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MIRANT

Brian Hug
Deputy Program Manager
Air Quality Planning Program
Air and Radiation Management Administration
Maryland Department of the Environment
1800 Washington Blvd.
Baltimore, Maryland 21230-1720

Dear Mr. Hug:

Enclosed please find the BART analysis for Mirant's Chalk Point Units 1, 2 and 3 and Morgantown Units 1 and 2.

Should you have any questions or require any additional information on the enclosed analysis, please feel free to contact me.

Sincerely,

Arnold Solomon

cc: Deirdre Elvis-Peterson, MDE

BART Analysis

Mirant Chalk Point Generating Station Units 1, 2 and 3 and Mirant Morgantown Generating Station Units 1 and 2

1. Introduction

On May 4, 2009, the Maryland Department of the Environment sent a letter to Mirant Mid-Atlantic, LLC regarding the applicability of the Regional Haze Regulations and Guidelines for Best Available Retrofit Technology (BART) Determinations Rule [40 CFR 51.302 and Appendix Y – Guidelines for BART Determinations Under the Regional Haze Rule] on Mirant Mid Atlantic's Generating Units. These Rules require a BART analysis for any:

(1) Fossil fueled steam generating units greater than 250 mmBtu/hour;

(2) Installed between the years 1962 to 1977 and;

(3) Has the potential to emit SO_2, NO_x or PM_{10} greater than 250 tons/year.

As shown in Table 1 Mirant's Chalk Point Units 1, 2 and 3 and Morgantown Units 1 and 2 were determined to be "BART-eligible" and are required to conduct a BART analysis for SO_2, NO_x and PM_{10}. As shown in Table 1 Mirant's Dickerson Units 1, 2 and 3 and Chalk Point Unit 4 were installed outside the BART applicability time-frame and are not required to conduct a BART analysis.

2. BART Determination

BART-eligible sources that are found to cause or contribute to visibility impairment at a Class I area are required to make a BART determination. The BART Guidelines define BART as follows:

BART means an emission limitation based on the degree of reduction achievable through the application of the best system of continuous emission reduction for each pollutant which is emitted by ...[a BART-eligible source]. The emission limitation must be established, on a case-by-case basis, taking into consideration the technology available, the costs of compliance, the energy and non-air quality environmental impacts of compliance, any pollution control equipment in use or in existence at the source, the remaining useful life of the source, and the degree of improvement in visibility which may reasonably be anticipated to result from the use of such technology. BART analysis identifies the best system of continuous emission reduction taking into account:

(1) The available retrofit control options,

(2) Any pollution control equipment in use at the source (which affects the availabilityof options and their impacts,)

(3) The cost of compliance with control options,

(4) The remaining useful life of the facility,

(5) The energy and non-air quality environmental impacts of control options[,and]

(6) The visibility impact analysis.

Further, the BART rule indicates that the five basic steps in a BART analysis can be summarizes as follows:

1. Identify all available retrofit control technologies;
2. Eliminate technically infeasible control technology;
3. Evaluate the control effectiveness of remaining control technology;
4. Evaluate impacts and document the result;
5. Evaluate visibility impacts.

In discussions with MDE, it was suggested that visibility impact analysis need not be conducted for high cost effective ($/ton) emission control alternatives. No visibility impact analyses conducted for these BART analyses since each of the BART analyses resulted in very high cost effective control alternatives.

3. BART – Eligible Source Description

Chalk Point Units 1, 2, and 3

The Chalk Point Electric Generating Station is located on the Patuxent River at Swanson Creek in Price George's County Maryland. The major components of the facility consist of four steam units (Units 1, 2, 3 and 4), seven #2 oil and gas fired combustion turbines (CTs 1 through 6 and SMECO CT 1) and five #2 oil fired auxiliary boilers. (Aux. Boiler 3 through 7).

Chalk Point Units 1 and 2 were installed in 1964 and 1965 and are walled fired, dry bottom, supercritical boilers, each rated at a nominal 355 MWs. These units are base loaded and have operated at average annual capacity factor of 68% over the last four years (Table 4). The primary fuel for these units is coal with natural gas or #2 fuel oil for ignition, arm-up and flame stabilization.

Units 1 and 2 are each equipped with a cold side Electrostatic Precipitator to control particulate matter (PM) emissions, Unit 1 is equipped with Low NOx Burners (LNBs), Over Fire Air (OFA) and Selective Catalytic Reactor System (SCR) and Unit 2 is equipped with LNBs, OFA and Selective Auto Catalytic Reactor (SACR) system to control Nitrogen Oxides (NOx) emissions and Units 1 and 2 have recently been equipped with a common Flue Gas Desulfurization (FGD) System to control sulfur dioxides (SO_2) emissions. When the FGR system is in operation the Units exhaust to a common 400 foot stack when the FGD is not in operation the Units exhaust to a common 700 foot stack.

Units 1 and 2 existing emission limits are present in Table 2. In addition to the emission limits set forth in Table 2, Units 1 and 2 must also comply with NOx and SO2 emission caps in MDE COMAR 26.11.27 Emission Limitation for Power Plants.

Unit 3 was installed in 1964 and is a tangentially fired, sub-critical Unit that fire residual fuel oil or natural gas. The Unit is rated at a nominal 640 MWs. The unit is considered cycling units and has operated at average annual capacity factor of 5% over the last four years (Table 4).

Unit 3 is each equipped with Low NOx Burners and Over Fire Air to control NOx emission. The Unit exhausts to its own 700 foot stack.

Chalk Point Units 1, 2 and 3 existing emission limits and emission totals for 2006 to 2009 are presented in Tables 2 and 3.

Morgantown Units 1 and 2

The Morgantown Generating Station is located on the Potomac River, just south of Route 301 at the Nice Bridge near the town of Newburg in Charles Count Maryland. The major components of the facility consists of two base loaded coal fired steam units (Units 1 and 2) and six #2 oil fired combustion turbines (CTs 1 through 6) and four #2 oil fired auxiliary boilers (Aux. Boiler 1, 2, 3 and 4).

Morgantown Units 1 and 2 were installed in 1970 and 1971 and are tangentially fired, dry bottom, supercritical boilers, each rated at a nominal 630 MWs. These units are base loaded and have operated at average annual capacity factor of 64% over the last four years. The primary fuel for these units is coal with #2 fuel oil for ignition, arm-up and flame stabilization.

Units 1 and 2 are each equipped with a cold side Electrostatic Precipitator to control PM emissions. Units 1 and 2 are equipped with LNBs, OFA and Selective Catalytic Reactor System (SCR) to control Nitrogen Oxides (NOx) emissions and Units 1 and 2 have recently been equipped each with a Flue Gas Desulfurization (FGD) System to control sulfur dioxides (SO_2) emissions. When the FGD system is in operation the Units exhaust to a dual flue 400 foot stack, when the FGD is not in operation the each Unit exhausts to a 700 foot stack.

Morgantown Units 1 and 2's existing emission limits and emission total for 2006 to 2009 are presented in Tables 2 and 3.

3.1 BART – Eligible Source's Existing Air Pollution Control Technology

Chalk Point Units 1 and 2

Chalk Point Units 1 and 2 are each equipped with highly efficient cold side Electrostatic Precipitators (ESPs) that remove over 99.5% of the particulate matter (PM) from the gas streams. Chalk Point Units 1 and 2 are equipped with LNBs and OFA that reduce NOx emissions by ~ 50%. In 2008 Chalk Point Unit 2 installed a SACR system to control NOx emissions that reduce NOx emissions by another ~35 to 45%. The SACR system is primarily operated only in the ozone season (May thru September). In 2009 Chalk Point Unit 1 installed an SCR system to control NOx emissions that reduce NOx emissions by up to 90%. In December 2009 Chalk Points Units 1 and 2 installed a common FGD system that reduces SO_2 emissions by up to 98%.

Chalk Point Unit 3

Chalk Point Unit 3 is not equipped with any PM control equipment. The Units equipped with LNBs and OFA to control NOx emissions. SO2 emissions are controlled by fuel sulfur content limits. Chalk Point Unit 3 also has operational that limit emissions. Unit 3 is under a 2006 Consent Order that requires the Unit to operate 95% of the time using natural gas during the ozone season [May-September]. In addition Mirant is in negotiation with MDE for a follow consent decree that will also restrict the Unit's operation using residual oil during the months outside of the ozone season. Since the the Unit is a cycling Unit and operates primarily during the ozone season, the operational restrictions on fuel use effectively limit total NOx emissions by over 50%, PM emission by 90%, and SOx emissions by over 95%.

Morgantown Units 1 and 2

Morgantown Units 1 and 2 are each equipped with highly efficient cold side Electrostatic Precipitators (ESPs) that remove over 99% of the particulate matter (PM) from the gas streams. Morgantown Units 1 and 2 are equipped with LNBs and OFA that reduce NOx emissions by ~ 50%. In 2007 and 2008 Morgantown Units 1 and 2 installed SCR systems to control NOx emissions that reduce NOx emissions by up to 90%. In December 2009 Morgantown Units 1 and 2 installed a common FGD system that reduces SO_2 emissions by up to 98%.

4.0 Identification of Available Retrofit Control Technologies

4.1 SO2 Best Available Retrofit Technology

The first step of a BART determination is the identification of all available retrofit SO2 control technologies. A list of control technologies was obtained by reviewing the U. S. EPA Clean Air Technology Center RACT/BACT/LAER Clearing House, control technology equipment vendor information, and publicly-available air permits.

The available SO2 control technologies are as follows;

- FGD [magnesium-enhanced lime with forced oxidation],
- FGD [limestone with forced oxidation],
- Spray Dryer Absorption,
- Dry Injection.

FGD [magnesium-enhanced lime with forced oxidation]

Wet scrubbing using a solution of water and lime, creating alkali slurry and passing the flue gas through the lime slurry spray. In the typical absorber design, the gas flows upward through the absorber countercurrent to the spray liquor flowing downward through the absorber. Each application of the FGD scrubbing is dependent on fuel sulfur content, and the scrubber design parameters, however, up to 98 percent removal of SO2 is demonstrated.

FGD [limestone with forced oxidation]

This is a variation on alkali wet scrubbing using limestone slurry as the reagent and where compressed air is used to oxide sulfites in the absorption of sulfates. Oxidation creates gypsum which is a salable by product for wallboard manufacturers. Oxidation makes the solids easier to remove from the solution and facilitates waste disposal. Such systems generally attain greater than 98 percent SO2 removal efficiency.

Spray Dryer Absorption

An alkali containing slurry is used in spray form to contact the SO2 laden flue gas prior to the particulate collection devise. Removal of SO2 depends on stoichiometric ratio of reactant to sulfur and the degree of saturation attained in the spray-dryer vessel. Solids from the PM collection device may be recycled to the absorber to attain optimal absorption and utilization of the reactant. Such systems generally attain greater than 90 percent control.

Dry Injection

Dry solid absorbent is injected directly into the ductwork upstream of the PM collection devise. SO2 removal occurs by adsorption of the pollutant on the particle surface and collection of the resulting solids with the fly ash in the PM control device. Lime or limestone based dry injection system typically do not perform as well as FGD systems and attain 40 to 60 percent removal, but may achieve up to 90 percent removal if another sorbent such a sodim bicarbonate is used.

4.2 NOx Best Available Retrofit Technology

The available NOx control technologies are as follows;

- Low NOx Burners,
- Over-Fired Air,
- Selective Non-Catalytic Reduction,
- Selective Catalytic Reduction.

Low NOx Burners (LNBs)

This technique requires control of the combustion stoichometric air/fuel ratio and the boiler temperature profile. NOx formation is dependent on peak flame temperature and the availiblility of excess air in around the combustion zone. Reduction of the oxygen content in the primary reaction zone and the attendant reduction in peak flame temperature limit NOx formation. Also, limitation in peak flame temperature residence time also will lower NOx emissions. By introducing combustion air in stages, and thoroughly mixing gases in the combustion chamber to reduce hot zones, significant reduction of 35 to 55 percent can be realized.

Over-Fired Air (OFA)

In OFA technology 5 to 20 percent of the combustion air is not injected into the main burner and is instead introduced above the main burner location. Adding OFA to LNB technology can reduce LN NOx levels by an additional 10 to 25 percent. Particularly significant NOx reductions can result from the application of these techniques to tangentially boilers resulting in a 50 percent decrease in NOx emissions.

Selective Non-Catalytic Reduction & Auto-Catalytic Reduction (SNCR & SACR)

The SNCR technology utilizes ammonia or urea reagent that is injected into the combustion zone where the flue gas is in the range of 1,600 to 2,000 degrees F. SACR technology uses an ammonia or urea reagent and small amount of natural gas acting as a catalyst is injected into the combustion zone where the flue gas is in the range of 2,200 to 2,500 degrees F. These technologies are capable of reducing NOx emissions by 25 to 35 percent.

Selective Catalytic Reduction (SCR)

The SCR process utilizes a honeycomb bed of active metal catalyst impregnated zeolite to reduce NOx to its molecular nitrogen and water. Ammonia or urea is injected upstream of the catalyst bed and by using the proper injection ratio of ammonia to NOx the reduction of NOx to N_2 and H_2O occurs. He process is temperature dependent and coal-fired boilers typically locate the catalyst bed in the boiler between the economizer outlet and the air preheater where the reaction temperature of 450 to 750 degrees F is found. This technology is capable of reducing NOx emissions by 90 percent.

4.3 PM Best Available Retrofit Technology

The available PM control technologies are as follows;

- Mechanical Collector,
- Electrostatic Precipitators,
- Fabric Filter - Baghouse.

Mechanical Collector

Mechanical collectors use inertial energy to separate particles by physical means. The devices are cylindrical with a tangential gas inlet. The tangential inlet induces a spinning motion to a particle laden gas stream with particles driven to the sides of the cylinder and gas with a reduced particle concentration exiting the top of the cyclones. For large gas flows, numerous parallel cyclones are typical and are called multiple cyclones. These devices are mostly used as pre-filtration devices to remove the largest particles and can remove up to 80 percent of the large particles.

Electrostatic Precipitators (ESPs)

EPS's utilize an electric field to ionize fine particulate matter in a gas stream using high voltage electrodes. The ionized particles are attracted to the oppositely charged tube or plate upon which layers of particles build over time. The ESP is typically composed of a large box-type structure with several sections of electrified parallel plates or tubes and rappers to periodically remove accumulated particulate. The collected material falls into a hopper and disposed. ESP technology is capable of high removal efficiencies of 99 percent or higher on fine particulate.

Fabric Filters – Baghouse

Fabric filter baghouses contain numerous cylindrical bags which particle laden gases pass through the cloth material depositing solid particles on the bag surface. The particles form a filter cake on the bag surface and must be periodically removed by blasts of reverse air, mechanical shaking or a blast of sonic energy. Fabric filters are highly efficient on removing very small particles from the gas stream and are capable of achieving over 99 percent efficiency for removing total particulate.

5.0 Evaluation of Best Available Control Technologies

As part of the BART analysis it is necessary to identify the most stringent control option and a reasonable set of options for each pollutant. A technology is considered as a BRT option if it is considered an “available” and “applicable”. A technology is considered available if it has reached the licensing and commercial demonstration phase. In addition to control technology being available it must also be applicable. Generally, a technology that has been applied to the source type under consideration indicates that the control technology is applicable.

5.1 NOx Best Available Retrofit Technology Emission Rates

Table 5.1 shows the emission rates for the BART NOx control technology. The Table presents the control technology the removal rates and there associated emission rates. The controls evaluated to improve NOx emissions include using LNBs and OFA, SNCR/SACR and SCRs. Since Morgantown and Chalk Point Units 1& 2 are already equipped with LNBs and OFA, SCR and SACR any other control technology for these units was not was not considered.

Table 5.1 NOx Control Alternatives

Control Option	Control Efficiency	Emission Rate (lb/mmBtu)
LNBs & OFA	NA	0.50 lb/mmBtu
SNCR & SACR	30 to 40%	0.30 lb/mmBtu
SCR	90 %	0.10 lb/mmBtu

5.2 SO2 Best Available Retrofit Technology Emission Rates

Table 5.2 shows the emission rates for the BART SO2 control technology. The Table presents the control technology the removal rates and there associated emission rates. The controls evaluated to improve SO2 emissions include using low sulfur fuels, dry sorbent injection, spray dryer injection and wet scrubbing. Since Morgantown and Chalk Point Units 1& 2 are equipped with FGDs any other control technology for these units was not was not considered.

Table 5.2 SO2 Control Alternatives

Control Option	Control Efficiency	Emission Rate (lb/mmBtu)
Sulfur in Fuel	NA	1.5 lb/mmBtu
Dry Sorbent Injection	30 to 70%	0.50 lb/mmBtu
Spray Dryer Absorption	90 to 95%	0.30 lb/mmBtu
FGD	98%	0.15 lb/mmBtu

5.3 PM Best Available Retrofit Technology Emission Rates

Table 5.3 shows the emission rates for the BART PM control technology. The Table presents present the existing PM State emission standard and the new NSPS standards for Fossil-Fuel-Fired Steam Generators. The presented emission rates can only be attained by the use of either ESPs or Baghouse technology. Mechanical collectors are not capable of attaining the high removal efficiencies required and are ruled out of further consideration. Since Morgantown and Chalk Point Units 1& 2 are equipped with ESPs any other control technology for these units was not considered.

Table 5.3 PM Control Alternatives

Control Option	Emission Rate (lb/mmBtu)
State Emission Limit	0.06[a] & 0.10[b]
NSPS Emission Limit	0.015

a-Chalk Point Units 1, 2 & 3 Emission Limit

b-Morgantown Units 1 & 2 Emission Limit

6.0 Best Available Retrofit Technology Evaluation

6.1 Morgantown Units 1 and 2

The Morgantown are presently equipped with ESPs, SCRs and FGDs and the 2010 emission rates for NOx, SO2 and PM are presented below. The control equipment installed and the units existing emission rates meet or exceed BART control requirements and presumptive emission limits. Therefore no additional BART analysis is required.

Table 6.1 Morgantown 2010 Emission Rates

Pollutant	2010 Emission Rate (lb/mmBtu) Combined for Units 1 & 2
NOx	0.05
SO2	0.15
PM	0.01

6.2 Chalk Point Units 1 and 2

The Chalk Point Units 1 and 2 are presently equipped with ESPs, SCR/SACR and FGDs and the 2010 emission rates for NOx, SO2 and PM are presented below. The control equipment installed and the units existing emission rates meet or exceed BART requirements. Therefore no additional BART analysis for SO2 and PM is required.

Table 6.2 Chalk Point Unit 1 and 2 2010 Emission Rates

Pollutant	2010 Emission Rate (lb/mmBtu) Combined for Units 1& 2
NOx	0.19
SO2	0.12
PM	0.01

Evaluation of NOx Control

A BART analysis was conducted for NOx control on Chalk Point Unit 2. Chalk Point Unit 2 is equipped with an SACR to control NOx. The installation of a SCR was evaluated to bring Chalk Point Unit 2 NOx emission rate below the BART presumptive 0.10 lb/mmBtu emission rate. No other control technology was evaluated since SCR technology is only technology available that can achieve the presumptive level of control for a coal fired boiler. The installation of SCR and operating at 0.10 lb/mmBtu would result in average annual emission reduction of approximately 2,100 tons of NOx per year.

Cost of NOx Control

The cost of NOx control for the installation of SCR technology on Chalk Point Unit 2 was estimated using the EPA Control Cost Manual (U. S. Environmental Protection Agency, EPA Air Pollution Control Manual, 6th ed., EPA-450-02-001, January 2002) and using the cost data for the installation of the SCR on Chalk Point Unit 1. The detailed cost analysis for the installation of the SCR is present in Appendix A. For SCR technology, an emission reduction from the present emission rate of 0.35 lb/mmBtu to 0.10 lb/mmBtu results in the reduction of 2,100 tons of NOx per year results and in cost effectiveness of 14,288 $ per ton.

Energy Impact of NOx Control

It is estimated the additional power requirements for the operation of the Chalk Point Unit 2 SCR is ~800 Kw. The power consumption of the fans and pumps and added pressure drop energy consumption has been factored into the cost analysis.

Non-Air Quality Environmental Impacts of NOx Control

The SCR itself will not require any use of water for its operations but the urea to ammonia system will require additional water to increase the production of ammonia to meet the SCR's increase demand. It is anticipated that the added water demand will be less than 10gpm. The water will be supplied from the Station's Demineralizer Plant which is in turn supplied through groundwater withdrawal.

Both the SCR and urea to ammonia system will generate additional waste streams. The SCR will generate spent catalyst and the urea to ammonia system will generate solid and wet residuals. The spent SCR catalyst is expected to be sent back to the manufacturer for reprocessing and solid and wet residuals will be sent off-site for disposal.

Remaining Useful Life of Unit

The life of the Chalk Point Unit 2 is expected to exceed the study period and is projected to have no effect on the costing analyses for this facility.

As a result of the above analysis, Mirant is proposing that the Chalk Point Unit 2 existing permit emission limits meet all BART control requirements.

6.3 Chalk Point Units 3

The Chalk Point Units 3 is presently equipped with LNBs and OFA for NOx control. In addition the Unit has a State enforceable operational restriction requiring the burning of natural gas for 95% of the total heat input during the ozone season and a proposed requirement to burning natural gas to 75% of the total heat input during the non ozone season. The 2010 emission rates for NOx, SO2 and PM are presented below. The with the fuel restriction the units existing emission rates meet or exceed BART requirements. Therefore no additional BART analysis for SO2 and PM is required.

Table 6.2 Chalk Point Unit 3 2010 Emission Rates

Pollutant	2010 Emission Rate (lb/mmBtu)
NOx	0.14
SO2	0.15
PM	0.004

Evaluation of NOx Control

A BART analysis was conducted for NOx control on Chalk Point Unit 3. Chalk Point Unit 2 is equipped with LNBs and OFA to control NOx. The installation of a SNCR was evaluated to bring Chalk Point Unit 3 NOx emission rate below the BART presumptive 0.10 lb/mmBtu emission rate. No other control technology was evaluated since SNCR technology is technology available that can achieve the presumptive level of control for a coal fired boiler. The installation of SNCR and operating at 0.10 lb/mmBtu would result in average annual emission reduction of approximately 41 tons of NOx per year.

Cost of NOx Control

The cost of NOx control for the installation of SCR technology on Chalk Point Unit 3 was estimated using the EPA Control Cost Manual (U. S. Environmental Protection Agency, EPA Air Pollution Control Manual, 6th ed., EPA-450-02-001, January 2002) and using the cost data for the installation of the SCR on Chalk Point Unit 3. The detailed cost analysis for the installation of the SCR is present in Appendix B. For SCR technology, an emission reduction from the present emission rate of 0.14 lb/mmBtu to 0.10 lb/mmBtu results in the reduction of 43 tons of NOx per year results and in cost effectiveness of 95,066 $ per ton.

Energy Impact of NOx Control

It is estimated the additional power requirements for the operation of the Chalk Point Unit 3 is 150 kw. The power consumption of the fans and pumps consumption has been factored into the cost analysis.

Non-Air Quality Environmental Impacts of NOx Control

The SNCR system requires up to 100 gpm of reagent dilution water. The SNCR installation ammonia slip could add ammonia to the fly ash. An ammonia slip of ~2 ppm could result in an ammonia concentration in the fly ash of ~100 ppm. SNCR systems normally have a ammonia slip guarantee of 5 ppm.

Remaining Useful Life of Unit

The life of the Chalk Point Unit 3 is expected to exceed the study period and is projected to have no effect on the costing analyses for this facility.

As a result of the above analysis, Mirant is proposing that the Chalk Point Unit 3 existing permit emission limits and fuel use restrictions meet all BART control requirements.

Table 1

Mirant's Maryland BART- Eligible Steam Units

Unit	Operation Date	Heat Input (mmBtu-hour)	BART-Eligible
Dickerson Unit 1	1957	1,713	No
Dickerson Unit 2	1957	1,713	No
Dickerson Unit 3	1960	1,713	No
Chalk Point Unit 1	1964	3,148	Yes
Chalk Point Unit 2	1965	3,148	Yes
Chalk Point Unit 3	1975	6,862	Yes
Chalk Point Unit 4	1981	6,862	No
Morgantown Unit 1	1970	5,800	Yes
Morgantown Unit 2	1971	5,800	Yes

Table 2

Existing SO_2, NOx & PM Emission Limits for BART Eligible Sources

Unit	SO2		NOx		PM
	Emission Limits	Annual Caps[6]	Emission Limits	Annual Caps[6]	
Chalk Point Unit 1	3.5 lb/mmBtu[1]	3,404 tn/yr	0.80 lb/mmBtu[3]	1,415 tn/yr	0.03 gr/scfd
Chalk Point Unit 2	3.5 lb/mmBtu[1]	3,568 tn/yr	0.80 lb/mmBtu[3]	1,484 tn/yr	0.03 gr/scfd
Chalk Point Unit 3	1% Fuel Oil	-	0.30 lb/mmBtu[4]	-	0.02 gr/scfd
Morgantown Unit 1	3.5 lb/mmBtu[2]	6,108 tn/tr	0.100 lb/mmBtu[5]	2,540 tn/yr	0.10 lb/mmBtu
Morgantown Unit 2	3.5 lb/mmBtu[2]	6,066 tn/yr	0.100 lb/mmBtu[5]	2,522 tn/yr	0.10 lb/mmBtu

1. 2-hour average
2. 1-hour average
3. 30-day rolling average
4. 30-day rolling average
5. 30-day rolling average
6. HAA annual unit specific emission caps, part of coal fired unit system-wide emission cap

Table 3

BART-Eligible Sources SO2, NOx and PM Emissions for Years 2006 to 2010

Year	2006 (tons/year)	2007 (tons/year)	2008 (tons/year)	2009 (tons/year)
Chalk Point Unit 1				
SO_2	23,357.6	22,878.9	21,088.5	20,507.9
NOx	4,590.0	4,885.5	3,169.0	603.4
PM	327.2	184.9	135.4	50.2
Chalk Point Unit 2				
SO_2	25,196.0	21,297.1	21,611.4	20,389.5
NOx	5,028.6	4,834.9	3,513.0	3,106.7
PM	349.6	182.1	135.6	50.0
Chalk Point Unit 3				
SO_2	639.7	1,031.3	133.1	145.3
NOx	310.4	540.0	208.5	138.6
PM	50.2	46.4	8.1	4.2
Morgantown Unit 1				
SO_2	50,019.0	45,270.0	39,694.8	32,913.0
NOx	8,029.8	3,094.7	1,019.6	868.6
PM	565.7	1,117.4	965.8	424.9
Morgantown Unit 2				
SO_2	48,053.8	47,798.5	30,863.8	36,633.3
NOx	7,414.9	6,321.3	1,820.5	1,013.1
PM	737.4	532.1	704.4	1366.2

1. Projected emissions using year-to-date emission, projected heat input and most recent stack test results

Table 4

BART-Eligible Source Capacity Factors for Years 2006 to 2009

Unit	2009	2008	2007	2006	Avg.
Chalk Point Unit 1	65.6	66.5	72.1	66.6	67.7
Chalk Point Unit 2	64.3	66.4	70.1	70.2	67.8
Chalk Point Unit 3	2.3	3.4	8.5	4.8	4.7
Morgantown Unit 1	57.6	71.6	60.7	69.0	64.7
Morgantown Unit 2	66.4	54.5	61.1	70.7	63.2

Appendix A - Chalk Point Unit 2 BART Cost Analysis - SCR Installation

Total Direct Capital Costs, TDCC		$118,925,000
Indirect Costs		
Indirect Installation Costs		
General Facilities Cost	0.05xTDCC	$5,946,250
Engineering and Home Office Fees	0.10xTDCC	$11,892,500
Process Contingency	0.05xTDCC	$5,946,250
Total Indirect Installation Cost, TIIC		$23,785,000
Other Capital Costs		
Project Contingency	0.15x(TDCC+TIIC)	$21,406,500
Preproduction Cost	0.02x(TDCC+TIIC+Proj. Cont.)	$3,282,330
Total Other Capital Costs, TOCC	TDCC+TIIC+Proj. Cont.	$24,688,830
Total Capital Cost-TCC	TDCC+TIIC+TOCC	$167,398,830
Direct Annual Costs		
Annual Ammonia Cost	$0.85 /gal	$602,000
Electical Cost	$0.08/kw-hr	$434,000
Annnual Maintennace Cost	0.015xTCC	0.015
Total Direct Annual Costs, TDAC		$2,510,982.45
Indirect Annual Costs		
Administrative	0.02xTCC	$3,347,977
Property Taxes	0.01xTCC	$1,673,988
Insurance	0.01xTCC	$1,673,988
Capital Recovery - Catalyst	CRF(3yr)xCatalyst Cost	$428,400
Capital Recovery - SCR system Less Catalyst	CRF(11yr)x(TCC-Catalyst Cost)	$20,368,656
Total Indirect Annual Cost, TIAC		$27,493,009
Total Annual Cost, TAC=TDAC+TIAC		$30,003,992
Cost Effectiveness ($/ton NOx removed)		$14,288

Appendix B - Chalk Point Unit 3 BART Cost Analysis - SNCR Installation

Total Direct Capital Costs, TDCC		$16,440,000
Indirect Costs		
Indirect Installation Costs		
General Facilities Cost	0.05xTDCC	$822,000
Engineering and Home Office Fees	0.10xTDCC	$1,644,000
Process Contingency	0.05xTDCC	$822,000
Total Indirect Installation Cost, TIIC		$3,288,000
Other Capital Costs		
Project Contingency	0.15x(TDCC+TIIC)	$2,959,200
Preproduction Cost	0.02x(TDCC+TIIC+Proj. Cont.)	$453,744
Total Other Capital Costs, TOCC	TDCC+TIIC+Proj. Cont.	$3,412,944
Total Capital Cost-TCC	TDCC+TIIC+TOCC	$23,140,944
Direct Annual Costs		
Annual Ammonia Cost	$0.85 /gal	$602,000
Electical Cost	$0.08/kw-hr	$105,000
Annnual Maintennace Cost	0.015xTCC	$347,114.16
Total Direct Annual Costs, TDAC		$347,114.16
Indirect Annual Costs		
Administrative	0.02xTCC	$462,819
Property Taxes	0.01xTCC	$231,409
Insurance	0.01xTCC	$231,409
Capital Recovery - SCR system Less Catalyst	CRF(11yr)xTCC	$2,624,936
Total Indirect Annual Cost, TIAC		$3,550,574
Total Annual Cost, TAC=TDAC+TIAC		$3,897,688
Cost Effectiveness ($/ton NOx removed)		$95,066