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Part II

Environmental Protection Agency

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40 CFR Parts 50, 53, and 58

Primary National Ambient Air Quality Standard for Sulfur Dioxide; Final

Rule

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and Regulations

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SUMMARY: Based on its review of the air quality criteria for oxides of

sulfur and the primary national ambient air quality standard (NAAQS)

for oxides of sulfur as measured by sulfur dioxide (SO2),

EPA is revising the primary SO2 NAAQS to provide requisite

protection of public health with an adequate margin of safety.

Specifically, EPA is establishing a new 1-hour SO2 standard

at a level of 75 parts per billion (ppb), based on the 3-year average

of the annual 99th percentile of 1-hour daily maximum concentrations.

The EPA is also revoking both the existing 24-hour and annual primary

SO2 standards.

DATES: This final rule is effective on August 23, 2010.

I. Background

A. Summary of Revisions to the SO2 Primary NAAQS

EPA is replacing the current 24-hour and

annual standards with a new short-term standard based on the 3-year

average of the 99th percentile of the yearly distribution of 1-hour

daily maximum SO2 concentrations. EPA is setting the level

of this new standard at 75 ppb. EPA is adding data handling conventions

for SO2 by adding provisions for this new 1-hour primary

standard. EPA is also establishing requirements for an SO2

monitoring network. These new provisions require monitors in areas

where there is an increased coincidence of population and

SO2 emissions. EPA is also making conforming changes to the

Air Quality Index (AQI).

B. Statutory Requirements

Section 109(a) of the Act directs the Administrator to promulgate

``primary'' and ``secondary'' NAAQS for pollutants for which air

quality criteria have been issued. Section 109(b)(1) defines a primary

standard as one ``the attainment and maintenance of which in the

judgment of the Administrator, based on [the air quality] criteria and

allowing an adequate margin of safety, are requisite to protect the

public health.'' \1\ Section 109(b)(1). A secondary standard, in turn,

must ``specify a level of air quality the attainment and maintenance of

which, in the judgment of the Administrator, based on [the air quality]

criteria, is requisite to protect the public welfare from any known or

anticipated adverse effects associated with the presence of such

pollutant in the ambient air.'' \2\ Section 109(b)(2) This rule

concerns exclusively the primary NAAQS for oxides of sulfur.

\1\ The legislative history of section 109 indicates that a

primary standard is to be set at ``the maximum permissible ambient

air level \* \* \* which will protect the health of any [sensitive]

group of the population,'' and that for this purpose ``reference

should be made to a representative sample of persons comprising the

sensitive group rather than to a single person in such a group.'' S.

Rep. No. 91-1196, 91st Cong., 2d Sess. 10 (1970). See also American

Lung Ass'n v. EPA, 134 F. 3d 388, 389 (DC Cir. 1998) (``NAAQS must

protect not only average healthy individuals, but also `sensitive

citizens'--children, for example, or people with asthma, emphysema,

or other conditions rendering them particularly vulnerable to air

pollution. If a pollutant adversely affects the health of these

sensitive individuals, EPA must strengthen the entire national

standard.'');

The requirement that primary standards include an adequate margin

of safety is intended to address uncertainties associated with

inconclusive scientific and technical information available at the time

of standard setting. It is also intended to provide a reasonable degree

of protection against hazards that research has not yet identified.

Lead Industries Association v. EPA, 647 F.2d 1130, 1154 (DC Cir 1980),

cert. denied, 449 U.S. 1042 (1980); American Petroleum Institute v.

Costle, 665 F.2d 1176, 1186 (DC Cir. 1981), cert. denied, 455 U.S. 1034

(1982). Both kinds of uncertainties are components of the risk

associated with pollution at levels below those at which human health

effects can be said to occur with reasonable scientific certainty.

Thus, in selecting primary standards that include an adequate margin of

safety, the Administrator is seeking not only to prevent pollution

levels that have been demonstrated to be harmful but also to prevent

lower pollutant levels that may pose an unacceptable risk of harm, even

if the risk is not precisely identified as to nature or degree. The CAA

does not require the Administrator to establish a primary NAAQS at a

zero-risk level or at background concentration levels, see Lead

Industries Association v. EPA, 647 F.2d at 1156 n. 51, but rather at a

level that reduces risk sufficiently so as to protect public health

with an adequate margin of safety.

In addressing the requirement for a margin of safety, EPA considers

such factors as the nature and severity of the health effects involved,

the size of the at-risk population(s), and the kind and degree of the

uncertainties that must be addressed. The selection of any particular

approach to providing an adequate margin of safety is a policy choice

left specifically to the Administrator's judgment. Lead Industries

Association v. EPA, 647 F.2d at 1161-62.

In setting standards that are ``requisite'' to protect public

health and welfare, as provided in section 109(b), EPA's task is to

establish standards that are neither more nor less stringent than

necessary for these purposes. In so doing, EPA may not consider the

costs of implementing the standards. Whitman v. American Trucking

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C. Related SO2 Control Programs

States are primarily responsible for ensuring attainment and

maintenance of ambient air quality standards once EPA has established

them. Under section 110 of the Act, and related provisions, States are

to submit, for EPA approval, State implementation plans (SIPs) that

provide for the attainment and maintenance of such standards through

control programs directed to sources of the pollutants involved.

As noted in that

plan, SOX includes multiple gaseous (e.g., SO3)

and particulate (e.g., sulfate) species. Because the health effects

associated with particulate species of SOX have been

considered within the context of the health effects of ambient

particles in the Agency's review of the NAAQS for particulate matter

(PM), the current review of the primary SO2 NAAQS is focused

on the gaseous species of SOX and does not consider health

effects directly associated with particulate species

E. Summary of Proposed Revisions to the SO2 Primary NAAQS

For the reasons discussed in the preamble of the proposal for the

SO2 primary NAAQS, EPA proposed to make revisions to the

primary SO2 NAAQS (and to add SO2 data handling

conventions) so the standards provide requisite protection of public

health with an adequate margin of safety. Specifically, EPA proposed to

replace the current 24-hour and annual standards with a new short-term

SO2 standard. EPA proposed that this new short-term standard

would be based on the 3-year average of the 99th percentile (or 4th

highest) of the yearly distribution of 1-hour daily maximum

SO2 concentrations. EPA proposed to set the level of this

new 1-hour standard within the range of 50 to 100 ppb and solicited

comment on standard levels as high as 150 ppb. EPA also proposed to

establish requirements for an SO2 monitoring network at

locations where maximum SO2 concentrations are expected to

occur and to add a new Federal Reference Method (FRM) for measuring

SO2 in the ambient air. Finally, EPA proposed to make

corresponding changes to the Air Quality Index for SO2.

II. Rationale for Decisions on the Primary Standards

This section presents the rationale for the Administrator's

decision to revise the existing SO2 primary standards by

replacing the current 24-hour and annual standards with a new 1-hour

SO2 standard at a level of 75 ppb, based on the 3-year

average of the annual 99th percentile of 1-hour daily maximum

concentrations. As discussed more fully below, this rationale takes

into account: (1) Judgments and conclusions presented in the ISA and

the REA; (2) CASAC advice and recommendations as reflected in the CASAC

panel's discussions of drafts of the ISA and REA at public meetings, in

separate written comments, and in letters to the Administrator

(Henderson 2008a; Henderson 2008b; Samet, 2009); (3) public comments

received at CASAC meetings during the development of the ISA and the

REA; and (4) public comments received on the notice of proposed

rulemaking.

A. Characterization of SO2 Air Quality

1. Anthropogenic Sources and Current Patterns of SO2 Air

Quality

Anthropogenic SO2 emissions originate chiefly from point

sources, with fossil fuel combustion at electric utilities (~66%) and

other industrial facilities (~29%) accounting for the majority of total

emissions (ISA, section 2.1). Other anthropogenic sources of

SO2 include both the extraction of metal from ore as well as

the burning of high sulfur-containing fuels by locomotives, large

ships, and equipment utilizing diesel engines. SO2 emissions

and ambient concentrations follow a strong east to west gradient due to

the large numbers of coal-fired electric generating units in the Ohio

River Valley and upper Southeast regions. In the 12 Consolidated

Metropolitan Statistical Areas (CMSAs) that had at least four

SO2 regulatory monitors from 2003-2005, 24-hour average

concentrations in the continental U.S. ranged from a reported low of ~1

ppb in Riverside, CA and San Francisco, CA to a high of ~12 ppb in

Pittsburgh, PA and Steubenville, OH (ISA, section 2.5.1). In addition,

outside or inside all CMSAs from 2003-2005, the annual average

SO2 concentration was 4 ppb (ISA, Table 2-8). However,

spikes in hourly concentrations occurred. The mean 1-hour maximum

concentration outside or inside CMSAs was 13 ppb, with a maximum value

of greater than 600 ppb outside CMSAs and greater than 700 ppb inside

CMSAs (ISA, Table 2-8).

Temporal and spatial patterns of 5-minute peaks of SO2

are also important given that controlled human exposure studies have

demonstrated that exposure to these peaks can result in adverse

respiratory effects in exercising asthmatics (see section II.B below).

2. SO2 Monitoring

Although EPA established the SO2 standards in 1971,

uniform minimum monitoring network requirements for SO2

monitoring were only adopted in May 1979. From the time of the

implementation of the 1979 monitoring rule through 2008, the

SO2 monitoring network has steadily decreased in size from

approximately 1496 sites in 1980 to the approximately 488 sites

operating in 2008. At present, except for SO2 monitoring

required at National Core Monitoring Stations (NCore stations), there

are no minimum monitoring requirements for SO2 in 40 CFR

part 58 Appendix D, other than a requirement for EPA Regional

Administrator approval before removing any existing monitors and a

requirement that any ongoing SO2 monitoring must have at

least one monitor sited to measure the maximum concentration of

SO2 in that area. EPA removed the specific minimum

monitoring requirements for SO2 in the 2006 monitoring rule

revisions, except for monitoring at NCore stations, based on the fact

that there were no SO2 nonattainment areas at that time,

coupled with trends showing an increasing gap between national average

SO2 concentrations and the current 24-hour and annual

standards. The rule was also intended to provide State, local, and

Tribal air monitoring agencies flexibility in meeting perceived higher

priority monitoring needs for other pollutants, or to implement the new

multi-pollutant sites (NCore network) required by the 2006 rule

revisions (71 FR 61236, (October 6, 2006)). More information on

SO2 monitoring can be found in section IV.

1. Short-Term (5-minute to 24-hour) SO2 Exposure and

Respiratory Morbidity Effects

The ISA examined numerous controlled human exposure studies and

found that moderate or greater decrements in lung function (i.e.,

[gteqt] 15% decline in Forced Expiratory Volume (FEV1) and/

or [gteqt] 100% increase in specific airway resistance (sRaw)) occur in

some exercising asthmatics exposed to SO2 concentrations as

low as 200-300 ppb for 5-10 minutes. The ISA also found that among

asthmatics, both the percentage of individuals affected, and the

severity of the response increased with increasing SO2

concentrations. That is, at 5-10 minute concentrations ranging from

200-300 ppb, the lowest levels tested in free breathing chamber

studies, approximately 5-30% percent of exercising asthmatics

experienced moderate or greater decrements in lung function (ISA, Table

3-1). At concentrations of 400-600 ppb, moderate or greater decrements

in lung function occurred in approximately 20-60% of exercising

asthmatics, and compared to exposures at 200-300 ppb, a larger

percentage of asthmatics experienced severe decrements in lung function

(i.e., [gteqt] 20% decrease in FEV1 and/or [gteqt] 200%

increase in sRaw; ISA, Table 3-1). Moreover, at SO2

concentrations [gteqt] 400 ppb (5-10 minute exposures), moderate or

greater decrements in lung function were often statistically

significant at the group mean level and frequently accompanied by

respiratory symptoms. Id.

The immediate effect of SO2 on the

respiratory system is bronchoconstriction. This response is mediated by

chemosensitive receptors in the tracheobronchial tree. Activation of

these receptors triggers central nervous system reflexes that result in

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bronchoconstriction and respiratory symptoms that are often followed by

rapid shallow breathing (id). The ISA noted that asthmatics are likely

more sensitive to the respiratory effects of SO2 due to pre-

existing inflammation associated with the disease. For example, pre-

existing inflammation may lead to enhanced release of inflammatory

mediators, and/or enhanced sensitization of the chemosensitive

receptors (id).

Taken together, the ISA concluded that the controlled human

exposure, epidemiologic, and toxicological evidence supported its

determination of a causal relationship between respiratory morbidity

and short-term (5-minutes to 24-hours) exposure to SO2.

1. Rationale for Proposed Decision

In the proposal, the Administrator initially concluded that the

current 24-hour and annual SO2 NAAQS were not adequate to

protect public health with an adequate margin of safety (see section

II.E.4, 74 FR at 64829). In reaching this conclusion, she considered

the: (1) Scientific evidence and conclusions in the ISA; (2) exposure

and risk information presented in the REA; (3) conclusions of the

policy assessment chapter of the REA; and (4) views expressed by CASAC.

These considerations are discussed in detail in the proposal (see

section II.E., 74 FR at 64826) and are summarized in this section.

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CASAC advice ``that the current 24-hour and annual

standards are not adequate to protect public health, especially in

relation to short term exposures to SO2 (5-10 minutes) by

exercising asthmatics'' (Samet, 2009, p. 15).

Based on these considerations (discussed in more detail in the

proposal, see sections II.E.1 and II.E.2), the Administrator proposed

that the current 24-hour and annual SO2 standards are not

requisite to protect public health with an adequate margin of safety

against adverse respiratory effects associated with short-term (5-

minute to 24-hour) SO2 exposures. In considering approaches

to revising the current standards, the Administrator initially

concluded it appropriate to consider setting a new 1-hour standard. The

Administrator noted that a 1-hour standard would likely provide

increased public health protection, especially for members of at-risk

groups, from the respiratory effects described in both epidemiologic

and controlled human exposure studies.