Appendix D
Cost Analysis Summary

PGE Boardman BART Analysis - Cost Analysis

Technology: New Low NOx Burners & Modified OFA System **Date:** August 4 2010

Cost Item		**Remarks/Cost Basis**
CAPITAL COST	**2010**	
Direct Costs		
Purchased Material Costs		
Low NOx Burners and OFA Equipment	$5,452,700	S&L Engineering Estimate
Boiler Cleaning Equipment	$1,186,900	S&L Engineering Estimate
CO Monitoring and Burner Management Equipment	$2,200,000	S&L Engineering Estimate
Piping and Insulation	$70,000	S&L Engineering Estimate
Electrical Equipment	$233,700	S&L Engineering Estimate
Controls and Instrumentation	$648,000	S&L Engineering Estimate
Direct Costs - Installation Costs		
Low NOx Burners and OFA Equipment	$5,252,400	S&L Engineering Estimate
Boiler Cleaning Equipment	$513,100	S&L Engineering Estimate
CO Monitoring and Burner Management Equipment	$865,500	S&L Engineering Estimate
Piping and Insulation	$143,600	S&L Engineering Estimate
Electrical Equipment	$499,700	S&L Engineering Estimate
Controls and Instrumentation	$493,500	S&L Engineering Estimate
Demolition and Relocation	$437,000	S&L Engineering Estimate
CFD Analysis & Testing	$148,100	S&L Engineering Estimate
Other Direct and Construction Costs	$2,783,100	S&L Engineering Estimate
Spare Parts	$159,500	S&L Engineering Estimate
Total direct costs (DC)	**$ 21,086,800**	
Indirect Costs		
Engineering	In owner's cost	
Owner's cost	$4,509,970	S&L Engineering Estimate
Construction management	In owner's cost	
Start-up and spare parts	In owner's cost	
Contingencies	$2,557,329	S&L Engineering Estimate
Total indirect costs (IC)	**$7,067,299**	
Allowance for Funds Used During Construction (AFDC)	$3,101,450	S&L Engineering Estimate
Property Taxes	$329,529	S&L Engineering Estimate
Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)	**$31,585,078**	
ANNUAL COST		
Direct Annual Costs		
Fixed annual costs		
Maintenance labor and materials	$695,000	S&L Engineering Estimate
Total fixed annual costs	$695,000	
Variable annual costs		
N/A	$0	No associated annual cost
Total variable annual costs	$0	
Total direct annual costs (DAC)	$695,000	
Indirect Annual Costs		
Cost for capital recovery	$4,662,895	(TCI) X 14.76% CRF at 7.0% interest based on 9.5 year life
Total indirect annual costs (IDAC)	$4,662,895	
Total Annual Cost (TAC) = (DAC) + (IDAC)	$5,357,895	
Rounded TAC	**$5,358,000**	

PGE Boardman BART Analysis - Cost Analysis

Technology: Selective Non-Catalytic Reduction (SNCR) **Date:** August 10 2010

Cost Item	$	Remarks/Cost Basis
CAPITAL COST	**2010 dollars**	
Direct Costs		
Purchased equipment costs		
Concrete	$2,300	S&L Engineering Estimate
Steel	$16,300	S&L Engineering Estimate
Mechanical Equipment	$2,267,500	S&L Engineering Estimate
Piping and Insulation	$126,900	S&L Engineering Estimate
Electrical Equipment	$162,400	S&L Engineering Estimate
Controls and Instrumentation	$60,000	S&L Engineering Estimate
Total PEC	$2,635,400	
Direct installation costs		
Concrete	$6,900	S&L Engineering Estimate
Steel	$40,900	S&L Engineering Estimate
Mechanical Equipment	$1,960,100	S&L Engineering Estimate
Piping and Insulation	$776,200	S&L Engineering Estimate
Electrical Equipment	$246,300	S&L Engineering Estimate
Controls and Instrumentation	$22,400	S&L Engineering Estimate
Demolition and Relocation	$54,600	S&L Engineering Estimate
Civil Work	$365,500	S&L Engineering Estimate
Other Direct and Construction Costs	$1,268,900	S&L Engineering Estimate
Total direct installation costs (DIC)	$4,741,800	
Total direct costs (DC) = (PEC) + (DIC)	$7,377,200	
Indirect Costs		
Engineering	$590,000	S&L Engineering Estimate
Owner's cost	$2,300,000	S&L Engineering Estimate
Construction management	$147,500	S&L Engineering Estimate
Commissioning	$73,800	S&L Engineering Estimate
Contingencies	$1,012,600	S&L Engineering Estimate
Total indirect costs (IC)	$4,123,900	
Allowance for Funds Used During Construction (AFDC)	$840,000	S&L Engineering Estimate
Property Taxes	$34,000	S&L Engineering Estimate
Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)	**$12,375,100**	
ANNUAL COST		
Direct Annual Costs		
Fixed annual costs		
Maintenance Material	$117,000	S&L Engineering Estimate
Maintenance Labor	$175,500	S&L Engineering Estimate
Total fixed annual costs	$292,500	
Variable annual costs		
Reagent	$2,974,556	S&L Engineering Estimate
Auxiliary and ID fan power	$74,500	S&L Engineering Estimate
Water	$12,300	S&L Engineering Estimate
Miscellaneous	$449,000	S&L Engineering Estimate
Total variable annual costs	$3,510,356	
Total direct annual costs (DAC)	$3,802,856	
Indirect Annual Costs		
Cost for capital recovery	$2,434,519	(TCI) X 19.67% CRF at 7% interest based on 6.5 year life
Total indirect annual costs (IDAC)	$2,434,519	
Total Annual Cost (TAC) = (DAC) + (IDAC)	$6,237,375	
Rounded TAC	**$6,237,000**	

PGE Boardman BART Analysis - Cost Analysis

Technology: New Low NOx Burners & Modified OFA System & SNCR **Date:** August 4 2010

Cost Item	$	Remarks/Cost Basis
CAPITAL COST		
Total Capital Investment (TCI) cost for:		
New Low NOx Burners & Modified OFA System	$31,585,078	B&V Cost estimate for independent system
Selective Non-Catalytic Reduction System	$12,375,100	B&V Cost estimate for independent system
Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)	**$43,960,178**	
ANNUAL COST		
Direct Annual Costs		
Fixed annual costs		
Maintenance labor and materials	$987,500	
Total fixed annual costs	$987,500	
Variable annual costs		
Reagent	$2,974,556	
Auxiliary and ID fan power	$74,500	
Water	$12,300	
Miscellaneous	$449,000	
Total variable annual costs	$3,510,356	
Total direct annual costs (DAC)	**$4,497,856**	
Indirect Annual Costs		
Cost for capital recovery (NLNB/MOFA)	$4,662,895	(TCI) X 14.76% CRF at 7% interest based on 9.5 year life
Cost for capital recovery (SNCR)	$2,434,519	(TCI) X 19.67% CRF at 7% interest based on 6.5 year life
Total indirect annual costs (IDAC)	$7,097,414	
Total Annual Cost (TAC) = (DAC) + (IDAC)	$11,595,270	
	$11,595,000	

PGE Boardman BART Analysis - Cost Analysis

Technology: Selective Catalytic Reduction (SCR) **Date:** August 4 2010

Cost Item	$	Remarks/Cost Basis
CAPITAL COST	**2010**	
Direct Costs		
Purchased equipment costs		
SCR Ductwork	$4,129,900	S&L Engineering Estimate
SCR Reactor	$5,953,100	S&L Engineering Estimate
SCR Catalyst	$5,473,000	S&L Engineering Estimate
SCR Structure	$5,012,500	S&L Engineering Estimate
Foundations	$1,070,000	S&L Engineering Estimate
Anhydrous Ammonia System	$1,590,800	S&L Engineering Estimate
Electrical Equipment	$1,114,300	S&L Engineering Estimate
Controls and Instrumentation	$820,000	S&L Engineering Estimate
	$25,163,600	
Total purchased equipment cost (PEC)	$25,163,600	
Direct installation costs		
SCR Ductwork	$ 7,194,800	S&L Engineering Estimate
SCR Reactor	$ 11,270,000	S&L Engineering Estimate
SCR Catalyst	$ 1,915,500	S&L Engineering Estimate
SCR Structure	$ 11,053,800	S&L Engineering Estimate
Foundations	$ 2,549,200	S&L Engineering Estimate
Anhydrous Ammonia System	$ 1,459,300	S&L Engineering Estimate
Electrical Equipment	$ 1,123,100	S&L Engineering Estimate
Controls and Instrumentation	$ 392,700	S&L Engineering Estimate
PDC Building	$ 400,300	S&L Engineering Estimate
Boiler Modifications	$ 15,631,600	S&L Engineering Estimate
Total direct installation costs (DIC)	$52,990,300	
Demolition and Relocation	$ 936,700	S&L Engineering Estimate
Other Direct and Construction Costs	$ 20,674,500	S&L Engineering Estimate
Spare Parts	$ 173,400	S&L Engineering Estimate
Freight, Duties, Etc.		
Total direct costs (DC) = (PEC) + (DIC)	$99,938,500	
Indirect Costs		
Engineering	$ 6,712,500	S&L Engineering Estimate
Owner's Costs	$ 19,469,880	S&L Engineering Estimate
Construction Management	$ 4,535,200	S&L Engineering Estimate
Commissioning	$ 2,229,800	S&L Engineering Estimate
Contingency	$ 11,101,800	S&L Engineering Estimate
Total indirect costs (IC)	$44,049,180	
Allowance for Funds Used During Construction (AFDC)	$ 42,351,736	S&L Engineering Estimate
Property Taxes	$ 5,726,665	S&L Engineering Estimate
Total SCR Capital Investment (TCI)	**$192,066,081**	
ANNUAL COST		
Direct Annual Costs		
Fixed annual costs		
Maintenance Material	$ 161,000	S&L Engineering Estimate
Maintenance Labor	$ 241,500	S&L Engineering Estimate
Total fixed annual costs	**$402,500**	
Variable annual costs		
Reagent	$ 1,220,400	S&L Engineering Estimate
Catalyst replacement	$ 1,264,000	S&L Engineering Estimate
Steam	$ 625,500	S&L Engineering Estimate
Auxilliary Power	$ 1,556,200	S&L Engineering Estimate
Total variable annual costs	**$ 4,666,100**	
Total direct annual costs (DAC)	**$5,068,600**	
Indirect Annual Costs		
Cost for capital recovery	$63,762,406	(TCI) X 33.20% CRF at 7% interest based on 3.5 year life
Total indirect annual costs (IDAC)	$63,762,406	
Total Annual Cost (TAC) = (DAC) + (IDAC)	$68,831,006	
Rounded TAC	**$68,831,000**	

PGE Boardman BART Analysis - Cost Analysis

Technology: New Low NOx Burners & Modified OFA System & SCR **Date:** August 4 2010

Cost Item	$	Remarks/Cost Basis
CAPITAL COST	**2010 dollars**	
Total Capital Investment (TCI) cost for:		
New Low NOx Burners & Modified OFA System	$31,585,078	Cost estimate for independent system
Selective Catalytic Reduction System	$192,066,081	Cost estimate for independent system
Total Capital Investment (TCI)	**$223,651,159**	
ANNUAL COST		
Direct Annual Costs		
Fixed annual costs		
Maintenance labor and materials	$1,097,500	Combined cost from multiple systems
Total Fixed Annual Costs	$ 1,097,500	
Variable annual costs		
Reagent	$1,220,400	Comined cost from multiple systems
Auxiliary and ID fan power	$1,264,000	Comined cost from multiple systems
Water	$625,500	Comined cost from multiple systems
Miscellaneous	$1,556,200	Comined cost from multiple systems
Total variable annual costs	$4,666,100	
Total direct annual costs (DAC)	**$5,763,600**	
Indirect Annual Costs		
Cost for capital recovery (NLNB/MOFA)	$4,662,895	(TCI) X 14.76% CRF at 7% interest based on 9.5 year life
Cost for capital recovery (SCR)	$63,762,406	(TCI) X 33.20% CRF at 7% interest based on 3.5 year life
Total indirect annual costs (IDAC)	$68,425,301	
Total Annual Cost (TAC) = (DAC) + (IDAC)	$74,188,901	
Rounded TAC	**$74,189,000**	

PGE Boardman BART Analysis - Cost Analysis

Technology: Wet Flue Gas Desulfurization (FGD) with Fabric Filter **Date:** August 4 2010

Cost Item	$	Remarks/Cost Basis
CAPITAL COST		
Direct Costs	**2010 dollars**	
Purchased equipment costs		
Reagent feed system: receiving, storage	$1,548,000	CUECost estimate
Ball mill & classifier	$2,354,000	CUECost estimate
SO2 removal system: tanks, pumps	$4,212,000	CUECost estimate
Absorber tower	$33,008,000	CUECost estimate
Spray pumps	$4,936,000	CUECost estimate
Byproduct handling system	$1,898,000	CUECost estimate
Vacuum filter system	$1,803,000	from ref. cost
Fabric filter with ash handling system	$18,058,000	from ref. cost
Booster fans	$5,289,000	B&V Engineering estimate
Electrical system upgrades	$4,639,000	from ref. cost
Flue gas handling system	$9,616,000	B&V Engineering estimate
Subtotal capital cost (CC)	$87,361,000	
Instrumentation and controls	$4,368,000	(CC) X 5.0%
Freight	$4,368,000	(CC) X 5.0%
Total purchased equipment cost (PEC)	$96,097,000	
Direct installation costs		
Foundation & supports	$26,427,000	(PEC) X 27.5%
Handling & erection	$38,439,000	(PEC) X 40.0%
Electrical	$19,219,000	(PEC) X 20.0%
Piping	$4,805,000	(PEC) X 5.0%
Insulation	$4,805,000	(PEC) X 5.0%
Painting	$961,000	(PEC) X 1.0%
Demolition	$3,844,000	(PEC) X 4.00%
Relocation	$3,844,000	(PEC) X 4.00%
Total direct installation costs (DIC)	$102,344,000	
Site preparation	$219,000	B&V Engineering estimate
Buildings	$8,195,000	B&V Engineering estimate
New wet stack	$25,133,000	Recent quotes estimate of $23 mil
Waste water treatment system	$16,391,000	B&V Engineering estimate
Total direct costs (DC) = (PEC) + (DIC)	$248,379,000	
Indirect Costs		
Engineering	$29,805,000	(DC) X 12.0%
Owner's cost	$9,935,000	(DC) X 4.0%
Construction management	$24,838,000	(DC) X 10.0%
Start-up and spare parts	$3,726,000	(DC) X 1.5%
Performance test	$219,000	B&V Engineering estimate
Contingencies	$37,257,000	(DC) X 15.0%
Total indirect costs (IC)	$105,780,000	
Allowance for Funds Used During Construction (AFDC)	$63,678,000	[(DC)+(IC)] 8.99% 4 years (project length / 2)
Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)	**$417,837,000**	
ANNUAL COST		
Direct Annual Costs		
Fixed annual costs		
Operating labor	$437,000	4 FTE and 100,000 $/year Estimated labor
Maintenance labor and materials	$7,451,000	(DC) X 3.0%
Total fixed annual costs	$7,888,000	
Variable annual costs		
Reagent	$2,427,000	6.484 tph and 46 $/ton Mass bal. calcs.
Byproduct disposal	$970,000	11.9 tph and 10 $/ton Mass bal. calcs.
Auxiliary and ID fan power	$6,347,000	16811 kW and 0.046 $/kWh CueCost calcs
Water	$640,000	655.7 gpm and 2 $/1,000 gal Mass bal. calcs.
Bag replacement cost	$691,000	6,322 bags and 100 $/bag 18,966 total bags
Cage replacement cost	$173,000	3,161 cages and 50 $/cage 18,966 total cages
Total variable annual costs	$11,248,000	
Total direct annual costs (DAC)	**$19,136,000**	
Indirect Annual Costs		
Cost for capital recovery	$82,200,000	(TCI) X 19.67% CRF at 7% interest
Total indirect annual costs (IDAC)	$82,200,000	based on 6.5 year life
Total Annual Cost (TAC) = (DAC) + (IDAC)	**$101,336,000**	
Alternate Case _ Wet FGD w/ 5.5 year life		
Indirect Annual Costs		
Cost for capital recovery	$94,129,000	(TCI) X 22.53% CRF at 7% interest
Total indirect annual costs (IDAC)	$94,129,000	based on 5.5 year life
Total Annual Cost (TAC) = (DAC) + (IDAC)	**$113,265,000**	

PGE Boardman BART Analysis - Cost Analysis

Technology: Semi-Dry Flue Gas Desulfurization (FGD) **Date:** August 4 2010

Cost Item	$	Remarks/Cost Basis
CAPITAL COST		
Direct Costs	**2010**	
Purchased equipment costs		
Dry FGD Mechanical Equipment	$31,299,500	S&L Engineering Estimate
Reagent Handling System Equipment	$834,500	S&L Engineering Estimate
Foundations	$2,068,200	S&L Engineering Estimate
Miscellaneous Buildings	$2,054,400	S&L Engineering Estimate
Fabric Filter Mechanical Equipment	$13,396,000	S&L Engineering Estimate
Ash Recycle System Equipment	$250,000	S&L Engineering Estimate
Ash Handling System Equipment	$5,000,000	S&L Engineering Estimate
Structural Supports	$2,489,400	S&L Engineering Estimate
Ductwork	$5,996,600	S&L Engineering Estimate
Booster ID Fans	$3,999,200	S&L Engineering Estimate
Piping Systems	$6,536,000	S&L Engineering Estimate
Electrical Equipment	$9,964,400	S&L Engineering Estimate
Controls and Instrumentation	$3,037,000	S&L Engineering Estimate
Subtotal capital cost (CC)	$86,925,200	
Total purchased equipment cost (PEC)	$86,925,200	
Direct installation costs		
Dry FGD Mechanical Equipment	$27,462,900	S&L Engineering Estimate
Reagent Handling System Equipment	$856,800	S&L Engineering Estimate
Foundations	$5,777,200	S&L Engineering Estimate
Miscellaneous Buildings	$2,588,300	S&L Engineering Estimate
Fabric Filter Mechanical Equipment	$11,846,700	S&L Engineering Estimate
Ash Recycle System Equipment	$172,300	S&L Engineering Estimate
Ash Handling System Equipment	$1,723,200	S&L Engineering Estimate
Structural Supports	$3,688,000	S&L Engineering Estimate
Ductwork	$9,179,900	S&L Engineering Estimate
Booster ID Fans	$1,272,700	S&L Engineering Estimate
Piping Systems	$7,588,100	S&L Engineering Estimate
Electrical Equipment	$13,999,000	S&L Engineering Estimate
Controls and Instrumentation	$1,348,800	S&L Engineering Estimate
Total direct installation costs (DIC)	$87,503,900	
Demolition and Relocation	$120,600	S&L Engineering Estimate
Civil Work	$3,861,000	S&L Engineering Estimate
Other Direct and Construction Costs	$21,041,800	S&L Engineering Estimate
Spare Parts	$1,463,400	S&L Engineering Estimate
Freight, Duties, Etc.		
Total direct costs (DC) = (PEC) + (DIC)	**$200,915,900**	
Indirect Costs		
Engineering	$14,064,100	S&L Engineering Estimate
Construction Management	$6,117,800	S&L Engineering Estimate
Owner's Costs	$21,383,174	S&L Engineering Estimate
Commissioning	$5,071,400	S&L Engineering Estimate
Contingency	$22,843,100	S&L Engineering Estimate
Total indirect costs (IC)	**$69,479,574**	
Allowance for Funds Used During Construction (AFDC)	$72,715,165	S&L Engineering Estimate
Property Taxes	$9,804,643	S&L Engineering Estimate
Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)	**$352,915,282**	
ANNUAL COST		
Direct Annual Costs		
Fixed annual costs		
Operating labor	$728,000	S&L Engineering Estimate
Maintenance materials	$784,000	S&L Engineering Estimate
Maintenance labor	$522,000	S&L Engineering Estimate
Total fixed annual costs	$2,034,000	
Variable annual costs		
Reagent	$2,433,100	S&L Engineering Estimate
Auxiliary Power	$2,932,600	S&L Engineering Estimate
Water	$445,900	S&L Engineering Estimate
Waste Disposal	$427,000	S&L Engineering Estimate
Bags and Cages	$558,000	S&L Engineering Estimate
Total variable annual costs	$6,796,600	
Total direct annual costs (DAC)	**$8,830,600**	
Indirect Annual Costs		
Cost for capital recovery	$69,428,040	(TCI) X 19.67% CRF at 7% interest based on 6.5 year life
Total indirect annual costs (IDAC)	$69,428,040	
Total Annual Cost (TAC) = (DAC) + (IDAC)	**$78,259,000**	
Alternate Case		
Indirect Annual Costs		
Cost for capital recovery	$79,503,268	(TCI) X 22.53% CRF at 7% interest based on 5.5 year life
Total indirect annual costs (IDAC)	$79,503,268	
Total Annual Cost (TAC) = (DAC) + (IDAC)	**$88,334,000**	

PGE Boardman BART Analysis - Cost Analysis

Technology: RSCR and DSI System **Date:** August 4 2010

Cost Item	$	Remarks/Cost Basis
CAPITAL COST		
Direct Costs	**2010**	
Purchased Equipment Costs		
Rail Spur	$875,000	S&L Engineering Estimate
Dry Sorbent Unloading System	$3,286,300	S&L Engineering Estimate
Concrete and Steel	$96,000	S&L Engineering Estimate
Dry Sorbent Injection Equipment	$2,809,900	S&L Engineering Estimate
Piping and Insulation	$92,200	S&L Engineering Estimate
Electrical Equipment	$519,000	S&L Engineering Estimate
Subtotal capital cost (CC)	$7,678,400	
Total Purchased Equipment Cost (PEC)	$7,678,400	
Direct Installation Costs		
Rail Spur	$422,100	S&L Engineering Estimate
Dry Sorbent Unloading System	$1,074,600	S&L Engineering Estimate
Concrete and Steel	$234,900	S&L Engineering Estimate
Dry Sorbent Injection Equipment	$1,562,700	S&L Engineering Estimate
Piping and Insulation	$460,200	S&L Engineering Estimate
Electrical Equipment	$888,300	S&L Engineering Estimate
Total Direct Installation Cost (DIC)	$4,642,800	
Demolition and Relocation	$131,800	S&L Engineering Estimate
Civil Work	$302,900	S&L Engineering Estimate
Other Direct and Construction Costs	$2,528,400	S&L Engineering Estimate
Total Direct Cost (DC) = (PEC) + (DIC)	**$15,284,300**	
Indirect Costs		
Engineering	$1,223,000	S&L Engineering Estimate
Owner's Costs	$2,300,000	S&L Engineering Estimate
Construction Management	$305,700	S&L Engineering Estimate
Commissioning	$152,800	S&L Engineering Estimate
Contingency	$2,041,800	S&L Engineering Estimate
Total Indirect Cost (IC)	**$6,023,300**	
Allowance for Funds Used During Construction (AFDC)	$1,562,000	S&L Engineering Estimate
Property Taxes	$63,000	S&L Engineering Estimate
Total Capital Investment (TCI) = (DC) + (IC) + (AFDC + Taxes)	**$22,932,600**	
ANNUAL COSTS		
Fixed Annual Costs		
Operating Labor	$249,600	S&L Engineering Estimate
Maintenance Labor and Material	$127,600	S&L Engineering Estimate
Administrative Labor	$9,000	S&L Engineering Estimate
Total Fixed Annual Cost	**$386,200**	
Variable Annual Costs		
Reagent	$8,324,259	S&L Engineering Estimate
Waste Disposal	$4,059,043	S&L Engineering Estimate
Auxiliary Power	$260,610	S&L Engineering Estimate
Total Variable Annual Cost	**$12,643,912**	
Total Direct Annual Costs (DAC)	**$13,030,112**	
Indirect Annual Costs		
Cost for Capital Recovery	$4,511,466	(TCI) x 19.67% CRF at 7 % interest based on 6.5 year life
Total Indirect Annual Costs (IDAC)	**$4,511,466**	
Total Annual Cost (TAC) = (DAC) + (IDAC)	**$17,541,578**	

PGE Boardman BART Analysis - Cost Analysis

Technology: Pulse Jet Fabric Filter (PJFF) **Date:** August 4 2010

Cost Item	$	Remarks/Cost Basis
CAPITAL COST		
Direct Costs	**2010 dollars**	
Purchased equipment costs		
Fabric filter system	$18,541,000	CUECost estimate
Initial FF bags inventory		
Ash handling system	$1,322,000	B&V Engineering estimate
Booster fans	$5,938,000	B&V Engineering estimate
Electrical system upgrades	$2,248,000	B&V Engineering estimate
Flue gas handling system	$3,967,000	B&V Engineering estimate
Subtotal capital cost (CC)	$32,016,000	
Instrumentation and controls	$1,601,000	(CC) X 5.0%
Freight	$1,601,000	(CC) X 5.0%
Total purchased equipment cost (PEC)	$35,218,000	
Direct installation costs		
Foundation & supports	$10,565,000	(PEC) X 30.0%
Handling & erection	$10,565,000	(PEC) X 30.0%
Electrical	$5,283,000	(PEC) X 15.0%
Piping	$880,000	(PEC) X 2.5%
Insulation	$704,000	(PEC) X 2.0%
Painting	$352,000	(PEC) X 1.0%
Demolition	$1,761,000	(PEC) X 5.00%
Relocation	$352,000	(PEC) X 1.00%
Total direct installation costs (DIC)	$30,462,000	
Site preparation	$164,000	B&V Engineering estimate
Buildings	$0	N/A
Total direct costs (DC) = (PEC) + (DIC)	$65,844,000	
Indirect Costs		
Engineering	$7,231,000	(DC) X 12.0%
Owner's cost	$3,013,000	(DC) X 5.0%
Construction management	$6,026,000	(DC) X 10.0%
Start-up and spare parts	$904,000	(DC) X 1.5%
Performance test	$100,000	B&V Engineering estimate
Contingencies	$9,039,000	(DC) X 15.0%
Total indirect costs (IC)	$26,313,000	
Allowance for Funds Used During Construction (AFDC)	$8,285,000	[(DC)+(IC)] 8.99% 2 years (project time length / 2)
Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)	**$100,442,000**	
ANNUAL COST		
Direct Annual Costs		
Fixed annual costs		
Maintenance labor and materials	$1,975,000	(DC) X 3.0%
Total fixed annual costs	$1,975,000	
Variable annual costs		
Bag replacement cost	$632,000	6,322 bags and 100 $/bag 18,966 total bags
Cage replacement cost	$158,000	3,161 cages and 50 $/cage 18,966 total cages
ID fan power	$774,000	2,258 kW and 0.046 $/kWh 6" water d.p.
Additional Auxiliary power	$206,000	554 kW and 0.05 $/kWh B&V Engineering estimate
Total variable annual costs	$1,770,000	
Total direct annual costs (DAC)	$3,745,000	
Indirect Annual Costs		
Cost for capital recovery	$19,760,000	(TCI) X 19.67% CRF at 7% interest for 6.5 year life
Total indirect annual costs (IDAC)	$19,760,000	
Total Annual Cost (TAC) = (DAC) + (IDAC)	**$23,505,000**	

PGE Boardman BART Analysis - Cost Analysis

Technology: Compact Hybrid Particulate Collector (COHPAC) **Date:** August 4 2010

Cost Item	$	Remarks/Cost Basis
CAPITAL COST		
Direct Costs	**2010 dollars**	
Purchased equipment costs		
Fabric filter system	$13,313,000	B&V Engineering Estimate
Initial FF bags inventory		
Ash handling system	$2,404,000	B&V Engineering Estimate
Booster fans	$5,481,000	B&V Engineering Estimate
Electrical system upgrades	$2,248,000	B&V Engineering Estimate
Flue gas handling system	$7,212,000	B&V Engineering Estimate
Subtotal capital cost (CC)	$30,658,000	
Instrumentation and controls	$1,533,000	(CC) X 5.0%
Freight	$1,533,000	(CC) X 5.0%
Total purchased equipment cost (PEC)	$33,724,000	
Direct installation costs		
Foundation & supports	$8,431,000	(PEC) X 25.0%
Handling & erection	$8,431,000	(PEC) X 25.0%
Electrical	$4,216,000	(PEC) X 12.5%
Piping	$843,000	(PEC) X 2.5%
Insulation	$674,000	(PEC) X 2.0%
Painting	$337,000	(PEC) X 1.0%
Demolition	$337,000	(PEC) X 1.00%
Relocation	$337,000	(PEC) X 1.00%
Total direct installation costs (DIC)	$23,606,000	
Site preparation	$546,000	B&V Engineering Estimate
Buildings	$0	N/A
Total direct costs (DC) = (PEC) + (DIC)	$57,876,000	
Indirect Costs		
Engineering	$6,356,000	(DC) X 12.0%
Owner's cost	$2,648,000	(DC) X 5.0%
Construction management	$5,297,000	(DC) X 10.0%
Start-up and spare parts	$795,000	(DC) X 1.5%
Performance test	$109,000	B&V Engineering Estimate
Contingencies	$7,945,000	(DC) X 15.0%
Total indirect costs (IC)	$23,150,000	
Allowance for Funds Used During Construction (AFDC)	$7,284,000	[(DC)+(IC)] 8.99% 2 years (project time length X 1/2)
Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)	**$88,310,000**	
ANNUAL COST		
Direct Annual Costs		
Fixed annual costs		
Maintenance labor and materials	$3,473,000	(DC) X 6.0%
Total fixed annual costs	$3,473,000	
Variable annual costs		
Filter bag replacement	$571,000	5,708 bags and 100 $/bag 11,415 total bags
Cage replacement	$95,000	1,903 cages and 50 $/cage 11,415 total cages
ID fan power	$998,000	2,889 kW and 0.046 $/kWh 8" water d.p.
Additional Auxiliary power	$332,000	893 kW and 0.05 $/kWh B&V Engineering Estimate
Total variable annual costs	$1,996,000	
Total direct annual costs (DAC)	$5,469,000	
Indirect Annual Costs		
Cost for capital recovery	$17,373,000	(TCI) X 19.67% CRF at 7% interest for 6.5 year life
Total indirect annual costs (IDAC)	$17,373,000	
Total Annual Cost (TAC) = (DAC) + (IDAC)	**$22,842,000**	

PGE Boardman BART Analysis - Cost Analysis

Technology: Wet ESP **Date:** August 4 2010

Cost Item	$	Remarks/Cost Basis
CAPITAL COST		
Direct Costs	**2010 dollars**	
Purchased equipment costs		
WESP system includes casing, electrical sys., penthouse blower & heater, access provisions	$34,139,000	B&V Engineering Estimate
Ash handling system	$2,644,000	B&V Engineering Estimate
Booster fans	$5,024,000	B&V Engineering Estimate
Electrical system upgrades	$1,454,000	B&V Engineering Estimate
Flue gas handling system	$3,967,000	B&V Engineering Estimate
Subtotal capital cost (CC)	$47,228,000	
Instrumentation and controls	$2,361,000	(CC) X 5.0%
Freight	$2,361,000	(CC) X 5.0%
Total purchased equipment cost (PEC)	$51,950,000	
Direct installation costs		
Foundation & supports	$15,585,000	(PEC) X 30.0%
Handling & erection	$15,585,000	(PEC) X 30.0%
Electrical	$7,793,000	(PEC) X 15.0%
Piping	$1,299,000	(PEC) X 2.5%
Insulation	$1,039,000	(PEC) X 2.0%
Painting	$520,000	(PEC) X 1.0%
Demolition	$520,000	(PEC) X 1.00%
Relocation	$520,000	(PEC) X 1.00%
Total direct installation costs (DIC)	$42,861,000	
Site preparation	$546,000	B&V Engineering Estimate
Buildings	$0	N/A
New wet stack	$25,133,000	B&V Engineering Estimate
Total direct costs (DC) = (PEC) + (DIC)	$120,490,000	
Indirect Costs		
Engineering	$14,459,000	(DC) X 12.0%
Owner's cost	$6,025,000	(DC) X 5.0%
Construction management	$12,049,000	(DC) X 10.0%
Start-up and spare parts	$1,807,000	(DC) X 1.5%
Performance test	$100,000	B&V Engineering Estimate
Contingencies	$18,074,000	(DC) X 15.0%
Total indirect costs (IC)	$52,514,000	
Allowance for Funds Used During Construction (AFDC)	$23,330,000	[(DC)+(IC)] X 8.99% 3 years (project length / 2)
Total Capital Investment (TCI) = (DC) + (IC) + (AFDC)	**$196,334,000**	
ANNUAL COST		
Direct Annual Costs		
Fixed annual costs		
Maintenance materials and labor	$2,861,000	(DC) X 3.0%
Operating labor	$100,000	1 FTE and 100000 $/year Estimated labor
Total fixed annual costs	$2,961,000	
Variable annual costs		
Reagent	$179,000	20 lb/hr and 1.20 $/ton Engr. Estimate
Additional Auxiliary power	$130,000	350 kW and 0.05 $/kWh Engr. Estimate
ID fan power	$481,000	1,402 kW and 0.046 $/kWh 4" water d.p.
Service water	$583,000	652 gpm and 2 $/1,000 gal B&V Engineering Estimate
Total variable annual costs	$1,373,000	
Total direct annual costs (DAC)	$4,334,000	
Indirect Annual Costs		
Cost for capital recovery	$38,624,000	(TCI) X 19.67% CRF at 7% interest for 6.5 year life
Total indirect annual costs (IDAC)	$38,624,000	
Total Annual Cost (TAC) = (DAC) + (IDAC)	**$42,958,000**	