 to 801 parts per million. The test with 289 parts per million had a Destruction and Removal Efficiency of 99.99996%. (Ogden Environmental, 1988)

65. Contrary to the plaintiffs' allegations, as can be seen by these three examples, incineration data is available that clearly shows the achievement of Destruction and Removal Efficiencies greater than 99.9999% for organics at concentrations below 1,000 or even 100 parts per million and for polychlorinated biphenyls at concentrations below 1,000 parts per million.

66. In addition, based on my experience and thermal stability research that I have done, the HD, GB and VX that will be incinerated at the Tooele Chemical Demilitarization Facility have very low thermal stabilities and should therefore be relatively easy to destroy at high Destruction and Removal Efficiencies and low concentrations.

67 DIOXIN EMISSIONS FROM THE INCINERATORS

68 The Memorandum in support of Plaintiffs' motion and Ms. Costner's Declaration both allege that dioxin emissions from the Tooele Chemical Demilitarization Facility incinerators will be significant Neither the Memorandum nor Ms. Costner's Declaration however, mentions the proposed dioxin emission standard in the proposed Hazardous Waste Combustor Maximum Achievable Control Technology regulations (EPA, 1996).

69. As can be seen in Table 2 of my Declaration, all the dioxin emission data from the Johnston Atoll Chemical Agent Disposal System and the Tooele Chemical Demilitarization Facility are below the proposed dioxin emission standard in the proposed Hazardous Waste Combustor Maximum Achievable Control Technology regulations. After a thorough evaluation, the U.S. Environmental Protection Agency has determined that the proposed dioxin emission standard is protective of the environment and the public When finalized, this proposed dioxin emission standard will apply to the 190 Resource Conservation and Recovery Act permitted hazardous waste incinerators in the country as well as the five incinerators at the Tooele Chemical Demilitarization Facility.

70. The reason that the dioxin emissions from the Johnston Atoll Chemical Agent Disposal System and the Tooele Chemical Demilitarization Facility are below the

Environmental Protection Agency's proposed dioxin emission standard is because the incinerators use a rapid quench system in the Pollution Abatement Systems.

71. Rapid quench is a process in which the hot combustion gas from an incinerator enters a quench chamber where water is sprayed on the hot gas. The water spray quickly cools the hot gas (1800°F to 2200°F), in a fraction of a second, to a temperature of 350°F or lower. This rapid cooling of the hot gas essentially eliminates significant formation of dioxin (EPA, 1994). This occurs because significant amounts of dioxin can be formed in a combustion gas if the hot gas is slowly cooled and passes through a temperature window of about 450°F to 750°F in one or more seconds (EPA, 1991). Based on evaluations of dioxin emissions from many incinerators, the Environmental Protection Agency has concluded that rapid quench in the presence of good combustion conditions is the most important factor in minimizing the formation of dioxins (EPA, 1994).

72. INCINERATOR STACK EMISSIONS OF DIOXIN LIKE COMPOUNDS

73. The Memorandum in support of Plaintiffs' motion, Ms. Costner's and Dr. Miller's Declarations all allege that emissions of dioxin like compounds from the Tooele Chemical Demilitarization Facility incinerators are of particular concern. There are no Utah Department of Environmental Quality, Environmental Protection Agency regulations, Environmental Protection Agency Guidance Documents or proposed regulations to control dioxin like compounds. If these compounds are formed in the Tooele Chemical Demilitarization Facility incinerators, I would expect the concentrations to be as low or lower than the dioxin emission concentrations shown in Table 2. If present, these low concentrations would result because of the previously discussed rapid quench systems being used in the Tooele Chemical Demilitarization Facility incinerator Pollution Abatement Systems. This rapid cooling of the hot combustion gas will essentially eliminate significant formation of these dioxin like compounds just as it does for dioxins.

74. INCINERATOR STACK EMISSIONS OF PRODUCTS OF INCOMPLETE COMBUSTION

75. The Memorandum in support of Plaintiffs' motion, Ms. Costner's and Dr. Miller's Declarations all allege that emissions of Products of Incomplete Combustion from the Tooele Chemical Demilitarization Facility incinerators will be present in the combustion gases from the incinerators. The Memorandum calls these Products of Incomplete Combustion "chemical poisons". According to the Environmental Protection Agency, Products of Incomplete Combustion can be unburned organics that were present in the incinerator feed, thermal decomposition products resulting from organic constituents in the feed, or compounds formed during or immediately after combustion (EPA, 1996). Based on an extensive test program to determine total organic mass emissions at a full-scale hazardous waste incinerator, most Products of Incomplete Combustion are non toxic hydrocarbons such as methane

and ethane (Dempsey, 1993). Products of Incomplete Combustion are typically present in a combustion gas at levels from about 10 parts per billion by volume down to the part per trillion or lower concentrations.

76. The Environmental Protection Agency and the Utah Department of Environmental Quality regulate Products of Incomplete Combustion emissions from hazardous waste incinerators by requiring control of combustion with a maximum carbon monoxide concentration in the incinerator stack gas. This maximum carbon monoxide limit is set at 100 parts per million by volume on a dry gas basis, corrected to 7% oxygen (EPA, 1991). In the preamble to the Boiler and Industrial Furnace regulations, the Environmental Protection Agency states that the 100 parts per million carbon monoxide limit will ensure that combustion devices operate continuously at high combustion efficiency and emit Products of Incomplete Combustion at levels that will not pose adverse effects on public health and the environment (EPA, 1991)

77. This maximum carbon monoxide limit must be continuously monitored and is used as an Automatic Waste Feed Cutoff under the Utah Department of Environmental Quality and Environmental Protection Agency regulations.

78 The concentrations of typical products of incomplete combustion from the incinerators at the Johnston Atoll Chemical Agent Disposal System facility are similar in type and concentration to products of incomplete combustion found in the stack gas of other hazardous waste incinerators (EPA, 1989). These products of incomplete combustion are formed in all combustion processes at concentrations in the part per billion level or lower. Automobiles, buses, diesel trucks, coal power plants, steel mills, etc., all generate and emit products of incomplete combustion, including dioxins (Lee, 1991).

79 UPSET EMISSIONS OF PRODUCTS OF INCOMPLETE COMBUSTION

80 The Memorandum in support of Plaintiffs' motion, Ms. Costner's and Dr. Miller's Declarations all allege that Products of Incomplete Combustion emissions from the Tooele Chemical Demilitarization Facility incinerators will increase substantially during upset conditions. I do not agree with this allegation. This allegation is based on early Environmental Protection Agency guidance that used worst case assumptions to estimate upset emissions because there was no data. Recently, however, a series of tests were conducted at the Environmental Protection Agency's Incineration Research Facility in Arkansas. These tests evaluated the impact of repeated upsets, caused by waste feed cutoffs, on the emissions of specific organics, metals, particulate and hydrogen chloride. Test program results showed that none of these emissions increased significantly over emissions during baseline tests without repeated upsets (Waterland, 1993).

81. At the Waste Technologies, Inc commercial hazardous waste incinerator in East Liverpool, Ohio, the Environmental Protection Agency recently allowed stack

sampling for dioxins to continue during an upset condition to determine the impact on emissions. The results of the sampling showed that there was no increase in dioxin emissions during the test conducted with the upset condition.

82. INCINERATOR FAILURE EMISSIONS

83. Ms. Costner's Declaration also alleges that the four Johnston Atoll Chemical Agent Disposal System incinerators operated in near-constant upset conditions during the 500 hour GB and VX burn campaign. Ms. Costner included a table (JACADS Performance During GB and VX Campaigns) in her Declaration which she says summarizes these upsets. The information in this table does not clearly identify the type of upsets that she alleges occurred. Many of the upsets in the table appear to be Automatic Waste Feed Cutoffs (burner lockouts, high carbon monoxide and RCRA exceedences) which are required by a Resource Conservation and Recovery Act incinerator permit to protect against possible higher emissions when an operating permit condition such as low combustion temperature or high carbon monoxide stack concentration is exceeded. In my opinion, it appears that many of the "upsets" that Ms. Costner refers to in her Declaration, are in fact Automatic Waste Feed Cutoffs that are required by the Resource Conservation and Recovery Act permits at the Johnston Atoll Chemical Agent Disposal System, the Tooele Chemical Demilitarization Facility and every one of the 190 hazardous waste incinerators in the nation. A summary of the Automatic Waste Feed Cutoffs which are required by the Utah Department of Environmental Quality and Region VIII of the Environmental Protection Agency for the incinerators at the Tooele Chemical Demilitarization Facility's permit application is included in Attachment 3 to my Declaration.

84. Ms. Costner also contends that because of the alleged upsets, that Products of Incomplete Combustion emissions from the incinerators will increase substantially. I do not agree with this allegation. The previously described test program at the Environmental Protection Agency's Incineration Research Facility and the full-scale testing at the Waste Technologies, Inc. commercial hazardous waste incinerator have shown, with actual stack sampling data, that emissions of Products of Incomplete Combustion do not increase during Automatic Waste Feed Cutoff situations.

85. AUTOMATIC CONTINUOUS AIR MONITORING SYSTEM

86. Ms. Costner's Declaration alleges that the Army's continuous agent emission monitor, which is called a Automatic Continuous Air Monitoring System, is susceptible to interferences and rates of malfunction which raise serious questions as to its usefulness in signaling potentially dangerous agent releases to workers and the general public.

87. I do not agree with this allegation. The continuous emission monitoring standard for the nation's hazardous waste incinerators is a carbon monoxide monitor which

is used as a control for good combustion and low Products of Incomplete Combustion emissions. The Tooele Chemical Demilitarization Facility incinerators have carbon monoxide continuous emission monitors and the Automatic Continuous Air Monitoring System which is used for detection of specific agents in the parts per trillion concentration range. None of the nation's hazardous waste incinerators, except the Army's agent incinerators, have a continuous emission monitor for specific organic chemical emissions.

88. All of the nation's incinerators have at least one carbon monoxide continuous emission monitor, some incinerators have two carbon monoxide continuous emission monitors with the second unit being used as a redundant back-up system. The Tooele Chemical Demilitarization Facility however, has three Automatic Continuous Air Monitoring Systems which directly monitor for agent in the common stack for all the incinerators except the Dunnage Incinerator. Two of the Automatic Continuous Air Monitoring Systems are in continuous use. The third Automatic Continuous Air Monitoring System is a back-up in case either of the operating Automatic Continuous Air Monitoring Systems malfunction. Feed of agent to the incinerators at the Tooele Chemical Demilitarization Facility will not be allowed by the Utah Department of Environmental Quality without a functioning Automatic Continuous Air Monitoring System in the stack.

89. In my opinion, contrary to Ms. Costner's allegations, the Tooele Chemical Demilitarization Facility continuous stack monitoring program is above the industry standard because: (1) the Automatic Continuous Air Monitoring System has the capability for continuous incinerator stack analysis of specific agents in the parts per trillion concentration range, (2) there are three Automatic Continuous Air Monitoring Systems in the common incinerator stack instead of one or two, and (3) carbon monoxide continuous emission monitors are also used to monitor good combustion and control non-agent Products of Incomplete Combustion. This stack monitoring program results in a significant level of safety to the public and the operators of the Tooele Chemical Demilitarization Facility.

90 FUGITIVE EMISSIONS OF AGENT

91 Ms. Costner's Declaration alleges that at incineration facilities, fugitive emissions and accidental spills may equal or exceed stack emissions, as potential hazards to public health and the environment.

92. Fugitive emissions are defined as emissions which enter the atmosphere without first passing through a stack or a duct designed to direct their flow. In general, this applies to organic liquid or solid emissions which come from sources such as pump seals, valves, piping flanges, pressure relief valves and sampling connections. Ms. Costner appears to assume that fugitive emissions from these types of processing equipment will occur to the atmosphere at the Tooele Chemical Demilitarization Facility. This assumption however, is incorrect. As shown in

Attachment 4 to my Declaration, the agent processing facilities are designed so that any agent processing that could result in fugitive emissions or accidental releases of agent is done in a completely sealed area called the Toxic Area. Agent is only processed in the Toxic Areas which are vented to the Tooele Chemical Demilitarization Facility carbon filter system. The carbon filter system is specially designed to capture agent contamination present in the air from any fugitive emissions and accidental releases such as spills that could occur in the Toxic Areas.

93. SHAKEDOWN PERIOD

94. The Memorandum in support of Plaintiffs' motion alleges that the shakedown period of the Tooele Chemical Demilitarization Facility incinerators on agent is expected to result in harmful emissions of agent and dioxin-like compounds and is a period in which there is a high likelihood of a serious accident.

95. I do not agree. As discussed previously in my Declaration, the Tooele Chemical Demilitarization Facility incinerators are a third generation, state of the art design, and have all ready been through a very thorough shakedown period.

96 The hot shakedown period at the Tooele Chemical Demilitarization Facility began in 1993 and has continued up to the current period Through July 7, 1996, Liquid Incinerator number 1 has had 18 months of hot operation, Liquid Incinerator number 2 has had 14 months of hot operation, the Deactivation Furnace System has had 20 months of hot operation, the Metal Parts Furnace has had 11 months of hot operation and the Dunnage Incinerator has had 6 months of hot operation. During this hot shakedown period, either natural gas, non-hazardous ethylene glycol as an agent surrogate or hazardous constituents during the Resource Conservation and Recovery Act and Toxic Substances Control Act Trial Burns were used as fuels and feeds for the incinerators. During this hot shakedown, the incinerators have been operated as if incinerating agent. This hot operation has allowed mechanical equipment, electrical, computers, control systems, instrumentation, the Automatic Waste Feed Cutoff system, pumps, piping, the Pollution Abatement Systems, operating procedures, operator training and operator capabilities to all be thoroughly checked out. Because of this long hot shakedown period, many of the equipment related operational problems that commonly occur during the start-up of any complex mechanical system have all ready been discovered and corrected prior to the feeding of agent.

97. In my opinion, because of the state of the art design of the Tooele Chemical Demilitarization Facility incinerators and the long hot shakedown period, the allegations about harmful emission problems and the high likelihood of a serious accident are incorrect.

98. OVERALL EVALUATION OF THE TOCDF

99. Based on my site visit, the documents and test results that I have reviewed and my experience and background in incineration, it is my professional opinion that the Tooele Chemical Demilitarization Facility is a state of the art facility which is properly installed and will be safely and effectively maintained and operated. I also believe that incineration is the best demonstrated, safest and most effective technology that can be used to destroy the agent and munitions stored at the Tooele Chemical Demilitarization Facility.

I declare under penalty of perjury that the foregoing is true and correct.

Date 7/15/96

James J Cudahy

James J Cudahy

CS012607

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TABLE 1. JACADS AGENT DRE RESULTS

Type Incinerator	Location	Test Date	Type Agent or Feed	Agent DRE (%)	
				Utah DEQ Standard	Incinerator Performance
Liquid Incinerator	JACADS	Dec 1990	GB	>99.99%	>99.999993%
Liquid Incinerator	JACADS	Mar 1992	VX	>99.99%	>99.999997
Liquid Incinerator	JACADS	Aug 1992	HD	>99.99%	>99.999955%
Metal Parts Furnace	JACADS	Aug 1992	HD	>99.99%	>99.9989%
Dunnage Incinerator	JACADS	Dec 1994	GB	>99.99%	>99.999987%

JACADS - Johnston Atoll Chemical Agent Disposal System

DRE - Destruction and Removal Efficiency

TABLE 2. JACADS AND TOCDF DIOXIN EMISSION RESULTS

Type Incinerator	Location	Test Date	Type Agent or Feed	Dioxin Toxic Equivalents (a,b) Proposed EPA Standard	Incinerator Emissions
Liquid Incinerator	JACADS	Mar 1992	VX	0.2	0.0024
Liquid Incinerator	JACADS	Aug 1992	HD	0.2	0.0013
Metal Parts Furnace	JACADS	Aug 1992	HD	0.2	0.0278
Deactivation Furnace	JACADS	Mar 1992	VX	0.2	0.0104
Dunnage Incinerator	JACADS	Dec 1994	GB	0.2	0.1505
Deactivation Furnace	TOCDF	Nov 1995	PCBs	0.2	0.0044

JACADS - Johnston Atoll Chemical Agent Disposal System

TOCDF - Tooele Chemical Demilitarization Facility

(a) - Dioxin standard and emissions are expressed in nanograms of 2,3,7,8-tetrachlorinated dibenzo-p-dioxin Toxic Equivalents per dry standard cubic meter of stack gas corrected to 7% oxygen. All JACADS dioxin emissions are the average of 4 runs. The TOCDF dioxin emission is the average of 3 runs. One nanogram is a billionth of a gram.

(b) - Dioxin and Furan congener concentrations which were below the analytical detection limit are assumed to have a zero concentration.

TABLE 3. TOCDF RCRA AND TSCA TRIAL BURN DATA

Test Activity	Liquid Incin No. 1	Liquid Incin No. 2	Deactivation Furnace	Deactivation Furnace
Date	Jul 1995	Jan 1996	Oct 1995	Nov 1995
Type Test	RCRA	RCRA	RCRA	TSCA
Destruction & Removal Efficiency				
Required Permit Minimum	99.9999%	99.9999%	99.9999%	99.9999%
Trial burn Value				
Tetrachloroethylene	99.9999953%	>99.999986%		
Trichlorobenzene	99.9999983%	>99.999973%		
Chlorobenzene			99.999985%	
Hexachloroethane			99.999989%	
Polychlorinated biphenyls				99.999982%
Combustion Efficiency (a)				
Required Permit Minimum				>99.9%
Trial burn Value				99.986%
Particulate Matter (b)				
Required Permit Minimum	0.08	0.08	0.08	0.08
Trial burn Value	0.0055	0.0032	0.0047	0.0046
Hydrogen Chloride (pounds per hour)				
Required Permit Minimum	<4	<4	<4	<4
Trial burn Value	0.005	< 003	0.025	<.000002

TOCDF - Tooele Chemical Demilitarization Facility

RCRA - Resource Conservation and Recovery Act

TSCA - Toxic Substances Control Act

(a) - Combustion efficiency is a TSCA parameter only

(b) - Particulate matter concentration expressed as grains per dry standard cubic foot of stack gas corrected to 7% oxygen. There are 7,000 grains in a pound.

October 24, 1996

DECLARATION - James J. Cudahy

1. My name is James J. Cudahy. I am the president of Focus Environmental, Inc. Focus Environmental is an environmental engineering firm which specializes in the design, permitting and technical evaluation of hazardous waste incineration and other thermal treatment systems. Our clients have included industry, hazardous waste services companies, the U.S. Environmental Protection Agency, the Department of Energy and the Department of Defense.

2. My educational background includes a B.S. in Chemical Engineering from Newark College of Engineering and an M.S. in Chemical Engineering from the University of Delaware. I am a registered professional engineer in Michigan, Louisiana and Delaware.

3. My background and expertise includes 25 years specializing in the technical evaluation, design and permitting of incineration and thermal treatment systems for hazardous wastes, contaminated soils and contaminated air from industrial process vents. I have served on national committees involved with incineration and thermal treatment. I have served on technical review panels for the Department of Defense and the Department of Energy. I have chaired technical sessions at national meetings which involved hazardous waste incineration and test burns and polychlorinated dibenzodioxin and furan (dioxin) emissions from hazardous waste incineration systems. A copy of my resume is included as Attachment 1 to my Declaration.

4 As part of my activities for the preparation of this Declaration, I have reviewed the Motion for Stay Pending Appeal (Appeal) and have discussed the incidents mentioned in the Appeal with Tooele Chemical Agent Disposal Facility personnel. I have also based the conclusions in this Declaration on the experience that I have obtained over my career. As part of an earlier declaration, I visited the Tooele Chemical Agent Disposal Facility and had an in-depth tour of the demilitarization equipment and incineration equipment. I have reviewed the facility Part B permit application for the and other documents that are relevant to the permitting, testing and operation of the facility

5. In their Appeal, the Plaintiffs describe situations at the Tooele facility and Johnston Atoll that they claim support their contention that continued operation of the facility will cause irreparable harm to the Plaintiffs. The Plaintiffs made specific claims about potential irreparable harm because of polychlorinated dibenzodioxin and furan emissions, the carbon filter vestibule agent leak, an alleged release at the Johnston Atoll facility, the decontamination solution leak and the slag removal burner in the Liquid Incinerator. A brief discussion of these claims follows:

6. The Plaintiffs claim dioxin emissions from the facility will cause irreparable harm. Nothing however, in the Appeal has changed my opinion about this issue. On April 19, 1996 the Environmental Protection Agency published a proposed dioxin emission standard in the proposed Hazardous Waste Combustor Maximum Achievable Control Technology regulations (61 FR 17358). When finalized, this proposed dioxin emission standard will apply to the 190 Resource Conservation and Recovery Act permitted hazardous waste incinerators in the country including the incinerators at the Tooele Chemical Agent Disposal Facility. All the dioxin emission data from Johnston Atoll and the Tooele facility are well below this proposed dioxin emission standard.

7. The Plaintiffs claim that an agent release in carbon filter containment vestibules at the facility demonstrates that they will be irreparably harmed. What is important about this situation is that the facility engineering controls and operational procedures worked as intended Neither a facility worker, member of the public, nor the environment was harmed in this incident.

8. The Plaintiffs claim that an alleged agent release during a planned power shutdown at the Johnston Atoll facility on August 16, 1996, demonstrates that they will be irreparably harmed. The Appeal states that the Groups are unaware of any action that has been taken by the Utah Department of Environmental Quality or the Army to ensure that the same agent release problem, caused by a power shut down or power loss, will not occur at the Tooele Chemical Agent Disposal Facility. Aside from being inconsistent with the theme of the Appeal, this allegation is also unfounded. An unplanned power outage occurred at the Tooele Chemical Agent Disposal Facility on September 16, 1996 without any agent being released.

9 The Plaintiffs claim that a small leak of used decontamination fluid that was found dripping from the ceiling of an electrical room demonstrates that they will be irreparably harmed The decontamination fluid contained no detectable agent, and no agent was found in the room to which the solution leaked. What is important about this situation is that the facility operational procedures worked as intended and there was no release of agent

10 The Plaintiffs stated that on September 18, 1966, the Slag Removal System on the Liquid Incinerator malfunctioned, causing a shutdown of the system. What is important about this situation is that the facility operational procedures worked as intended. The system continued to operate normally. There was no release of agent caused by this situation

11. The plaintiffs conclude that considering all the incidents noted in the Appeal, it is clear that the Tooele Chemical Agent Disposal Facility is ill-prepared to begin hazardous waste or nerve agent operations. Based on my 25 years of experience with the design, permitting and operation of incineration systems, I do not agree with this conclusion. In a previous declaration filed in the United States District

Court for the District of Utah (Civil No. 2:96-CV-425C), I made the following statement:

12. Through July 7, 1996, the five Tooele Chemical Agent Disposal Facility incinerators have been operated for a total period of 5 years and eight months in a hot shakedown period using either natural gas, non-hazardous ethylene glycol as an agent surrogate or hazardous constituents during the Resource Conservation and Recovery Act and Toxic Substances Control Act Trial Burns. Therefore, many of the equipment related operational problems that commonly occur during the start-up of any mechanical system have all ready been discovered and corrected prior to the feeding of agent. (Emphasis added)

13. I still stand by this statement. While the Tooele Chemical Agent Disposal Facility incinerators have been thoroughly tested out, it is not uncommon in the operation of complex systems, to have these kinds of situations occur. What is most important about the situations that occurred is that the facility engineering controls and operational procedures worked as intended.

14. None of these claims have changed my opinion, as stated in my previous Declaration, that the Tooele Chemical Agent Disposal Facility is a state of the art facility which is properly installed and will be safely and effectively maintained and operated.

15. I declare under penalty of perjury that the foregoing is true and correct.

Date _____

_____
James J Cudahy

October 28, 1996

AFFIDAVIT - James J. Cudahy

1. My name is James J. Cudahy. I am the president of Focus Environmental, Inc. Focus Environmental is an environmental engineering firm which specializes in the design, permitting and technical evaluation of hazardous waste incineration and other thermal treatment systems. Our clients have included industry, hazardous waste services companies, the U.S. Environmental Protection Agency, the Department of Energy and the Department of Defense.

2. My educational background includes a B.S. in Chemical Engineering from Newark College of Engineering and an M.S. in Chemical Engineering from the University of Delaware. I am a registered professional engineer in Michigan, Louisiana and Delaware.

3. My background and expertise includes 25 years specializing in the technical evaluation, design and permitting of incineration and thermal treatment systems for hazardous wastes, contaminated soils and contaminated air from industrial process vents. I have served on national committees involved with incineration and thermal treatment. I have served on technical review panels for the Department of Defense and the Department of Energy. I have chaired technical sessions at national meetings which involved hazardous waste incineration and test burns and polychlorinated dibenzodioxin and furan (dioxin) emissions from hazardous waste incineration systems. A copy of my resume is included as Attachment 1 to my Affidavit.

4. As part of my activities for the preparation of this Affidavit, I have reviewed the Petitioner's Second Motion for a Stay (Stay) and have discussed the incidents mentioned in the Stay with Tooele Chemical Agent Disposal Facility personnel. I have also based the conclusions in this Affidavit on the experience that I have obtained over my career. As part of a previous Declaration, I visited the Tooele Chemical Agent Disposal Facility and had an in-depth tour of the demilitarization equipment and incineration equipment. I have reviewed the facility Part B permit application for the and other documents that are relevant to the permitting, testing and operation of the facility

5. In their Stay, the Plaintiffs describe situations at the Tooele facility and Johnston Atoll that they claim support their contention that continued operation of the facility will cause irreparable harm to the Plaintiffs. The Plaintiffs made specific claims about potential irreparable harm because of polychlorinated dibenzodioxin and furan emissions, the carbon filter vestibule agent leak, an alleged release at the Johnston Atoll facility, the decontamination solution leak and the slag removal burner in the Liquid Incinerator A brief discussion of these claims follows

6. The Plaintiffs claim dioxin emissions from the facility will cause irreparable harm. Nothing however, in the Stay has changed my opinion about this issue. On April 19, 1996 the Environmental Protection Agency published a proposed dioxin emission standard in the proposed Hazardous Waste Combustor Maximum Achievable Control Technology regulations (61 FR 17358). When finalized, this proposed dioxin emission standard will apply to the 190 Resource Conservation and Recovery Act permitted hazardous waste incinerators in the country including the incinerators at the Tooele Chemical Agent Disposal Facility. All the dioxin emission data from Johnston Atoll and the Tooele facility are well below this proposed dioxin emission standard.

7. The Plaintiffs claim that an agent release in carbon filter containment vestibules at the facility demonstrates that they will be irreparably harmed. What is important about this situation is that the facility engineering controls and operational procedures worked as intended. Neither a facility worker, member of the public, nor the environment was harmed in this incident.

8. The Plaintiffs claim that an alleged agent release during a planned power shutdown at the Johnston Atoll facility on August 16, 1996, demonstrates that they will be irreparably harmed. The Stay states that the Groups are unaware of any action that has been taken by the Utah Department of Environmental Quality or the Army to ensure that the same agent release problem, caused by a power shut down or power loss, will not occur at the Tooele Chemical Agent Disposal Facility. Aside from being inconsistent with the theme of the Stay, this allegation is also unfounded. An unplanned power outage occurred at the Tooele Chemical Agent Disposal Facility on September 16, 1996 without any agent being released.

9. The Plaintiffs claim that a small leak of used decontamination fluid that was found dripping from the ceiling of an electrical room demonstrates that they will be irreparably harmed. The decontamination fluid contained no detectable agent, and no agent was found in the room to which the solution leaked. What is important about this situation is that the facility operational procedures worked as intended and there was no release of agent.

10. The Plaintiffs stated that on September 18, 1966, the Slag Removal System on the Liquid Incinerator malfunctioned, causing a shutdown of the system. What is important about this situation is that the facility operational procedures worked as intended. The system continued to operate normally. There was no release of agent caused by this situation.

11. The plaintiffs conclude that considering all the incidents noted in the Stay, it is clear that the Tooele Chemical Agent Disposal Facility is ill-prepared to begin hazardous waste or nerve agent operations. Based on my 25 years of experience

with the design, permitting and operation of incineration systems, I do not agree with this conclusion. In a previous Declaration filed in the United States District Court for the District of Utah (Civil No. 2:96-CV-425C), I made the following statement:

12. Through July 7, 1996, the five Tooele Chemical Agent Disposal Facility incinerators have been operated for a total period of 5 years and eight months in a hot shakedown period using either natural gas, non-hazardous ethylene glycol as an agent surrogate or hazardous constituents during the Resource Conservation and Recovery Act and Toxic Substances Control Act Trial Burns. Therefore, many of the equipment related operational problems that commonly occur during the start-up of any mechanical system have all ready been discovered and corrected prior to the feeding of agent. (Emphasis added)

13. I still stand by this statement. While the Tooele Chemical Agent Disposal Facility incinerators have been thoroughly tested out, it is not uncommon in the operation of complex systems, to have these kinds of situations occur. What is most important about the situations that occurred is that the facility engineering controls and operational procedures worked as intended.

14. None of these claims have changed my opinion, as stated in my previous Declaration, that the Tooele Chemical Agent Disposal Facility is a state of the art facility which is properly installed and will be safely and effectively maintained and operated.

Further affiant sayeth not.

James V. Cudahy

Subscribed and sworn to before me this 30th day of October, 1996

Dana S. Reynolds, Notary Public in and for the State of Tennessee

DANA S. REYNOLDS NOTARY PUBLIC STATE AT LARGE KNOX COUNTY, TN

M/ Commission Expires: 8/30/99

February 4, 1997

DECLARATION - JAMES J. CUDAHY

1. My name is James J. Cudahy. I am the president of Focus Environmental, Inc. Focus Environmental is an environmental engineering firm which specializes in the design, permitting and technical evaluation of hazardous waste incineration and other thermal treatment systems. Our clients have included industry, hazardous waste services companies, the U.S. Environmental Protection Agency, the Department of Energy and the Department of Defense.

2. My educational background includes a B.S. in Chemical Engineering from Newark College of Engineering and an M.S. in Chemical Engineering from the University of Delaware. I am a registered professional engineer in Michigan, Louisiana and Delaware.

3. My background and expertise includes over 25 years specializing in the technical evaluation, design, operation and permitting of incineration and thermal treatment systems for hazardous wastes, contaminated soils and contaminated air from industrial process vents. I have served on national committees involved with incineration and thermal treatment. I have served on technical review panels for the Department of Defense and the Department of Energy. I have chaired technical sessions at national meetings which involved hazardous waste incineration, test burns and polychlorinated dibenzodioxin and furan (dioxin) emissions from hazardous waste incineration systems. A copy of my resume is included with this Declaration as Exhibit 1.

4. I have been retained by the United States Department of Justice to give my opinion on the significance, from an operations point of view, of the concerns raised by the Plaintiffs in their Consolidated Memorandum. I was specifically asked to give my opinion on whether the information supplied by the Plaintiffs indicated to me that the operation of the Tooele Chemical Demilitarization Facility was unsafe.

5. As part of my activities for the preparation of this Declaration, I have reviewed the Plaintiffs' Consolidated Memorandum in Support of Plaintiffs' Motion for an Injunction Pending Appeal and Plaintiffs' Second Motion for Preliminary Injunction (Consolidated Memorandum). I have based the conclusions in this Declaration on the experience that I have obtained over my career, two visits to the Tooele Chemical Demilitarization Facility and various facility related documents that I have reviewed. A list of documents that I reviewed and people that I contacted is included as Exhibit 2. During my first visit, I had an in-depth tour of the demilitarization equipment and incineration equipment. During my second visit, I discussed allegations in the Consolidated Memorandum with facility personnel. The allegations that I discussed were those for which I have appropriate experience. Based on my first visit, I prepared a Declaration which

was used in the 1996 court case involving the Chemical Weapons Working Group and the Department of the Army. I also appeared before the court as an expert witness in the 1996 case.

6. In their Consolidated Memorandum, the Plaintiffs claim that newly discovered documents and witness testimony demonstrate that the risk of an agent accident as well as routine stack emissions of toxic chemicals will cause irreparable harm to Plaintiffs and the public. A brief discussion of these claims follows:

7. CHARCOAL FILTERS (Consolidated Memorandum - pgs 8 and 26)

8. The Plaintiffs claim that the agent filters experienced a serious malfunction in August 1996 that resulted in agent release to the environment and employee exposure to agent. While there was a release of agent into the vestibules of the stand-by and back-up filters, the facility engineering controls and operational procedures worked as intended. Neither a facility worker, member of the public, nor the environment was harmed in this incident. There are nine carbon (charcoal) filters in nine buildings in the agent filter system. Seven of the nine are always filtering air from the Munitions Demilitarization Building, while one filter is designated as back-up and one as a stand-by. The agent release into the vestibule occurred because the inlet and outlet valves of the stand-by and back-up filters were both closed and solar heating of the filter buildings caused agent to be desorbed off the carbon into the filter buildings and vestibules. The corrective action for this situation has been implemented. The corrective action involves continuous venting of the stand-by and back-up filters into the on-line filters. This is done by slightly opening the inlet valve of the stand-by and back-up filters and keeping the outlet valve closed. Any agent contained within the stand-by and back-up filters is thereby drawn into the on-line filters and adsorbed by these filters (U.S. Army, Aug 29, 1996).

9. FIRE SUPPRESSION MALFUNCTION (Consolidated Memorandum - pg 8)

10. The Plaintiffs claim that a fire suppression system problem in September 1996 caused a near total loss of negative pressure in the facility which threatened to cause agent to migrate through the facility. While it is correct that the Munitions Demilitarization Building negative pressure did drop during this incident, pressure did not go positive in any area. The corrective action for this situation involves the development of detailed fire system maintenance and operating procedures (Dawson, 1996).

11. AIR FILTER FAILURE (Consolidated Memorandum - pg 9)

12. The Plaintiffs claim on page 9 of the Consolidated Memorandum that total failure of the facility's entire air filtering system occurred in September 1996. In Exhibit C of the Consolidated Memorandum (From the Journals of Gary Millar), Plaintiffs also allege that this "total failure of the facility's entire air filtering system",

involved a filter blower motor failure. These statements are incorrect. There are nine carbon (charcoal) filters in nine buildings in the facility air filtering system. Each of these nine carbon filter systems has a dedicated filter blower and filter blower motor associated with it. Only seven of the nine are on-line at any one time filtering air from the Munitions Demilitarization Building, while one filter is designated as a stand-by and one as a back-up. When the filter blower motor failed, the stand-by filter and filter blower were immediately brought on-line. This event involved the failure of one filter blower motor, not the failure of the entire seven air filtering systems as alleged by the Plaintiffs.

13. AGENT QUANTIFICATION SYSTEM (Consolidated Memorandum - pgs 10 and 11)

14. The plaintiffs allege that the Agent Quantification System does not work and that because it does not work, that neither EG&G nor the Army would know if some agent was missing. This is a production issue, not a safety nor surety issue. While the Agent Quantification System did have operational problems, those problems have been fixed and it is now operating satisfactorily. Relative to surety, the Agent Quantification System is located in a remote room which is constantly being televised and requires special permission and procedures for entry.

15. GB-PARTICULATE EMISSIONS (Consolidated Memorandum - pg 12)

16. The Plaintiffs allege that they will be irreparably harmed as a result of on-going toxic chemical emissions from the facility incinerators. They claim that stack sampling done in November and December of 1996 shows that agent is being emitted into the environment on an on-going basis from the facility incinerators and dispersed into the surrounding communities. This statement is misleading. The stack sampling data shows two particulate filters out of the five tested with positive results for GB agent (Siddoway, 1996). The two positive results however, were both below the Level of Quantification. Values below the Level of Quantification have a lower confidence that the quantity of GB detected is accurate. For these particulate tests, the Level of Quantification was approximately equivalent to a GB stack concentration which is over 5,500 times less than the maximum allowable regulatory based stack concentration of GB.

17. EQUIPMENT RELATED OPERATIONAL PROBLEMS (Consolidated Memorandum- pgs 16, 20 and 21)

18. The Plaintiffs allege that the incidents that have occurred at the Tooele Chemical Demilitarization Facility and the Johnston Atoll Chemical Agent Disposal System over the last four to five months demonstrate that the evidence and opinions offered by the defendants during the first hearing "are simply no longer worthy of belief". Based on my 25 years of experience with the design, permitting and operation of incineration systems, I do not agree with this conclusion. In my previous Declaration, filed in the United States District Court for the District of

Utah (Civil No. 2:96-CV-425C), I made the following statement: "Through July 7, 1996, the five Tooele Chemical Agent Disposal Facility incinerators have been operated for a total period of 5 years and eight months in a hot shakedown period using either natural gas, non-hazardous ethylene glycol as an agent surrogate or hazardous constituents during the Resource Conservation and Recovery Act and Toxic Substances Control Act Trial Burns Therefore, many of the equipment related operational problems that commonly occur during the start-up of any mechanical system have all ready been discovered and corrected prior to the feeding of agent." (Emphasis added) I still stand by this statement. While the Tooele Chemical Agent Disposal Facility incinerators have been thoroughly tested out, it is not uncommon in the operation of complex systems, to have these kinds of situations occur. What is most important about the situations that have occurred is that the facility engineering controls and operational procedures have worked as intended.

19. DIOXIN EMISSIONS (Consolidated Memorandum - pgs 23 to 26)

20. The Plaintiffs allege that dioxin emissions from the facility will cause irreparable harm to them. Nothing however, in the Consolidated Memorandum has changed my opinion about this issue. On April 19, 1996 the Environmental Protection Agency published a proposed dioxin emission standard in the proposed Hazardous Waste Combustor Maximum Achievable Control Technology regulations (EPA, 1996). When finalized, this proposed dioxin emission standard will apply to the 190 Resource Conservation and Recovery Act permitted hazardous waste incinerators in the country including the incinerators at the Tooele Chemical Agent Disposal Facility. All the dioxin emission data from Johnston Atoll and the Tooele facility are well below this proposed dioxin emission standard.

21. WTI and Arkansas Peace Center (Consolidated Memorandum - pgs 24 to 26)

22. The Plaintiffs claim that other courts, when faced with examining the issue of irreparable harm from finite periods of dioxin emissions from hazardous waste incinerators, have found such emissions to constitute irreparable harm. The plaintiffs use two court cases to illustrate their allegation; Greenpeace v. Waste Technologies, Inc. and Arkansas Peace Center v. the Department of Pollution Control. The first case involved the Waste Technologies, Inc. (WTI) commercial hazardous waste incinerator in East Liverpool, Ohio and the second case involved a mobile incinerator at the Vertac superfund site in Jacksonville, Arkansas. The use of these two cases by the Plaintiffs is misleading because the dioxin emissions from the WTI and Vertac incinerators were significantly higher than the dioxin emissions from the Johnston Atoll and Tooele incinerators. The WTI emissions were about 500 times higher than the Johnston Atoll and Tooele Army incinerators (ENSR, 1993). The Vertac incinerator dioxin emissions were about 1,000 times higher than the Johnston Atoll and Tooele Army incinerators (EPA, 1995). These comparisons are based on dioxin emissions from the Liquid Incinerators and the

Deactivation Furnace System at Johnston Atoll and the Deactivation Furnace System from the Tooele facility. The WTI incinerator has since installed a carbon injection system for dioxin control and is now operating with dioxin emissions which are well below the proposed Hazardous Waste Combustor Maximum Achievable Control Technology dioxin standard. The mobile incinerator at the Vertac site remediated over 9,000 tons of dioxin contaminated wastes and has been moved to another location.

23. MIGRATION OF AGENT AT JACADS (Consolidated Memorandum - pgs 28, 29)

24. An agent migration occurred during a planned power shutdown at the Johnston Atoll facility on August 16, 1996 (U.S. Army, Aug 24, 1996). The Consolidated Memorandum states that the Plaintiffs are unaware of any action that has been taken by the Utah Department of Environmental Quality or the Army to ensure that the same agent release problem, caused by a power shut down or power loss, will not occur at the Tooele Chemical Agent Disposal Facility. An extensive program however, exists at the Tooele facility for minimizing agent releases during both planned power shutdowns and unplanned power outages. The Tooele facility has two emergency power generator systems. Every two weeks, one of the emergency power generator systems is tested during a planned power shutdown. Before these planned power shutdowns, any operations involving agent are stopped to minimize the likelihood of agent migration during the generator tests. A recent program involved a significant level of emergency power generator system testing to improve the response of the electrical system to unplanned outages and to test different power outage scenarios The Uninterruptible Power Systems are also tested during the planned power shutdowns. An unplanned power outage occurred at the Tooele Chemical Agent Disposal Facility on December 16, 1996. During this unplanned outage, the emergency generators and the ventilation system worked very well and there was no release of agent.

25. LEAK OF DECONTAMINATION FLUID THROUGH FLOOR CRACK (Consolidated Memorandum - pg 29)

26. The Plaintiffs claim that a small leak of used decontamination fluid that was found dripping from cracks in the floor down into an electrical room demonstrates shoddy construction and inadequate design of the facility. I have visited the Tooele Chemical Demilitarization Facility and based on visits to many other facilities incinerating hazardous wastes, I do not believe the facility has shoddy construction or has been inadequately designed. The decontamination fluid contained no detectable agent, and no agent was found in the room to which the solution leaked. To prevent future problems of this nature, the facility is being examined for floor cracks at least once a week and generally on a more frequent basis.

27. SLAG HEATERS (Consolidated Memorandum - pg 30)

28. The Plaintiffs stated that the slag removal system on the Liquid Incinerator malfunctioned, causing a shutdown of the system. This is a production problem, not a safety problem. There was no release of agent caused by this situation. The design of the slag removal system heaters on the second Liquid Incinerator has been modified and the heaters are now working.

29. SUMMARY

30. None of these claims have changed my opinion, as stated in my previous Declaration, that the Tooele Chemical Agent Disposal Facility is a state of the art facility which is properly installed and will be safely and effectively maintained and operated.

31. In my opinion, based on the documents that I have reviewed and my experience with hazardous waste incineration systems, the Tooele Chemical Demilitarization Facility is not unsafe or being operated in an unsafe manner. The number of safety related incidents described by the Plaintiffs, when compared to typical start-ups of modern complex systems for the incineration of hazardous liquids and solids, are not unusually high. What is most important about the incidents that have occurred is that the facility engineering controls and operational procedures have worked as intended.

I declare under penalty of perjury that the foregoing is true and correct.

Date 2/5/97

James J. Cudahy

REFERENCES

Dawson, Eric, "2 Sep 96 CHB/UPA Fire Suppression System Incident Investigation", Interoffice Memorandum to S. Guello, September 6, 1996

ENSR Consulting and Engineering, "Waste Technologies Industries, East Liverpool Ohio, Final Trial Burn Report for the Rotary Kiln Incinerator", May, 1993

Environmental Protection Agency, Office of Solid Waste, "Draft Technical Support Document for HWC MACT Standards, Appendix C: Emissions Database: Incinerator Report", November 20, 1995

Environmental Protection Agency, "Revised Standards for Hazardous Waste Combustors", Federal Register, Volume 61, page 17358, April 19, 1996

Siddoway, Kernla, "12/10/96 Miniburn Sample Results", Letter to R. Sisson, December 12, 1996

U.S. Army, "Report of Investigation into Indications of GB Agent in Observation Corridors on 16 August 1996", August 24, 1996

U.S. Army, "Carbon Filter Vestibule Chemical Agent Event Report", August 29, 1996

December 1, 1997

DECLARATION - JAMES J. CUDAHY

1. My name is James J. Cudahy. I am the president of Focus Environmental, Inc. Focus Environmental is an environmental engineering firm which specializes in the design, permitting and technical evaluation of hazardous waste incineration and other thermal treatment systems. Our clients have included industry, hazardous waste services companies, the U.S. Environmental Protection Agency, the Department of Energy and the Department of Defense.

2. My educational background includes a B.S. in Chemical Engineering from Newark College of Engineering and an M.S. in Chemical Engineering from the University of Delaware. I am a registered professional engineer in Michigan, Tennessee, Louisiana and Delaware.

3. My background and expertise includes over 26 years specializing in the technical evaluation, design, operation and permitting of incineration and thermal treatment systems for hazardous wastes, contaminated soils and contaminated air from industrial process vents. I have served on national committees involved with incineration and thermal treatment. I have served on technical review panels for the Department of Defense and the Department of Energy involved with the evaluation of Alternative Technologies. I have chaired technical sessions at national meetings which involved hazardous waste incineration, test burns and polychlorinated dibenzodioxin and furan (dioxin) emissions from hazardous waste incineration systems. A copy of my resume is included with this Declaration as Exhibit 1.

4. I have been asked by counsel to prepare this Declaration in response to Plaintiffs' Second Amended Complaint. I have previously prepared and submitted five other Declarations and Affidavits for this and other related cases, dated July 15, 1996, October 24, 1996, October 28, 1996, February 4, 1997 and February 28, 1997. All of these are included in Exhibit 2 of this Declaration. I have also given testimony on July 29, 1996 and March 7, 1997 in the U.S. District Court for the State of Utah and on March 20, 1997 before the Utah Solid and Hazardous waste Control Board.

5. As part of my activities for the preparation of this Declaration, I have reviewed Plaintiffs' Second Amended Complaint, Plaintiffs' Responses to Defendant Army's First Set of Interrogatories and Document Requests, various other documents and had telephone conversations with TOCDF and Army personnel. A list of documents that I reviewed and people that I contacted is included in Exhibit 3.

6. I have based the conclusions in this Declaration on the experience that I have obtained over my career, two visits to the Tooele Chemical Agent Dispoal Facility (TOCDF), various facility related documents and other documents that I have reviewed, my previous Declarations and Affidavits, and literature which I have referenced in this Declaration or my previous Declarations.

7. Since my last Declaration, dated February 28, 1997, the following important events have occurred.

8. The Metal Parts Furnace Agent trail burn testing was successfully implemented on April 4, 15 and 17 of 1997. During the Metal Parts Furnace testing, emissions of Agent GB, particulate matter, hydrogen chloride and carbon monoxide were all within the State of Utah permit limits established for the Metal Parts Furnace (1). The average Agent GB Destruction Removal Efficiency (DRE) was greater than 99.99999975% or greater than eight-9s. This means that the Agent GB emissions from the Metal Parts Furnace during the April 1997 testing, averaged over 40,000 times lower than the amount allowed by the State of Utah permit which is based on a DRE of 99.99% or four-9s.

9. The dioxin emissions from the Metal Parts Furnace, expressed as 2,3,7,8-tetrachlorodibenzo-p-dioxin Toxic Equivalents (TEQ), averaged 0.025 nanograms per dry standard cubic meter corrected to 7% oxygen. This emission is 8 times lower than the Environmental Protection Agency's proposed Hazardous Waste Combustor Maximum Achievable Control Technology standard of 0.2 nanograms of dioxin TEQ per dry standard cubic meter corrected to 7% oxygen (2).

10. The Liquid Incinerator System #2 Agent trail burn testing was successfully implemented on August 20, 22 and 23, of 1997. During the Liquid Incinerator System #2 testing, emissions of Agent GB, particulate matter, hydrogen chloride and carbon monoxide were all within the State of Utah permit limits established for the Liquid Incinerator System #2 (3). The average Agent GB Destruction Removal Efficiency was greater than 99.999999977% or greater than nine-9s. This means that the Agent GB emissions from the Liquid Incinerator System #2 during the August 1997 testing, averaged over 4,347 times lower than the amount allowed by the State of Utah permit which is based on a DRE of 99.9999% or six-9s.

11. The dioxin emissions for the Liquid Incinerator System #2, expressed as 2,3,7,8-tetrachlorodibenzo-p-dioxin Toxic Equivalents (TEQ), averaged less than 0.00048 nanograms per dry standard cubic meter corrected to 7% oxygen. This emission is more than 416 times lower than the Environmental Protection Agency's proposed Hazardous Waste Combustor Maximum Achievable Control

Technology standard of 0.2 nanograms of dioxin TEQ per dry standard cubic meter corrected to 7% oxygen.

12. All of the major TOCDF incinerators, except for the dunnage incinerator which may never be operated, have now successfully completed Agent trial burns. The emissions during these trial burns were all within the State of Utah permit limits established for the Liquid Incinerator System #1, Liquid Incinerator System #2, Deactivation Furnace System and Metal Parts Furnace.

13. Dioxin emissions for these incinerators during the Agent trial burns were all significantly below the Environmental Protection Agency's proposed Hazardous Waste Combustor Maximum Achievable Control Technology standard of 0.2 nanograms of dioxin TEQ per dry standard cubic meter corrected to 7% oxygen. The actual measured dioxin emissions for these incinerators during the Agent trial burns ranged from more than eight times to more than 588 times lower than the Environmental Protection Agency's proposed dioxin emission standard. The actual dioxin emissions for these incinerators are summarized in Table 1.

14. In this Declaration I will address three incineration related allegations from the Plaintiffs' Second Amended Complaint, two of which I believe are new allegations since the March 1997 Federal court proceedings.

15. DREs AT LOW WASTE FEED CONCENTRATIONS

16. The Plaintiffs' allege in paragraph 74 of the Second Amended Complaint, that "chemicals present in the waste feed to an incinerator at concentrations of less than 1,000 parts per million (ppm) will not be incinerated at a 99.9999% DRE and chemicals in the incinerator waste feed at concentrations of less than 100 ppm will not achieve a 99.99% DRE."

17. I still do not agree with this allegation. I base my conclusion on my experience with numerous Destruction and Removal Efficiency tests done on incinerators treating soils contaminated with low concentrations of organic contaminants in the Superfund program.

18. I am aware of 19 incinerator tests during five trial burns performed as part of the nationwide Superfund contaminated soil remediation program, in which the incinerators achieved greater than 99.9999% DREs with chemicals present at less than 1,000 ppm. During seven of these 19 tests, at three trial burns, the incinerators achieved greater than 99.9999% DREs with chemicals present at less than 100 ppm. During two of these 19 tests, during one trial burn, the incinerator achieved greater than 99.9999% DREs with chemicals present at concentrations in the low parts per billion range.

19. Some examples of where Destruction and Removal Efficiencies greater than 99.9999% at low organic feed concentrations occurred are the Denney Farm site, the Times Beach site and the Swanson River site.

20. At Denney Farm in Missouri, the Environmental Protection Agency used an incinerator to remediate a site contaminated with dioxin. During four tests, the incinerator achieved an average Destruction and Removal Efficiency of 99.999986% at an average 2,3,7,8-tetrachlorodibenzo-p-dioxin concentration in the feed of 40 parts per million. The concentration range was 28 to 53 parts per million. The test with 28 parts per million had a Destruction and Removal Efficiency of 99.999995% (4,5).

21. At the Times Beach site in Missouri, six incinerator Trial Burn tests were run, three with trichlorobenzene and three with hexachloroethane at concentrations in the soil feed averaging about 180 parts per million. The average Destruction and Removal Efficiencies for these six tests was 99.999984% (6).

22. At the Swanson River site in Alaska, six Trial Burn tests were run with polychlorinated biphenyls at concentrations in the soil feed averaging about 595 parts per million. The average Destruction and Removal Efficiencies for these six tests was 99.99994%. The concentration range was 289 to 801 parts per million. The test with 289 parts per million had a Destruction and Removal Efficiency of 99.99996% (7). The polychlorinated biphenyl concentrations in the soils were the actual concentrations. No spiking with polychlorinated biphenyls was done for the six Trial Burn tests (8).

23. Contrary to the Plaintiffs' allegations, as can be seen by paragraph 18 and these three examples, incineration data is available that clearly shows the achievement of Destruction and Removal Efficiencies greater than 99.9999% for organics at concentrations below both 1,000 and 100 parts per million.

24. SHAKEDOWN PERIOD

25. In paragraph 154 of the Second Amended Complaint, the Plaintiffs' allege that the "Defendants have improperly utilized the shakedown period beyond what was needed to prepare for trial burn in order to process hazardous waste. This is an incorrect allegation. As per 40 CFR 264.344, the Army's permits allowed it to operate the Liquid Incinerator System #1, Liquid Incinerator System #2 and Metal Parts Furnace, each for a total of 720 operating hours. Because of Utah state requirements, the Deactivation Furnace System was allowed to operate for a total of 500 hours during a shakedown period prior to the trial burns. This 720 or 500 hours is operating time and not calendar time. None of the TOCDF incinerators exceeded the 720 or 500 hours prior to the trial burns.

26. ACAMS ALARMS

27. In paragraph 160 of the Second Amended Complaint, the Plaintiffs' allege that the Defendants have confirmed at least six ACAMS alarms. This allegation is incorrect. There have not been any ACAMS alarms for the incinerator stacks which have been confirmed by the DAAMS tubes.

28. SUMMARY

29. None of the allegations in the Plaintiffs' Second Amended Complaint have changed my professional opinion, as stated in my previous Declarations, that the Tooele Chemical Agent Dispoal Facility is a state of the art facility which is properly installed and will be safely and effectively maintained and operated. I also believe that incineration is the best demonstrated, safest and most effective technology that can be used to destroy the agent and munitions stored at the Tooele Chemical Agent Disposal Facility.

I declare under penalty of perjury that the foregoing is true and correct.

Date: 12/1/97

James J. Cudahy

TABLE 1. DIOXIN EMISSIONS FROM TOCDF INCINERATORS DURING AGENT TRIAL BURNS

Type Incinerator	LIC-1 (a)	LIC-2 (b)	DFS (c)	MPF (d)
Test Dates	Feb 26,27,28-97	Aug 20,22,23-97	Jan 7,10,11-97	Apr 4,15,17-97
Agent	GB	GB	GB	GB
Dioxin Emissions (e)	0.00034	0.00048	0.00059	0.025
Proposed HWC MACT (e,f)	0.2	0.2	0.2	0.2
Ratio MACT/Emissions (g)	>588.2	>416.7	>339.0	>8.0

NOTES:

a - LIC-1 is the Liquid Incinerator no. 1

b - LIC-2 is the Liquid Incinerator no. 2

c - DFS is the Deactivation Furnace System

d - MPF is the Metal Parts Furnace

e - Dioxin emissions are expressed in nanograms of toxic equivalents per dry standard cubic meter corrected to 7% oxygen.

f - HWC MACT is the proposed EPA Hazardous Waste Combustor Maximum Acheivable Control Technology dioxin emission standard.

g - This ratio is the 0.2 proposed HWC MACT dioxin standard divided by actual measured dioxin emissions. This ratio indicates how many times lower the actual dioxin emissions are than the proposed EPA standard.

REFERENCES

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3. RCRA Agent Trial Burn Report for the Liquid Incinerator System #2. EG&G Defense Materials, Inc., October 27, 1997

4. Personal communication, R. Miller, IT Corporation, to J. Cudahy, Focus Environmental, February 3, 1993

5. Environmental Protection Agency, "EPA Mobile Incinerator Safely Destroys Dioxin", Environmental News, EPA Region 7, May 30, 1985

6. Foster, M., M. Douglas, P. Nicotri and A. Wyss, "Status of the Times Beach Remediation Project", Proceedings of the 1996 University of California Incineration Conference, Savannah, GA, May 6-10, 1996

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8. Young, D. and J. Ives, "Site Remediation Soils Handling, Incineration and Site Closeout Challenges and Solutions", paper presented at the 85th Annual Meeting of the Air and Waste Management Association, Kansas City, Missouri, June 21-26, 1992

EXHIBIT 1

RESUME

JAMES J. CUDAHY

Professional Qualifications

Mr. Cudahy is a chemical engineer with 31 years of experience in the chemical industry and as an environmental engineering consultant. His chemical industry experience includes research, marketing, and production work, with over 5 years spent in technical and supervisory chemical production positions. As an environmental engineering consultant, he has specialized for 26 years in the evaluation, design and permitting of incineration, thermal and alternative technologies for the treatment of solid and hazardous wastes and contaminated soils. He has over 90 publications and presentations in these areas, has served as an expert witness, and has chaired sessions on incineration and soil cleanup at international conferences. He has served on national and local committees involved with technology evaluation and the environmental aspects of industrial and hazardous wastes, incinerator metals emissions, the development of EPA incineration guidance documents, energy recovery from waste incineration, and environmental quality.

Education

M.B.A., Michigan State University, East Lansing, Michigan; 1968
M.S., Chemical Engineering, University of Delaware, Newark, Delaware; 1966
B.S., Chemical Engineering, Newark College of Engineering, Newark, New Jersey; 1963

Experience and Background

1989-Present President, Focus Environmental, Inc., Knoxville, Tennessee. Develops business market strategies for Focus. Functions as senior consultant on project work. Specific experience includes.

- Innovative thermal technology evaluation for the DOE and DOD
- Expert witness on incineration design, permitting, operation, and stack emissions.
- Consultant on incineration and mobile thermal treatment public education issues for industry, PRPs and the EPA.
- Evaluation of commercially available mobile systems for contaminated soil thermal remediation on technical and economic bases.
- Evaluation of fixed incineration alternatives for specific waste profiles on technical, economic, and regulatory bases.
- Prepared and consulted on about 25 RCRA and TSCA trial burn plans for all major incinerator types.
- Waste characterizations for many different industry waste types, including chemical, pharmaceutical, plastics, petroleum refinery, explosives, radioactive, and biomedical.

1985-1988 Director, Business Development Thermal Treatment Systems, IT Corporation, Knoxville, Tennessee. Defined market needs and potential winning strategies in the areas of fixed and transportable hazardous waste incineration systems. Required staying current on latest developments in thermal treatment and appropriate regulations.

1980-1985 Process Consultant in Hazardous Waste Incineration, IT Corporation, Knoxville, Tennessee. Was responsible for RCRA incineration regulations, incineration, and hazardous waste management technologies. Duties included administrative assistance for the thermal group in labor planning and scheduling and supervising and training group employees in incineration system technology, the RCRA regulatory program, safety, and hazardous waste management.

1975-1980 Environmental Specialist in Solids, Thermal, Air Pollution Control, Hydroscience, Inc., Knoxville, Tennessee. Was responsible for hazardous and solid waste technology in the areas of incineration, air pollution control, recycle water systems, resource recovery, and energy recovery. Tracked and interpreted RCRA regulations relative to permitting and operation of client facilities.

1971-1975 Senior Environmental Engineer, Environmental Systems Division, Technology Resource Center, Dow Chemical Company, Midland, Michigan. Responsible for application of best technology to waste disposal projects for Dow and outside industrial clients.

1969-1971 Assistant Superintendent of an organic production plant. Technical and supervisory duties for a $6MM capital production facility for Dow.

1968-1969 Production Development Engineer. Responsible for quality, yields, safety, process improvements, and capital installation at various Dow Chemical production facilities.

1967-1968 Leave of absence from Dow to obtain MBA.

1965-1967 Special Assignments Engineer. Project work in sales, research, and production for Dow Chemical in Midland, MI

Registration/Certification

Registered Professional Engineer: Michigan, Tennessee, Louisiana and Delaware.

National Committee, Expert Panel and Peer Review Participation

Department of Energy, Peer Review Panel for DC Arc Melter and Plasma Hearth Vitrification Processes for Mixed Wastes, Regulatory Science Institute, Idaho Falls, ID, August 25-28, 1997

Department of Energy, Peer Review Panel for Integrated Non-Thermal Treatment Systems Study for Mixed Waste, Idaho Falls, ID, August 6-9, 1996

Department of Defense, Technical Review Panel for Alternative Technologies for Chemical Demilitarization, Aberdeen, MD, October 16-27, 1995

Department of Energy, Internal Review Panel for Integrated Thermal Treatment Systems Study for Mixed Waste, Gaithersburg, MD, November 15-18, 1994

Department of Energy, Technical Review Panel for Molten Salt Oxidation, Gaithersburg, MD, October 25-27, 1993

Agency for Toxic Substances and Disease Registry, Non-Incineration Remedial Technologies Panel, Bloomington IN, September 13-15, 1993

Journal of Air and Waste Management Association, Peer Review of Waste Treatment Papers, 1991 to 1994

American Academy of Environmental Engineers, Wastech '92, Innovative Technology, Thermal Destruction Task Group, 1994

USEPA, Peer Review of Vitrification Handbook, September 1991

ASME and USEPA, Workshop on the Control of Metal Emissions from Waste Combustion Devices, Workshop Organizing Committee, November 7-8, 1991

ASME, Research Committee on Industrial and Municipal Waste, Review Committee for Volume II of the Hazardous Waste Incinerator Guidance Document, 1988

ASME, Research Committee on Industrial and Municipal Wastes, Author of one section in Hazardous Waste Incineration - A Resource Document, 1987 ASME Research Committee on Industrial and Municipal Waste, Combustion Energy Recovery Sub-Committee, 1974-1976

Conference Chairs or Co-chairs

90th Annual Air & Waste Management Meeting, Co-chair, Thermal Treatment of Mixed Wastes and Military Wastes, Toronto, Ontario, Canada, June 11, 1997

90th Annual Air & Waste Management Meeting, Co-chair, Dioxin Emissions and Controls for Hazardous Waste Incinerators, Toronto, Ontario, Canada, June 9, 1997

89th Annual Air & Waste Management Meeting, Co-chair, Dioxin, Metals, and Particulate Emissions and Controls for Hazardous Waste Incinerators, Nashville, TN, June 26, 1996

1994 Incineration Conference, University of California, Co-chair, Emerging Thermal Treatment Technologies, Houston, TX, May 1994

1993 Incineration Conference, University of California, Co-chair, Boilers and Industrial Furnaces, Knoxville, TN, May 1993

1992 Incineration Conference, University of California, Chair, Thermal Treatment of Petroleum Contaminated Soils and Sludges, Albuquerque, NM, May 1992

1991 Incineration Conference, University of California, Co-chair, Trial Burns, Knoxville, TN, May 1991

1991 Incineration Conference, University of California, Co-chair, Mixed Waste Permitting, Knoxville, TN, May, 1991

Haztech International '88, Co-chair, Incineration, Cleveland, OH, September 1988

Publications and Presentations

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Rigo, H. G. and J. J. Cudahy, "National Annual Dioxin Emissions Estimates from Waste Combustors", Proceedings of the 1997 International Incineration Conference, University of California, Oakland, CA, May 14, 1997. (Paper and Presentation)

Cudahy, J.J. and William J. Quapp, "Innovative Thermal Treatment Technologies", Advanced Tutorials Workshop, 1997 International Incineration and Thermal Treatment Conference, University of California, Oakland, CA, May 15, 1997. (Presentation)

Cudahy, J.J. and Paul A. Sadler, "Mobile Incineration of Contaminated Soils", Chapter 20 in Bioremediation : A Comparison with Other Technologies , to be published by Technomic in 1997. (Book Chapter)

Holcomb D. H and J. J. Cudahy, "Thermal Treatment of Coal Tar and Coal Tar Contaminated Soils", 89th Meeting of the Air and Waste Management Association, Nashville, TN, June 26, 1996. (Paper)

Cudahy, J. J., et al, "Incineration of Rocket Propellant and Oxidizer from Ukrainian Missiles", Proceedings of the 1996 International Incineration Conference, University of California, Savannah, GA, May 9, 1996. (Paper and Presentation)

Cudahy, J. J., et al, "Community Liaison Panel Involvement at a Superfund Project ", Panel on Communication with the Public During Incineration Projects, Proceedings of the 1996 International Incineration Conference, University of California, Savannah, GA, May 8, 1996. (Presentation)

Cudahy, J.J., "Proposed Hazardous Waste Combustion MACT Standards and Its Implication for APC Upgrade", Seminar on EPA's Evolving Regulations for Hazardous Waste Combustion Systems, Focus Environmental, Houston, TX and Baton Rouge, LA, March 27 and March 29, 1996 (Presentations)

Cudahy, J.J., "Mobile Incineration and Thermal Desorption of Superfund Sites", World Environmental Congress, London, Ontario, September 20, 1995. (Presentation)

Cudahy, J.J., "Hazardous Waste Management and Incineration in the United States", Presentation to the Philippine Islands Technology Matching Mission/Chemical Sector, sponsored by the World Bank at the University of Tennessee, Knoxville, TN, August 23, 1995. (Presentation)

Cudahy, J.J., Seminar on Proven and Innovative Site Remediation Thermal Technologies, American Society of Civil Engineers Continuing Education Program, Presented in Pittsburgh, PA, July 23, 1995. (Presentation)

Cudahy, J.J., "Comparison of Hazardous Waste Incinerator Emissions with Common Non-Hazardous Combustion Devices", 88th Meeting of the Air and Waste Management Association, San Antonio, TX, June 18-23, 1995 (Paper and Presentation)

Cudahy, J.J., "Dioxin Emission Database", Combustion Strategy Workshop, Focus Environmental, Inc., Knoxville, TN, September 19, 1994 (Presentation)

Cudahy, J.J., "Innovations in Thermal Destruction Technologies", Seminar on Innovative Site Remediation Technologies, American Academy of Environmental Engineers, Presentations in New York, San Francisco, Dallas, and Atlanta, May, August, September, and December, 1994. (Presentations)

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FILE

A P P E A R A N C E S

FOR THE PLAINTIFFS:

MICK HARRISON, ESQUIRE
P.O. Box 467
Bera, KY 40403

FOR THE DEFENDANTS:

ROBERT H. FOSTER, ESQUIRE
U.S. Dept. of Justice
999 18th Street, Suite 945
Denver, CO 80202

ALSO PRESENT:

Maj. Peter C. Zolper
U.S. Dept. of the Army

* * * * *

WITNESS:	EXAMINATION BY COUNSEL FOR THE PLAINTIFF	DEFENDANT
Richard Holmes	8	

* * * * *

E X H I B I T S

EXHIBIT NUMBER:	MARKED FOR IDENTIFICATION

99-1722

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF UTAH, CENTRAL DIVISION

- - - - - - - - - - - - - - - - - - - -X
CHEMICAL WEAPONS WORKING GROUP (CWWG), INC., SIERRA CLUB, AND VIETNAM VETERANS FOUNDATION,

Plaintiffs,

v. Case No. 2i96CV 425C

UNITED STATES DEPARTMENT OF THE ARMY UNITED STATES DEPARTMENT OF DEFENSE AND EG&G DEFENSE MATERIAL INC.,

Defendants.

- - - - - - - - - - - - - - - - - - - -X

Tuesday, April 14, 1998
Arlington, Virginia

Telephonic Deposition of

RICHARD HOLMES

witness, called for examination by counsel for the plaintiff, pursuant to notice, at the offices of Army Environmental Lit. Office, 901 N. Stuart Street, Arlington, Virginia, beginning at 11:06 a.m., before Timothy Clark, a notary public in and for the State of Virginia, when were present on behalf of the respective parties:

that could be used for this purpose?

A Yes, there is.

Q And where would that be?

A The toxic maintenance area is RCRA permanent storage.

Q Okay. Does that mean anything you want to store in there is okay?

A Subject to what is defined in the permit that authorizes that storage area.

Q All right. Do you know whether it was contemplated to store charcoal?

A I don't know for certain that charcoal is included in the permanent storage in the TMA.

Q All right. Now, some waste generated at TOCDF has been sent to CAMDS for storage, has it not?

A I don't know if we have sent waste to CAMDS for storage or not.

Q Okay. Now, apart from the charcoal waste stream we've talked about, why is it that you have drawn the conclusion that the dunnage incinerator is not required for the other waste streams for which it was intended?

A There is not a need to incinerate the wood that is the packing material around the munitions that has not been exposed to chemical agent.

Q Okay.

4/98D
PENCO CO BAYONNE NJ 07002 (201) 436-1400

A Which was by poundage the largest quantity of material that was going to be fed into the dunnage incinerator.

Q All right. Now, some of that wood would have actually been exposed on occasion, is that correct?

A A very small amount would have been exposed.

Q All right. And there are other waste streams, I take it, that were intended for the dunnage incinerator besides the wood?

A The other one was DPE suits. That's the suits you wear to perform work in the contaminated spaces in the facility.

Q Right. And is there a reason you don't need the dunnage incinerator for that?

A Years ago we decided that we would not incinerate the DPE suits.

Q All right. Is that a decision that applies to both Tooele and JACADS?

A Yes, it does.

Q All right. Do you recall when that decision was made?

A I don't, I don't remember the, the timing of it.

Q All right. Do you recall who made the decision?

A Yes, I do.

Q And who made the decision?

A It was the then program manager for chemical demilitarization.

Q All right. And do you recall who that was at that time?

A Yes. His last name was Baronian -- B-a-r-o-n-i-a-n.

Q Do you know the basis for making that decision at that time?

A Yes, I do.

Q What was that?

A The, the DPE suit is made out of a chlorinated plastic.

Q Right.

A And the pollution abatement system that's attached to the dunnage incinerator we felt would not be an effective scrubber for the likely dioxins that would be produced from the incineration of those suits.

Q All right. Is there any intent at this moment to use the dunnage incinerator at the JACADS facility in the future?

A Um, at this point it's subject to the same evaluation for charcoal disposal as is going on for Tooele.

Q All right. Apart from the charcoal is there any plan to use it at JACADS?

A Not that I'm aware of.

Q All right. And I take it the answer is the same for the dunnage incinerator at Tooele?

A That's correct. Again, subject to completion of the evaluation of to determine how we're going to dispose of the charcoal.

Q All right. Now, the wood that we've been discussing that was originally intended for processing in the dunnage incinerator, you've identified most of it would not be contaminated with an agent. What is the current disposition of that wood in terms of that type of dunnage created at the Tooele facility? What's being done with it?

A I, I think it's going to a landfill.

Q Okay. And I take it that this would be sent to a landfill after doing some sort of testing, or, inspection to determine whether or not it was exposed to agent?

A That's correct.

Q Do you know what process is used to make that determination?

A There are multiple layers and they're defined in the waste analysis plan. It starts with a statistical sampling of material where we took actual wood samples and in the laboratory performed an agent analysis of that wood. It's then based upon the sampling that is done of the vapor space inside of the on-site container that is used to bring the munitions and the dunnage to the facility and I believe

includes some statistical base, rechecking of the results utilizing the laboratory procedure on a periodic basis.

Q When you say statistical rechecking, what are you referring to?

A I think there's some requirement every so many days to take another wood sample and take it to the laboratory as a confirmation that the check of the vapor space inside of the on-site container is a, is an indicator that there is no agent present in the wood.

Q Okay. So, I take it the vapor space in the container is checked in every case for wood that is to be disposed of. It's not a statistical sampling, but, it's done in every case?

A That's correct.

Q All right. And the actual analysis of the wood is done on a statistical sampling basis?

A Correct.

Q Do you know what quantity of dunnage was contemplated as being generated and required to be processed in the dunnage incinerator for Tooele?

A I think that there are, that there is approximately 25 million pounds of wood dunnage associated with the entire stockpile at Deseret Chemical Depo.

Q Okay. And that would not count the non-wood type of dunnage?

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EQC Meeting May 18, 2000
Attachment U, Page U-107

A Uh, when I say the 25 million pounds I'm not trying to be exclusive of -- I --

Q I mean that figure was made for the wood, right, not for the DPE's, or, the charcoal, or, other items of dunnage?

A Correct. I'm talking about the packing material that is surrounding the current stockpile as dunnage. That number does not include DPE suits nor charcoal.

Q Okay. When you say surrounding what does that mean exactly?

A Um, in some cases that there are pallets. In some cases those pallets are at the base of the munition and at the top of the munition. In some cases in rockets there are the pallet almost totally surrounds with some open space the packing of rockets.

Q Okay. I understand. So, this would be officially the wood packing in whatever form it takes?

A Right. When I say surrounding it's all on the outside. It's outside of the projectile. It's outside of the rocket.

Q I understand. So, it wouldn't come into contact with agent if leaking were occurring?

A Correct.

Q All right. And do you have any idea what the amount of non-wood dunnage that was anticipated being

ATTACHMENT V

LISTING OF DOCUMENTS RELATED TO THE DUNNAGE INCINERATOR

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DUNNAGE INCINERATOR DOCUMENTS CURRENTLY UNDER REVIEW BY THE DEPARTMENT

DEQ Item No	Date Received	Date of Document	Organization From	Organization To	Document Description
653		1/12/95	GAO	Sec. of Army	Funding Miscalculated, Dunnage Purchase
1024		6/1/93	US ARMY		RCRA Permit Application Update UMCDF Volume B-Reference DFS & DUN Vendor Drawings for TOCDF [Response to the 4th NOD]
1409		3/1/95	Raytheon Engineers & Constructors	Aberdeen Proving Ground	RCRA Trial Burn Report for Agent GB/Dunnage
00-0023	1/7/00	1/4/00	UMCDF	DEQ-Hermiston	Permit Condition I.W., Other Information, Dunnage Furnace Retrofit Design Report
00-0024	1/7/00	12/1/94	Maumee Research & Engineering	DEQ-Hermiston	Dunnage Furnace Retrofit Design Report, December 1994 MR&E Report No. 94026 (Prepared for EG&G Defense Materials, Inc.)
00-0109	1/24/00	1/24/00	DEQ-Hermiston	File Category 700	Memo to File: Dunnage Incinerator (DUN) Meeting Notes from the January 13, 2000 Meeting with Raytheon and the Army
00-0111	1/24/00	1/24/00	DEQ-Hermiston	DEQ-Portland	Memo (Confidential) Secondary Waste and Dunnage Incinerator Issues
00-0194	2/3/00	1/13/00	Environmental Quality Commission	Morrow County Court	Dunnage Incinerator and the Management of Secondary Waste Issues
00-0232	2/11/00	2/9/00	UMCDF	DEQ-Hermiston	Permit Condition I.W., Other Information, Thermal Analysis of DUN Furnace System for Continuous Loading, Report No. 94038

DUNNAGE INCINERATOR DOCUMENTS CURRENTLY UNDER REVIEW BY THE DEPARTMENT

DEQ Item No	Date Received	Date of Document	Organization From	Organization To	Document Description
00-0233	2/11/00	29-Jul-94	Maumee Research and Engineering, Inc.	EG & G Defense Materials, Inc.	Thermal Analysis of DUN Furnace System for Continuous Loading, Report No. 94038
00-0240		1/6/00			UMCDF Configuration Change Concurrence Sheets - ECPS for the Dunnage Incinerator
00-0260	2/15/00	2/11/00	UMCDF	DEQ-Hermiston	Permit Condition I.W., Other Information, Dunnage Incinerator (DUN) Replacement Risk Assessment Report
00-0261	?	1/1/00 & 11/1/98	PMCD-East	DEQ-Hermiston	U.S. Army Program Manager for Chemical Demilitarization DUN Replacement Risk Assessment Report/Carbon Micronization System at Umatilla CDF Feasibility Study
00-0298	2/29/00	2/25/00	Ecology & Environment Inc.	DEQ-Hermiston	Comments on: "Dunnage Incinerator System Improvement Options Feasibility Study"
00-0406	3/22/00	Unknown	PMCD		JACADS Dunnage Incinerator (DUN) Modifications
00-0407	3/22/00	1/16/91 (1/16/91, 9/19/91 and 10/9/91 for attached documents	Surface Combustion, also PMCD for some of the attached stuff	United Engineers and Constructors, Inc.--Stearns Roger Division	Attachment to 00-0406; Your Order No. TE-2003 9338400 Dunnage Incinerator for TOCDF, Our Job No. JC-3091 Document 16 "Equipment Data Sheets" for Ash Discharge Gate Valve
00-0409	3/22/00	9/28/91	United Engineers and Constructors	PMCD-East	Attachment to 00-0408; Restart Requirements for the DUN Furnace System Contract No. DACA87-86-C-

DUNNAGE INCINERATOR DOCUMENTS CURRENTLY UNDER REVIEW BY THE DEPARTMENT

DEQ Item No	Date Received	Date of Document	Organization From	Organization To	Document Description
00-0411	3/22/00	29-Jan-88	JACOBS Engineering Group, Inc.	PMCD	Incineration Methods (Existing Furnaces) for Chemical Agent Contaminated Charcoal-Final
00-0412	3/22/00	28-Jun-88	JACOBS Engineering Group, Inc.	PMCD-East	Non-Agent Charcoal Testing in CAMDS Toxic Dunnage Incinerator Contract No. DACA87-86-D-0085
00-0413	3/22/00	5/23/89	Maumee Research and Engineering, Inc.	Stearns Roger Division	Final DUN Grate Design Report for Burning Granular Activate Carbon JACADS DUN Furnace Project 7094
00-0414	3/22/00	Unknown	Midland-Ross Corporation	Stearns Catalytic Corp	DUN Design Proposal per RFP No. C03X-02
00-0415	3/22/00	8/19/91		Deputy Program Manager & Technical Director	Comparison between JACADS Dunnage Incinerator (DUN) and CAMDS Toxic Dunnage Incinerator
00-0416	3/22/00	6/6/91	PMCD-East	JACADS Project Officer	Attachment to 00-0415; Incineration of Filter Carbon in the JACADS DUN
00-0417	3/22/00	10/25/90	United Engineers and Constructors	PMCD-East	Transmittal Page: DUN Furnace RCRA Parameter Problems
00-0418	3/22/00	10/23/90			Attachment to 00-0417; DUN Furnace RCRA Parameter Problems
00-0419	3/22/00	2/9/91	Stearns Roger Division-OMC	PMCD-JACADS	DUN Status
00-0420	3/22/00	2/9/91	Stearns Roger Division-OMC	PMCD-East	Attachment to 00-0419; Status of the current DUN Documentation

DUNNAGE INCINERATOR DOCUMENTS CURRENTLY UNDER REVIEW BY THE DEPARTMENT

DEQ Item No	Date Received	Date of Document	Organization From	Organization To	Document Description
00-0421	3/22/00	11/17/90	PMCD-East	Stearns Roger Division-OMC	Dunnage Incinerator (DUN) Furnace Acceptance Report
00-0422	3/22/00	11/15/90		PMCD-East	Attachment to 00-0421; DUN Furnace Phase II Acceptance Test Report
00-0423	3/22/00	1/22/91	United Engineers and Constructors	PMCD-East	Attachment to 00-0419; Dunnage Furnace Agent Feed Procedure
00-0424	3/22/00	23-Jan-91	Rader Companies	United Engineers & Contractors	Letter confirming fax transmittal of prior evening
00-0425	3/22/00	23-Jan-91	Rader Companies	United Engineers & Contractors	Quotation for Rader Conveying System
00-0426	3/22/00	1/22/91	Surface Combustion	Stearns Roger Division, OMC	Your Order No. TE-2003 9338400 Dunnage Incinerator for TOCDF, Out Job JC-3091 Study to Review Impact on Diverting Flow from Dun-Blower-102 to Primary Chamber and Also to Increase Flow of Air Through Air Grates
00-0427	3/22/00	2/22/91	Maumee Research and Engineering, Inc.	PMCD-JACADS	Fax Transmission regarding JACADS DUN Questions, MRE File 91004
00-0428	3/22/00	2/22/91	Maumee Research and Engineering, Inc.	PMCD-JACADS	Attachment to 00-0427 and 00-0432; Memorandum regarding the JACADS DUN Questions, MRE File 91004

DUNNAGE INCINERATOR DOCUMENTS CURRENTLY UNDER REVIEW BY THE DEPARTMENT

DEQ Item No	Date Received	Date of Document	Organization From	Organization To	Document Description
00-0429	3/22/00	2/13/91	Maumee Research and Engineering, Inc.	PMCD-JACADS	Attachment to 00-0427; Facsimile Transmission Sheet regarding DUN Furnace Blow-102 Air Diversion Need Piping Drawings to do our Drawings
00-0430	3/22/00	1-Mar-91	Maumee Research and Engineering, Inc.	PMCD-JACADS	Attachment to 00-0427 and 00-0432; Facsimile Transmission Sheet regarding DUN Furnace Study, MRE 91004 Request for Guidance Transmittal of Advance Drawings
00-0431	3/22/00	11/26/90	PMCD	PMCD	Attachment to 00-0427; Memorandum for record regarding JACADS and TOCDF DUN Recommendations.
00-0432	3/22/00	1/3/91	Mitre Corporation	Record File	DUN Furnace Status to Date
00-0433	3/22/00	8/31/90	Maumee Research and Engineering, Inc.	UEC-Stearns Roger Division	Commentary on Report No. 89030 Operational Status of JACADS Dunnage Incinerator (DUN) Furnace
00-0434	3/23/00	8/1/90	Maumee Research and Engineering, Inc.	Stearns Roger Division, OMC	Attachment to 00-0433; Operational Status Report on JACADS Dunnage Incinerator (DUN) Furnace Project No. 89030
00-0445	3/22/00	3/8/91	PMCD-East	PMCD-East	Improvements to DUN Lift
00-0446	3/22/00	8-Mar-91	PMCD	PMCD	Attachment to 00-0445; Scope of Work for DUN Lift Vendor
00-0447	3/22/00	3/14/91	Arthur D. Little Inc.	PMCD-East	Attachment to 00-0445; Preliminary Investigation of the DUN Ram Malfunction

DUNNAGE INCINERATOR DOCUMENTS CURRENTLY UNDER REVIEW BY THE DEPARTMENT

DEQ Item No	Date Received	Date of Document	Organization From	Organization To	Document Description
00-0448	3/22/00	3/26/91	Arthur D. Little Inc.	PMCD-East	Historical Survey of Problems Associated with the DUN Feed System
00-0449	3/22/00	3/26/91	Stearns Roger Division-OMC	Arthur D. Little and PMCD	Attachment to 00-0448; DUN Furnace Feed System, Enclosure: DUN Furnace Feed System Problems DUN Log Book Excerpts
00-0450	3/22/00	3/27/91	Authur D. Little Inc	PMCD-East	Attachment to 00-0448; Summary of DUN Operations from 1700 hrs 21 Mar 91 to 1700 hrs 22 Mar 91
00-0451	3/22/00	1/11/99	PMCD-East		DUN History at JACADS, Comments from Cheryl Maggio (1/11/99)
00-0452	3/22/00	6/28/99	TOCDF		Attachment to 00-0451; DUN History at TOCDF-Comments from Tom Valente (DUN System Engineer at TOCDF)
00-0453	3/22/00	2-Aug-91	Maumee Reseach and Engineering, Inc.	PMCD	Analysis of CSDP Incinerator Shutdown Alternatives, MR&E Report, Project No. 9-SC-6712-0061B
00-0454	3/22/00	1-Apr-89	Maumee Research and Engineering, Inc.	Ralph M. Parsons Co.	Attachment to 00-0453; Analysis of CSDP Incinerator Shutdown Alternatives, First Draft
98-0584	8/20/98	8/18/98	UMCDF	DEQ-Hermiston	Decision Being Pursued to Remove the Dunnage Incinerator (DUN) from the UMCDF Scope
98-0606	8/27/98	8/27/98	DEQ-Hermiston	Dept of Army	Letter RE: Dunnage Incinerator

DUNNAGE INCINERATOR DOCUMENTS CURRENTLY UNDER REVIEW BY THE DEPARTMENT

DEQ Item No	Date Received	Date of Document	Organization From	Organization To	Document Description
98-0861	11/2/98	11/2/98	DEQ-Hermiston	Ecology & Environment Inc.	Memorandum Re: Transmittal of dunnage Incinerator, and HRA documents
98-0866	10/27/98	10/27/98	DEQ-Hermiston	Interested Parties	UMCDF DUN REPLACEMENT AND ALTERNATIVE WASTE MANAGEMENT PRESENTATION FOR ODEQ OCT 27,1998
98-0867	10/27/98	10/27/98	DEQ-Hermiston	Interested Parties	Attachment to 98-0866 Risk Assessment for UMCDF Dun Replacement
98-0868	10/27/98	10/27/98	DEQ-Hermiston	Interested Parties	Attachment to 98-0866 UMCDF Facility Operations and Emission Rate Estimates After Dun Replacement
98-0869	11/3/98	11/3/98	DEQ-Hermiston	EPA	Memorandum Re: Materials from DUN meeting with the Army
98-0943	11/18/98	11/12/98	UMCDF	DEQ-Hermiston	Transmittal Letter Re: Dunnage Incinerator (DUN) Replacement and Alternative Waste Management for the Umatilla Chemical Agent Disposal Facility
98-0944	11/18/98	10/27/98	UMCDF	DEQ-Hermiston	Attachment to 98-0943 SAIC Meeting Minutes: DUN Replacement Presentation for ODEQ
98-1031	12/3/98	12/3/98	DEQ-Hermiston	Dept of Army	Letter Re: Dunnage Incinerator Umatilla Chemicaol Agent Disposal Facility
99-1031	7/2/99	6/25/99	UMCDF	DEQ-Hermiston	Letter Re: Summary of June 15, 1999, Exploratory Meeting regarding the Dunnage Incinerator
99-1032	7/2/99	6/25/99	UMCDF	DEQ-Hermiston	Attachment to 99-1031 Summary of June 15, 1999, Meeting with the DEQ on the Dunnage Incinerator (DUN)

DUNNAGE INCINERATOR DOCUMENTS CURRENTLY UNDER REVIEW BY THE DEPARTMENT

DEQ Item No	Date Received	Date of Document	Organization From	Organization To	Document Description
99-1245	7/23/99	8/18/99	DEQ-Hermiston		EQC Agenda Re: Special Meeting Dunnage Incinerator August 18, 1999 held in Portland, Oregon
99-1273	7/26/99	7/26/99	DEQ-Hermiston	UMCDF	DEQ Letter Re: Dunnage Incinerator Feasibility Study Permit Condition I.W.
99-1350	8/9/99	8/6/99	UMCDF	DEQ-Hermiston	Letter Re: Dunnage Incinerator (Dun) Feasibility Study
99-1367	8/13/99	8/13/99	DEQ-Hermiston	EQC	DEQ Memorandum Re: August 18, 1999 EQC Work Session: Dunnage Incinerator and Carbon Filters at Umatilla
99-1416	8/26/99	14-Jun-99		DEQ-Hermiston	Agenda for June 15, 1999 Meeting on the Dunnage Incinerator
99-1647	10/4/99	9/28/99	UMCDF	DEQ-Hermiston	Letter Re: Transmittal of the Army Report Dunnage Incinerator System Improvement Options Feasibility Study, Final
99-1648	10/4/99	9/28/99	UMCDF	DEQ-Hermiston	Attachment to 99-1647 Army Report-Dunnage Incinerator System Improvement Options Feasibility Study

ATTACHMENT W

"A Report on the September 15, 1999 Industrial Accident at the Umatilla Chemical Agent Disposal Facility,"
by

Oregon Department of Environmental Quality
Oregon Emergency Management
Oregon Occupational Safety and Health Administration
Oregon Health Division

April 20, 2000
(DEQ Item No. 00-0582)

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A Report on the September 15, 1999 Industrial Accident at the Umatilla Chemical Agent Disposal Facility

Prepared by:

Wayne C. Thomas, Department of Environmental Quality

Chris Brown, Oregon Emergency Management

Rodney Boast, Oregon OSHA

Bryan Hopkins, Oregon Health Division

April 20, 2000

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Executive Summary

On September 15, 1999, at approximately 11:10 a.m., workers in the Munitions Demilitarization Building (MDB) at the Umatilla Chemical Agent Disposal Facility (UMCDF) experienced the sudden onslaught of breathing difficulties. The workers evacuated the building through whatever egress was available.

After waiting approximately two hours at the site, thirty-four employees were transported via van and ambulance to Good Shepherd Community Hospital in Hermiston. The employees reported the following symptoms: difficulty in breathing, tightness in the chest, irritated throat, nausea and some indicated a metallic taste. Five employees were admitted to the hospital for further observation. The source and nature of the contamination remains unknown.

Under the leadership of the Governor's Office, a Four Agency Team (Team) was established to investigate response actions conducted by the Umatilla Chemical Depot (UMCD), Raytheon Demilitarization Company (RDC) and Off-Post Communities as a result of the September 15, 1999 incident. The purpose of the investigation was to evaluate worker safety, emergency response and public awareness to identify any lessons that should be learned for any future incidents and make recommendations based on the findings. **The Agency Team concurs with the Army and Raytheon findings that there is sufficient evidence to indicate that this was not a chemical event (for reasons so stated in their reports).**

However, the Team has identified failures in the following areas:

- Site Evacuation and Medical Evacuation
- Communication between the On-Post and Off-Post Emergency Response Communities, medical facilities and the public
- Communication between the Army, Raytheon and the employees

The Agency Team has determined that the response actions by RDC were inadequate and seriously jeopardized the health and welfare of employees. An area of particular concern is how and when the decision was reached and by whom, that this incident was not caused by a

chemical agent release. The timing and accuracy of this decision was crucial for all subsequent response actions. We remain unclear how the decision was reached. It is problematic that the UMCD and RDC did not implement the Chemical Accident/Incident Response Action (CAIRA) Plan until such time that monitoring of the storage igloos confirmed that a release of chemical agent did not occur. The results of chemical agent monitoring were not available for three hours following the incident.

RDC's decision to reject medical aid offered by the UMCD medical clinic is inconceivable. This multi-casualty event overwhelmed RDC's resources and the off-post medical facilities. Providing the best medical services for the injured workers should have been RDC's first priority.

The failure to communicate the scope of the event to the off-post emergency operation centers and the public is a significant issue. The evacuation or so-called "early release" of workers caused a major impact and concern for the surrounding communities. The first press release for the event was not issued until several hours after the incident by which time rumors were rife throughout the community. The first press conference was not held until five days after the incident. It is not difficult for the Agency Team to understand questions and concerns from the community that UMCD and RDC were trying to conceal information.

Comments from site workers during the November 1, 1999, public meeting demonstrate that there is a communication problem between RDC and the construction workers. Several commenters stated that they were confused about what happened at the site and that as of November 1, 1999, they had not been provided sufficient information. The Agency Team did not find any evidence that this communication challenge has been addressed.

We do note that in reviewing the responses provided by the UMCD Commander (LTC Tom Woloszyn) that UMCD has conducted a thorough assessment of the issues resulting from the incident. The Commander has expressed and demonstrated intent to learn lessons from the incident and implement appropriate corrective measures. RDC responded to the Agency Team's questions citing Raytheon procedures, which have not been provided to the Team, even though

they were requested. If appropriate procedures were in place and correctly implemented, then workers should have been adequately protected, treated and the public notified in a timely manner. Clearly, the events that transpired on September 15, 1999 illustrate that appropriate procedures were not being used.

The cause of the incident remains unknown. Analyses of the clothing samples by RDC have reported the presence of pepper spray and associated compounds. The Federal OSHA has analyzed for the pepper spray compounds, but the results did not show the presence of the compounds. Without independent confirmation of the pepper spray results from a different sample set and using a different laboratory, the presence of the pepper spray is questionable. The Agency Team recognizes that the cause of the incident may never be known, but we believe that lessons must be learned and corrective actions implemented to prevent another incident.

Recommendations

Based on the Agency Team's review of the available information the following recommendations should be implemented by the end of calendar year 2000:

1. A Memorandum of Agreement between UMCD and the Off-Post Emergency Response Communities for initial notification of **all incidents** at the UMCD. UMCD and the Off-Post Emergency Response Communities must define an "incident" as part of the MOA;
2. RDC establish a communication program for all workers at the construction project and provide regular updates on activities;
3. UMCD implement an enhanced chemical agent monitoring program for the storage igloos in "K" Block, with emphasis on the igloos storing the M-55 rockets and leaking munitions;
4. UMCD and RDC establish clear lines of communication and decision-making authority to ensure that appropriate response actions are implemented as soon as possible for any incident;
5. A communication agreement/plan be developed and implemented by the on-post and off-post jurisdictions concerned with public outreach for the UMCD activities;
6. RDC have a Memorandum of Agreement with UMCD stating that the UMCD medical clinic becomes involved in any incident involving casualties in excess of two. UMCD involvement

should remain until a chemical agent release has been ruled out and patients have been stabilized and transferred to a local hospital or released;

7. RDC establish a Memorandum of Agreement with Good Shepherd Community Hospital for patient care;
8. RDC establish a Memorandum of Agreement with the Hermiston Fire Department for patient transportation;
9. UMCD must communicate the procedures used by the facility to notify the off-post community so that the communities can understand the information they will be receiving; and
10. The Army must implement an active Public Awareness program for all activities on-going at the UMCD.

Background and Scope of the Investigation

Introduction

Under the leadership of the Governor's Office, a Four Agency Team was established to investigate worker safety, emergency response and public awareness actions conducted by the UMCD, RDC and Off-Post Communities as a result of the September 15, 1999 incident.

Purpose of the Investigation and Report

The purpose of the investigation was to evaluate worker safety, emergency response and public awareness in order to identify lessons to be learned for any future incidents. The scope of the investigation was limited to interviews and reviewing information provided by the various jurisdictions and companies involved. No environmental or medical data was collected during this investigation. Medical records of affected workers were not reviewed during the investigation. This report documents the actions of the Team, provides a record of meetings and public involvement, and makes recommendations to ensure future incidents are managed in an effective manner.

A Summary Description of the Incident

On September 15, 1999, at approximately 11:10 a.m., workers in the Munitions Demilitarization Building (MDB) at the Umatilla Chemical Agent Disposal Facility (UMCDF) experienced the sudden onslaught of breathing difficulties. The workers, who primarily worked in or near the munitions corridor on the first floor, evacuated the building through whatever egress was available.

After waiting approximately two hours at the site, thirty-four employees were transported via van and ambulance to Good Shepherd Community Hospital in Hermiston. The employees reported the following symptoms: difficulty in breathing, tightness in the chest, irritated throat, nausea and some indicated a metallic taste. Five employees were admitted to the hospital for further observation. The source and nature of the contamination remains unknown.

Investigation

The Agency Team members held a scoping meeting on September 24, 1999, and developed a comprehensive list of questions (Attachment 1) to capture the concerns expressed by the communities around the UMCD.

On September 29, 1999, the Agency Team convened a meeting with the Army and Raytheon at the UMCD to receive a preliminary report on the incident. Representatives from Umatilla County, Morrow County and the Hermiston Fire Department were also present. Following a briefing by the Army and Raytheon, the Team presented the list of questions and required a response by November 1, 1999. The Army provided a timeline of events that occurred on September 15, 1999 (Attachment 2).

The Umatilla Chemical Depot Commander held a Town Hall meeting in Irrigon on October 19, 1999. The purpose of the meeting was to provide assurances to the community that appropriate actions were being taken following the incident and lessons had been learned.

On November 1, 1999, a public meeting of the Agency Team was held at the National Guard Armory in Hermiston. Approximately sixty people were in attendance. The Army and Raytheon made presentations in response to the Agency questions provided on September 29, 1999 (Attachment 3). In addition, members of the public were invited to make statements and ask questions of the Agency Team, the Army and Raytheon.

The Agency Team held two additional meetings to review the information provided by the Army, Raytheon, Hermiston Fire Department and Good Shepherd Community Hospital to develop findings. The intent of the review was to complete a thorough examination of the September 15, 1999, incident, identify failures, identify lessons learned and assure those lessons are applied in a consistent and robust manner for any potential future incident.

Findings

1. On-Off Post Notification

For the On-Post notification, we concur with the Army and Raytheon findings that there is sufficient evidence to indicate that this was not a chemical event (for reasons so stated in their reports). However, it is also clear that at the time of the incident, Raytheon notification was limited to word of mouth and a plant radio system via supervisors (message was "evacuate the MDB"). Although requested, copies of Raytheon's actual emergency plan have not been provided for examination of details.

Raytheon management personnel have indicated that as a result of this event, a new public address system has been installed in the Munitions Demilitarization Building (MDB), additional cell phones were issued, additional marking of evacuation routes was done and placement of industrial air monitors accomplished within the MDB. Other measures to increase worker awareness have been instituted, including the release of periodic information papers and strengthening the education program about the UMCD mission.

Off-Post notification procedures are in place at UMCD to notify the off-post community in a non-surety accident (one which poses no chemical agent hazard). It is important to note; the Army's policy is that there is no formal requirement to make notifications for a non-surety event. However, the UMCD Commander (LTC Wolosyzn) acknowledged on numerous occasions the importance of early communications to the off-post communities to avoid confusion or misconception. The issue for this incident was timeliness, accuracy and verification of the off-post notification. This is one area requiring improvement from UMCD (90 minutes after the incident and patients already transported to the local hospital before notification to the counties is not acceptable.) A mitigating communications factor that occurred on September 15 was the Central Oregon accidental severance of a T-1 communication line, which impaired the community's long distance and cellular phone coverage, as well as fax and e-mail capabilities. However, it did not interfere with the state microwave "all call" communications line which allowed for communications with off-post communities and the State Emergency Communication Center (ECC).

The UMCD Commander made several public presentations with a commitment to immediately notify the off-post community--even in the case of a non-surety type event (state/counties will acknowledge there has been a significant improvement in this area since September 15). He instituted immediate action drills and procedural review for his Emergency Operations Center (EOC) to strengthen the off-post notification process and has examined additional means of backup or redundant communications systems (For example--microwave blast fax and additional daily communications checks to EOC county dispatch centers).

2. Emergency Evacuation and Initial Response

UMCD has a Chemical Accident/Incident Response and Assistance (CAIRA) Plan for chemical incidents. If the magnitude is such that evacuation occurs, staff and workers are directed to a pre-designated assembly area where they are accounted for prior to release from the installation. In this case, since there was no evidence of a chemical agent release, no official evacuation occurred. For Raytheon personnel, their Emergency Response Plan and Accident Prevention Plan require employees to be made aware of proper reporting procedures (actual plans were not made available, although requested).

On September 15, when several breakdowns of existing procedures occurred, craft workers at the MDB reported difficulty breathing due to noxious fumes and the Hermiston ambulance was called by Raytheon staff to transport patients to Good Shepherd Community Hospital. Although evidence suggests that the UMCD clinic went beyond the formal request channel and called Raytheon employees to ensure no help was required (they even sent a UMCD fire and rescue team to the site), Raytheon stated that assistance was not required. Therefore, UMCD did not provide any resources to help, and per existing Memorandum of Agreement (MOA) in place, did not have any part in the notification of medical facilities or communication of relevant medical information. One worker was transported to Good Shepherd Community Hospital with no notification from Raytheon, and within two hours another thirty employees arrived in company vans. There is no justification on Raytheon's part as to why it took so long to transport these remaining injured employees to a medical facility in Hermiston. Additionally, RDC failed to provide advance notification to the receiving hospital that a mass casualty event had occurred and at least thirty victims were en route.

The UMCD Commander and the Raytheon project manager have agreed to "tighten up" procedures for accident notification and to follow existing agreements and protocols for emergency evacuation. Other corrective actions include a review of UMCD plans to ensure they are coordinated with community response plans. Since this incident, there have been two meetings between UMCD staff, Raytheon emergency planners and state/county emergency managers to synchronize on/off-site plans, to include evacuation.

3. Public Awareness

The actions undertaken by the Army, RDC and the Army Corps of Engineers were seriously inadequate to inform the public in a timely manner about the September 15, 1999 incident. The evacuation of 800 workers from the site released "800 press releases" into the surrounding communities and rumors spread quickly. Recovering from the rumors has been a significant challenge for all involved with the activities at the UMCD.

A significant failure was the delay in issuing a press release. The UMCD has reported in a chronological timeline of events that the first press release was issued at 14:30 on September 15; however; there were delays in issuing the press release. As an example, the press release was not received by DEQ Hermiston office until 16:54, approximately 5 hours after the incident.

UMCD and RDC did not undertake adequate measures to provide immediate assurances to the public that the incident was not related to chemical agent. The failure to promptly inform the public raised concerns that the Army and Raytheon were hiding the "facts" and that chemical agent may have been involved. The Army has enjoyed considerable support from the surrounding communities for the activities on-going at the UMCD, but they have failed to recognize that the support can only be maintained by thorough and timely disclosure of information.

4. Hazard Assessment

It appears that RDC does have procedures in place to handle workplace/employee issues and safety. These procedures were referenced in many of the sections listed in the response to Agency questions (Attachment 3). However, a copy of all of their procedures was requested but has not been provided. Therefore, we cannot confirm that all of the procedures quoted in the

responses to Agency Team questions are in their entirety, actually exist and have not been borrowed at random from existing regulations.

RDC stated many times in their documentation that a chemical release was ruled out due to Federal Emergency Management Information System (FEMIS) information and Real Time Analytical Platforms (RTAP) monitoring. The FEMIS argument is valid, if it shows that the wind direction never blew in the direction of the construction site.

The limitations of the chemical agent monitoring program conducted at "K" Block do not allow UMCD to immediately determine whether a release of chemical agent has occurred. The Agency Team believes that UMCD should have the ability to immediately determine if a chemical agent has been released from a storage igloo as this is crucial for the protection of both the on-post and offpost communities.

RDC also states in their documentation that the RTAPs were utilized to monitor the air in the MDB to rule out chemical agent. However, this monitoring did not take place immediately—it was not conducted until about three hours after the incident occurred. A rapid response from the RTAPs in any situation where there are large numbers of employees suffering from inhalation exposures from an unknown source could give conclusive data and help ease employees' concerns, thus minimizing any potential for hysteria.

5. Medical Management

Since RDC utilizes paramedics as Emergency Medical Technician (EMT)-1's on site at all times, we believe that their medical treatment program is adequate. RDC again quoted procedures but failed to produce them. However, due to the testimonies of exposed workers, the Agency Team questions how effectively RDC executes the listed procedures. It is one thing to have a procedure, but another to follow the protocols.

RDC does not have any procedure on when to contact Good Shepherd Community Hospital (GSCH). They purchased another van to take patients to the hospital if needed, but they have not

worked out a system with GSCH to accept the workers. RDC needs to establish a MOA with Good Shepherd Community Hospital for patient care.

6. Worker safety

In reviewing Raytheon's responses as they relate to employee safety and health for both on-post and off-post personnel, many inconsistencies were noted. The written responses by Raytheon, the verbal responses by Raytheon, employees of Raytheon, Raytheon sub-contractors and off-post emergency services, all seem to be inconsistent with one another. Some of the responses to the Agency Team questions are presented below and illustrate the inconsistencies between the responses from Raytheon and the workers.

1. The Agency Team asked the question **"When employees started experiencing symptoms of exposure, what steps were taken to ensure the employees were evacuated and received timely medical attention? If there was a delay-what was the cause?"**

   a. Responses from Raytheon indicated that employees were evaluated by EMT/Paramedics. Employees displaying the most acute symptoms were transported to the hospital immediately and other affected personnel were assessed, then sent to the hospital depending on symptoms displayed. There was as much as a two hour delay between transporting the most symptomatic employees and other employees to the hospital. Delays in transportation were created by limited availability of vehicles used to transport the employees.

   b. Responses from the employees of Raytheon sub-contractors were that the employees that displayed the most acute symptoms of exposure indicated that they were told to sit out in the fresh air and that it took two hours to be transported to the hospital.

2. The Agency team asked the question "Once detected, what measures were taken to protect workers while investigating?"

a. Written responses from Raytheon indicated that after the event, all entries were made by personnel using self-contained breathing apparatus (SCBA). Raytheon indicated that a three-person team comprised of personnel from the safety department, environmental department and the site's industrial hygienist made a sweep of all areas of the building using an organic vapor analyzer. Raytheon also indicated that all subsequent investigation entries into the area were made in accordance with job hazard analysis (JHA) documents, specifically prepared to cover each aspect of the continuing incident investigation. Verbal responses from Raytheon indicated that a JHA was accomplished on each type of work activity for Raytheon and Raytheon sub-contractor employees.

b. Employees for Raytheon and Raytheon sub-contractor employees noted that they were not aware of any JHA that was accomplished for their work activities, but rather they were told to return to work because it was safe. No additional information was given to the employees at that time. There was continuous monitoring being accomplished by whoever was tasked for the day. Employees indicated that this was an additional task and that the employees may or may not have been trained.

3. The Agency Team asked the question **"When were the off-post medical staff members advised of the situation at the Depot? Was full disclosure given?"**

a. Raytheon's written response was that they called 911 to request ambulance service from Hermiston Fire and Emergency Services and notified the Umatilla Chemical Depot Emergency Operations Center of the in-coming ambulance. Good Shepherd Community Hospital was not called by Raytheon. Full disclosure was given to the extent of the information available at the time of notification.

b. It was brought to the attention of the Agency Team that when the off-post medical representatives asked the Army Depot about the potential exposure to the ill employees, the Depot replied by saying, "We are not authorized to release that information at this time." Procedures need to be in place to ensure the timely

transport of injured workers to the hospital in event of an industrial accident. If medical attention is not available from Raytheon for its employees and sub-contracted employees, medical attention should be obtained from the medical staff of the Army Depot until off-post EMT services can respond. There is no reasonable explanation as to why it took two hours to start the patient transport process. Federal OSHA has issued citations to Raytheon for the excessive amount of time it took to get the injured employees medical attention.

Raytheon must ensure that all work activities have a job hazard analysis (JHA) accomplished prior to future work activities. If multiple trades are going to work in the same area, Raytheon and its sub-contractors must ensure that a joint JHA is accomplished for the combined hazards of the different trades. If monitoring is going to be conducted, monitoring must be conducted by staff who have been appropriately trained in the function of the monitoring equipment. In accordance with 29 CFR 1910.1200 Hazard Communication, all employees must be trained and informed of the hazards they are exposed to.

Notifications to the off-post medical community must occur immediately if patients will be transferred to an off-post medical location. This communication must occur whether it is a surety or non-surety event. Without this valuable information, the response and medical community cannot effectively protect their employees. If the material is unknown, as it was in this accident, then that information must be conveyed as well.

The Army Depot and Raytheon should ensure that they have all of the necessary resources to address any industrial accident they may encounter at the Depot. It is apparent that the Depot is prepared for surety type accidents, but there seems to be some gaps to bridge when it comes to industrial accidents. As the MDB moves from the construction phase to the operational phase, there will always be a potential for industrial accidents.

The off-post response and medical services need to ensure that their employees are properly protected in the event of an accident. No matter if the accident is a surety event or if it is not, they must ensure a proper protective level for their employees.

Recommendations

Based on the Agency Team's review of the available information the following recommendations should be implemented by the end of calendar year 2000:

1. A Memorandum of Agreement between UMCD and the Off-Post Emergency Response Communities for initial notification of **all incidents** at the UMCD. UMCD and the Off-Post Emergency Response Communities must define an "incident" as part of the MOA;

2. RDC establish a communication program for all workers at the construction project and provide regular updates on activities;

3. UMCD implement an enhanced chemical agent monitoring program for the storage igloos in "K" Block, with emphasis on the igloos storing the M-55 rockets and leaking munitions;

4. UMCD and RDC establish clear lines of communication and decision-making authority to ensure that appropriate response actions are implemented as soon as possible for any incident;

5. A communication agreement/plan be developed and implemented by the on-post and off-post jurisdictions concerned with public outreach for the UMCD activities;

6. RDC have a Memorandum of Agreement with UMCD stating that the UMCD medical clinic becomes involved in any incident involving casualties in excess of two. UMCD involvement should remain until a chemical agent release has been ruled out;

7. RDC establish a Memorandum of Agreement with Good Shepherd Community Hospital for patient care;

8. RDC establish a Memorandum of Agreement with the Hermiston Fire Department for patient transportation;

9. UMCD must communicate the procedures used by the facility to notify the off-post community so that the communities can understand the information they will be receiving; and

10. The Army must implement an active Public Awareness program for all activities on-going at the UMCD.

Attachment 1

Four Agency Team Questions

ON-POST/OFF-POST NOTIFICATION

Warning to the on-post population at risk.

1. How was it decided who was at risk?
2. How would all personnel expected to be at risk be notified?
3. How long did it take for that warning to reach all affected workers?
4. What procedures have been provided to the workers for actions to take in case of an industrial accident?
5. What was the exact warning provided to the workers--did they understand?

Initial Notification of the off-post community.

1. What are the procedures in place at UMCD to notify the off-post community in case of a non-surety accident?
2. Were those procedures followed?
3. Were there problems encountered in timely, accurate and verified notification of the off-post community?
4. In terms of this accident, what communication means was used to provide initial notification-recognizing that this situation was made more difficult due to the fiber optic cable cut in Oregon?
5. Was UMCD aware of the loss of telecommunications from the cable cut?
6. If so, what method was used to circumvent this communications link to provide essential information?

EMERGENCY EVACUATION AND INITIAL RESPONSE

Mobilization and Evacuation.

1. What evacuation procedures are in place for UMCD/RDC personnel?
2. Are such procedures coordinated with the off-post community?
3. What procedures have been provided to the workers for actions to take in case of an industrial accident?
4. What was the exact warning message that was provided to the workers--did they understand?
5. How long did it take for the RDC workers to be mobilized to evacuate?
6. How long did it take for them to leave the depot?

Initial Emergency Response.

1. What are the procedures in place at UMCD for transportation of casualties off-post and were they followed?
2. Is there a MOA/MOU in place for provision of such services?
3. Was Good Shepherd Community Hospital notified on incoming casualties and by whom?
4. What essential elements of information were transferred from RDC/UMCD to the hospital?
5. Was this information also shared with all potential receiving hospitals?
6. In this particular case, did Good Shepherd Community Hospital convey any information back to UMCD or to County Emergency Operation Centers (i. e. the hospital may have determined the nature of exposure from the manner in which casualties responded to treatment)?

PUBLIC AWARENESS

1. How did RDC provide information to the public and the media? Perception is that information was released to slow and that something was being hidden (i. e. Was it chemical agent)?
2. What is the relationship between RDC and UMCD for distribution of information to the media and the public? Raytheon was not seen as being up front and the perception is that information was filtered by the Army.
3. When was the first press conference held?
4. How did the UMCD EOC ensure that sufficient information was provided to people that the incident was not related to chemical agents?
5. Were FEMIS Shared Reports used to share information on the incident between UMCD EOC and the counties?
6. Has a log been kept of all messages sent out?
7. Are there pre-prepared fact sheets that were used?
8. Was a telephone number provided for media inquiries?
9. How were information needs of UMCD and RDC personnel handled?
10. Did more people than normal visit the PMCD Public Outreach Office as a result of the incident?
11. Were there information requests from the community hospitals? Which ones? When did they call? Who did they call? What did they ask? What information was provided to them? When? By whom?
12. Were there information requests from the community hospitals? Which ones? When did they call? Who did they call? What did they ask? What information was provided to them? When? By whom?

HAZARD ASSESSMENT

Perception of Hazard:

1. Who noticed the problem and did they follow the proper reporting procedures?
2. Are there procedures in place to immediately notify UMCD to utilize RTAPS if a chemical agent release is suspected?

Hazard Assessment:

1. What information was collected to make a determination of the threat/incident?
2. Does Raytheon have procedures to direct workers on how to respond in the event the incident was a chemical agent release?
3. How long will it take for UMCD to respond with monitoring equipment if a chemical leak is suspected?
4. Are there protocols to use neutral, third party agencies to conduct air monitoring/sampling immediately following any suspected industrial incident at the worksite?
5. Does Raytheon have a process for screening chemicals, used on site, for toxicity, needed PPE (i. e. respirators), volatility, ventilation needs etc.?
6. Does Raytheon Safety conduct hazard assessments of each job to ensure that the proper PPE and work rules are being followed? Are there procedures documenting the proper PPE use and ventilation requirements?

(Please provide a copy of all relevant procedures and policies.)

MEDICAL MANAGEMENT

1. Triage:

   Does Raytheon have procedures on how to triage? If procedures exist, who is trained and did triage occur during this incident?

2. Treatment:

   Are there procedures on how to treat employees suffering from any condition: chemical or traumatic? Do the procedures incorporate the UMCD clinic or off-post fire/rescue?

3. Decontamination:

   Does Raytheon have procedures for employee decontamination on the job site? If so, were they followed (the concern is how employees got to the hospital without being decontaminated at the site)?

4. Medical Transportation:

   Does Raytheon have a procedure/protocol on how injured/sick workers are to be transported off of the UMCD grounds? If yes, were they followed?

   Do the above procedures take into consideration chemical vs. traumatic injuries?

5. Medical Screening of Workers:

   Are there procedures in place on how to screen all employees leaving the worksite?

   Were all employees assembled and screened before they were allowed to leave the site?

   What is the process to ensure that all employees are accounted for during an emergency? Is the process documented and are employees trained?

(Please provide a copy of all relevant procedures and policies)

WORKER SAFETY

1. When employees started experiencing symptoms of exposure, what steps were taken — to ensure the employees were evacuated and received timely medical attention? If there was a delay - what was the cause?

2. Once detected, what measures were taken to protect workers while investigating?

3. When were the off-post medical staff members advised of the situation at the depot? Was full disclosure given?

4. What information was conveyed to off post response staff and the hospital so they could protect themselves?

5. What safety and health plan or expertise does the Army Depot have to deal with industrial safety – beyond chemical/biological issues?

Attachment 2

Timeline of Events

March 31, 2000

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Chronological Record of Events
Raytheon Incident (Day One: 15 Sep 99)

Time	Event
0600	Routine All call test conducted. Everyone answered except Hermiston Safety Center. (HSC was called separately via microwave. Problem noted by OEM) (eoc)
0948	Dial Central Office called and informed EOC that U.S. West said 9 lines were out. (eoc)
0955	Email from Morrow County sent to Chief, Chem Prep stated that long distance phone lines were out. The email message was not opened/read until after 6 p.m. due to ongoing Raytheon activity. Spent the afternoon in the EOC. (eoc)
1105	Workers began exiting MDB, complaining of very irritating odor. (rdc)
1107	Construction Safety Supervisor called via radio for medical and safety assistance at east exit from MDB Corridor 143. (rdc)
1110	Construction Safety Manager and Paramedic arrived on scene with construction safety van and rescue equipment. Additional Paramedic responds with site ambulance. Numerous personnel were observed exiting doors of MDB. (rdc)
1115	After briefing Construction Safety Manager and Paramedic donned Scott air packs and entered MDB via Corridors 142 and 143 to affected area to search for disabled personnel. Prior to entry, Construction Safety Supervisor was instructed to have roll taken to identify missing workers. (rdc)
1120	One (1) craftsman reported to site infirmary. Two others in break room complained of chest pains and difficulty breathing; they are dispatched to the infirmary. (rdc)
1120	Civil Superintendent advised search team (Construction Safety Manager and Paramedic) that one Ironworker was not accounted for. The Ironworker's last known work location (roof of south ECR MDB) was searched. He was not found on roof of ECR. Emergency Preparedness Manager notifies RDC Safety Manager of incident in progress (via cellular phone) (rdc).
1125	Emergency Preparedness manager called Depot Fire Department on cellular phone and requested them to standby at the incident scene.
1125 (rdc)	Missing Ironworker was located outside and all personnel accountability was complete.
1125	Safety supervisor called 911 from infirmary. (rdc)

1130 Craig Scott, *East Oregonian* reporter, called PAO and asked about a gas leak at the construction site and possibly having to transport individuals to the hospital. He stated he'd heard this on his office scanner. (pao)

1130 Fire Department called EOC and said that they were responding to Raytheon.(eoc)

1130 CoE notified UMCD liaison officer of incident. Five CoE people in the MDB/PAS evacuated MDB building. (rm)

1132 Initial RDC event report: Raytheon Safety called and told the EOC they had an unknown noxious gas and had evacuated the building. (eoc)

1135 UMCDF deputy project manager relayed same information as CoE to UMCD liaison officer. (rm)

1135 EOC notified Civilian Executive Assistant (CEA), PAO and the clinic of the situation (commander on leave) (eoc)

1135 PAO checked with CEA who had just been notified and stated 5 individuals had respiratory problems and 1 was unaccounted for. (pao)

1135 Depot Fire Chief and two fire rigs with crews arrive on scene. (rdc)

1136 EOC called the Depot Clinic to inform doctor of patients at construction site having breathing problems. (ohc)

1136 EOC called RDC emergency manager and asked for an update. RDC told EOC they hadn't identified the noxious gas at this time. A command post had been set up and 32 people had been accounted for; 1 was missing. The safety manager was going in to the building in SCBA gear to look for him. Provided the EOC his cell number. (eoc)

1137 Depot Fire Department talked with RDC safety personnel and was informed MDB was evacuated, was asked to continue to stand by. (rm)

1140 EOC Coordinator contacted CEA with situation report (SITREP) in Building 1(UMCD Depot HQs). (rm)

1140 EOC called PAO from the Opns Center and stated 5 individuals at the construction site had respiratory problems and 1 was unaccounted for. Point of contact, RDC emergency manager, 377-5445. (pao)

1140 Depot Clinic contacted RDC to offer assistance. RDC informed clinic that medical support was not required. (ohc)

1140 Construction Safety Manager and Paramedic exit MDB building and briefed Depot Fire Chief. (rdc)

1141 Fire Department received information to contact the Director of Risk Management on landline. (rm)

1142 Fire Chief called and said that Raytheon had them standing by and no medics were requested by RDC. (eoc)

1143 Security received call that an off-base ambulance would be coming on post and going to Raytheon. (sec)

1144 Depot Clinic doctor called the EOC and said he had contacted Raytheon at the site and that Raytheon did not need their assistance at this time. (eoc)

1145 Construction Safety Manager and Paramedic re-entered MDB to try to identify obvious emissions such as smoke, mist, haze, etc. None found. (rdc)

1150 UMCD Security received call from EOC regarding an noxious odor at Raytheon. No evacuation called for, but three people were being sent to the hospital via ambulance. (sec)

1150 Depot Fire Department talked with craftsman about the odor and craftsman stated it was not epoxy.(rm)

1200 EOC Coordinator notified Director of Risk Management. (rm)

1200 EOC asked Fire Department if our depot medical personnel were needed. Fire Department relayed to EOC that Raytheon safety stated they were not required. (rm)

1200 EOC contacted Director of Risk Management and Chief of Chemical Preparedness with a SITREP. (eoc)

1203 Hermiston ambulance departed RDC site for Good Shepherd Hospital in Hermiston, OR. (rdc)

1205 Construction Safety Manager and Paramedic exited MDB building. Construction Safety Manager turns over incident command to Raytheon Emergency Preparedness Manager. (rdc)

1205 MDB declared off limits, no entry without SCBA (per instructions from RDC Emergency Preparedness Manager). (rdc)

1210 RDC establishes its command post. (rm)

1215 Confirmed that thirty (30+) people were being sent to Good Shepherd Hospital (GSH) (rdc)

1215 Depot Fire Department talked to another craftsman who stated it was more like burned car wiring, a pungent odor and with a metallic taste. (rm)

1220 Construction Safety Manager and Paramedic re-entered MDB after determining which areas most employees were in when overcome (OBS-1 42, Munitions Corridor #1 53, BSA Room). No obvious sources of emissions found. (rdc)

1220 PAO unsuccessfully attempted to call Raytheon protocol officer for information. (pao)

1220 Depot Risk Management Staff received call from southeast gate security about people leaving depot. Security wanted to know if they should stop people from coming in. (rm)

1220 EOC called Fire Department for an update; they are still standing by. All personnel were now accounted for. Raytheon safety manager got on the line and said that it could be epoxy or an argon bottle that had been left on. One person was taken by ambulance to Good Shepherd Hospital and 34 personnel would be transported by vans for check up. (*Ed note: initiated at 1420.*) Raytheon has closed down all construction work for the rest of the day. Left contact phone number. (*Ed note: This was the first complete report and scope of the problem given to the EOC by Raytheon*). (eoc)

1223 RDC protocol officer called PAO with an update – full accounting of people; 1 to Good Shepherd Hospital, condition unknown. Questioned by PAO on how many workers were involved. Raytheon was sending all craft workers home. By 1330 hours there would be a decision on whether the second shift is to report. Noted there was no explosion, that the incident occurred in the Munitions Demilitarization Building's toxic maintenance area and that it happened about 1115 hours. Workers smelled an odor and experienced a physical reaction – throats constricted; cause is not known, but may be epoxy. (pao)

1225 EOC contacted the commander (leave/vacation status) at home to update him of the situation. Commander asked to be kept appraised of the situation (eoc)

1227 EOC called depot Security and told them that Raytheon had shut down operations and needed the gates open for employees who were released to go home. (eoc)

1228 PAO briefed CEA on conversation with RDC protocol. (pao)

1230 RDC Construction Senior Waste Technician made required notifications per event notification checklist. (rdc)

1230 EOC Controller physically locates to EOC. (rm)

1230 PAO briefed Chemical Agent Disposal Outreach Office (ORO) manager on the incident. ORO manager agreed to come to the depot to answer phones while PAO went to the EOC. PAO requested PAO augmentees go to the EOC to assist. (pao)

1239 RDC protocol officer called PAO and said 32 workers would be sent to Good Shepherd Hospital; 1 had been taken by ambulance. (pao)

1243 RDC safety manager called EOC and asked that depot security be informed that the second shift was cancelled. (eoc)

1244 Depot Security called and informed of above information by EOC. (eoc)

1244 CEA authorized "All-Call" notification and declares a non-surety event.

1244 Depot CSEPP Coordinator contacted off-post EOCs via the "all call" and informed about the incident. The "all call' list includes Umatilla County EOC, Morrow County EOC, Hermiston Safety Center, Benton County EOC, Washington State Patrol, and the Oregon Emergency Response. Roll call of receipt to verify receipt not conducted by EOC. (eoc)

1244 - Washington State receives all call notification. (*Ed note: these times were verified by community logs after the event to include these times in this summary*) (eoc)

1245 Hermiston Safety Center verifies receipt of notification fax. Prosser Dispatch received all call notification. . (*Ed note: these times were verified by community logs after the event to include these times in this summary*) (eoc)

1247 Benton County receives all call notification. (eoc) . (*Ed note: these times were verified by community logs after the event to include these times in this summary*)

1250 RDC Emergency Preparedness Manager requested that Depot conduct chemical agent sweep of area (site). (rdc)

1250 EOC called to CEA requesting RTAP; sweep conducted for worker confidence. (eoc)

1250 Security received call from EOC that Raytheon would be sending 34 personnel out the gates for medical evaluations. Security dispatched to open E35. (sec)

1252 PAO received update from CEA on the incident. (pao)

1255 Depot security received call from EOC that Raytheon had shut down operations for the rest of the day including second shift. (sec)

1255 EOC faxed information with follow up hard copy of notification of a non-surety event (via group dial fax) to Umatilla County EOC, Morrow County EOC, Hermiston Safety Center, Benton County EOC, Washington State Patrol, and the Oregon Emergency

Response. (eoc)

1255 RDC Nightshift notified not to come to work. (rdc)

1310 Depot Lab Chief notified by CEA that an incident occurred at Raytheon where 30+ personnel had been evacuated to hospital. CEA instructed Lab Chief to monitor the SE corner of K-Block for GB, VX and HD and to report back to the CEA when lab chief was in position on-site. (lab)

1313 Fax confirmation sheet returned; all but one were "incomplete". The fax to RDC surety officer went through. Chief, Chemical Preparedness asked that. Began to re-fax the form to off- post EOCs. (eoc)

1315 Chief, Chemical Preparedness began to use FEMIS shared reports to pass information to Morrow County EOC since they could not be reached via "all-call/point-to-point and that long distance phone lines were not working. (eoc)

1315 Depot lab chief notified lab technicians to report to the lab to perform monitoring. He also informed them of what he knew about the incident at the Raytheon site. (lab)

1320 Depot Fire Department D was notified we were no longer requested by RDC Emergency Preparedness Manager to stand by and returned to quarters in depot admin area. (rm)

1325 EOC Updated UMCD Commander of all current data.

1325 EOC makes up line reports to SBCCOM EOC; Safety Officer contacted SBCCOM Safety and EOC. All counties and states have been telephonically contacted to ensure they received faxed information. (eoc)

1325 Outreach Office manager arrived at the PAO office; PAO moved to the EOC. (pao)

1325 OERS called EOC and advised that long distance lines are out due to a cut trunk line in Bend. Washington State advised OERS of the event. Asked depot EOC to provide updates to Washington EOC so they could relay information to OERS (eoc)

1325 RDC Industrial Hygienist called to check on status of additional monitoring instruments from Hanford. (rdc)

1327 Depot safety officer sends email to SBCCOM safety office with basic information. (SBCCOM Safety officer left work for the day at 1710 EST) (rm)

1328 PAO arrived at the EOC and started working on a press release. (pao)

1330 Washington State verified receipt of notification fax. (eoc)

1330 Depot lab personnel arrive at the lab and start preparing RTAPs. Unknown personnel from Raytheon are calling the laboratory asking if the lab was detecting any chemical agents and if the lab is going to come to RDC to perform monitoring. Lab chief tells them that we will begin monitoring the the perimeter of K-Block momentarily for all agents and that the MDB will be monitored afterward. (lab)

1330 RDC Emergency Preparedness Manager releases Depot Fire Department to their quarters on standby. (rdc)

1332 Morrow County Planning Department (Irrigon) called PAO to relay a call from Morrow County ADP Specialist (Hoeppner). Long distance phone lines are down and they aren't receiving any information. PAO provided them an update. Morrow County Planning Department would pass information on to Morrow County EOC. (Note: There is a direct phone line established between Heppner and Irrigon that allowed local calls.) (pao)

1333 Depot Security received an complete update from EOC concerning incident at Raytheon:
- ✓ OC received a call at approximately 1130 from Fire Dept of an noxious odor at RDC.
- ✓ A count was conducted and one individual was missing. He was later discovered to have been sent to the hospital via ambulance.
- ✓ Thirty-two personnel were subsequently sent out for medical evaluations.
- ✓ Odor possibly caused by Argon gas or an epoxy component. Raytheon was currently conducting a search to determine the exact cause.
- ✓ Raytheon had ceased operations for the day including the second shift.
- ✓ No UMCD personnel other than Fire Department personnel, were used during the incident. (sec)

1335 Fire Department Rescue called EOC and reported that they were returning to fire department. (eoc)

1337 EOC called all directorates and security called and brought up to date on situation with Raytheon per CEA's request. All personnel contacted. (eoc)

1340 Umatilla County verified receipt of notification fax. (eoc)

1340 Depot lab chief called CEA and informed him of the progress at the. CEA directs depot lab chief to monitor the MDB. Lab chief said affirmative if there are personnel in SCBA to carry RTAP lines inside. CEA directed lab chief to have the RTAPs first monitor the SE corner of K-Block. CEA then directed lab chief to go to the Raytheon site and coordinate with RDC personnel (emergency manager and safety manager) about monitoring the MDB. (lab)

1345 Depot Safety Officer contacted SBCCOM EOC to update them of the situation. (eoc)

1345 RDC Chemical Surety/Security Manager reported on status of chemical agent sweep coordination by Depot personnel. (rdc)

1345 Construction Safety Manager and Paramedic completed sweep of 100 elevation MDB and exit building. (rdc)

1346 Confirmation sheet showed all EOCs received the notification fax with the exception of Morrow County. (eoc)

1347 Umatilla County EOC called the depot EOC to ask that the notification fax be resent. She gave a different number than the one listed and at 1349 the fax was confirmed. (eoc)

1352 Construction Safety Manager and Paramedic changed air tanks and re-entered the MDB to check 122 elevation MDB for sources of emissions. Two (2) safety personnel don SCBA as standby. Radio communications made with Construction Safety Manager and Paramedic at 5-minute intervals. (rdc)

1400 Due to the calls from OERS and Morrow County, EOC called community EOCs individually to ensure they received the fax. (eoc)

1400 PAO faxed draft release to UMCD commander; Raytheon protocol officer; PMCD at UMCDF; ORO for review. (pao)

1401 Hermiston Safety Center called and said they got the fax but did not receive the phone call. (*Ed note: OEM communications officer is aware of this ongoing telephone problem with Hermiston Safety Center. Since corrected*) (eoc)

1410 Depot lab chief arrived at the Raytheon site and met with RDC emergency manager and RDC safety manager. Lab chief was taken to the MDB and shown the doorways through which they would like monitoring. He requested that two personnel from Raytheon in SCBA place the sampling lines inside the MDB. (lab)

1405 CEA spoke with the Commanding General, SBCCOM and updated him on the situation.

1410 Chemical agent monitoring begins. RTAP 15 arrived at SE corner of K-Block and begins monitoring for HD (mustard). (lab)

1412 EOC staff called all community EOCs individually follow up on the fax sent. The speed dial phone (direct point-to-point) was used. All answered with the exception of Washington State and Morrow County. All others received the fax.

1417 Construction Safety Manager and Paramedic emerged from the MDB building. Nothing found. Building is wrapped with red danger tape, posted with "Keep Out" signs and guarded. (rdc)

1417 RTAP 12 arrived at the SE corner of K-Block and began monitoring for GB (nerve agent). (lab)

1418 RTAP 14 arrived at the SE corner of K-Block and began monitoring for VX and GB (nerve agents). (lab)

1420 RDC Safety team moved to RDC infirmary to assist the patient assessment and triage. Personnel transport to GSH in Hermiston began (less the ambulance sent at 1203). (rdc)

1422 RTAP 15 reported negative readings for HD at SE corner of K-Block. (lab)

1422 Emergency Preparedness Manager called RDC site manager for additional transport vehicles for ambulatory patients after discussion with infirmary. These patients in non-critical condition were transported via RDC vans. One person was sent by Hermiston Fire Department Ambulance to GSH at 1203. (rdc)

1425 RDC Incident Team met at RDC Safety office to plan strategy. (rdc)

1426 Depot Lab Manager reported to RDC that Real Time Analytical Platform (RTAP) results for agent sweep of perimeter of K-Block are negative. Testing vans moving to south end of MDB. (rdc)

1428 RTAP 12 reported negative readings for GB at SE corner of K-Block. (lab)

1429 RTAP 14 reported negative readings for VX and GB at the SE corner of K-Block. (lab)

1429 Three RTAPs reported negative readings at the SE perimeter of K-Block. All three agents were monitored. RTAPs sent to MDB to perform building monitoring with RDC coordination. (eoc)

1430 RDC protocol officer called; he confirmed release OK with RDC/PMCD. He also provided PAO updated numbers of workers involved. (pao)

1430 Initial press release. (pao)

1431 PAO had problems getting faxes out with cut cable problems. Started using alternate fax machines at ORO and depot headquarters. (pao)

1435 CEA asked Depot Director of Risk Management to contact DEQ (downtown) to inform them of the incident. (eoc)

1435 Depot lab chief called the CEA at the EOC and informed him that all RTAPs report negative readings at the SE corner inside K-Block. Lab chief informed CEA that everything is coordinated at the site to bring in the RTAP and begin monitoring at MDB. CEA gave his go ahead. (lab)

1435 PAO started returning media calls/preparing second release. (pao)

1436 Plan for RTAP sampling in and around MDB established. RDC Emergency Preparedness Manager requested SCBA personnel from RDC Safety assist Depot by carrying sample hoses into the MDB. (rdc)

1440 Depot Lab chief called RTAP operators and told them to bring RTAPs to the Raytheon site. (lab)

1449 Depot Security was called the second time and informed that RDC second shift was not working today. (eoc)

1450 RTAPs 12, 14 and 15 arrive outside MDB at Raytheon construction site. (lab)

1452 EOC informed security at E38 gate to refer all delivery personnel to check with RDC before reporting to work. Any RDC personnel reporting for work who may not have heard about work stoppage should also be stopped and directed to the RDC human resource office. (eoc)

1500 RTAP vans (3) set up on roadway south of the MDB. (rdc)

1502 Morrow County still had no commercial long distance phone or fax. They relied on FEMIS (shared reports function). They were able to communicate with Umatilla County, Washington State and Benton County via the microwave conference bridge but could not communicate with the depot and Oregon State. (They did receive reports via FEMIS shared reports). (eoc)

1510 RTAP 12, 14 and 15 began monitoring for GB, VX and HD (inside the south facing first floor east door of the MDB). (lab)

1511 DINAH Report (chemical event (non-surety report) sent to UMCD Commander; HQDA; Director of Criminal Investigation Command at Ft. Belvoir; Information Systems Command; Army Materiel Command; U.S. Army Nuclear and Chemical Agency, Soldiers Biological and Chemical Command (now DTRA); and Program Manager for Chemical Demilitarization via email. (rm)

1515 SCBA equipped safety personnel carried RTAP sample hoses into MDB building and obtained samples from the following areas: South Liquid Incinerator (LIC) Pit; Airlocks 162,163,164; Monitor Room 160. (rdc)

1520 Update with RDC emergency manager regarding the RDC safety manager. When RDC emergency manger made his SCBA entry into the building, empty containers of epoxy were found, but NO bottles of argon were left on. This was reported in the 1220 time frame. Raytheon is working with the RTAPs. They had personnel coming in with air monitoring equipment and planned to make another SCBA entry to see if they could

pinpoint the cause. If all clear, they will form teams and sweep the building. RDC PAO has been in contact with UMCD's PAO throughout the day (eoc)

1521 RTAPs 12, 14 and 15 reported negative readings. They began monitoring inside the south- facing first floor east door of the MDB. (lab)

1523 Lab reported they were monitoring in MDB. (eoc)

1524 Update from CEA via RDC deputy project manager: 30 people were being checked at Good Shepherd Hospital. Two were admitted to the hospital for observation over night. Deputy project manager also said that industrial chemicals were stored on the 2nd floor of the MDB. (eoc)

1530 Initial results from RTAP are negative. (rdc)

1532 RTAPs 12, 14 and 15 reported negative readings from sample #2; they begin monitoring sample #3 (inside the south facing second floor east door of the MDB). (lab)

1540 Personnel began to return from GSH hospital. (rdc)

1542 Lab reported RTAPs 12, 14 and 15 had negative readings from MDB (sample #3). (lab)

1545 UMCD lab reports RTAP monitoring complete. (Note: First reports of injury obtained from all treated employees and their location at the time of the incident was plotted on a floor plan and identified with a unique number assigned to them prior to going home.) (rdc)

1547 Completed monitoring inside the MDB southeast corner. All three agents at three separate locations; negative results. (eoc)

1550 Phone lines restored. Morrow County reported commercial long distance phone and fax service. FEMIS OK (eoc)

1551 PAO notified by UMCDF that DEQ sent two individuals to Good Shepherd Hospital for observation just because they were at the construction site. (eoc)

1600 RDC Construction Safety Office called Hermiston Fire Department to determine if additional Scott air pack bottles were available and if filing capabilities were available for our spent bottles. Answer was yes. (rdc)

1600 RDC Construction Safety Supervisor dispatched to Hermiston Fire Department to pick up eight (8) additional Scott bottles and to get RCI bottles refilled. (rdc)

1600 Depot lab chief and all RTAPs left RDC site. Informed EOC that no agent was detected inside the MDB. (lab)

1610 RDC reported that the actual cause was unknown. It appeared that the epoxy and argon were not the cause. RDC intended to continue to monitor the MDB area using industrial monitors. (eoc)

1618 Press release #99-29 faxed to SBCCOM EOC to forward to Director of Operations and Commanding General. (eoc)

1624 Morrow County finally received the 1430 faxed press release at 1605 (per FEMIS shared reports). (eoc)

1641 First log (created in FEMIS shared reports) faxed to SBCCOM EOC, Safety, and public affairs. Depot EOC confirmed receipt with SBCCOM Duty Officer.(eoc)

1645 RDC reported that no depot support was required for RDC's efforts that night with the exception of the fire department. They remain on standby at the station for backup of SCBA entries. (eoc)

1655 Morrow County reported that they disseminated UMCD EOC's FEMIS shared report to Morrow county, staff, and 911 dispatchers. (eoc)

1700 RDC advised they would be conducting interviews with employees who were working in the MDB to help narrow the search. RDC also advised they hope to use the data received from hospital reports. After this wais complete, RDC will determine whether or not to work on Thursday, 9/16. At this time, RDC reported that 29 people have been sent home and 3 have been kept at the Good Shepherd hospital for observation overnight. (eoc)

1715 RDC Construction Safety Supervisor returned with all bottles. (rdc)

1719 Updated log faxed to SBCCOM EOC. (eoc)

1720 Eight (8) two-man teams formed to do systematic search of MDB to try to identify possible sources (melted containers, residue of fire, etc.). All were radio equipped and 10-minute interval checks made on their status during entry. (rdc)

1747 SBCCOM EOC faxed FEMIS shared reports log. (eoc)

1802 EOC Updated CSEPP EOCs by fax on the day's events. Faxed a copy of the log created in FEMIS shared reports. (eoc)

1806 EOC Completed group dial fax of Press Release #99-29 (release time 2:30 p.m.) to off-post CSEPP entities. (eoc)

1814 UMCDF deputy project manager was notified by EOC that the lab monitored the MDB perimeter and it came up clean. (eoc)

1815 EOC was asked by the commander to follow up on specifics of chemical operations for the day: The crew was in Igloo 1897 (northeast corner of K-Block). The wind at the time was from 310 degrees at 3 mph. The igloo was opened at 1003 and the door closed at 1038. The crew didn't return to work due to the Raytheon incident. The igloo was being monitored the entire time it was open and received only negative readings. No depot employee has experienced any signs or symptoms similar to Raytheon employees. (eoc)

1830 Second press release sent out; more media calls answered. (pao)

1830 EOC Began faxing PR #99-30 to SBCCOM EOC and off-post EOCs. (eoc)

1838 UMCD Commander provides situation report to Chief, Stockpile Management/Operation Enterprise at his home in Maryland. (eoc)

1920 RDC MDB search team completed its sweep of the MDB building (all levels) with no results. No one detected any odors, containers or other unusual items. Sweep of area with PID was conducted prior to these entries by the RDC Industrial Hygienist. (rdc)

2000 RDC checked intake and plenum of building ventilation. The ventilation was restarted and PID monitoring done at all outfalls in the MDB, with negative results. (rdc)

2040 Received summary of incident from UMCDF. (eoc)

2045 RDC emergency manager called and reported that monitoring of MDB was complete. Portable monitoring will continue throughout the night. Monitoring found no reason for worker symptoms. (eoc)

2100 Operations secured until September 16. Note: OSHA Area Director notified by Construction Safety Manager prior to (Construction Safety Manager's) leaving 15 September 1999. (rdc)

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Attachment 3

Responses to Agency Questions

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Fact Finding Mission
Umatilla Chemical Agent Disposal Facility (UMCDF)
Industrial Release (September 15, 1999)

ON-POST/OFF-POST NOTIFICATION

1. Warning to the on-post population at risk.

(Bullet 1) How was it decided who was at risk?

UMCD	It was clear from the beginning that it was not a chemical event. There were no weapons surveillance operations ongoing at the time of the incident. At no time did wind direction flow from the storage site over the boundary of the construction site. Likewise, all readings for chemical agent vapors were negative. The winds are monitored and recorded in real-time from meteorological sensors around the Depot and construction site when operations are in progress.
RDC	Based on the symptoms being experienced by the MDB craft personnel, the condition of all other employees on site (office, PMB, PAS, LAB, etc.), the status of K-Block activities and measurements made in the MDB following the incident, the Deputy Project Manager in discussion with Safety and Construction Management, concluded that the incident was not related to chemical agent from K-Block.

(Bullet 2) How would all personnel expected to be at risk be notified?

UMCD – Chemical Accident/Incident Response and Assistance Plan (CAIRAP)	There are strict procedures in place for alert and notification when hazards exist due to chemical events. On-post personnel are alerted of activities related to the chemical stockpile by outdoor sirens. ➢ A steady ten-second blast indicates that a test is being conducted. ➢ A steady three-minute wailing blast means there has been a chemical accident or incident. ➢ Employees at the Raytheon construction site evacuate and assemble in the southeast corner of the Depot. The Depot evacuation coordinator maintains contact with Raytheon to ensure employees are provided with information on routes of evacuation and off-post reception centers. All other contractors receive emergency procedure briefings prior to working on the Depot. They have been instructed to evacuate to an assembly area near the clinic when they hear the emergency alert siren. Residents and their guests are directed to either shelter-in-place or evacuate based on the threat. The electronic reader board at the front gate indicates evacuation directions. This is also tested during CSEPP exercises.
RDC	At the time of the incident, notification was by word of mouth and the plant radio system via supervisors/foremen. This has now been augmented by a Public Address System, which has been installed in the Munitions Demilitarization Building (MDB) and the Pollution Abatement System (PAS).

(Bullet 3) How long did it take for that warning to reach all affected workers?

UMCD	The chemical event alert and notification system was not sounded because it was a construction incident and did not involve the chemical munitions.
RDC	The warning reached all affected workers within approximately 5-8 minutes.

(Bullet 4) What procedures have been provided to the workers for actions to take in case of an industrial accident?

UMCD - Spill Prevention and Countermeasure Plan (SPCC), Disaster Control Plan and RCRA Part B Application Contingency Plan	The hazardous material (HM) in question determines the appropriate response plan to be implemented; The CAIRA plan for chemical agents or the Spill Prevention and Countermeasure Plan (SPCC) for all other chemicals (an industrial accident). The North American Emergency Response Guidebook supplements the SPCC to determine protective action distances for non-chemical agent emergencies.
RDC	See response under: Emergency Evacuation and Initial Response, (1) Mobilization and Evacuation, Bullet 3.

EQC Meeting May 18, 2000
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(Bullet 5) What was the exact warning provided to the workers--did they understand?

RDC

The general statement made by craft supervisors and safety supervisor personnel over the radio at the time of the incident was "Evacuate the MDB". The statement was understood by the workers in the building.

2. Initial Notification of the off-post community.

(Bullet 1) What are the procedures in place at UMCD to notify the off-post community in case of a non-surety accident?

UMCD - CAIRA Plan, DA Pam 50-6 (Chemical Accident or Incident Response and Assistance (CAIRA) Operations, 17 May 91) and Chemical Stockpile Emergency Preparedness Program (CSEPP) Guidance

A non-surety emergency will be declared when events are likely to occur, or have occurred, that may be perceived as a chemical surety emergency or that may be of general public interest, but which pose no chemical agent hazard.

A non-surety event is defined in DA Pam 50-6 as any malfunction or other significant activity at a chemical demilitarization plant, which could reasonably be expected to cause concern within the local community.

If it is determined that public perception may associate an emergency with chemical surety material, a telephonic notification will be made to the off-post community via the all-call system.

(Bullet 2) Were those procedures followed?

UMCD

Initial notification confirmed this was a construction site vs. a chemical weapons incident. Therefore, normal CAIRA response plan actions were not taken. There was no indication initially as to the actual numbers of construction workers ultimately involved. Off-post notifications have not been made in the past when an ambulance took a worker to the hospital. However, once the Depot found out that 34 people were involved, experiencing respiratory difficulties and were being transported to the hospital, it was clearly more than a typical construction incident. Notification procedures were immediately initiated at that point.

The Soldier Biological and Chemical Command Safety and EOC, and the Army Operations Center were informed within specified time frames in accordance with Army guidance and internal procedures.

(Bullet 3) Were there problems encountered in timely, accurate, and verified notification of the off-post community?

UMCD

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This was not a chemical event. There are no formal requirements to make notifications for a non-surety event. However, the Depot does realize the importance of the community receiving information to avoid misconceptions.

The All-Call system is a dedicated microwave system. Long distance problems such as the fiber optic lines being cut should not affect the ability to communicate. However, one EOC (Morrow County) experienced problems with the All-Call.

There were some reporting difficulties internally between RDC and the UMCD EOC. These have been identified and corrected. Procedures are being established to formalize reporting procedures. Furthermore, PMCD and RDC will now send liaison personnel to the Depot EOC during events.

Roll call was not taken at the time the initial call was made off-post. Because of the severed lines, phone calls were repeated to ensure that all jurisdictions were aware of the incident and that they had received a follow up fax with detailed information.

Lessons Learned: The All-Call system is now being recorded. Standing Operating Procedures are being reviewed and updated.

(Bullet 4) In terms of this accident, what communication means were used to provide initial notification--recognizing that this situation was made more difficult due to the fiber optic cable cut in Oregon?

UMCD

The All-Call system is the primary means of initial alert and notification between UMCD, state and county EOCs. This system is operated via a microwave and includes Umatilla County EOC, Morrow County EOC, Hermiston Safety Center, Benton County EOC, Washington State EOC, Prosser Dispatch, Oregon State Police (Bend), and the Oregon Emergency Response System (OERS - Salem). All jurisdictions answered the all call with the exception of Morrow County, Hermiston Safety Center, Oregon Emergency Response System, and OSP (Bend).

According to Oregon Emergency Management, the all call system should not have been affected by cutting the long distance lines since it operates via microwave and is a dedicated line. Fax lines, however, are still dependent on landlines, but will soon be accessible by microwave as well.

This notification was followed up with a group fax.

There was no chemical agent involved so the Federal Emergency Management Information System (FEMIS) was not used to make initial notifications of the incident. However, the FEMIS computer program was used to maintain a time line of key events. This time line was shared with off-post EOCs. Cell phones were also used as a redundant communication system.

(Bullet 5) Was UMCD aware of the loss of telecommunications from the cable cut?

UMCD

Yes, at 9:48 a.m. the EOC staff was informed that the long distance lines were out. This was noted in the daily log maintained by the staff. The primary means of communication is the All-Call as indicated earlier.

Lessons Learned: A plan for aggressive communication equipment checks is being formulated and current procedures are being reviewed.

(Bullet 6) If so, what method was used to circumvent this communications link to provide essential information?

UMCD

As indicated in bullet #4, the All-Call telephone system was used initially. This notification was followed up with a fax. The FEMIS computer program was used to maintain a time line of events. This time line was shared with off-post EOCs. Cell phones were also used. Morrow County was also obtaining information from the Planning Department in Irrigon. They have a local line established between the two locations. Washington State advised OERS, and OERS called OSP (Bend) to have them send a state trooper to Pendleton to pick up information. All jurisdictions were sharing information with those they could contact to pass on information.

WORKER SAFETY

1. When employees started experiencing symptoms of exposure, what steps were taken to ensure the employees were evacuated and received timely medical attention? If there was a delay—what was the cause?

RDC

The initial assessment of employee symptoms was made at the construction site infirmary by EMT/Paramedics. Employees displaying the most acute symptoms were transported to the hospital immediately. Other affected personnel were assessed and sent to the hospital depending on symptoms displayed. There was a 2-hour timeframe between transporting the most symptomatic employees and other employees to the hospital. Delays in transportation were created by limited availability of vehicles used to transport the employees.

2. Once detected, what measures were taken to protect workers while investigating?

RDC

All initial entries to the building after the event (during the investigation phase) wee made by personnel using self-contained breathing apparatus (SCBA). The perimeter of the MDB was first secured by wooden barricades and red danger tape. Building ventilation was shut down to isolate any fumes or vapors that may have been present, and to enhance opportunities to detect any residual fumes/vapors. A three person team, which included personnel from safety department, environmental department, and the site's industrial hygienist (using SCBA) made a sweep of all areas of the building using an organic vapor analyzer (Photo Ionization Detector – PID). No vapors were detected

	by the initial investigation entry team on the evening of the event. Subsequent investigation entries into the MDB were made in accordance with Job Hazard Analysis (JHA) documents, specifically prepared to cover each aspect of the continuing incident investigation.
3. When were the off-post medical staff members advised of the situation at the Depot? Was full disclosure given?	
RDC	Raytheon called "911" to request ambulance service from Hermiston Fire and Emergency Services and notified the UMCD Emergency Operation Center of the in-coming ambulance. Good Shepherd Hospital was not called by Raytheon. Full disclosure was given to the extent of the information available at the time of notification.
4. What information was conveyed to off-post response staff and the hospital so they could protect themselves?	
RDC	The patient's condition were transferred to the medical team on-board the ambulance. The condition of those employees being transported by company van was provided at the time of their arrival to the hospital.
5. What safety and health plan and or expertise does the army Depot have to deal with industrial safety--beyond chemical/biological issues?	
UMCD	UMCD does not store biological chemicals. The Depot clinic Officer in Charge is a General Practice Physician with specialized training in the management of chemical agent casualties, basic emergency toxicology, occupational health, and triage. He is certified in Advanced Cardiac Life Saving, Advanced Trauma Life Saving, Pediatric Advanced Life Saving, Basic Life Saving and maintains emergency procedure currency by supporting the local emergency room during his off-duty hours. The clinic is staffed with 5 medics, 1 ambulance and 2 patient transport vehicles. The Depot doctor and medics will handle a chemical incident. The doctor will call local hospitals and describe the extent and nature of injuries for chemical and non-chemical incidents.
RDC	In accordance with contractual requirements, the UMCDF Project has an infirmary staffed with two Emergency Medical Technicians (EMTs) during work hours. Additionally, a Nurse is on duty during the day shift to assist with medical issues. The UMCDF medical team is equipped with life support equipment and ambulance. Ambulance and emergency medical services are available and supplemented through a contractual agreement with Hermiston Fire and Emergency Services. UMCDF will have a medical clinic staffed with a medical staff including a physician, occupational nurse and support personnel.
EMERGENCY EVACUATION AND INITIAL RESPONSE	
1. Mobilization and Evacuation	
(Bullets 1 and 2) What evacuation procedures are in place for UMCD/RDC personnel? Are such procedures coordinated with the off-post community?	
UMCD - Chemical Accident/Incident Response and Assistance Plan (CAIRAP) with Changes 1-3, Disaster Control Plan SOP, Installation Spill Control Plan, Contingency Plan (Section G of RCRA B Permit), and DA Pam 50-6.	The Chemical Accident/Incident Response and Assistance Plan covers chemical munition incidents. UMCD employees have a role in responding to a chemical event. Those who don't, as well as contractors and residents, are only evacuated should the magnitude of the event dictate such action. In case of an evacuation, whether or not it involves chemical munitions, personnel are directed to a pre-designated assembly area where they will be accounted for prior to departure from the installation. In case of a chemical accident, pre-determined reception areas have been designated by the Chemical Stockpile Emergency Preparedness Program emergency planners. The evacuees are sent to areas that lead away from the disaster based on hazardous conditions.
UMCD - EOC Procedure, DA Pam 50-6, CSEPP MOU (to be published in the near future)	Off-post jurisdictions are telephonically notified simultaneously by UMCD EOC of all chemical emergencies within 10 minutes or once a non-surety emergency is declared. A non-surety chemical emergency will be declared when events are likely to occur, or have occurred, that may be perceived as a chemical surety emergency or that may be of general public interest, but which pose no chemical agent hazard. The list of jurisdictions notified include Umatilla County EOC, Morrow County EOC, Hermiston Safety Center, Benton County EOC, Washington State EOC,

	Prosser Dispatch, Oregon State Police (Bend), and the Oregon Emergency Response System (Salem). After initial notification, these locations are kept informed telephonically and electronically through the Federal Emergency Management Information System (FEMIS).
RDC UM-PL-014, Management Plan Volume 1, Revision 2	See referenced procedures as indicated below. (Section 14.0, Depot Evacuation): RDC and RDC Construction have developed evacuation procedures in the event of a chemical agent release to safeguard visitors and facility personnel (PSP 02.03, Site Evacuation Plan and UM-SU-001, Site Evacuation..." (2 pages)
UM-SU-001, Site Evacuation, Revision 0	(Entire procedure – 7 pages): "The purpose of this procedure is to provide for a safe and orderly exit from the Raytheon Demilitarization Company (RDC) Umatilla Chemical Agent Disposal Facility (UMCDF) administrative areas..."
PSP 02.03, Site Evacuation Plan, Revision 3	(Entire procedure – 10 pages): "This procedure is to provide for a safe and orderly exit from the Umatilla Chemical Agent Disposal Facility (UMCDF) should the need arise due to a chemical event or impending operations in K-block that have the potential of a release of chemical agent to the UMCDF construction area."
PSP 02.07, Office Building Evacuation and Accountability Plan, Revision 1	(Entire procedure – 6 pages): This procedure is to provide accurate accountability for Raytheon Cost Plus Award Fee (CPAF) and Firm Fixed Price (FFP) non-manual employees on the Umatilla Chemical Agent Disposal Facility (UMCDF), should the need arise due to any type of non-chemical related emergency. The procedures have not, at this time, been coordinated with the off-post community.
(Bullet 3) What procedures have been provided to the workers for actions to take in case of an Industrial accident?	
UMCD - Disaster Control Plan SOP, Installation Spill Control Plan. and Policy Statement Number 99-29 (Clinic First Policy). MOAs between St. Anthony Hospital (Pendleton), Good Shepherd Community Hospital (GSCH, Hermiston), Kadlec Medical Center (Richland, WA) and the Fire District Board of Directors (Hermiston).	Should a military/DOD employee become seriously injured or ill at work, they report to the occupational health clinic (OHC) for medical evaluation and treatment by the physician. The Depot physician will assess the medical condition of the employee and provide treatment. If a life or limb-threatening on-the-job injury or illness is reported to the on-call medic, he/she will call 911 (Hermiston emergency ambulance). Medics may not diagnose or treat some injuries or illnesses without prior screening by the Depot physician. Injuries or illnesses will be evaluated and treated, if possible. If a doctor is required, and the Depot physician can not be located, employees will be referred to the emergency room at Good Shepherd Community Hospital in Hermiston for treatment.
RDC	See the referenced procedures as indicated below.
UM-PL-014, Emergency Response Plan, Volume 1, Revision 2	(Section 8.0, Categories of Emergencies): "The appendixes address each of the five types of emergency situations with regard to initial response by discovery personnel and emergency response personnel..." Property Damage (Appendix A) Accident, Injury, or Illness (Appendix B) Fire (Appendix C) Chemical Spill of Release (Appendix D)"
	(Paragraph 10.3): "Each Raytheon and subcontractor employee intending to work at the UMCDF project will receive a general overview of the elements of this Emergency Response Plan to ensure they are aware of those steps to be taken in the event they discover or are in the area of an emergency occurrence. They will be given the

emergency call-in phone numbers and will be made aware of proper reporting procedures. It will be stressed very strongly that unless they are a member of the emergency response team, have formal training in handling the emergency that could be safely utilized to terminate or impede the progression of the emergency, they are to report the incident and retreat from the area immediately."

(Section 11.0, Reporting of an Emergency Occurrence): "At new-hire orientation, each employee will be instructed on the proper procedure to report emergencies. Emergencies can be classified as minor emergencies or major emergencies. The reporting and activity for each is as follows. For each example given, refer to the appropriate appendix for more complete instructions.

Section 11.1 Minor Emergencies.

For minor emergencies, such as a small Class A fire (wood, paper, cardboard, etc.) or small Class B fire (flammable liquid), when a fire extinguisher is available and the employee can safely extinguish the fire, the employee should so with extreme care but in no way jeopardize themselves. Once the fire is extinguished, the employee should call the RDC Construction Safety Office (564-7351) immediately and report it.

Section 11.2 Major Emergencies.

For major emergencies such as a large fire, chemical or gas release or serious injury, the employee shall call the predetermined emergency reporting phone number or, if possible, have someone report the situation to the Safety Department via radio. Other employees in the immediate area should also be made aware of the situation. Injured personnel should be attended to, until the EMT arrives. It is important that assistance rendered be limited to that which one is trained to do. Seriously injured personnel are not to be moved unless they are in further danger from existing situations such as fire, falling, debris, etc. They should then be moved only the distance required to remove the threat of further injury."

(Appendix A, Property Damage):

"1.0 Area Worker
1.1 Stop work and notify area supervisor immediately. Isolate accident scene.
1.2 If injury or fire is involved, take the appropriate action according to Appendixes B and C of this plan."

(Appendix B, Accident, Injury, or Illness (Entire appendix - 2 pages):
"Should a worker become seriously injured or ill at the project, the following guidelines shall be used in summoning and rendering assistance..."

(Appendix C, Fire (Entire appendix – 2 pages):
"...Appendix C discusses measures to be taken should a fire occur on the project..."

(Appendix D, Chemical Spill or Release (Entire appendix – 1 page):

"For the purpose of this plan, hazardous materials will include fuels, chemicals and other materials typically used at a construction site. Military agents are not included in this plan because of the nature of activity on the site while this plan is in effect. No interaction with nerve or mustard gas in anticipated, however, construction personnel

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will be instructed, during new-hire orientation on how to react to an agent release alarm. Evacuation procedures are discussed in Section 14.0 of this plan. Spill response and notification will be in accordance with UM-EC-008, Environmental Spill and Incident Reporting..."

CDRL A018A, Accident Prevention Plan, Volume 1, Revision 0

(Section 6.2, Medical and First Aid Reporting):

"All injuries, regardless of how minor must be reported to your foreman immediately and recorded in the site medical center. Minor injuries, if not treated immediately, can become more serious later.

Failure to report an injury immediately could result in loss of benefits and would cause delay in treatment if you leave the job site without reporting an injury that was sustained. If no injury is reported prior to leaving the project, it will be assumed that it occurred off the job. If an employee is injured on the job:

If there is a serious accident or injury, locate someone with a radio or go to the nearest building or trailer with a telephone and call the First Aid station at 564-7349.

The employee reporting the injury should give their own name, location of the injured person and type of injury, if known."

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(Section 23.2, Accident and Incident Reporting):
"The employee must report all accidents, injuries, near misses and hazards or potential hazards that could result in injury or property damage immediately to their supervisor. The supervisor shall advise all affected employees and remove them immediately from the effects of the hazard. The supervisor shall then do the following:

- Notify personnel deemed responsible for correcting the situation.
- Secure the area by barricading or posting sentries to keep personnel from entering the affected area.
- Notify the construction Safety Manager.
- Ensure the proper steps are completed and the hazard is eliminated or proper control measures are put into place prior to removing barricades and allowing workers to return to the area. Each employee must be thoroughly briefed on the existing hazard and applicable control measures if it applies."

UM-PL-010, Facility Security Plan, Volume 1, Revision 1

(Section 13.0, Reporting of Incidents During Routine Work Hours):
"13.1 All security and emergency incidents occurring during working hours shall be reported to the Construction Manager or Construction Superintendent.
13.2 All project security incidents shall be reported immediately to the Raytheon SSC and UMCD shift security supervisor.
13.3 Should any incident arise involving UMCD property adjacent to the project, the UMCD security office (9-564-5240) at the main gate shall be notified, including a request that the shift commander on duty be notified."

UM-EC-008, Environmental Spill and Incident Reporting, Revision 1

(Section 5.0, Responsibility):
"5.1 All Raytheon Personnel
Immediately report each spill or environmental incident to Construction Safety."

(Bullet 4) What was the exact warning message that was provided to the workers—did they understand?

RDC

The general statement made by the craft supervisors and safety supervisor personnel over the radio at the time of the incident was, "Evacuate the MDB." The statement was understood by the workers in the building. (RDC)
(NOTE: This is the same question and answer as shown above as bullet 5 for On-Post/Off-Post Notification.)

(Bullet 5) How long did it take for the RDC workers to be mobilized to evacuate?	
RDC	Workers evacuated the affected building within 5 – 10 minutes.
(Bullet 6) How long did it take for them to leave the Depot?	
RDC	Workers from the UMCDF construction site were not directed to leave the Depot when they evacuated the MDB. Construction employees were released from the site at approximately 12:30 p.m.
EMERGENCY EVACUATION AND INITIAL RESPONSE	
2. Initial Emergency Response	
(Bullet 1) What are the procedures in place at UMCD for transportation of casualties off-post and were they followed?	
UMCD – PMCSD/RDC Medical Clinic and U.S. Army Occupational Health Clinic (OHC)-UMCD Emergency Response MOU (draft), MOAs with St. Anthony Hospital (Pendleton), Good Shepherd Community Hospital (GSCH, Hermiston), Kadlec Medical Center (Richland, WA) and the Fire District Board of Directors (Hermiston).	UMCD will help transport or treat casualties from the Raytheon Clinic only when requested by RDC. There is a formal chain of command for each clinic to go through in order to make such a request. The UMCD clinic actually went even beyond this formal request channel and called the Raytheon Clinic to ensure that no help was truly needed. RDC representatives stated that UMCD clinic assistance was not needed. If requested, the UMCD clinic would have provided resources necessary to aid in the 15 Sep event. Since UMCD was not involved in the event, the Depot did not have any part in the notification of medical facilities, communication of relevant medical information, nor other information exchange during the initial event. The UMCD clinic may aid the Raytheon clinic per the draft MOU as mission and resources permit. The UMCD clinic will always take care of chemical casualties and arrange transport of such patients to higher levels of care. MOAs exist with area caregivers/first responders in case of chemical casualties.
RDC	See the procedures as indicated below.
UM-PL-013, Medical Implementation Plan, Volume 1, Revision 1	**(Section 8.0, Onsite Ambulance Service):** "Raytheon shall maintain and operate a fully equipped ambulance for emergency response only. In the event of multiple injuries, Raytheon has a mutual aid agreement with the Hermiston Fire Department to augment the need for transportation of additional personnel."
UM-PL-014, Emergency Response Plan, Volume 1, Revision 2	**(Appendix B, Accident, Injury, or Illness):** "3.3 Once the injured person is stable, transport him/her to the appropriate medical facility."
(Bullet 2) Is there an MOA/MOU in place for provision of such services?	
UMCD - MOA with the Fire District Board of Directors (Hermiston).	It's important to note that the UMCD fire and rescue team arrived at the Raytheon site within minutes from the time they received the request for support. The resources of the U.S. Army Occupational Health Clinic (USAOHC), Umatilla, are not sufficient to provide complete emergency treatment and care of personnel at UMCD following a major chemical or non-chemical event with multiple casualties, or to provide emergency transport of patients to area hospitals. At the earliest possible time, following a chemical or UMCD non-chemical event, the Officer in Charge (OIC) of the UMCD clinic will notify the Hermiston Safety Center and communicate the requirement for ambulance support and the potential risk for contamination. This is delineated in the MOA between UMCD and the Hermiston Safety Center. During duty hours, non-chemical patients/casualties may be stabilized in place by the USAOHC and transported from the site by community response teams, or transported to the USAOHC and stabilized prior to

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	transport by community response teams. During non-duty hours, non-chemical patients/casualties will be stabilized in place by any resources available and transported from the site by community response teams.
RDC	Yes. See purchase order discussion as indicated below.
Raytheon Constructors, Inc., Purchase Order 1171, Seller – City of Hermiston	"Provide advanced life support ambulance when requested for the purpose of providing emergency medical care and transport to Good Shepherd Hospital. The price listed herein is based upon an average of three responses per month at an average rate of $514.00 per response. The value of this order shall not exceed that listed herein. Each ambulance shall be fully equipped and staffed with two emergency medical technicians with advance life support capabilities."
UM-PL-013, Medical Implementation Plan, Volume 1, Revision 1	(Paragraph 8.1.1): "In the event of multiple injuries, Raytheon has a mutual aid agreement with the Hermiston Fire Department to augment the need for transport of additional personnel."
(Bullet 3) Was Good Shepherd Hospital notified on incoming casualties and by whom?	
UMCD	RDC is responsible to notify all emergency facilities of inbound non-chemical incident related patients. The Depot physician was told by RDC that only one patient was to be transported by the Hermiston Fire Department ambulance.
RDC	Raytheon called "911" to request ambulance service from Hermiston Fire and Emergency Services and notified the UMCD Emergency Operation Center of the incoming ambulance. Good Shepherd Hospital was not called by Raytheon.
(Bullet 4) What Essential elements of information were transferred from RDC/UMCD to the hospital?	
RDC	The patient's conditions were transferred to the medical team on-board the ambulance. The condition of those employees being transported by company van was provided at the time of their arrival at the hospital.
(Bullet 5) Was this information also shared with all potential receiving hospitals?	
RDC	N/A
(Bullet 6) In this particular case, did Good Shepherd Hospital convey any information back to UMCD or to County Emergency Operation Centers (i.e. the hospital may have determined the nature of exposure from the manner in which casualties responded to treatment)?	
RDC	No information was received from the hospital.
PUBLIC AWARENESS	
1. How did RDC provide information to the public and the media? Perception is that information was released too slow and that something was being hidden (i.e. Was it chemical agent?)	
UMCD	Raytheon participates as an integral part of the UMCDF public affairs program. Public affairs is a partnership among three Army agencies (UMCD, PMCD and the Army Corps of Engineers) and two private contractors (Raytheon, the systems contractor; and Booz Allen & Hamilton, the Outreach Office operator). Public affairs staff members for each of these entities work together daily to coordinate activities, and take on various roles and responsibilities to work more efficiently and avoid duplicating efforts. Public affairs is the UMCD commander's responsibility. In an emergency such as the Sept. 15 incident, the UMCD PAO has the task of disseminating information to the media and public. For this incident, Raytheon provided information for news releases, which were disseminated by and through the UMCD PAO. These procedures helped ensure accurate information was provided. They follow the Army's public affairs "speaking with one voice"

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philosophy, meaning those talking to the media and public are using the same information. This helps ensure accuracy and consistency. Although information was sketchy in the hours following the incident, at no time was information intentionally withheld from those who made inquiries.

Because initial reports confirmed this was a construction site incident rather than a chemical weapons incident, normal CAIRA response plan actions were not immediately taken (e.g., calling public affairs augmentees, notifying higher headquarters, and notifying the governor, congressional offices, media and outside agencies). Although there is not the same requirement for the UMCD to notify the public in a non-chemical event, we know we have an obligation to attempt to allay misinformation and community concerns. Therefore, the public affairs team started response actions as soon as information revealed the potential impacts of the incident.

Lessons Learned: It is now our intention to respond to such non-chemical events as "community" events. A top priority will be an immediate alert to major local print and broadcast media by telephone and/or fax to confirm an incident has taken place and provide available information.

Further, for such events we will explain in greater detail how and why we know chemical agents aren't involved.

2. What is the relationship between RDC and UMCD for distribution of information to the media and the public? Raytheon was not seen as being up front and the perception is that information was filtered by the Army.

UMCD/RDC

Regarding the relationship between Raytheon and the UMCD for information distribution, please see the response to Question 1.

Regarding the question of Raytheon being "up front" in providing public information, Raytheon was the chief source of information on Sept. 15, as events unfolded during the following weeks, and continues to be the primary information source. Raytheon project manager participated with the Depot commander in on-site television interviews with two Tri-City stations Sept. 17, and again at the on-site media opportunity Sept. 20, along with several other Raytheon employees and the commander. Raytheon staff members have continued to participate in various media interviews and public meetings following the Sept. 15 incident.

3. When was the first press conference held?

UMCD/RDC

The first general media invitation to visit the UMCDF went out Sunday, Sept. 19 for Monday morning, Sept. 20.

Prior to Sept. 20, the public affairs staff responded to numerous requests from the media on an individual basis, including: *East Oregonian, Tri-City Herald, Hermiston Herald, The Oregonian,* KVEW Television, KEPR Television, KNDU Television, KGW Television (Portland), KOHU Radio, KLCC Radio (Eugene), Oregon Public Broadcasting (Portland), Associated Press (Portland). And, as stated above, two Tri-City TV stations were also on site Friday morning, Sept. 17, for interviews with the Depot command and Raytheon project manager.

Lessons Learned: An opportunity was lost to allay concerns and provide additional information for news articles by not holding a press conference as soon as feasible following the incident. The UMCD commander has now made it his policy to hold a press conference within 24 hours after such an event.

4. How did the UMCD EOC ensure that sufficient information was provided to people that the incident was not related to chemical agents?

UMCD

Initially, there was no reason to believe that the scope of the incident was anything other than a typical construction incident. There was a conscious decision by the leadership to treat it as such. There have been several instances in the past where construction workers were injured or have taken ill (such as heart attacks) and have been sent to the local hospital via ambulance. Once the magnitude of the event was realized it was obvious that the community may perceive the situation as a chemical event. It was determined at H+90 (event plus 90 minutes) that

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the off-post CSEPP community should be notified of a non-surety emergency (not related to chemical agents). Although, in retrospect, this decision could have occurred earlier, every attempt was taken from that point forward to keep emergency managers informed of the ongoing situation. There were communication challenges due to the long distance phone lines being cut. However, the basic notification system was not impacted since it is operated via microwave. Several redundant systems were used (computer, fax, cell phone, etc.), to ensure the community was kept informed.

The Citizens Chemical Advisory Commission was briefed on Sep. 16th at their monthly public meeting. Congressman Greg Walden was briefed on Sep. 17th in the headquarters conference room.

Lessons Learned: The fact that chemicals were not involved should have been reported much sooner. In order to avoid this delay in the future, the off-post community will be notified of any non-chemical event that may be perceived as a chemical agents and/or munitions accidents, including industrial accidents and grass fires.

A review of internal reporting procedures is currently being conducted.

5. Were FEMIS Shared Reports used to share information on the incident between UMCD OC and the counties?

UMCD

Yes. The CSEPP Coordinator kept a running time line of events in shared reports once the initial notification to off-post jurisdictions was made telephonically. The information was then provided by fax.

6. Has a log been kept of all messages sent out?

UMCD

A logbook is kept of all events by the Depot EOC. A timeline for this specific event has been collected during the period 15-23 Sep (attached).

Lessons Learned: It was discovered during the investigation that the All Call was not part of the voice recording system. This has been corrected. All emergency response phones used in the EOC are now connected to the voice recording system.

7. Are there pre-prepared fact sheets that were used?

UMCD

Fact sheets already existing on the program were provided to visiting media during the Sept. 20 press conference and at other times following the event, upon request. No fact sheets were prepared specifically for this incident.

8. Was a telephone number provided for media inquiries?

UMCD

All press releases relating to the incident included at least one telephone contact number, the UMCD Public Affairs Office. Many of the news releases also included the UMCD PAO's home and cell phone numbers and/or the Outreach Office. The UMCDF, through its Outreach Office, also maintains a "Guide to Public Information Contacts" that gives phone numbers and areas of responsibility for two dozen public affairs specialists with interests in chemical disposal activities. This was distributed to members of the media, on request, following the Sept. 15 incident.

9. How were information needs of UMCD and RDC personnel handled?

UMCD

The UMCD commander conducted a "commander's call" Sept. 20 to personally update employees about the incident. Raytheon held "all hands" meetings for all UMCDF employees on Sept. 20 and 21. In addition, Raytheon employees were provided information on the incident through the distribution of press releases and updates from supervisors, union stewards and business agents.

In early October, UMCD and RDC employees received "Inside the Fence," a special supplement to the monthly Depot newsletter. It provided information about K-Block, the Depot's chemical weapons, and storage and

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	monitoring operations. This had been scheduled for October publication prior to the incident.
RDC	Raytheon employees were provided information related to the incident through the distribution of press releases and updates from supervisors and union shop stewards and business agents, which were integrally involved in the investigation.
10. Did more people than normal visit the PMCD Public Outreach Office as a result of the incident?	
UMCD	No. The Outreach Office has averaged 20 to 25 visitors over the past year. During the week of the Sept. 15 incident and the following two weeks, the number of Outreach Office visitors fell below those average numbers. During the heaviest week of activity during this incident, the week of Sept. 20-24, the Outreach Office recorded 18 visitors and 28 callers, many of them media. Many of the visitors were aware of the Sept. 15 incident.
11. Were there information requests from the community hospitals? Which ones? When did they call? Who did they call? What did they ask? What information was provided to them? When? By whom?	
UMCD	Yes, there was one information request from Good Shepherd Community Hospital. On the afternoon of Sept. 15, the hospital's media spokesman asked to be kept informed about the incident as it unfolded. As a result, his name was added to the list of elected officials, media and other interested parties who received press releases by fax.
HAZARD ASSESSMENT	
1. Perception of Hazard:	
(Bullet 1) Who noticed the problem and did they follow the proper reporting procedures?	
RDC	Affected craft workers were the first to notice the problem as they were overcome by fumes. They told everyone in their immediate vicinity to get out of the facility; supervisors then spread the word via radio, and informed a safety supervisor who was currently located at an entrance to the facility. This is consistent with reporting procedures.
(Bullet 2) Are there procedures in place to immediately notify UMCD to utilize RTAPs if a chemical agent release is suspected?	
UMCD	RTAP monitoring systems were employed to test the storage area after the accident was reported. This monitoring was conducted to assure the workforce that chemical agents were not a factor. Furthermore, the interior of the MDB was tested for the presence of chemical agents using the RTAP. All monitoring results, which were recorded, were negative. These were verified by OSHA, who concurred with our decision that chemical agent was not involved. There is no formal procedure in place at this time to utilize UMCD's RTAPs when chemical agent is not an issue. RTAP monitoring will be included in future non-chemical emergency planning procedures.
2. Hazard Assessment:	
(Bullet 1) What information was collected to make a determination of the threat/incident?	
UMCD	There are two different aspects in this question. Raytheon will provide their response. However, it is necessary to point out that UMCD conducted a thorough investigation as well. There were no weapons surveillance operations ongoing at the time of the incident. Routine monitoring operations were conducted (without opening the structures) earlier in Bunkers K1825, K1826, K1880 and K1881. Operations were also conducted that morning in Igloo K1897 and ceased at 1038 when the igloo was sealed. K1897 is 1,000 meters from the construction site. At no time did wind direction flow from the storage site over the boundary of the construction site. Likewise, all readings for chemical agent vapors were negative. The winds are monitored and recorded in real-time from meteorological sensors around the Depot and construction site.

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A Federal OSHA team fully investigated the weather and operational factors and concluded that chemical agents played no role in the incident. Doctors treating the individuals likewise ruled out chemical agents as a cause of the symptoms. Several factors support this:

1. Prior to surveillance operations that require opening storage igloos, a thorough computer-driven model and hazard/risk analysis is conducted in the Depot operations center. The operational risk is evaluated, and if weather conditions either indicate a possible toxic plume release off the Depot or threaten personnel on the construction site, surveillance operations are cancelled or relocated to another structure until weather permits. Weather conditions are continuously monitored. If changes occur that would threaten workers on the construction site or the off Depot community, ongoing operations are stopped immediately. Recorded weather conditions at the time of the incident did not indicate winds across the site.

2. Over fourteen hundred employees were working around the construction site. Furthermore, Depot employees were conducting routine security patrols and grounds maintenance in the storage yard without protection (masks). The workers involved in the incident were located within thirty feet of each other in the Munitions Demilitarization Building. The known behavior of chemical agent vapors would have resulted in more widespread injuries for workers in the downwind hazard. This hazard did not exist.

3. RTAP monitoring systems were employed to test the storage area and MDB after the accident. All monitoring results, which were recorded, were negative.

(Bullet 2) Does Raytheon have procedures to direct workers on how to respond in the event the incident was a chemical agent release?

RDC

See the referenced procedures as indicated below.

UM-PL-014, Emergency Response Plan, Volume 1, Revision 2

(Section 14.0, Depot Evacuation)
"RDC and RDC Construction have developed evacuation procedures in the event of a chemical agent release to safeguard visitors and facility personnel. The RDC Construction procedure is PSP 02.03, Site Evacuation Plan. The RDC procedure is UM-SU-001, Site Evacuation. A map of the site evacuation route and assembly areas is provided as Figure 1..." (2 Pages)

(Appendix D, Chemical Spill or Release)
"For the purpose of this plan, hazardous materials will include fuels, chemicals and other materials typically used at a construction site. Military chemical agents are not included in this plan because of the nature of activity on the site while this plan is in effect. No interaction with nerve or mustard gas is anticipated, however, construction personnel will be instructed, during new-hire orientation, on how to react to an agent release alarm. Evacuation procedures are discussed in Section 14.0 of this plan. Spill response and notification will be in accordance with UM-EC-008, Environmental Spill and Incident Reporting..." (1 Page)

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UM-SU-001, Site Evacuation, Revision 0

(Entire procedure; 7 pages)
"The purpose of this procedure is to provide for a safe and orderly exit from the Raytheon Demilitarization Company (RDC) Umatilla Chemical Agent Disposal Facility (UMCDF) administrative areas."

PSP 02.03, Site Evacuation Plan, Revision 3

(Entire procedure, 11 pages)
"This procedure is to provide for a safe and orderly exit from the Umatilla Chemical Agent Disposal Facility (UMCDF) should the need arise due to a chemical event of impending operations at K-block that have the potential of a release of chemical agent to the UMCDF construction area..."

(Bullet 3) How long will it take for UMCD to respond with monitoring equipment if a chemical leak is suspected?

UMCD	It is our first priority to immediately respond when a chemical agent leaker is suspected. One RTAP is on standby to perform necessary monitoring functions. Our mission is to store the chemical munitions in a safe manner to protect the workers, the public and the environment. Army operational procedures require that storage bunkers are monitored prior to initial entry for surveillance operations and then continuously while the bunkers are open and occupied. The Depot uses Real Time Analysis Platforms (RTAP) to conduct this testing. These monitors, which are basically mobile laboratories, are capable of real-time detection of chemical agent vapors at 17 parts per trillion, and corrective action can be taken immediately. The commander has the authority to direct the monitoring of structures and the area. He has directed that if a leak is suspected, RTAPs will immediately support verification. He has also directed that RTAPs be used to verify that no agents were involved in the case of a non-chemical event that might be perceived as involving chemical agents.
(Bullet 4) Are there protocols to use neutral, third party agencies to conduct air monitoring/sampling immediately following any suspected industrial incident at the worksite?	
RDC	No.
(Bullet 5) Does Raytheon have a process for screening chemicals, used on site, for toxicity, needed PPE (i.e. respirators), volatility, ventilation needs, etc.?	
RDC UM-PL-019, Environmental Compliance Plan, Revision 2	**(Section 8.1, ENVIRONMENTAL COMPLIANCE PROGRAM)** "8.1.1 Program Description An Environmental Compliance Program will be used to demonstrate and maintain conformity with environmental permits and regulations. This program will consist of routine audits, surveillances, and monitoring of site activities..." (1 page) **(Section 16.4.2, General)** "The following are general requirements. Pesticides and herbicides must be approved for use by the Site Safety Manager prior to their purchase, and must be handled in accordance with FIFRA and Army Regulation AR 200-5, Pest Management..." **(Section 16.4.3, CONSTRUCTION)** "An inventory of all hazardous materials procured for the construction of the UMCDF must be maintained by quantity, requestor, location, use and disposition. Per SARA Title III requirements, RDC is required to perform, notify, and/or submit via PMCSD and the UMCD to applicable agencies the following: 1. Compare the inventory to the list of extremely hazardous substances and notify the Local Emergency Planning Committee within 60 days for those that are present in quantities above the threshold planning quantity. 2. Submit MSDSs or a list of MSDSs and other inventory information, 60 days after the material is received, to the responding agencies and the local fire department for those materials that the Occupational Safety and Health Administration (OSHA) requires be kept under Worker Right-To-Know laws. 3. Make emergency notification to the responding agencies for emergency releases. Annually report the amount of listed toxic chemicals released in the environment either routinely or by accident per Section 313 of SARA Title III for UMCDF operations."
CDRL A020, Occupational Health and Hygiene Plan, Revision 0	**(Section 1.0, PURPOSE)** "During the construction of any facility, employees may be faced with varying levels of occupational health hazards. The intent of this plan is to establish means for identifying those hazards, evaluating levels of potential exposure, and developing and implementing measures to eliminate or reduce the hazard or protect employees against its

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designed to establish clear goals and objectives and to ensure that each employee is aware of all-hazard existing and the measures required to eliminating or controlling them. This program shall be reviewed annually to ensure that any changes in company operations and Occupational Safety and Health Act (OSHA) hazard communication (HazCom) standards are addressed and included.

Raytheon shall provide a program for proper labeling of containers, describe other needed forms of warning labels, and detail the use and purpose of material warning labels, and detail the use and purpose of MSDSs. Raytheon shall generate a list of hazardous chemicals known to be present in the workplace. This list shall be kept in the RCI Safety Office. Each employee shall be trained in the use of MSDSs and shall be informed where the MSDS is kept. They shall also be advised that it is their right to ask to review the MSDSs anytime they intend to use a hazardous chemical or product. A copy of all MSDSs shall be maintained in the RCI Safety Office along with the chemical inventory..." (5 pages)

(Bullet 6) Does Raytheon Safety conduct hazard assessments of each job to ensure that the proper PPE and work rules are being followed? Are there procedures documenting the proper PPE use and ventilation requirements?

RDC

Yes. This process occurs as part of the Job Hazards Analysis (JHA) process and the Hazards Communications (HazCom) program. See specific procedure references as indicated below.

CDRL A018A, Accident Prevention Plan Volume 1, Revision 0

(Section 8.0, Job Hazard Analysis)
"The scope of this plan is to provide guidance for the development of a JHA..." (6 pages)

(Section 18.0, Respiratory Protection)
"The use of respiratory protection equipment is necessary for the safety and health of employees working in atmospheres where harmful or toxic dusts, fogs, fumes, mists, gases, smokes, or vapors exist or in an oxygen deficient atmosphere..." (4 pages)

MEDICAL MANAGEMENT

1. Triage: Does Raytheon have procedures on how to triage? If procedures exist, who is trained and did triage occur during this incident?

UMCD

This is a Raytheon question, but also applies to the Depot. UMCD medical personnel frequently train in triage in preparation for a surety event. The OHC physician has trained much of the Hermiston Fire Department on the medical management of chemical casualties, which contains some training in general triage. The training is also available to the Raytheon clinic. However, many of their paramedics are also members of the Hermiston Fire Department.

RDC

Yes. Paramedic/EMT personnel are certified by the State of Oregon to conduct these activities. These personnel work under protocols developed by Beverly Harn, M.D., who is their local area registered Physician Advisor with the State of Oregon. In addition, Paramedic/EMT personnel work to "Emergency Care in the Streets," 3rd edition, Nancy L. Caroline, M.D.

UM-PL-013, Medical Implementation Plan, Volume 1, Revision 1

(Section 6.3)
"The EMTs will hold a current State of Oregon EMT's certification. Their duties and responsibilities are as follows . .

Evaluate injured and ill employees and determine the need for off site transportation and/or treatment."

(Section 9.0, FIRST-AID TREATMENT)

"9.1 GENERAL

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effects."

(Section 5.0, HAZARD COMMUNICATION PROGRAM)
Raytheon Engineers & Constructor's Corporate Hazard Communication (HazCom) Program shall be the basis for establishing employee right to know and training requirements on the UMCDF Project. These basic statutory requirements shall be expanded upon to meet specific project needs. The Raytheon HazCom Program has been developed in accordance with statutory requirements found in Federal standards, e.g., OSHA and EPA, and state standards as described in the Accident Prevention Plan (CDRL A018A).
The HazCom Program shall be an element of the new hire orientation training program for all employees. This training shall be documented and made available for review by the designated authority at any time.

(Section 7.0, CHEMICAL HAZARDS)
"A variety of products containing hazardous substances will be used on this project..." (3 pages.)

(Section 8.0, PHYSICAL HAZARDS)
"Construction activities pose a number of physical hazards to employees (i.e., noise, radiation, nuisance dust, airborne objects and temperature extremes)..."(4 pages)

CDRL A018A, Accident Prevention Plan
Volume 1, Revision 0

(Section 6.3, PERSONAL PROTECTIVE EQUIPMENT)
"The following personal protective equipment (PPE) will be required while on the job site. Certain items, such as goggles, face shields, safety harnesses, etc. are needed only in specific situations. Employees are to be thoroughly instructed on the use, maintenance and inspection of all their equipment. This instruction shall be given by the site Safety Manager/designee as part of the new hire orientation. All training shall be documented and kept on file in the Safety Office. Additional safety related training will be conducted as required in the RCI Safety Training Building.

Visitors intending to enter the work area shall be required to meet all personal protective equipment requirements as the work force. All safety related equipment, (i.e., hard hats, safety glasses, goggles, etc.) will be issued by the Safety Department. At time of issue, the employer's training records will be reviewed to ensure he/she has been trained in the proper use of the personal protection equipment is being used..."

(Section 6.4.9, Respiratory Protection)
"Certain work tasks require additional protection against dust, fumes and other inhalation hazards. In such cases, it is necessary to install additional ventilation to remove these hazards. When this is not sufficient then additional respiratory protection is required.. In such cases the employee must be properly trained in the use, selection and maintenance of his/her equipment as well as fit tested on the respirator to be used and medically qualified. Medical qualifications shall be determined by a licensed physician. All employees will receive instructions on the use and selection of maintenance free respirators at new hire orientation. (Respirators, dust masks, such as the MSA 9920 and MSA 8610 are considered as single use, maintenance free types.) Employees who are required to use negative pressure air purifying respirators will receive additional training, prior to use. The construction Safety Manager shall be consulted on all occasions where respiratory equipment is required."

(Section 7.0, HAZARD COMMUNICATIONS)
"This section will be communicated to all personnel that are assigned to the UMCDF project. Each employee will receive this information initially at new hire orientation and as needed if revisions, modifications or additions to the program as they occur. This program encompasses the entire workplace, regardless of number of employees. It is

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	All treatment will be in accordance with established procedures and protocols. The on-scene EMT staff shall request a check of the employee's Safety File so as to better evaluate the injured employee's condition." "9.2 CHEMICAL ACCIDENT/INCIDENT MEDICAL RESPONSE UMCDF employees suspected of the chemical agent exposure will be referred to the UMCD clinic until such time the UMCDF health clinic is established and equipped to provide."
UM-PL-014, Emergency Response Plan, Volume 1, Revision 2	(Appendix B, Accident, Injury, or Illness) "Should a worker become seriously injured or ill at the project, the following guidelines shall be used in summoning and rendering assistance..." 3.0 RDC CONSTRUCTION EMT 3.1 Obtain information from the caller and proceed to the scene. 3.2 Assess the injured person's condition and administer treatment according to medical direction and protocol. 3.3 Once the injured person is stable, transport him/her to the appropriate medical facility. 3.4 The EMT will keep the RDC Construction Safety Manager informed of the injured person's condition as it is made available.
2. Treatment: Are there procedures on how to treat employees suffering from any condition: chemical or traumatic? Do the procedures incorporate the UMCD clinic or off-post *fire/rescue*?	
UMCD – PMCSD/RDC and U.S. OHC-UMCD MOU (draft).	Chemical casualties (i.e. from surety chemical material) will always be treated by the UMCD clinic. Other types of injuries (including irritant exposures from an industrial accident) sustained at the UMCDF site which involve UMCDF employees are treated by the Raytheon clinic unless help is requested of the UMCD clinic (i.e. for a Mass Casualty event) per the MOU that is in progress.
RDC	Yes. As addressed in question #1 above, and as described in reference procedures as indicated below.
UM-PL-013, Medical Implementation Plan, Volume 1, Revision 1	(Section 3.0, SCOPE) "An integral part of the Plan is how injured employees will be treated. The UMCDF project will staff two intermediate level EMTs any time work is being conducted for evaluating and treating occupational illnesses and injuries related to construction activities." (Section 7.4, OBJECTIVES) "The objectives of the UMCDF Infirmary and staff are as follows... Provide emergency first-aid response in the event of occupational illness or injury. Respond to the needs of employees regarding non-job related conditions that may result in loss of life or other serious consequences (e.g., heart attack, seizures, etc.)." (Section 9.0, FIRST-AID TREATMENT) "9.1 GENERAL All treatment will be in accordance with established procedures and protocols. The on-scene EMT staff shall request a check of the employee's medical resume for preexisting conditions and/or allergies from the employee's Safety File so as to better evaluate the injured employee's condition." 9.2 CHEMICAL ACCIDENT/INCIDENT MEDICAL RESPONSE UMCDF employees suspected of chemical agent exposure will be referred to the UMCD clinic until such time the UMCDF health clinic is established and equipped to provide this service."
3. Decontamination: Does Raytheon have procedures for employee decontamination on the job site? If so, were they followed (the concern is how employees got to the hospital without being decontaminated at the site)?	

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UMCD	This is a Raytheon question, but it's important to note that there were no weapons surveillance operations ongoing at the time of the Incident. At no time did wind direction flow from the storage site over the boundary of the construction site. Likewise, all readings for chemical agent vapors were negative. The winds are monitored and recorded in real-time from meteorological sensors around the Depot and construction site when operations are in progress. There was no need for chemical agent decontamination. Although the cause is not yet known, the source was definitely not the Depot's chemical weapons stockpile. Depot mobile air monitoring labs monitored the storage area; the area between the workmen and the storage area; and the building's interior and exterior. All readings have been negative.
RDC	Our first assessment was that incident victims were suffering from a respiratory irritant, showed no signs of skin or appreciable eye irritation, and no signs of visible contamination. Had the agent been involved there would have been other symptoms. Therefore, there was no perceived need to conduct any special decontamination process(es) prior to victim transport to the hospital facility. In the case of a chemical agent contamination, (at this time) it is the responsibility of the UMCD to conduct personnel decontamination.
4. Medical Transportation: **(Bullet 1) Does Raytheon have a procedure/protocol on how injured/sick workers are to be transported off of the UMCD grounds? If yes, were they followed?**	
UMCD	This is also a Raytheon question. However, the UMCD clinic may aid the Raytheon clinic per the MOU noted previously. The Depot clinic's mission will ALWAYS take care of chemical casualties (i.e. from surety chemical material) and arrange for transport of such patients to higher levels of care. **Lessons Learned:** One deficiency made in the event was that there is not a plan or MOA between RDC and UMCD for additional evacuation support (i.e. UMCD bus) for a mass casualty situation. RDC has recognized this and has one dedicated 19-passenger van and two additional vans in close proximity for patient evacuation. This is in addition to the RDC ambulance that has been on station since construction started.
RDC	
UM-PL-013, Medical Implementation Plan, Volume 1, Revision 1	**(Appendix B. ACCIDENT, INJURY, OR ILLNESS)** "3.3 Once the injured person is stable, transport him/her to the appropriate medical facility." "4.0 **OUTSIDE AMBULANCE SERVICE** 4.1 In the event an outside ambulance must be summoned, call "9-911" for Hermiston Ambulance. Advise the main gate (9-564-5217) of the situation so that an escort can be set up upon their arrival. **5.0 Multiple Injuries/Illnesses** In the event there are multiple injuries and/or illnesses, off site ambulances shall be called immediately to augment ambulance personnel. This decision shall be made by the first medical person on scene."
UM-PL-014, Emergency Response Plan, Volume 1, Revision 2	**(Section 6.3, UMCDF EMERGENCY MEDICAL TECHNICIAN STAFF)** "The EMTs will hold a current State of Oregon EMT's Certification. Their duties and responsibilities are as follows. . . Evaluate injured and ill employees and determine the need for off site transportation and/or treatment. Ensure that UMCD Security is made aware of the off site ambulance being called and request that an escort be

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stationed at the southeast gate to esc.. the ambulance to the patient's location."

(Section 8.0, ONSITE AMBULANCE SERVICE)
"8.1.1 Raytheon shall maintain and operate a fully equipped ambulance for emergency response only. In the event of multiple injuries, Raytheon has a mutual aid agreement with the Hermiston Fire Department to augment the need for transport of additional personnel."

(Bullet 2) Do the above procedures take into consideration chemical vs. traumatic injuries?

RDC

Yes. In addition to the above procedures, chemical versus traumatic injuries would be considered as part of the triage process, which are enumerated in the Paramedic/EMT protocols, discussed in the response to question #1.

5. Medical Screening of Workers:

(Bullet 1) Are there procedures in place on how to screen all employees leaving the work site?

UMCD

Government employees who work for UMCD, PMCSD, SAIC and the Corps of Engineers receive training in First Aid, CPR, chemical surety, hazardous communications, and hazardous waste operations and emergency response. RDC and DEQ representatives who have offices at the UMCDF are required to attend a chemical safety, surety, and security orientation conducted by the UMCD surety office. They are taught how to identify chemical agent symptoms in themselves and others. Individuals who have been in an area that is contaminated, or are showing two or more signs and symptoms, are immediately taken to the Depot clinic for evaluation and/or treatment. Nerve agent symptoms are immediate, so it is highly unlikely that anyone would be evacuated who had been exposed.

RDC

The initial assessment of employee symptoms was made at the construction site infirmary by EMT/Paramedics. Employees displaying the most acute symptoms were transported to the hospital immediately. Other affected personnel were assessed and sent to the hospital depending on symptoms displayed. UMCD would request support from off-site, as needed.

(Bullet 2) Were all employees assembled and screened before they were allowed to leave the site?

RDC

All affected/exposed employees were triaged at the infirmary prior to their transport for additional medical assistance. All employees were screened prior to leaving the site. No employees were exposed to chemical agent.

(Bullet 3) What is the process to ensure that all employees are accounted for during an emergency? Is the process documented and are employees trained?

RDC

UM-SU-001, Site Evacuation, Revision 0

(Section 10.0, ACCOUNTABILITY)
"6.5.1 All UMCDF personnel will be provided with a card that bears that individual's name and a color code to indicate category of employee. These cards will be worn behind the Depot badge at all times. If this card is lost or left at home, notify the SC Surety Manager for a permanent or temporary replacement.
6.5.2 Upon arrival at the designated assembly area in A-block, these cards will be placed in the drop box located on "I" street. Since RDC has one assembly area the SC Surety Manager will gather these cards and take them to the command post located on Pier 2 and report to the point posted with the respective group identification number.
6.5.3 Personnel going on long term medical, temporary duly, family leave, vacation, etc., in excess of 3 days, will turn their card in to the SC Surety Manager prior to departure. The SC Surety Manager will process these cards in accordance with section 6.5.4. This will facilitate the accountability process for this category of employee.
6.5.4 The evacuation cards will be compared with the current Roster of Personnel furnished by the Human Resources (HR) Manager to assure accountability of all personnel. The SC Surety Manager will take a copy of the

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current roster, cards that have been turned in, and cards/lists from the drop box to Pier 2. Managers and/or supervisors are responsible to notify the Pier 2 command post of personnel who are absent from the workplace for unforeseen reasons or for 3 days or less. This may be accomplished by listing the individual's name(s) and placing the list in the drop box.
NOTE: This is an exception to section 6.5.3.
6.5.5 Personnel traveling in carpools, with drivers having assembly area other than "I" street, will deposit their accountability cards in the drop box in the assembly area of the driver. Accountability will be resolved at the Pier 2 command post.
6.5.6 Visitors, vendors, and sub-contractors will be provided with a temporary evacuation card (Figure 3) by the RDC point of contact. Temporary cards are available from the SC Surety Manager. These cards will be collected and discarded upon departure of the visitor. If an emergency occurs and the visitor will not return, the temporary card will be discarded after the emergency has been terminated and accountability reconciled. The point of contact or escort of the visitor will assure that the visitor evacuates via the appropriate route. Visitors who have been issued Depot badges will comply with the directions in this procedure.
6.5.7 Cards will be returned to the SC Surety Manager at the evacuation assembly point and returned to the employees as soon as possible by the SC Surety Manager."

(Section 6.6, TRAINING)
"6.6.1 All SC personnel will be trained on the requirements contained in this procedure. This training will be recorded and maintained on file for the effective period of this procedure."
6.6.2 Changes to this procedure will be communicated through the management structure to all employees to keep them informed of new or changed procedures.

PSP 02.03, Site Evacuation Plan, Revision 3

(Section 10.0, ACCOUNTABILITY)
"10.1 All Raytheon personnel will receive an accountability card. It must be worn behind their project badge. When they reach their assembly area, in "A" block they are to drop evacuation I.D. card only, not their regular badge, in the drop box and proceed to the end of the road or behind the next vehicle ahead of them and wait for further instructions. Once traffic has stopped and it appears all personnel are at the assembly area, the general foreman and job stewards will gather up the I.D. cards and take them to P-2 and report to the areas posted with their respective number. The I.D. cards will be compared with the employee master lists to insure everyone is accounted for. . ."

(Section 13.0, TRAINING)
"All Raytheon personnel will be trained on the element of this plan prior to it being implemented. This plan will also become part of the new hire orientation."

PSP 02.07, Office Building Evacuation and Accountability, Revision 1

(Entire Procedure)
"This procedure is to provide accurate accountability for Raytheon Cost Plus Award Fee (CPAF) and Firm Fixed Price (FFP) non-manual employees at the Umatilla Chemical Agent Disposal Facility (UMCDF)..." (6 pages)

UMCDF Startup Checklist (Surrogate Operations)

Revision 1 (March 31, 2000)

PERMITTING DOCUMENTATION/PERMIT COMPLIANCE

1. UMCD Storage Permit approved, issued and implemented.
2. UMCDF Class 3 Storage Permit Modification Request approved and implemented.
3. UMCDF Dunnage Incinerator Permit Modification Request submitted and approved.
4. Final decision issued on Class 3 UMCDF Compliance Schedule Permit Modification Request, and if approved, all required provisions implemented.
5. UMCDF HW Permit and RCRA Part B Application current and approved. All information, attachments and documentation will be revised and updated, and will include valid PE stamps where required.
6. All required surrogate trial burn plans submitted (at least 180 days prior) and approved.
7. UMCD/UMCDF in compliance with all HW Permit Conditions and other Department requirements.
8. 40 CFR 264 Subparts AA/BB/CC requirements incorporated into the HW Permit and Application, as well as the UMCDF design and operational configuration.
9. Revisions to OAR 340-101 and 340-102 to address the appropriate application of the Oregon state-only waste codes F998/F999 and P998/P999 have been promulgated and corresponding changes properly incorporated into the HW Permit and RCRA Part B Permit Application.
10. UMCDF Perimeter Monitoring Network for CMP Baseline air monitoring activated at least 1 calendar year prior.
11. UMCDF Independent Oversight Program structure and implementation acceptable to the Department.
12. All required tank and tank system, including primary containment sumps, certifications submitted to the Department.
13. Information demonstrating that the planned surrogate materials are "non-ignitable" submitted (at least 6 months prior) and approved by the Department.
14. All required miscellaneous treatment unit certifications submitted to the Department.
15. At least eight CMP sampling events completed and resulting data included in the CMP baseline dataset.
16. Remote UMCDF monitoring station(s) installed and operational per Department request.
17. UMCD/UMCDF standard operating procedure related to operational limitations during adverse weather conditions submitted at least 180 days prior.
18. Treatment and disposal options, including sampling and analytical requirements, identified and implemented for ALL expected UMCDF secondary waste streams.
19. BRA limited stack test plan submitted to the Department (90 days prior to the test) and approved. *This <u>may</u> not be necessary prior to start of surrogate operations, depending on the timing of the test.*

EMERGENCY RESPONSE READINESS

20. CSEPP readiness approval received from the Oregon Governor's office.

FACILITY CONSTRUCTION/SYSTEMIZATION/OPERATIONS

21. All required Facility Construction Certification (FCC) packages submitted and approved.
22. UMCDF construction complete, facility turned over to operations and maintenance, and all systemization activities successfully completed, including preparation of necessary operational and maintenance procedures.
23. Unlined carbon steel duplex strainers removed from PAS's and replaced by new dual simplex strainer design. This includes the submittal and approval of a Permit Modification Request to reflect the change.
24. UMCDF waste/munitions tracking procedure and system developed, approved and implemented.
25. Pollution Abatement System carbon filter system (PFS) and upstream sampling/monitoring system installed and operational.
26. All necessary waste management processes and contracts implemented to manage all waste streams generated during surrogate operations.

MISCELLANEOUS ISSUES

27. Appropriate Department personnel approved for unescorted access to UMCDF.
28. Post-Trial Burn Risk Assessment Protocol completed and issued by the Department.
29. UMCD/UMCDF in compliance with approved/issued Air Quality Permit and all applicable MACT and air quality regulations. All outstanding air quality issues resolved to Department's satisfaction.
30. UMCD/UMCDF in compliance with all applicable water quality regulations. All outstanding water quality issues resolved to Department's satisfaction.
31. Department Public Outreach efforts completed.

Permittees' Reply

Agency Team Recommendations

- Raytheon - Mr. Sharp
  - Worker communication program
  - Medical clinic MOA
  - Good Shepherd Community Hospital MOA
  - Hermiston Fire Department MOA

Permittees' Reply

Agency Team Recommendations

- Recent practical experience
- May 10, 2000 CSEPP/CAIRA exercise
- Readiness training continues

Department of Environmental Quality

Memo

To: Environmental Quality Commission

From: Wayne C. Thomas, Administrator, Chemical Demilitarization Program

CC: Langdon Marsh, Director, Larry Knudsen, EQC Counsel, Sue Oliver, Senior Hazardous Waste Specialist

Date: May 18, 2000

Re: Item K: "Permit Revocation Request Related to the Umatilla Chemical Agent Disposal Facility"

Commissioners:

The official agenda for the May Environmental Quality Commission (EQC) meeting on May 18, 2000 does not include a break down of the schedule for Item K: Permit Revocation Request related to the Umatilla Chemical Agent Disposal facility. The agenda presented below describes the activities scheduled for Item K on May 18, 2000.

9:30 – 9:40	Department Staff Introduction/briefing on legal requirements by DOJ
9:40 – 10:30	Oral Testimony by Petitioners
10:30 – 10:40	Break
10:40 – 11:30	Oral Testimony by Permittees
11:30 – 12:00	Public Comment
12:00 – 1:00	Lunch Break
1:00 – 2:30	Presentation of Staff Report by Department
2:30 – 2:40	Break
2:40 – 4:15	Discussion, questions, and action by Commission