EXHIBIT D

BART Permit Application

DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION

BART Application Analysis
AP-6043

May 28, 2009

NAME OF FIRM:	PacifiCorp
NAME OF FACILITY:	Wyodak Plant
FACILITY LOCATION:	Section 27, T50N, R71W UTM Zone: 13, NAD 27 Easting: 469,410 m, Northing: 4,903,708 m Campbell County, Wyoming
TYPE OF OPERATION:	Coal-Fired Electric Generating Plant
RESPONSIBLE OFFICIAL:	Gary L. Harris
MAILING ADDRESS:	48 Wyodak Road - Garner Lake Route Gillette, WY 82718
TELEPHONE NUMBER:	(307) 687-4230
REVIEWERS:	Cole Anderson, Air Quality Engineer Josh Nall, Air Quality Modeler

PURPOSE OF APPLICATION:

Sections 169A and 169B of the 1990 Clean Air Act Amendments require states to improve visibility at Class I areas. On July 1, 1999, EPA first published the Regional Haze Rule, which provided specific details regarding the overall program requirements to improve visibility. The goal of the regional haze program is to achieve natural conditions by 2064.

Section 308 of the Regional Haze Rule (40 CFR part 51) includes discussion on control strategies for improving visibility impairment. One of these strategies is the requirement under 40 CFR 51.308(e) for certain stationary sources to install Best Available Retrofit Technology (BART) to reduce emissions of three (3) visibility impairing pollutants, nitrogen oxides (NO_x), particulate matter (PM), and sulfur dioxide (SO_2). EPA published Appendix Y to part 51 - *Guidelines for BART Determinations Under the Regional Haze Rule* in the July 6, 2005 Federal Register to provide guidance to regulatory authorities for making BART determinations. Chapter 6, Section 9, Best Available Retrofit Technology was adopted into the Wyoming Air Quality Standards and Regulations (WAQSR) and became effective on December 5, 2006. The Wyoming Department of Environmental Quality, Air Quality Division (Division) will determine BART for NO_x and PM_{10} for each source subject to BART and include each determination in the §308 Wyoming Regional Haze State Implementation Plan (SIP).

Section 309 of the Regional Haze Rule (40 CFR part 51), *Requirements related to the Grand Canyon Visibility Transport Commission*, provides states that are included within the Transport Region addressed by the Grand Canyon Visibility Transport Commission (i.e., Arizona, California, Colorado, Idaho, Nevada, New Mexico, Oregon, Utah, and Wyoming) an alternative to the requirements established in 40 CFR 51.308. This alternative control strategy for improving visibility contains special provisions for addressing SO_2 emissions, which include a market trading program and a provision for a series of SO_2 milestones. Wyoming submitted a §309 Regional Haze SIP to EPA on December 29, 2003. As of the date of this analysis, EPA has not taken action on the SIP. National litigation issues related to the Regional Haze Rule, including BART, required states to submit revisions. On November 21, 2008, the State of Wyoming submitted revisions to the 2003 §309 Regional Haze SIP submittal. Sources that are subject to BART are required to address SO_2 emissions as part of the BART analysis even though the control strategy has been identified in the Wyoming §309 Regional Haze SIP.

On February 5, 2007, in accordance with the requirements of WAQSR Chapter 6 Section 9(e)(i), the Division received a BART application for the existing coal-fired boiler at the PacifiCorp Wyodak Power Plant. A map showing Wyodak's location is attached as Appendix A.

On June 5, 2007, PacifiCorp submitted additional copies of the February application for the existing unit at Wyodak subject to BART.

On October 16, 2007, PacifiCorp submitted an updated application for the single unit subject to BART at Wyodak. Additional modeling performed after the February 5, 2007 submittal and revised visibility control effectiveness calculations were included.

On December 5, 2007, PacifiCorp submitted a revised application incorporating changes to the post-processing of the visibility model runs for Wyodak Unit 1.

On March 31, 2008, PacifiCorp submitted an addendum to the BART application for Wyodak Unit 1. Revised cost estimates and updated visibility modeling for two (2) NO_x control scenarios were included in the addendum.

BART ELIGIBILITY DETERMINATION:

In August of 2005 the Wyoming Air Quality Division began an internal review of sources that could be subject to BART. This initial effort followed the methods prescribed in 40 CFR part 51, Appendix Y: *Guidelines for BART Determinations Under the Regional Haze Rule* to identify sources and facilities. The rule requires that States identify and list BART-eligible sources, which are sources that fall within the 26 source categories, have emission units which were in existence on August 7, 1977 but not in operation before August 7, 1962 and have the potential to emit more than 250 tons per year (tpy) of any visibility impairing pollutant when emissions are aggregated from all eligible emission units at a stationary source. Fifty-one (51) sources at fourteen (14) facilities were identified that could be subject to BART in Wyoming.

The next step for the Division was to identify BART-eligible sources that may emit any air pollutant which may reasonably be anticipated to cause or contribute to impairment of Class I area visibility. Three pollutants are identified by 40 CFR part 51, Appendix Y as visibility impairing pollutants. They are sulfur dioxide (SO_2), nitrogen oxides (NO_x), and particulate matter (PM). Particulate matter with an aerodynamic diameter of 10 microns or less (PM_{10}) was used as an indicator of PM. In order to determine visibility impairment of each source, a screening analysis was performed using CALPUFF. Sources that emitted over 40 tons of SO_2 or NO_x or 15 tons of PM_{10} were included in the screening analysis. Using three years of meteorological data, the screening analysis calculated visibility impacts from sources at nearby Class I areas. Sources whose modeled 98th percentile 24-hour impact or 8th highest modeled impact, by year, was equal to or greater than 0.5 deciviews (dv) above natural background conditions (Δdv) were determined to be subject to BART. For additional information on the Division's screening analysis see the Visibility Improvement Determination: Screening Modeling section of this analysis. The single existing coal-fired boiler at PacifiCorp's Wyodak Power Plant, Unit 1, was determined to be subject to BART. PacifiCorp was notified in a letter dated June 14, 2006 of the Division's finding.

DESCRIPTION OF BART ELIGIBLE SOURCES:

PacifiCorp's Wyodak Power Plant is comprised of one (1) coal-fired boiler burning pulverized sub-bituminous Powder River Basin coal for a total net generating capacity of a nominal 335 megawatts (MW). Wyodak's pulverized coal-fired boiler commenced service in 1978. It was manufactured by Babcock & Wilcox and equipped with wall-fired burners. NO_x emissions from the boiler are currently controlled with first generation low NO_x burners. Particulate matter (PM) emissions from the unit are controlled using a Babcock & Wilcox Rothemuhle weighted wire electrostatic precipitator (ESP). SO_2 emissions from Wyodak Unit 1 are controlled using a Joy Niro, three-tower lime-based spray dryer installed in 1986.

Table 1: Wyodak Unit 1 Pre-2005 Emission Limits [a]

Source	Firing Rate (MMBtu/hour)	Existing Controls	NO_x (lb/MMBtu)	SO_2 (lb/MMBtu)	PM/PM_{10} (lb/MMBtu)
Unit 1	4,100 [b]	LNB, ESP, & dry FGD	0.70 (3-hour fixed) 0.31 (annual) [c]	0.5 (3-hour fixed)	0.10

[a] Emissions taken from Operating Permit 3-1-101-1.
[b] Boiler heat input reported based on historical monthly coal data.
[c] Annual emission limit established under 40 CFR part 76.

On April 24, 2007, WAQSR Chapter 6, Section 3 Operating Permit 3-1-101-1, was issued to PacifiCorp for Wyodak Unit 1. NO_x and PM emission limits did not change from the previous Operating Permit 30-101-1. SO_2 emission limit established under the Acid Rain Program (40 CFR 76.11) for the baseline period were 0.31 lb/MMBtu, annual average.

The reported maximum firing rate of the boiler stated in Operating Permit 3-1-101-1 is based on monthly coal data. The maximum firing rate of the boiler, as measured by the existing continuous emission monitoring system (CEM), is 4,700 MMBtu/hr. PacifiCorp based emissions calculations for the BART analysis on the highest firing rate of 4,700 MMBtu/hr.

PacifiCorp recently received an Air Quality permit to modify Wyodak Unit 1. The first generation LNB on Unit 1 will be replaced with Alstom TFS 2000™ LNB with overfire air. The existing ESP will be replaced with a new full-scale fabric filter baghouse. Table 2 lists the new emission limits for Unit 1. They become effective after the corresponding controls are installed and the applicable initial performance tests are completed.

Table 2: New Emission Limits for Wyodak Unit 1 [(a)]

Source	Permitted Controls	NO_x	SO_2	PM/PM_{10} [(b)]
Unit 1	New LNB with advanced OFA, Dry FGD, Fabric Filter Baghouse	0.23 lb/MMBtu (30-day rolling) 1,081.0 lb/hr (30-day rolling)	0.16 lb/MMBtu (30-day rolling) 0.5 lb/MMBtu (3-hr block) 2,115.0 lb/hr (3-hr block)	0.015 lb/MMBtu 71.0 lb/hr 308.8 tpy

[(a)] Emissions limits taken from recent New Source Review construction permit for Wyodak Unit 1.
[(b)] Averaging period is determined by the appropriate test method.

PacifiCorp provided a construction schedule for the installation of the new LNB with advanced OFA and a new full-scale fabric filter baghouse in the permit application. Construction activities for the pollution control upgrades on Unit 1 are anticipated to begin March 5, 2011 during the scheduled outage and end approximately April 16, 2011.

CHAPTER 6, SECTION 9 – BEST AVAILABLE RETROFIT TECHNOLOGY (BART)

A BART determination is an emission limit based on the application of a continuous emission reduction technology for each visibility impairing pollutant emitted by a source. It is "…established, on a case-by-case basis, taking into consideration (1) the costs of compliance, (2) the energy and non-air quality environmental impacts of compliance, (3) any pollution equipment in use or in existence at the source, (4) the remaining useful life of the source, and (5) the degree of improvement in visibility which may reasonably be anticipated to result from the use of such technology."[1] A BART analysis is a comprehensive evaluation of potential retrofit technologies with respect to the five criteria above. At the conclusion of the BART analysis, a technology and corresponding emission limit is chosen for each pollutant for each unit subject to BART.

Visibility control options presented in the application for each source were reviewed using the methodology prescribed in 40 CFR 51 Appendix Y, as required in WAQSR Chapter 6 Section 9(c)(i). This methodology is comprised of five basic steps:

Step 1: Identify all[2] available retrofit control technologies
Step 2: Eliminate technically infeasible options
Step 3: Evaluate control effectiveness of remaining control technologies
Step 4: Evaluate impacts and document the results
Step 5: Evaluate visibility impacts

[1] 40 CFR Part 51 Appendix Y: Guidelines for BART Determinations under the Regional Haze Rule (70 Federal Register 39163).
[2] Footnote 12 of 40 CFR 51 Appendix Y defines the intended use of 'all' by stating "…you must identify the most stringent option and a reasonable set of options for analysis that reflects a comprehensive list of available technologies."

The Division acknowledges that BART is intended to identify retrofit technology for existing sources and is not the same as a top down analysis required for new sources under the Prevention of Significant Deterioration (PSD) rules known as Best Available Control Technology (BACT). Although BART is not the same as BACT, it is possible that BART may be equivalent to BACT on a case-by-case basis. The Division applied all five steps to each visibility impairing pollutant emitted from Wyodak Unit 1 thereby conducting a comprehensive BART analysis for NO_x, SO_2 and PM/PM_{10}.

PRESUMPTIVE LIMITS FOR SO_2 AND NO_X FROM UTILITY BOILERS

EPA conducted detailed analyses of available retrofit technology to control NO_x and SO_2 emissions from coal-fired power plants. These analyses considered unit size, fuel type, cost effectiveness, and existing controls to determine reasonable control levels based on the application of an emissions reduction technology.

EPA's presumptive BART SO_2 limits analysis considered coal-fired units with existing SO_2 controls and units without existing control. Four key elements of the analysis were: "…(1) identification of all potentially BART-eligible EGUs [electric generating units], and (2) technical analyses and industry research to determine applicable and appropriate SO_2 control options, (3) economic analysis to determine cost effectiveness for each potentially BART-eligible EGU, and (4) evaluation of historical emissions and forecast emission reduction for each potentially BART-eligible EGU."[3] 491 BART-eligible coal-fired units were identified and included in the presumptive BART analysis for SO_2. Based on removal efficiencies of 90% for spray dry lime dry flue gas desulfurization systems and 95% for limestone forced oxidation wet flue gas desulfurization systems, EPA calculated projected SO_2 emission reductions and cost effectiveness for each unit. Based on the results of this analysis, EPA concluded that the majority of identified BART-eligible units greater than 200 MW without existing SO_2 control can meet the presumptive limits at a cost of $400 to $2,000 per ton of SO_2 removed.

A presumptive BART NO_x limits analysis was performed using the same 491 BART-eligible coal-fired units identified in the SO_2 presumptive BART analysis. EPA considered the same four key elements and established presumptive NO_x limits for EGUs based coal type and boiler configuration. For all boiler types, except cyclone, presumptive limits were based on combustion control technology (e.g., low NO_x burners and overfire air). Presumptive NO_x limits for cyclone boilers are based on the installation of SCR, a post combustion add-on control. EPA acknowledged that approximately 25% of the reviewed units could not meet the proposed limits based on current combustion control technology, but that nearly all the units could meet the presumptive limits using advanced combustion control technology, such as rotating opposed fire air. National average cost effectiveness values for presumptive NO_x limits ranged from $281 to $1,296 per ton removed.

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[3] 40 CFR Part 51 Appendix Y: Guidelines for BART Determinations under the Regional Haze Rule (70 Federal Register 39133).

Based on the results of the analyses for presumptive NO_x and SO_2 limits, EPA established presumptive limits for EGUs greater than 200 MW operating without NO_x post combustion controls or existing SO_2 controls located at facilities with a generating capacity greater than 750 MW. 40 CFR part 51 Appendix Y states that the presumptive SO_2 level for an uncontrolled unit is either 95% control or 0.15 lb/MMBtu. Presumptive NO_x levels for uncontrolled units are listed in Table 1 of Appendix Y and classified by the boiler burner configuration (unit type) and coal type. NO_x emission values range from 0.62 lb/MMBtu down to 0.15 lb/MMBtu. While Appendix Y establishes presumptive SO_2 limits and says that states should require presumptive NO_x, it also clearly gives states discretion to "…determine that an alternative [BART] control level is justified based on a careful consideration of the statutory factors."[4] The Division's following BART analysis for NO_x, SO_2, and PM/PM_{10} takes into account each of the five statutory factors.

PacifiCorp's Wyodak Power Plant generates nominal 335 MW from the single unit. A three-tower lime-based spray dryer currently controls SO_2 emissions. The unit does not have NO_x post-combustion controls. Presumptive SO_2 limit of 95% reduction or 0.15 lb/MMBtu and presumptive NO_x limit of 0.23 lb/MMBtu, based on unit type and coal type, do not apply to Unit 1 since the cumulative generating capacity of the facility is less than 750 MW. Before making a BART determination for Unit 1, the Division analyzed potential retrofit controls for NO_x, SO_2, and PM/PM_{10}, taking into consideration all five statutory factors. The analysis is presented below.

NO_x: IDENTIFY AVAILABLE RETROFIT CONTROL TECHNOLOGIES

PacifiCorp identified four control technologies to control NO_x emissions: (1) low NO_x burners with advanced overfire air, (2) rotating opposed fire air (ROFA), (3) selective non-catalytic reduction (SNCR), and (4) selective catalytic reduction (SCR). LNB with advanced OFA and ROFA are two combustion control technologies that reduce NO_x emissions by controlling the combustion process within the boiler. These two technologies have been demonstrated to effectively control NO_x emissions by reducing the amount of oxygen directly accessible to the fuel during combustion creating a fuel-rich environment and by enhancing control of air-fuel mixing throughout the boiler's combustion zone. SNCR and SCR are add-on controls that provide a chemical conversion mechanism for NO_x to form molecular nitrogen (N_2) in the flue gas after combustion occurs. These four technologies are proven emissions controls commonly used on coal-fired electric generating units.

1. Low NO_x Burners with Advanced Overfire Air – LNB technologies can rely on a combination of fuel staging and combustion air control to suppress the formation of thermal NO_x. Fuel staging occurs in the very beginning of combustion, where the pulverized coal is injected through the burner into the furnace. Careful control of the fuel-air mixture leaving the burner can limit the amount of oxygen available to the fuel during combustion creating a fuel rich zone that reduces the nitrogen to molecular nitrogen (N_2) rather than using oxygen in the combustion air to oxidize the nitrogen to NO_x. The addition of advanced overfire air provides additional NO_x control by injecting air into the lower temperature combustion zone when NO_x is less likely to form. This allows complete combustion of the fuel while reducing both thermal and chemical NO_x formation.

[4] Ibid. (70 Federal Register 39171).

2. Rotating Opposed Fire Air – ROFA can be used with LNB technology to control the combustion process inside the boiler. Similar to the advanced overfire air technology discussed above, ROFA manipulates the flow of combustion air to enhance fuel-mixing and air-flow characteristics within the boiler. By inducing rotation of the combustion air within the boiler, ROFA can reduce the number of high temperature combustion zones in the boiler and increase the effective heat absorption. Both of which effectively reduce the formation of NO_x caused by fuel combustion within the boiler.

3. Selective Non-Catalytic Reduction – SNCR is similar to SCR in that it involves the injection of a reducing agent such as ammonia or urea into the flue gas stream. The reduction chemistry, however, takes place without the aid of a catalyst. SNCR systems rely on appropriate injection temperatures, proper mixing of the reagent and flue gas, and prolonged retention time in place of the catalyst. SNCR operates at higher temperatures than SCR. The effective temperature range for SNCR is 1,600 to 2,100°F. SNCR systems are very sensitive to temperature changes and typically have lower NO_x emissions reduction (up to fifty or sixty percent) and may emit ammonia out of the exhaust stack when too much ammonia is added to the system.

4. Selective Catalytic Reduction – SCR is a post combustion control technique in which vaporized ammonia or urea is injected into the flue gas upstream of a catalyst. NO_x entrained in the flue gas is reduced to molecular nitrogen (N_2) and water. The use of a catalyst facilitates the reaction at an exhaust temperature range of 300 to 1,100°F, depending on the application and type of catalyst used. When catalyst temperatures are not in the optimal range for the reduction reaction or when too much ammonia is injected into the process, unreacted ammonia can be released to the atmosphere through the stack. This release is commonly referred to as ammonia slip. A well controlled SCR system typically emits less ammonia than a comparable SNCR control system.

In addition to applying these control technologies separately, they can be combined to increase overall NO_x reduction. PacifiCorp evaluated the application of LNB with advanced OFA in combination with both SNCR and SCR add-on controls.

NO_x: ELIMINATE TECHNICALLY INFEASIBLE OPTIONS

None of the four control technologies proposed to control NO_x emissions were deemed technically infeasible by PacifiCorp.

NO_x: EVALUATE EFFECTIVENESS OF REMAINING CONTROL TECHNOLOGIES

The Division considers the control effectiveness of a proposed control technology to be equivalent to the BART-determined permit limit. The limit is based on continuous compliance when the control equipment is well maintained and operated in a manner consistent with good air pollution control practices for minimizing emissions. In order to demonstrate continuous compliance with the permit limit it is important to consider that even well maintained and operated equipment will have some emissions variability. Complex emission control equipment, such as LNB with advanced OFA, generally have inherent variability that must be considered when establishing the limit. Otherwise, the source will be out of compliance even though the equipment is operated and maintained as well as possible.

PacifiCorp contracted with Sargent and Lundy (S&L) to conduct a study of applicable NO_x control technologies for the Wyodak unit and to collect data from boiler vendors. Based on results from the study, PacifiCorp indicates that new LNB with advanced OFA on Wyodak Unit 1 would result in a NO_x emission rate of 0.23 lb/MMBtu. On page 3-4 of the December 2007 submittal PacifiCorp states: "PacifiCorp has indicated that this rate [0.23 lb/MMBtu] corresponds to a vendor guarantee plus an added operating margin, not a vendor prediction, and they believe that this emission rate can be sustained as an average between overhauls."

PacifiCorp worked with Mobotec to conduct an analysis of retrofitting the existing boiler at the Wyodak Power Plant with Mobotec's ROFA. Mobotec analyzed the operation of existing burners and OFA ports. Typically the existing burner system does not require modification and the existing OFA ports are not used by a new ROFA system. Instead, computational fluid modeling is performed to determine the location of the new ROFA ports. Mobotec concluded that a NO_x emission rate of 0.18 lb/MMBtu was achievable on Unit 1 using ROFA technology. PacifiCorp added an additional operating margin of 0.02 lb/MMBtu to Unit 1 to account for site specific issues, such as feed coal variance, for total proposed emission rate of 0.20 lb/MMBtu.

S&L evaluated emission reductions associated with installing SNCR in addition to retrofitting the boilers with LNB with advanced OFA. Based on installing LNB with advanced OFA capable of achieving a NO_x emission rate of 0.23 lb/MMBtu on Unit 1, S&L concluded that SNCR can reduce emissions by 20% resulting in projected NO_x emission rate of 0.18 lb/MMBtu. PacifiCorp noted in the analysis that the economics of SNCR are greatly impacted by reagent utilization. When SNCR is used to achieve high levels of NO_x reduction, lower reagent utilization can result in significantly higher operating cost. PacifiCorp did not model visibility improvement from installing SNCR on Unit 1 on account of the expected marginal emission rate improvement, the burden of significant ongoing parasitic costs, the operating difficulties, and the potential ammonia slip.

S&L prepared the design conditions and cost estimates for installing SCR on Wyodak Unit 1. A high-dust SCR configuration, where the catalyst is located downstream from the boiler economizer before the air heater and any particulate control equipment, was used in the analysis. The flue gas ducts would be routed to a separate reactor containing the catalyst to increase physical space occupied by the catalyst to improve the NO_x removal rate. Additional catalyst would be added to accommodate nitrogen levels in the coal feedstock. Based on the S&L design, which included installing both LNB with advanced OFA and SCR, PacifiCorp concluded Unit 1 can achieve a NO_x emission rate of 0.07 lb/MMBtu.

Table 3: Wyodak Unit 1 Boiler NO_x Emission Rates

Control Technology	Resulting NO_x Emission Rate (lb/MMBtu)
Existing LNB	0.31 [(a)]
New LNB with advanced OFA	0.23
Existing burners with ROFA	0.20
New LNB with advanced OFA and SNCR	0.18
New LNB with advanced OFA and SCR	0.07

[(a)] Operating Permit 3-1-101-1 annual averaged NO_x emissions established through 40 CFR part 76.

NO_x: EVALUATE IMPACTS AND DOCUMENT RESULTS

PacifiCorp evaluated the energy impacts associated with installing each of the proposed control technologies. Replacing the existing LNB with new LNB with advanced OFA will not significantly impact the boiler efficiency or forced draft fan power usage, two common boiler features for adverse energy impact often affected by changes in boiler combustion.

Installing the Mobotec ROFA system has a significant energy impact on Wyodak. One 7,000 horsepower (hp) ROFA fan on Unit 1 is required to induct a sufficient volume of air into the boiler to cause rotation of the combustion air throughout the boiler. The annual energy impact from operating the proposed ROFA fan is 41,200 Mega Watt-hour (MW-hr).

PacifiCorp determined the SNCR system would require 340 kilo Watt (kW) of additional power to operate pretreatment and injection equipment, pumps, compressors, and control systems. In addition to energy costs associated with the reagent handling and injection, installation of the SCR catalyst will require additional power from the existing flue gas fan systems to overcome the pressure drop across the catalyst. Based on the S&L study, PacifiCorp estimated the additional power requirement for SCR installation on Unit 1 would be approximately 2.4 MW.

PacifiCorp evaluated the environmental impacts from the proposed NO_x control technologies. Installing LNB with advanced OFA may increase carbon monoxide (CO) emissions and unburned carbon in the ash, commonly referred to as loss on ignition (LOI). Mobotec has predicted CO emissions and LOI would be the same or lower than prior levels for the ROFA system. The installation of SNCR and SCR could impact the saleability and disposal of fly ash due to higher ammonia levels, and could potentially create a visible stack plume sometimes referred to as a blue plume, if the ammonia injection rate is not well controlled. Other environmental impacts involve the storage of ammonia, especially if anhydrous ammonia is used, and transportation of the ammonia to the power plant site.

PacifiCorp anticipates operating Wyodak Unit 1 indefinitely and did not include life extension costs in the economic analysis. A standard control life of 20 years was used to calculate the capital recovery factor. The annual cost to control was determined using a capital recovery factor based on a 7.1% interest rate. PacifiCorp labor and service costs were used to calculate the annual operating and maintenance costs. Annual power costs, including a cost escalation factor, associated with the operation of pollution controls were included.

Several different metrics can be considered when evaluating the cost-benefit relationships of different emission control technologies. In 40 CFR part 51 Appendix Y two metrics are specifically mentioned: cost effectiveness and incremental cost effectiveness. Through the application of BACT, the Division has extensive experience using cost effectiveness (i.e., dollars per ton of pollutant removed) to evaluate different control technologies. Incremental cost effectiveness is also used extensively by the Division when comparing emission controls under the BACT process. While the BART and the BACT processes are not necessarily equivalent, control determinations from either process are based on cost effectiveness and incremental cost effectiveness and are indicative of the economic costs to control emissions. In addition to providing cost effectiveness and incremental cost effectiveness results, PacifiCorp provided cost information in terms of cost of applying emission controls and the level of visibility improvement achieved (i.e., dollars per deciviews). While this metric can illustrate the control cost and visibility improvement differences between control options, it is not commonly used to assess the overall effectiveness of pollution control equipment. When performing the presumptive BART limits analyses for NO_x and SO_2, EPA addressed cost effectiveness and incremental cost effectiveness separate from visibility improvement. EPA did not use the dollars per deciview metric to compare control options. Visibility improvements from the application of the analyzed control measures used to establish presumptive levels were addressed in a separate visibility analysis. As discussed in the comprehensive visibility analysis presented later in this analysis as Step 5: Evaluate visibility impacts, the Division evaluated the amount of anticipated visibility improvement gained by the application of additional emission control technology. The Division considered capital cost, annual cost, cost effectiveness, and incremental cost effectiveness in the evaluation of each proposed NO_x emission control. Economic and environmental costs for additional NO_x controls on Wyodak Unit 1 are summarized in the following tables.

Table 4: Wyodak Unit 1 Economic Costs

Cost	Existing LNB	New LNB with advanced OFA	Existing Burners with ROFA	New LNB with advanced OFA and SNCR	New LNB with advanced OFA and SCR
Control Equipment Capital Cost	$0	$13,100,000	$15,252,149	$19,495,654	$171,900,000
Capital Recovery Factor	N/A	0.09513	0.09513	0.09513	0.09513
Annual Capital Recovery Costs	$0	$1,246,203	$1,450,937	$1,854,622	$16,352,847
Annual O&M Costs	$0	$60,000	$2,147,685	$452,106	$2,557,934
Annual Cost of Control	$0	$1,306,203	$3,598,622	$2,306,728	$18,910,781

Table 5: Wyodak Unit 1 Environmental Costs

	Existing LNB	New LNB with advanced OFA	Existing Burners with ROFA	New LNB with advanced OFA and SNCR	New LNB with advanced OFA and SCR
NO_x Emission Rate (lb/MMBtu)	0.31	0.23	0.20	0.18	0.07
Annual NO_x Emission (tpy) [a]	5,744	4,261	3,706	3,335	1,297
Annual NO_x Reduction (tpy)	N/A	1,483	2,038	2,409	4,447
Annual Cost of Control	$0	$1,306,203	$3,598,622	$2,306,728	$18,910,781
Cost per ton of Reduction	N/A	$881	$1,766	$958	$4,252
Incremental Cost per ton of Reduction	N/A	$881	$4,130	-$3,482 [b]	$8,147

[a] Annual emissions based on unit heat input rate of 4,700 MMBtu/hr and 7,884 hours of operation per year.
[b] Incremental cost is negative because the annual cost of control for existing burners with ROFA is significantly higher than new LNB with advanced OFA and SNCR.

The cost effectiveness of the four proposed BART technologies for NO_x are all reasonable. The incremental cost effectiveness is reasonable for all NO_x control technologies. PacifiCorp modeled the range of anticipated visibility improvement from the company-proposed BART controls for Unit 1 by modeling LNB with advanced OFA and LNB with advanced OFA and SCR. While the installation of SNCR and ROFA were not individually evaluated in Step 5: Evaluate visibility impact, the anticipated degree of visibility improvement from applying either control lies within the modeled range of visibility impacts.

The final step in the NO_x BART determination process for Wyodak Unit 1, Step 5: Evaluate visibility impacts, is addressed in a comprehensive visibility analysis covering all three visibility impairing pollutants. The visibility analysis follows Steps 1-4 for SO_2 emissions in this application analysis. Table 15 on page 28 lists the modeled control scenarios and associated emission rates.

<u>PM_{10}: IDENTIFY AVAILABLE RETROFIT CONTROL TECHNOLOGIES</u>

Wyodak Unit 1 is currently equipped with an electrostatic precipitator (ESP) to control PM emissions from the boiler. As discussed below in more detail below, ESPs control PM/PM_{10} from the flue gas stream by creating a strong electro-magnetic field in which fly ash particles gain electric charge. While the current PM_{10} emission limit for Unit 1 is 0.10 lb/MMBtu, PacifiCorp states that the existing ESP is achieving controlled PM/PM_{10} emissions of 0.030 lb/MMBtu. PacifiCorp analyzed three technologies for additional PM control: fabric filters or baghouses, ESPs, and flue gas conditioning.

1. <u>Fabric filters (FF)</u> – FF are woven pieces of material that collect particles with sizes ranging from submicron to several hundred microns in diameter at efficiencies generally in excess of 99%. The layer of dust trapped on the surface of the fabric, commonly referred to as dust cake, is primarily responsible for such high efficiency. Joined pores within the cake act as barriers to trap particulate matter too large to flow through the pores as it travels through the cake. Limitations are imposed by the temperature and corrosivity of the gas and by adhesive properties of the particles. Most of the energy used to operate the system results from pressure drop across the bags and associated hardware and ducting.

2. Electrostatic precipitators – ESPs use electrical forces (charge) to move particulate matter out the gas stream onto collection plates. The particles are given an electrical charge by directing the gas stream through a corona, or region of gaseous ion flow. The charged particles are acted upon by an induced electrical field from high voltage electrodes in the gas flow that forces them to the walls or collection plates. Once the particles couple with the collection plates, they must be removed without re-entraining them into the gas stream. In dry ESP applications, this is usually accomplished by physically knocking them loose from the plates and into a hopper for disposal. Wet ESPs use water to wash the particles from the collector plates into a sump. The efficiency of an ESP is primarily determined by the resistivity of the particle, which is dependent on chemical composition, and also by the ability to clean the collector plates without reintroducing the particles back into the flue gas stream.

3. Flue Gas Conditioning (FGC) – Injecting a conditioning medium, typically SO_3, into the flue gas can lower the resistivity of the fly ash, improving the particles' ability to gain an electric charge. If the material is injected upstream of an ESP the flue gas particles more readily accept charge from the corona and are drawn to the collection plates. Adding FGC can account for large improvements in PM collection efficiency for existing ESPs that are constrained by space and flue gas residence time.

PM_{10}: ELIMINATE TECHNICALLY INFEASIBLE OPTIONS

PacifiCorp did not eliminate the use of the existing ESP with a polishing fabric filter or installing a new full-scale fabric filter to control PM/PM_{10} emissions as technically infeasible. However, PacifiCorp did not further analyze the use of FGC or installing a new full-scale fabric filter. According to PacifiCorp, the existing ESP on Unit 1 is well designed and provides adequate space and residence time for the flue gas particles to gain an electric charge and migrate to the collection plate. The application of FGC is not expected to significantly improve PM/PM_{10} removal efficiency. Installing a new full-scale fabric filter is cost-prohibitive in comparison to installing a polishing fabric filter on the existing ESP, which can achieve the same PM/PM_{10} emission rate.

PM_{10}: EVALUATE EFFECTIVENESS OF REMAINING CONTROL TECHNOLOGIES

The Division considers the control effectiveness of a proposed control technology to be equivalent to the BART-determined permit limit. The limit is based on continuous compliance when the control equipment is well maintained and operated in a manner consistent with good air pollution control practices for minimizing emissions. In order to demonstrate continuous compliance with the permit limit it is important to consider that even well maintained and operated equipment will have some emissions variability. Complex emission control equipment, such as electrostatic precipitators, generally have inherent variability that must be considered when establishing the limit. Otherwise, the source will be out of compliance even though the equipment is operated and maintained as well as possible.

Unit 1 has an existing ESP and rather than evaluate costs of replacing the unit, PacifiCorp evaluated additional controls to improve the PM removal efficiency. An ESP is an effective PM control device, as the existing unit is already capable of controlling PM_{10} emissions from Unit 1 to 0.030 lb/MMBtu. The technology continually improves and is commonly proposed for consideration in BACT analyses to control particulate emissions from new PC boilers. In addition to maintaining the existing ESP, a polishing fabric filter can be installed downstream of the existing ESPs. PacifiCorp proposed the use of Compact Hybrid Particulate Collector (COHPAC) licensed by Electric Power Research Institute (EPRI).

The COHPAC unit is smaller than a full-scale fabric filter and has a higher air-to-cloth ratio (7 to 9:1), compared to a full-size pulse jet fabric filter (3.5 to 4:1). COHPAC is effective at controlling particulates not captured by the primary PM control device, but is not designed to treat high PM concentrations in the entire flue gas stream immediately downstream of the boiler. The existing ESP must remain in service for the COHPAC fabric filter to effectively reduce PM/PM_{10} emissions. PacifiCorp estimates the application of the COHPAC unit in addition to using the existing ESP on Unit 1 can reduce emissions an additional 50% resulting in a PM_{10} emission rate of 0.015 lb/MMBtu. PacifiCorp did not further evaluate the installation on a new full-scale fabric filter on Unit 1 since there is a substantial capital cost associated with the control and no anticipated benefit when compared to COHPAC.

Table 6: Wyodak Unit 1 Boiler PM_{10} Emission Rates

Source	Existing ESP PM_{10} Emission (lb/MMBtu)	Existing ESP With Polishing Fabric Filter PM_{10} Emission (lb/MMBtu)
Unit 1	0.030	0.015

PM_{10}: EVALUATE IMPACTS AND DOCUMENT RESULTS

PacifiCorp evaluated the energy impact of installing COHPAC on Unit 1. The pressure drop created by the fabric filter and associated ductwork requires additional energy from the existing draft fan, which will have to be upgraded. PacifiCorp calculated the additional energy costs based on a 90 percent annual plant capacity factor. The installation of a COHPAC fabric filter would require approximately 2.1 MW of power, equating to an annual power usage of approximately 16,200 MW-hr.

PacifiCorp evaluated the environmental impacts from the proposed installation of COHPAC on Unit 1 and did not anticipate negative environmental impacts from the addition of this PM control technology.

PacifiCorp anticipates operating Wyodak Unit 1 indefinitely and did not include life extension costs in the economic analysis. A standard control life of 20 years was used to calculate the capital recovery factor. The annual cost to control was determined using a capital recovery factor based on a 7.1% interest rate. PacifiCorp labor and service costs were used to calculate the annual operating and maintenance costs. Annual power costs, including a cost escalation factor, associated with the operation of pollution controls were included.

Several different metrics can be considered when evaluating the cost-benefit relationships of different emission control technologies. In 40 CFR part 51 Appendix Y two metrics are specifically mentioned: cost effectiveness and incremental cost effectiveness. Through the application of BACT, the Division has extensive experience using cost effectiveness (i.e., dollars per ton of pollutant removed) to evaluate different control technologies. Incremental cost effectiveness is also used extensively by the Division when comparing emission controls under the BACT process. While the BART and the BACT processes are not necessarily equivalent, control determinations from either process are based on cost effectiveness and incremental cost effectiveness and are indicative of the economic costs to control emissions. In addition to providing cost effectiveness and incremental cost effectiveness results, PacifiCorp provided cost information in terms of cost of applying emission controls and the level of visibility improvement achieved (i.e., dollars per deciviews). While this metric can illustrate the control cost and visibility improvement differences between control options, it is not commonly used to assess the overall effectiveness of pollution control equipment. When performing the presumptive BART limits analyses for NO_x and SO_2, EPA addressed cost effectiveness and incremental cost effectiveness separate from visibility improvement. EPA did not use the dollars per deciview metric to compare control options. Visibility improvements from the application of the analyzed control measures used to establish presumptive levels were addressed in a separate visibility analysis. As discussed in the comprehensive visibility analysis presented later in this analysis as Step 5: Evaluate visibility impacts, the Division evaluated the amount of anticipated visibility improvement gained by the application of additional emission control technology. The Division considered capital cost, annual cost, cost effectiveness, and incremental cost effectiveness in the evaluation of the proposed PM/PM_{10} emission control. Economic and environmental costs for additional PM/PM_{10} control on Wyodak Unit 1 are summarized in the following tables.

Table 7: Wyodak Unit 1 Economic Costs

Cost	Existing ESP	Existing ESP with New Polishing Fabric Filter
Control Equipment Capital Cost	$0	$32,630,832
Capital Recovery Factor	N/A	0.09513
Annual Capital Recovery Costs	$0	$3,104,171
Annual O&M Costs	$0	$1,120,709
Annual Cost of Control	$0	$4,224,880

Table 8: Wyodak Unit 1 Environmental Costs

	Existing ESP	Exiting ESP with New Polishing Fabric Filter
PM_{10} Emission Rate (lb/MMBtu)	0.030	0.015
Annual PM_{10} Emission (tpy) [a]	556	278
Annual PM_{10} Reduction (tpy)	N/A	278
Annual Cost of Control	$0	$4,224,880
Cost per ton of Reduction	N/A	$15,197
Incremental Cost per ton of Reduction	N/A	$15,197

[a] Annual emissions based on unit heat input rate of 4,700 MMBtu/hr and 7,884 hours of operation per year.

The cost effectiveness and incremental cost effectiveness of applying a new polishing fabric filter to Unit 1 are not reasonable. However, the control was included in the final step in the PM/PM_{10} BART determination process for Wyodak Unit 1, Step 5: Evaluate visibility impacts, which is addressed in a comprehensive visibility analysis covering all three visibility impairing pollutants. The visibility analysis follows Steps 1-4 for SO_2 emissions in this application analysis. Table 15 on page 28 lists the modeled control scenarios and associated emission rates.

SO_2: IDENTIFY AVAILABLE RETROFIT CONTROL TECHNOLOGIES

PacifiCorp reviewed a broad range of informative sources, including EPA's RACT/BACT/LAER clearinghouse, in an effort to identify applicable SO_2 emission control technologies for Wyodak Unit 1. Based on the results of this review, PacifiCorp proposed wet flue gas desulfurization (WFGD) and dry flue gas desulfurization (DFGD) as potential retrofit technologies to reduced SO_2 emissions.

1. Wet FGD – SO_2 is removed through absorption by mass transfer as soluble SO_2 in the exhaust gas mixture is dissolved in an alkaline water solvent that has low volatility under process conditions. SO_2 diffuses from the gas into the scrubber water when the liquid contains less than the equilibrium concentration of the gaseous SO_2. The rate of SO_2 mass transfer between the two phases is largely dependent on the surface area exposed and the time of contact. A properly designed wet scrubber or gas absorber will provide sufficient contact between the gas and the liquid solvent to allow diffusion of SO_2. Once the SO_2 enters the alkaline water phase, it will form a weak acid and react with the alkaline component dissolved in the scrubber water to form a sulfate (SO_4) or sulfite (SO_3). The acid/alkali chemical reaction prevents the SO_2 from diffusing back into the flue gas stream. When the alkaline scrubber water is saturated with sulfur compounds, it can be converted to a wet gypsum by-product that may be sold. SO_2 removal efficiencies for wet scrubbers can be as high as 99%.

2. Dry FGD – Dry scrubbers are similar to sorbent injection systems in that both systems introduce media directly into the flue gas stream, however the addition of the dry scrubber vessel provides greater contact area for adsorption and enhances chemical reactivity. A spray dryer dry scrubber sprays an atomized alkaline slurry into the flue gas upstream of particulate control system, often a fabric filter. Water in the slurry evaporates, hydrolizing the SO_2 into a weak acid, which reacts with the alkali to form a sulfate or sulfite. The resulting dry product is captured in the particulate control and physically moved from the exhaust gas into a storage bin. The dry by-product may be dissolved back into the lime slurry or dried and sold as a gypsum by-product. Spray dryer dry scrubbers typically require lower capital cost than a wet scrubber. They also require less flue gas after-treatment. When exhaust gas leaves the wet scrubber, it is at or near saturation. A wet scrubber can lower exhaust gas temperatures down into a temperature range of 110 to 140°F, which may lead to corrosive condensation in the exhaust stack. A spray dryer dry scrubber does not enhance stack corrosion like a wet scrubber because it will not saturate the exhaust gas or significantly lower the gas temperature. Removal efficiencies for spray dryer dry scrubbers can range from 70% to 95%.

SO_2: ELIMINATE TECHNICALLY INFEASIBLE OPTIONS

PacifiCorp did not eliminate either control technology listed above as technically infeasible. Both dry FGD and wet FGD are proven SO_2 control technologies. PacifiCorp analyzed the impact of both SO_2 emission reduction technologies on Wyodak Unit 1.

SO_2: EVALUATE EFFECTIVENESS OF REMAINING CONTROL TECHNOLOGIES

The Division considers the control effectiveness of a proposed control technology to be equivalent to the BART-determined permit limit. The limit is based on continuous compliance when the control equipment is well maintained and operated in a manner consistent with good air pollution control practices for minimizing emissions. In order to demonstrate continuous compliance with the permit limit it is important to consider that even well maintained and operated equipment will have some emissions variability. Complex emission control equipment, such as dry FGD, generally have inherent variability that must be considered when establishing the limit. Otherwise, the source will be out of compliance even though the equipment is operated and maintained as well as possible.

PacifiCorp determined that Wyodak Unit 1 has an uncontrolled SO_2 emission rate of 1.61 lb/MMBtu, based on an average coal sulfur content of 0.65% by weight. The existing three column dry scrubber currently reduces SO_2 emissions by approximately 69% to achieve the SO_2 emission limit of 0.50 lb/MMBtu. Upgrading the existing dry FGD system by eliminating bypass flue gas flow, placing new static mixers to redistribute the flue gas flow prior to the ESP, increasing the reagent feed ratio, and increasing the recycle ratio is projected to reduce SO_2 emissions by 80% from uncontrolled levels, based on an average sulfur content in the feed coal of 0.65% by weight. The resulting SO_2 emission rate would be 0.32 lb/MMBtu.

If the existing ESP is replaced with a new full-scale fabric filter downstream of the lime spray dryer, the dry FGD system is projected to achieve 90% SO_2 removal after the aforementioned upgrades are applied to the dry scrubber. Based on an average sulfur content of 0.65% by weight, the resulting SO_2 emission rate is 0.16 lb/MMBtu.

PacifiCorp evaluated the application of wet FGD on Wyodak Unit 1. A new wet FGD would likely use lime/limestone forced oxidation scrubbing, which is available in several variations from vendors. Wet lime/limestone scrubbing is projected to achieve a SO_2 removal rate of 95% resulting in an outlet SO_2 emission rate of 0.08 lb/MMBtu, based on a sulfur content of 0.65% by weight in the feed coal. PacifiCorp's proposed emission rates for each SO_2 emission reduction technology applied to Wyodak Unit 1 are shown in Table 9.

Table 9: Wyodak Unit 1 SO_2 Emission Rates

Control Technology	SO_2 Emission Rate (lb/MMBtu)
Existing Dry FGD	0.50
Upgraded Dry FGD with existing ESP	0.32
Upgraded Dry FGD with full-scale Fabric Filter	0.16
Wet Lime FGD with existing ESP	0.08

<u>SO_2: EVALUATE IMPACTS AND DOCUMENT RESULTS</u>

PacifiCorp evaluated the energy impacts of upgrading the existing dry FGD system with the existing ESP on Wyodak Unit 1. Dry FGD requires less electric power than a wet FGD system. Upgrading the current dry FGD system with the existing ESP at Wyodak would require approximately 0.1 MW of additional power. Upgrading the existing dry FGD and installing a new polishing fabric filter would require 0.2 MW, while a new wet FGD would require approximately 1.8 MW. Using a 90% annual plant capacity factor, upgrading the existing dry FGD and installing a full-scale fabric filter equates to an annual power savings of approximately 12,600 MW-hr as opposed to installing and operating a new wet FGD system.

PacifiCorp compared the environmental impacts of dry FGD versus wet FGD technology. PacifiCorp concluded that dry FGD has five significant environmental advantages over wet FGD. These advantages are taken directly from PacifiCorp's environmental analysis for SO_2 controls on Wyodak Unit 1 and listed below.

- Sulfuric Acid Mist Sulfur trioxide (SO_3) in the flue gas, which condenses to liquid sulfuric acid at temperatures below the acid dew point, is removed efficiently with a lime spray dryer system. Wet scrubbers capture less than 40 to 60 percent of SO_3 and may require the addition of a wet electrostatic precipitator (ESP) or hydrated lime injection when medium to high sulfur coal is burned in a unit to remove the balance of SO_3. Otherwise, the emission of sulfuric acid mist, if above a threshold value, may result in a visible plume after the vapor plume dissipates.

- Plume Buoyancy Flue gas following a dry FGD system is not saturated with water (gas temperature 30°F to 50°F above dew point), which reduces or eliminates a visible moisture plume. Wet FGD scrubbers produce flue gas saturated with water, which would require a gas-gas heat exchanger to reheat the flue gas if it were to operate as a dry stack. Because of the high capital and operating costs associated with heating the flue gas, all recent wet FGD systems in the United States have used wet stack operation.

- Liquid Waste Disposal There is no liquid waste from a dry FGD system. However, wet FGD systems produce a wastewater blowdown stream that must be treated to limit chloride buildup in the absorber scrubbing loop. In some cases, a wastewater treatment plant must be installed to treat the liquid waste prior to disposal. The wastewater treatment plant would produce a small volume of solid waste, which may be contaminated with toxic metals (including mercury), requiring proper disposal.

- Solid Waste Disposal The creation of a wet sludge from the wet FGD process creates a solid waste handling and disposal challenge. This sludge must be handled properly to prevent groundwater contamination. Wet FGD systems can produce saleable gypsum if a gypsum market is available, reducing the quantity of solid waste from the power plant to be disposed.

- Makeup Water Requirements Dry FGD has advantages over a wet scrubber, producing a dry waste material and requiring less makeup water in the absorber. Given that water is a valuable commodity in Wyoming, the reduced water consumption required for dry FGD is major advantage for this technology.

PacifiCorp anticipates operating Wyodak Unit 1 indefinitely and did not include life extension costs in the economic analysis. A standard control life of 20 years was used to calculate the capital recovery factor. The annual cost to control was determined using a capital recovery factor based on a 7.1% interest rate. PacifiCorp labor and service costs were used to calculate the annual operating and maintenance costs. Annual power costs, including a cost escalation factor, associated with the operation of pollution controls were included.

Several different metrics can be considered when evaluating the cost-benefit relationships of different emission control technologies. In 40 CFR part 51 Appendix Y two metrics are specifically mentioned: cost effectiveness and incremental cost effectiveness. Through the application of BACT, the Division has extensive experience using cost effectiveness (i.e., dollars per ton of pollutant removed) to evaluate different control technologies. Incremental cost effectiveness is also used extensively by the Division when comparing emission controls under the BACT process. While the BART and the BACT processes are not necessarily equivalent, control determinations from either process are based on cost effectiveness and incremental cost effectiveness and are indicative of the economic costs to control emissions. In addition to providing cost effectiveness and incremental cost effectiveness results, PacifiCorp provided cost information in terms of cost of applying emission controls and the level of visibility improvement achieved (i.e., dollars per deciviews). While this metric can illustrate the control cost and visibility improvement differences between control options, it is not commonly used to assess the overall effectiveness of pollution control equipment. When performing the presumptive BART limits analyses for NO_x and SO_2, EPA addressed cost effectiveness and incremental cost effectiveness separate from visibility improvement. EPA did not use the dollars per deciview metric to compare control options. Visibility improvements from the application of the analyzed control measures used to establish presumptive levels were addressed in a separate visibility analysis. As discussed in the comprehensive visibility analysis presented later in this analysis as Step 5: Evaluate visibility impacts, the Division evaluated the amount of anticipated visibility improvement gained by the application of additional emission control technology. The Division considered capital cost, annual cost, cost effectiveness, and incremental cost effectiveness in the evaluation of each proposed SO_2 emission control. Economic and environmental costs for additional SO_2 controls on Wyodak Unit 1 are summarized in the following tables.

Table 10: Wyodak Unit 1 Economic Costs

Cost	Existing Dry FGD with existing ESP	Upgraded Dry FGD with existing ESP	Upgraded Dry FGD with new full-scale Fabric Filter	New Wet FGD
Control Equipment Capital Cost	$0	$26,759,011	$66,777,531	$95,136,483
Capital Recovery Factor	N/A	0.09513	0.09513	0.09513
Annual Capital Recovery Costs	$0	$2,545,585	$6,352,547	$9,050,334
Annual O&M Costs	$0	$1,346,423	$1,471,432	$2,798,979
Annual Cost of Control	$0	$3,892,008	$7,823,979	$11,849,313

Table 11: Wyodak Unit 1 Environmental Costs

	Existing Dry FGD with existing ESP	Upgraded Dry FGD with existing ESP	Upgraded Dry FGD with new full-scale Fabric Filter	New Wet FGD
SO_2 Emission Rate (lb/MMBtu)	0.5	0.32	0.16	0.08
Annual SO_2 Emission (tpy) [a]	9,264	5,929	2,964	1,482
Annual SO_2 Reduction (tpy)	N/A	3,335	6,300	7,782
Annual Cost of Control	$0	$3,892,008	$7,823,979	$11,849,313
Cost per ton of Reduction	N/A	$1,167	$1,242	$1,523
Incremental Cost per ton of Reduction	N/A	$1,167	$1,326	$2,716

[a] Annual emissions based on unit heat input rate of 4,700 MMBtu/hr and 7,884 hours of operation per year.

The cost effectiveness and incremental cost effectiveness of the proposed wet FGD and dry FGD controls for Unit 1 are reasonable. The final step in the SO_2 BART determination process for Wyodak Unit 1, Step 5: Evaluate visibility impacts, is addressed in a comprehensive visibility analysis presented in the next section of this BART application analysis. The Division evaluated the amount of visibility improvement gained from the application of additional NO_x, PM/PM_{10}, and SO_2 emission control technology in relation to all three visibility impairing pollutants. Table 15 on page 28 lists the modeled control scenarios and associated emission rates.

VISIBILITY IMPROVEMENT DETERMINATION:

The fifth of five steps in a BART determination analysis, as required by 40 CFR part 51 Appendix Y, is the determination of the degree of Class I area visibility improvement that would result from installation of the various options for control technology. This factor was evaluated for the PacifiCorp Wyodak plant with an EPA-approved dispersion modeling system (CALPUFF) to predict the changes in Class I area visibility. The Division had previously determined that the facility was subject to BART based on the results of initial screening modeling that was conducted using current (baseline) emissions from the facility. The screening modeling, as well as more refined modeling conducted by the applicant, is described in detail below.

Wind Cave and Badlands National Parks (NP) in South Dakota are the closest Class I areas to the Wyodak plant, as shown in Figure 1 below. Wind Cave NP is located approximately 168 kilometers (km) east-southeast of the plant and Badlands NP is located approximately 240 km east-southeast of the plant.

Only those Class I areas most likely to be impacted by the Wyodak sources were modeled, as determined by source/Class I area locations, distances to each Class I area, and professional judgment considering meteorological and terrain factors. It can be reasonably assumed that areas at greater distances and in directions of less frequent plume transport will experience lower impacts than those predicted for the two modeled areas.

SCREENING MODELING

To determine if the Wyodak plant would be subject to BART, the Division conducted CALPUFF visibility modeling using three years of meteorological data. These data, from 2001-2003, consisted of surface and upper-air observations from individual weather stations and gridded output from the Mesoscale Model (MM5). Resolution of the MM5 data was 36-km for all three of the modeled years. Potential emissions for current operation from the coal-fired boiler at the Wyodak plant were input to the model.

Results of the modeling showed that the 98^{th} percentile value for the change in visibility (in units of delta deciview [Δdv]) was above 0.5 Δdv for Badlands NP and Wind Cave NP. As defined in EPA's final BART rule, a predicted 98^{th} percentile impact equal to or greater than 0.5 Δdv from a given source indicates that the source contributes to visibility impairment, and therefore is subject to BART. The results of the screening modeling are shown in Table 12.

Figure 1
Wyodak Power Plant and Class I Areas

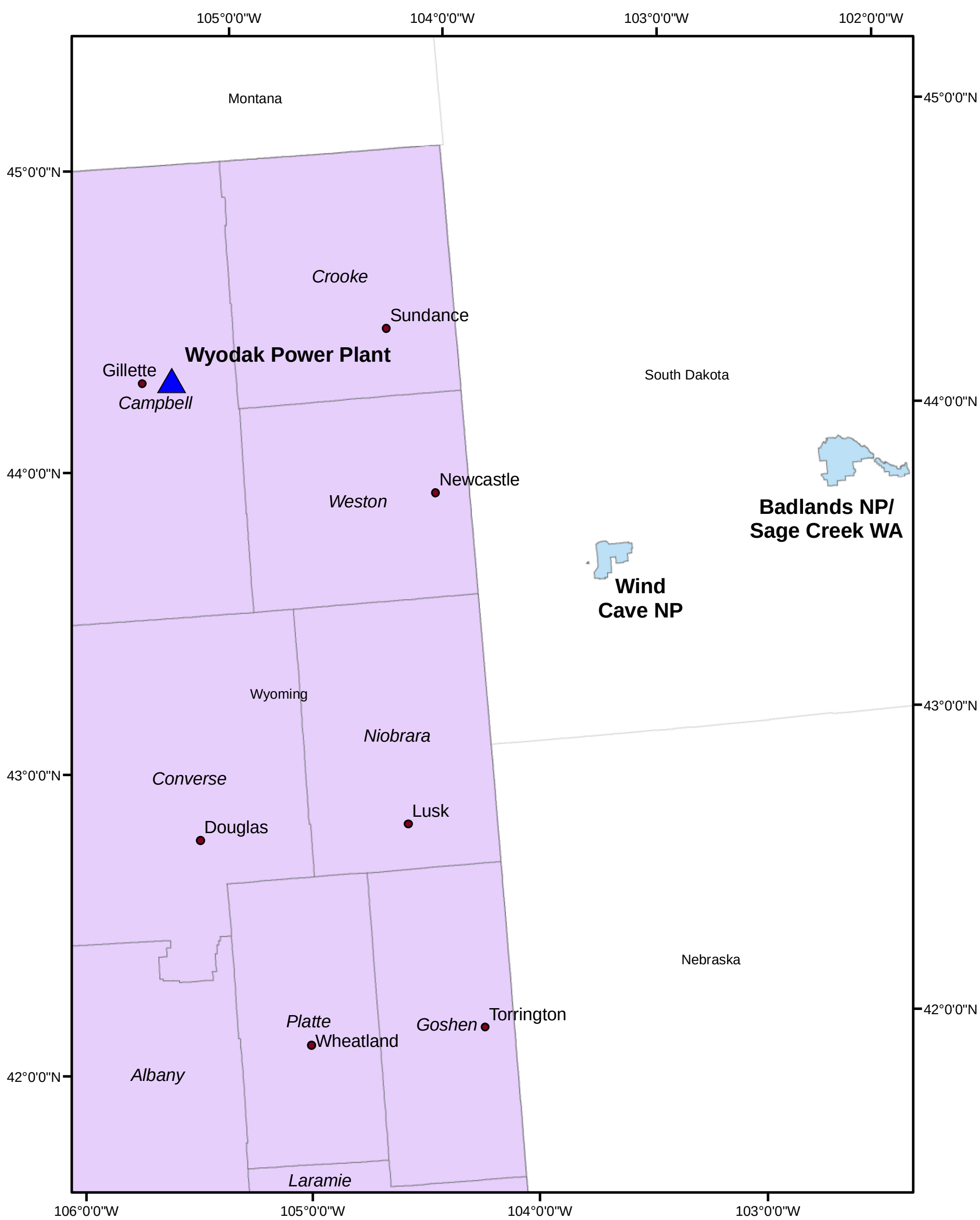


Table 12: Results of the Class I Area Screening Modeling

Class I Area	Maximum Modeled Value (Δdv)	98th Percentile Value (Δdv)
2001		
Badlands NP	1.155	0.842
Wind Cave NP	1.671	1.007
2002		
Badlands NP	2.160	1.246
Wind Cave NP	2.490	1.213
2003		
Badlands NP	2.484	1.097
Wind Cave NP	3.685	1.657

Δdv = delta deciview
NP = national park

REFINED MODELING

Because of the results of the Division's screening modeling, PacifiCorp was required to conduct a BART analysis that included refined CALPUFF visibility modeling for the facility. The modeling approach followed the requirements described in the Division's BART modeling protocol, *BART Air Modeling Protocol - Individual Source Visibility Assessments for BART Control Analyses* (WDEQ-AQD, September 2006).

CALPUFF System

Predicted visibility impacts from the Wyodak plant were determined with the EPA CALPUFF modeling system, which is the EPA-preferred modeling system for long-range transport. As described in the EPA Guideline on Air Quality Models (Appendix W of 40 CFR part 51), long-range transport is defined as modeling with source-receptor distances greater than 50 km. Because all modeled areas are located more than 50 km from the facility, the CALPUFF system was appropriate for use.

The CALPUFF modeling system consists of a meteorological data pre-processor (CALMET), an air dispersion model (CALPUFF), and post-processor programs (POSTUTIL, CALSUM, CALPOST). The CALPUFF model was developed as a non-steady-state air quality modeling system for assessing the effects of time- and space-varying meteorological conditions on pollutant transport, transformation, and removal.

CALMET is a diagnostic wind model that develops hourly wind and temperature fields in a three-dimensional, gridded modeling domain. Meteorological inputs to CALMET can include surface and upper-air observations from multiple meteorological monitoring stations. Additionally, the CALMET model can utilize gridded analysis fields from various mesoscale models such as MM5 to better represent regional wind flows and complex terrain circulations. Associated two-dimensional fields such as mixing height, land use, and surface roughness are included in the input to CALMET. The CALMET model allows the user to "weight" various terrain influence parameters in the vertical and horizontal directions by defining the radius of influence for surface and upper-air stations.

CALPUFF is a multi-layer, Lagrangian puff dispersion model. CALPUFF can be driven by the three-dimensional wind fields developed by the CALMET model (refined mode), or by data from a single surface and upper-air station in a format consistent with the meteorological files used to drive steady-state dispersion models. All far-field modeling assessments described here were completed using the CALPUFF model in a refined mode.

CALSUM is a post-processing program that can operate on multiple CALPUFF output files to combine the results for further post-processing. POSTUTIL is a post-processing program that processes CALPUFF concentrations and wet/dry flux files. The POSTUTIL model operates on one or more output data files from CALPUFF to sum, scale, and/or compute species derived from those that are modeled, and outputs selected species to a file for further post-processing. CALPOST is a post-processing program that can read the CALPUFF (or POSTUTIL or CALSUM) output files and calculate the impacts to visibility.

All of the refined CALPUFF modeling was conducted with the version of the CALPUFF system that was recognized as the EPA-approved release at the time of the development of the Division's modeling protocol. Version designations of the key programs are listed in the table below.

Table 13: Key Programs in CALPUFF System

Program	Version	Level
CALMET	5.53a	040716
CALPUFF	5.711a	040716
CALPOST	5.51	030709

<u>Meteorological Data Processing (CALMET)</u>

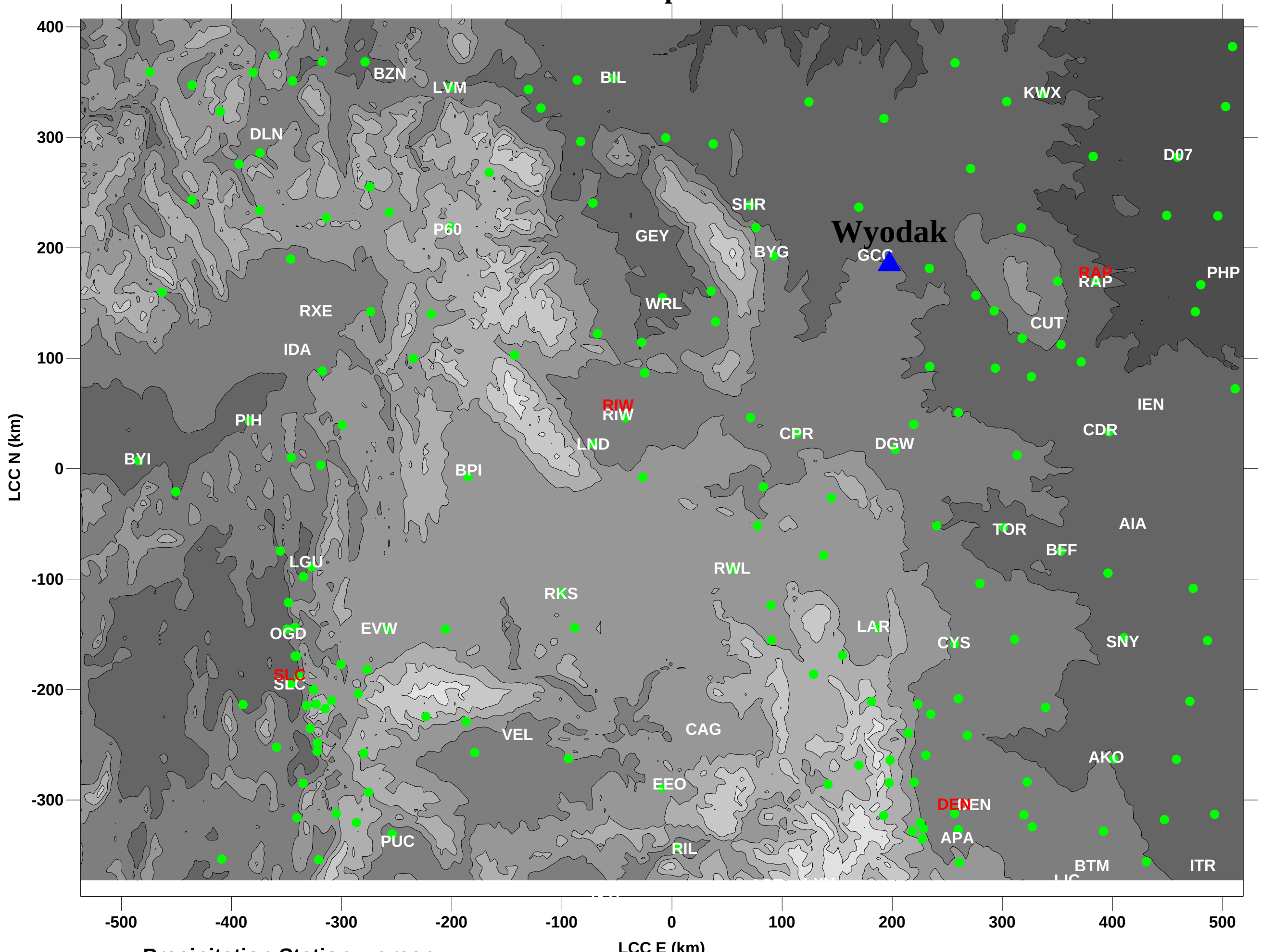
As required by the Division's modeling protocol, the CALMET model was used to construct an initial three-dimensional windfield using data from the MM5 model. Surface and upper-air observations were input to CALMET to adjust the initial windfield, but because of the relative scarcity of wind observations in the modeling domain, the influence of the observations on the initial windfield was minimized. Because the MM5 data were afforded a high degree of influence on the CALMET windfields, the Division obtained MM5 data at 12-km resolution that spanned the years 2001-2003.

Locations of the observations that were input to CALMET, including surface, upper-air, and precipitation stations, are shown in the figure below. Default settings were used in the CALMET input files for most of the technical options. The following table lists the key user-defined CALMET settings that were selected.

Table 14: Key User-Defined CALMET Settings

Variable	Description	Value
PMAP	Map projection	LCC
DGRIDKM	Grid spacing (km)	4
NZ	Number of layers	10
ZFACE	Cell face heights (m)	0, 20, 40, 100, 140, 320, 580, 1020, 1480, 2220, 3400
RMIN2	Minimum distance for extrapolation	-1
IPROG	Use gridded prognostic model output	14
RMAX 1	Maximum radius of influence (surface layer, km)	30
RMAX 2	Maximum radius of influence (layers aloft, km)	50
TERRAD	Radius of influence for terrain (km)	15
R1	Relative weighting of first guess wind field and observations (km)	5
R2	Relative weighting aloft (km)	25

Figure 2
Observations Input to CALMET



Precipitation Station = green
Surface Station = white 3-letter
Upper-Air (+ surface) = red 3-letter

CALPUFF Modeling Setup

To allow chemical transformations within CALPUFF using the recommended chemistry mechanism (MESOPUFF II), the model required input of background ozone and ammonia concentrations. For ozone, hourly data collected from the following stations were used:

- Rocky Mountain NP, Colorado
- Craters of the Moon National Monument, Idaho
- Highland, Utah
- Thunder Basin, Wyoming
- Yellowstone NP, Wyoming
- Centennial, Wyoming
- Pinedale, Wyoming

For any hour that was missing ozone data from all stations, a default value of 44 parts per billion (ppb) was used by the model as a substitute. For ammonia, a domain-wide background value of 2 ppb was used.

Latitude and longitude coordinates for Class I area discrete receptors were taken from the National Park Service (NPS) Class I Receptors database and converted to the appropriate Lambert Conformal Conic coordinates. Figures 3 through 4 show the receptor configurations that were used for Badlands NP and Wind Cave NP. Receptor spacing within Wind Cave NP is approximately 0.7 km in the east-west direction and approximately 0.9 km in the north-south direction. For Badlands NP, the receptor spacing is approximately 1.3 km in the east-west direction and approximately 1.8 km in the north-south direction.

Figure 3
Receptors for Wind Cave NP

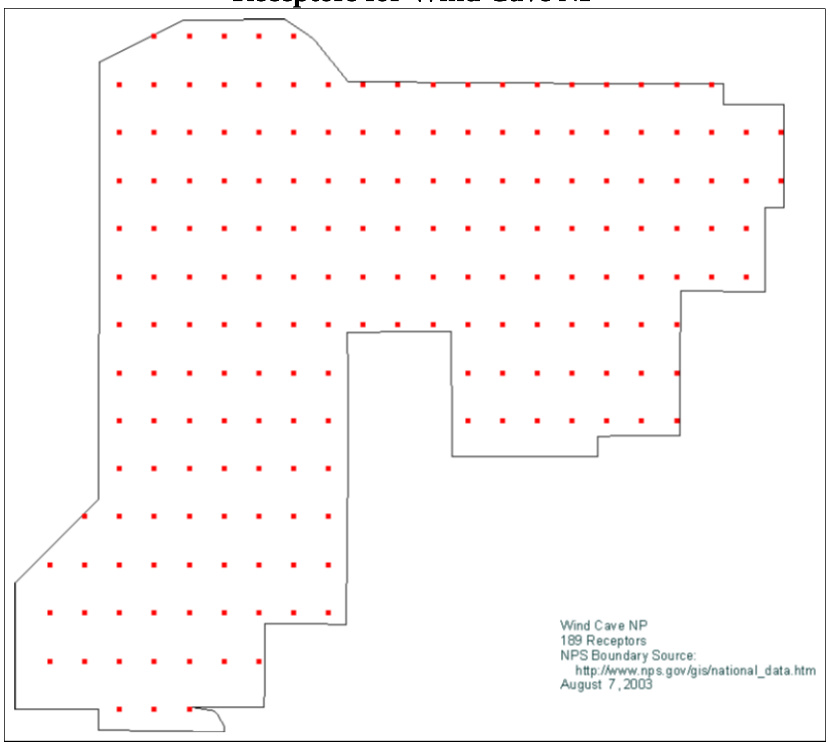
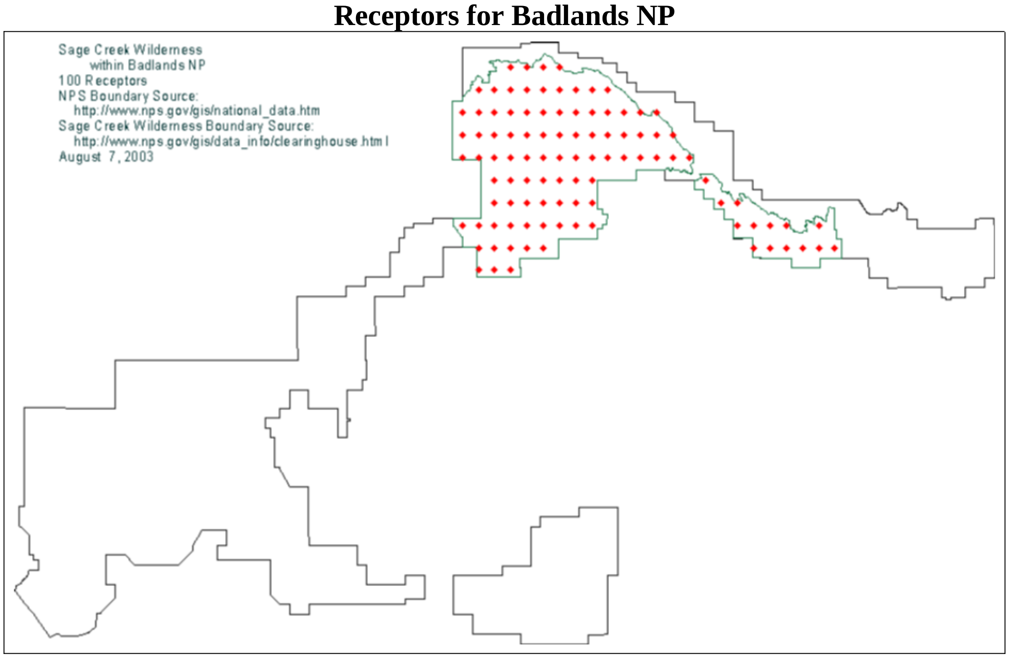


Figure 4
Receptors for Badlands NP



CALPUFF Inputs – Baseline and Control Options

Source release parameters and emissions for baseline and control options for the Wyodak plant are shown in the table below.

Table 15: CALPUFF Inputs for Wyodak Unit 1

Wyodak Unit 1	Baseline	Post-Control Scenario 1	Post-Control Scenario 2	Post-Control Scenario 3	Post-Control Scenario 4	Post-Control Scenario A	Post-Control Scenario B
Model Input Data	Current Operation with Dry FGD and ESP	LNB with advanced OFA, Dry FGD, ESP	LNB with advanced OFA, Dry FGD, New Fabric Filter	LNB with advanced OFA and SCR, Dry FGD, New Fabric Filter	LNB with advanced OFA and SCR, Wet FGD, ESP	Committed Controls: LNB with advanced OFA, Dry FGD, New Fabric Filter	Committed Controls and SCR
Hourly Heat Input (mmBtu/hour)	4,700	4,700	4,700	4,700	4,700	4,700	4,700
Sulfur Dioxide (SO_2) (lb/mmBtu)	0.50	0.32	0.16	0.16	0.08	0.16	0.16
Sulfur Dioxide (SO_2) (lb/hr)	2,350	1,518	759	759	380	759	759
Nitrogen Oxide (NO_x) (lb/mmBtu)	0.31	0.23	0.23	0.07	0.07	0.23	0.07
Nitrogen Oxide (NO_x) (lb/hr)	1,457	1,081	1,081	329	329	1,081	329
PM_{10} (lb/mmBtu)	0.030	0.030	0.015	0.015	0.030	0.015	0.015
PM_{10} (lb/hr)	141.0	141.0	70.5	70.5	141.0	70.5	70.5
Coarse Particulate ($PM_{2.5}$ <diameter < PM_{10}) (lb/hr)[a]	60.6	60.6	40.2	40.2	60.6	40.2	40.2
Fine Particulate (diameter < $PM_{2.5}$) (lb/hr)[b]	80.4	80.4	30.3	30.3	80.4	30.3	30.3
Sulfuric Acid (H_2SO_4) (lb/hr)	5.6	5.6	5.6	9.4	105.0	5.6	9.4
Ammonium Sulfate [$(NH_4)_2SO_4$] (lb/hr)	--	--	--	1.1	5.5	--	1.1
$(NH_4)HSO_4$ (lb/hr)	--	--	--	1.9	9.5	--	1.9
H_2SO_4 as Sulfate (SO_4) (lb/hr)	5.5	5.5	5.5	9.2	103.0	5.5	9.2
$(NH_4)_2SO_4$ as SO_4 (lb/hr)	--	--	--	0.8	4.0	--	0.8
$(NH_4)HSO_4$ as SO_4 (lb/hr)	--	--	--	1.6	8.0	--	1.6
Total Sulfate (SO_4) (lb/hr)[c]	5.5	5.5	5.5	11.6	114.9	5.5	11.6
Stack Conditions							
Stack Height (meters)	122	122	122	122	122	122	122
Stack Exit Diameter (meters)	6.1	6.1	6.1	6.1	6.1	6.1	6.1
Stack Exit Temperature (Kelvin)	358	353	350	350	322	350	350
Stack Exit Velocity (meters per second)	23.5	23.5	23.5	23.5	23.5	23.5	23.5

Notes:

(a) AP-42, Table 1.1-6: coarse PM counted as a percentage of PM_{10}. This equates to 43 percent for ESP and 57 percent for Baghouse.

(b) AP-42, Table 1.1-6: fine PM counted as a percentage of PM_{10}. This equates to 57 percent for ESP and 43 percent for Baghouse.

<u>Visibility Post-Processing (CALPOST)</u>

The changes in visibility were modeled using Method 6 within the CALPOST post-processor. Method 6 requires input of monthly relative humidity factors [f(RH)] for each Class I area. Monthly f(RH) factors that were used for Badlands NP and Wind Cave NP are shown in the table below.

Table 16: Relative Humidity Factors for CALPOST

Month	Badlands NP & Wind Cave NP
January	2.65
February	2.65
March	2.65
April	2.55
May	2.70
June	2.60
July	2.30
August	2.30
September	2.20
October	2.25
November	2.75
December	2.65

According to the final BART rule, natural background conditions as a reference for determination of the modeled Δdv change should be representative of the 20 percent best natural visibility days in a given Class I area. EPA BART guidance provides the 20 percent best days deciview values for each Class I area on an annual basis, but does not provide the individual species concentration data required for input to CALPOST.

Species concentrations corresponding to the 20 percent best days were calculated for each Class I area by scaling back the annual average (natural background) concentrations given in Table 2-1 of the EPA document *Guidance for Estimating Natural Visibility Conditions Under the Regional Haze Rule.* A separate scaling factor was derived for each Class I area such that, when multiplied by the guidance table annual concentrations, the 20 percent best days deciview values for that particular Class I area would be calculated.

The scaling procedure is illustrated here for Badlands NP. From Appendix B in the EPA natural visibility guidance document, the deciview value for the 20 percent best days at Badlands NP is 2.18 dv. To obtain the speciated background concentrations representative of the 20 percent best days, the deciview value (2.18 dv) was first converted to light extinction. The relationship between deciviews and light extinction is expressed as follows:

$dv = 10 \ln (b_{ext}/10)$ or $b_{ext} = 10 \exp (dv/10)$

where: b_{ext} = light extinction expressed in inverse megameters (Mm^{-1}).

Using this relationship with the known deciview value of 2.18, one obtains an equivalent light extinction value of 12.44 Mm^{-1}. Next, the annual average natural visibility concentrations were set equal to a total extinction value of 12.44 Mm^{-1}. The relationship between total light extinction and the individual components of the light extinction is as follows:

b_{ext} = (3)f(RH)[ammonium sulfate] + (3)f(RH)[ammonium nitrate] + (0.6)[coarse mass] + (4)[organic carbon] + (1)[soil] + (10)[elemental carbon] + b_{ray}

where:

- bracketed quantities represent background concentrations in $\mu g/m^3$
- values in parenthesis represent scattering efficiencies
- f(RH) is the relative humidity adjustment factor (applied to hygroscopic species only)
- b_{ray} is light extinction due to Rayleigh scattering (10 Mm^{-1} used for all Class I areas)

Substituting the annual average natural background concentrations, the average f(RH) for Badlands NP, and including a coefficient for scaling, one obtains:

12.44 = (3)(2.55)[0.12]X + (3)(2.55)[0.1]X + (0.6)[3.0]X + (4)[0.47]X + (1)[0.5]X + (10)[0.02]X + 10

In the equation above, X represents a scaling factor needed to convert the annual average natural background concentrations to values representative of the 20 percent best days. Solving for X provides a value of 0.402. Table 17 presents the annual average natural background concentrations, the calculated scaling factor, and the calculated background concentrations for the 20 percent best days for Badlands NP.

Table 17: Calculated Background Components for Badlands NP

Component	**Annual Average for West Region ($\mu g/m^3$)**	**Calculated Scaling Factor**	**20% Best Days for Badlands NP ($\mu g/m^3$)**
Ammonium Sulfate	0.12	0.402	0.048
Ammonium Nitrate	0.10	0.402	0.040
Organic Carbon	0.47	0.402	0.189
Elemental Carbon	0.02	0.402	0.008
Soil	0.50	0.402	0.201
Coarse Mass	3.00	0.402	1.205

The scaled aerosol concentrations were averaged for Badlands NP and Wind Cave NP because of their geographical proximity and similar annual background visibility. The 20 percent best days aerosol concentrations for the two Class I areas in question are listed in the table below.

Table 18: Natural Background Aerosol Concentrations (μg/m^3)

Aerosol Component	Wind Cave NP & Badlands NP
Ammonium Sulfate	0.047
Ammonium Nitrate	0.040
Organic Carbon	0.186
Elemental Carbon	0.008
Soil	0.198
Coarse Mass	1.191

<u>Visibility Post-Processing Results</u>

The results of the visibility modeling for the Wyodak facility for the baseline and control scenarios are shown in the tables below. For each scenario, the 98th percentile Δdv results are reported along with the total number of days for which the predicted impacts exceeded 0.5 dv. Following the tables are figures that present the results graphically for baseline, the BART configuration proposed by PacifiCorp, and for the proposed BART configuration with the addition of SCR.

Table 19: CALPUFF Visibility Modeling Results for Wyodak Unit 1

Class I Area	2001		2002		2003		3-Year Average	
	98th Percentile Value (Δdv)	No. of Days > 0.5 Δdv	98th Percentile Value (Δdv)	No. of Days > 0.5 Δdv	98th Percentile Value (Δdv)	No. of Days > 0.5 Δdv	98th Percentile Value (Δdv)	No. of Days > 0.5 Δdv
Baseline – Dry FGD, ESP								
Badlands NP	0.841	27	1.140	34	1.070	31	1.017	31
Wind Cave NP	1.153	41	1.323	38	1.530	37	1.335	39
Post-Control Scenario 1 – LNB w/ advanced OFA, Dry FGD, ESP								
Badlands NP	0.595	12	0.829	18	0.739	20	0.721	17
Wind Cave NP	0.817	19	0.940	26	1.114	28	0.957	24
Post-Control Scenario 2 – LNB w/ advanced OFA, Dry FGD, Fabric Filter								
Badlands NP	0.472	6	0.624	14	0.583	13	0.560	11
Wind Cave NP	0.671	11	0.788	17	0.929	17	0.796	15
Post-Control Scenario 3 – LNB w/ advanced OFA and SCR, Dry FGD, Fabric Filter								
Badlands NP	0.254	1	0.331	2	0.314	2	0.300	2
Wind Cave NP	0.333	2	0.383	5	0.457	6	0.391	4
Post-Control Scenario 4 – LNB w/ advanced OFA and SCR, Wet FGD, ESP								
Badlands NP	0.294	1	0.405	3	0.340	3	0.346	2
Wind Cave NP	0.396	2	0.519	9	0.684	10	0.533	7
Post-Control Scenario A – Committed Controls: LNB w/ advanced OFA, Dry FGD, Fabric Filter								
Badlands NP	0.473	6	0.624	14	0.583	13	0.560	11
Wind Cave NP	0.671	11	0.788	17	0.929	17	0.796	15
Post-Control Scenario B – Committed Controls + SCR								
Badlands NP	0.254	1	0.331	2	0.314	2	0.300	2
Wind Cave NP	0.333	2	0.383	5	0.457	6	0.391	4

Figure 5
Modeled BART Impacts: 98th Percentile (delta-dv)

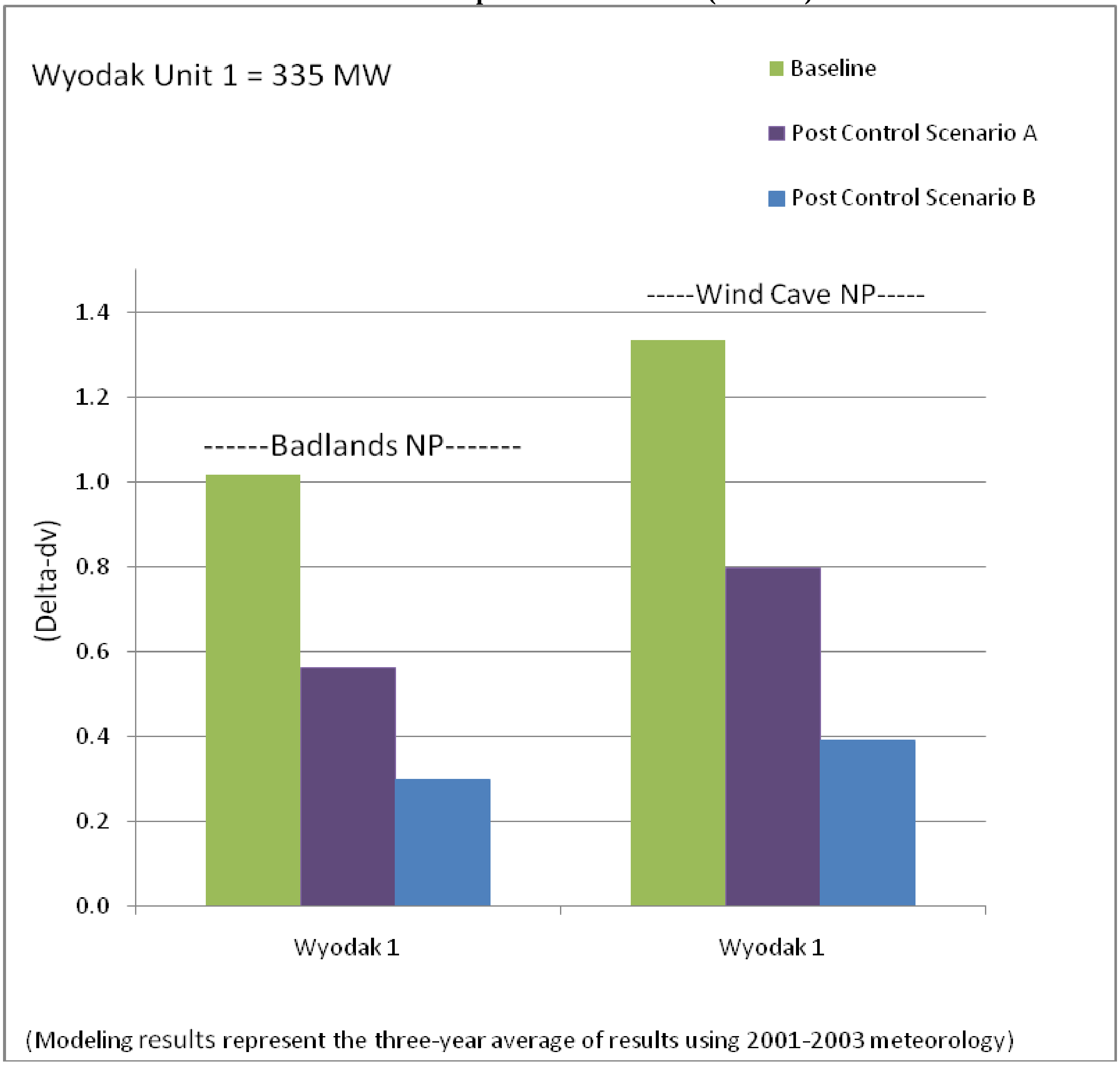
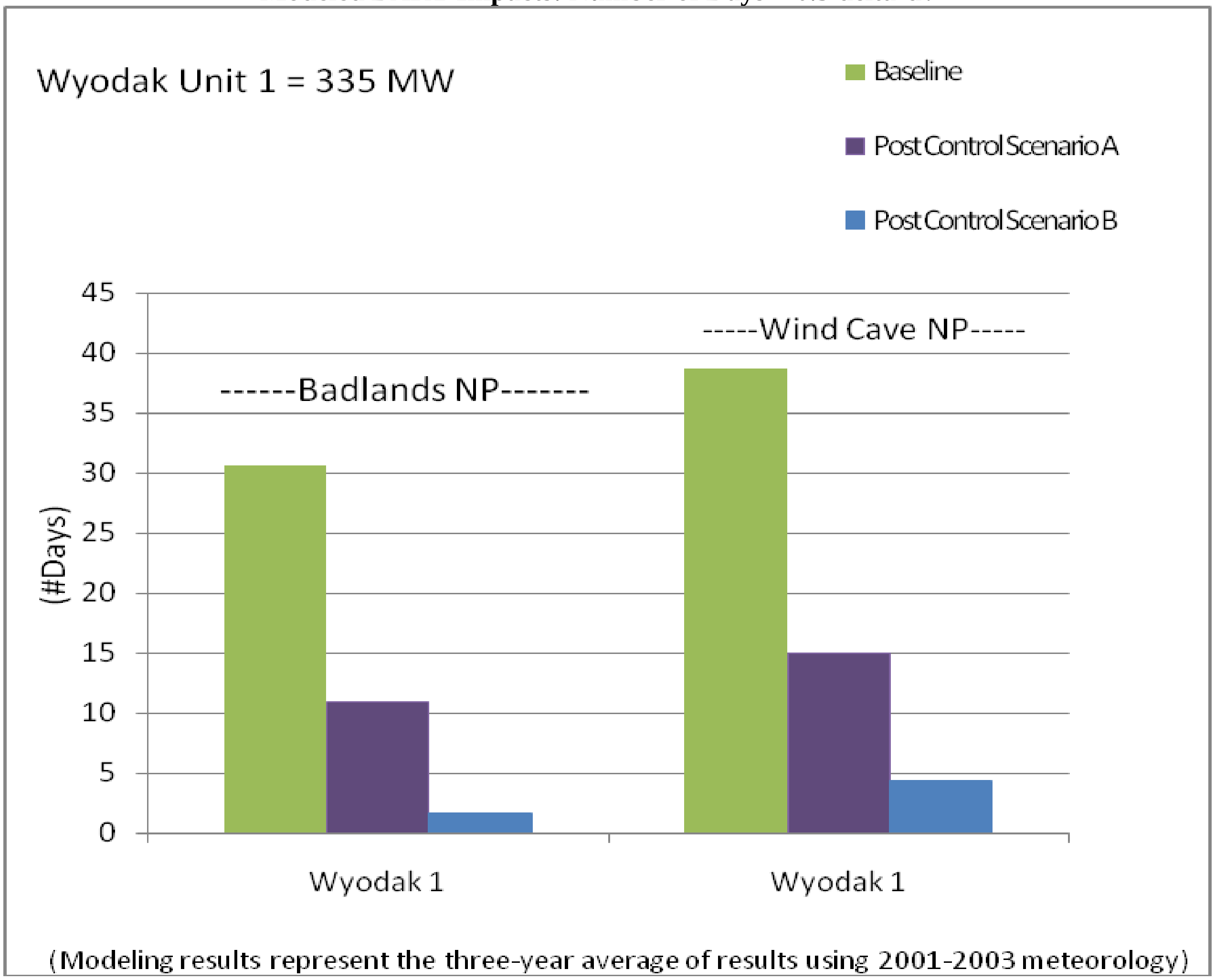


Figure 6
Modeled BART Impacts: Number of Days > 0.5 delta-dv



BART CONCLUSIONS:

After considering (1) the costs of compliance, (2) the energy and non-air quality environmental impacts of compliance, (3) any pollution equipment in use or in existence at the source, (4) the remaining useful life of the source, and (5) the degree of improvement in visibility (all five statutory factors) from each proposed control technology, the Division determined BART for each visibility impairing pollutant emitted from the single unit subject to BART at the Wyodak Power Plant.

NO_x

LNB with advanced OFA is determined to be BART for Unit 1 for NO_x based, in part, on the following conclusions:

1. LNB with advanced OFA on Unit 1 was cost effective with a capital cost of $13,100,000. The average cost effectiveness, over a twenty year operational life, is $881 per ton of NO_x removed.

2. Combustion control using LNB with advanced OFA does not require non-air quality environmental mitigation for the use of chemical reagents (i.e., ammonia or urea) and there is a minimal energy impact.

3. After careful consideration of the five statutory factors, especially the costs of compliance and the existing pollution control equipment, a NO_x control level of 0.23 lb/MMBtu on a 30-day rolling average, equal to EPA's presumptive limit of 0.23 lb/MMBtu for wall-fired boilers burning sub-bituminous coal, though it is not applicable, is justified for Unit 1.

4. Visibility impacts were addressed in a comprehensive visibility analysis covering all three visibility impairing pollutants and associated control options. The cumulative 3-year averaged 98^{th} percentile visibility improvement from the baseline summed across both Class I areas achieved with LNB with advanced OFA, upgrading the existing dry FGD, and a new full-scale fabric filter, Post-Control Scenario A for Unit 1, was 0.996 Δdv.

5. Annual NO_x emission reduction from baseline achieved by applying LNB with advanced OFA on Unit 1 is 1,483 tons.

LNB with advanced OFA and SCR was not determined to be BART for Unit 1 for NO_x based, in part, on the following conclusions:

1. The cost of compliance for installing SCR on the unit is significantly higher than LNB with advanced OFA. Capital cost for SCR on Unit 1 is $171,900,000. Annual SCR O&M costs for Unit 1 are $2,557,934.

2. Additional non-air quality environmental mitigation is required for the use of chemical reagents.

3. Operation of LNB with advanced OFA and SCR is parasitic and requires an estimated 2.4 MW from Unit 1.

4. While visibility impacts were addressed in a cumulative analysis of all three pollutants, Post-Control Scenario B is directly comparable to Post-Control Scenario A as the only difference is directly attributable to the installation of SCR. Subtracting the modeled 98th percentile values from each other yield the incremental 98th percentile visibility improvement from SCR. The cumulative 3-year averaged 98th percentile visibility improvement from Post-Control Scenario A summed across both Class I areas achieved with Post-Control Scenario B was 0.665 Δdv.

The Division considers the installation and operation of the BART-determined NO_x control, new LNB with advanced OFA on Unit 1 to meet corresponding emission limits on a continuous basis, to meet the statutory requirements of BART.

Unit-by-unit NO_x BART determinations:

Wyodak Unit 1:	Installing new LNB with advanced OFA and meeting NO_x emission limits of 0.23 lb/MMBtu (30-day rolling average), 1,081.0 lb/hr (30-day rolling average), and 4,735 tpy as BART for NO_x.

PM/PM_{10}

A new full-scale fabric filter is determined to be BART for Unit 1 for PM/PM_{10} based, in part, on the following conclusions:

1. While the Division considers the cost of compliance for a full-scale fabric filter on Unit 1 not reasonable, PacifiCorp is committed to installing this control device and has permitted the installation of a full-scale fabric filter on Unit 1 in a recently issued New Source Review construction permit. A full-scale fabric filter is the most stringent PM/PM_{10} control technology and therefore the Division will accept it as BART.

The Division considers the installation and operation of the BART-determined PM/PM_{10} control, new full-scale fabric filter on Unit 1 to meet corresponding emission limits on a continuous basis, to meet the statutory requirements of BART.

Unit-by-unit PM/PM_{10} BART determinations:

Wyodak Unit 1:	Installing a new full-scale fabric filter and meeting PM/PM_{10} emission limits of 0.015 lb/MMBtu, 71.0 lb/hr, and 309 tpy as BART for PM/PM_{10}.

SO_2: WESTERN BACKSTOP SULFUR DIOXIDE TRADING PROGRAM

PacifiCorp evaluated control SO_2 control technologies that can achieve a SO_2 emission rate of 0.16 lb/MMBtu or lower from the coal-fired boilers. PacifiCorp proposed upgrading the existing dry FGD and installing a full-scale fabric filter as SO_2 BART controls on Wyodak Unit 1.

Wyoming is a §309 state participating in the Regional SO_2 Milestone and Backstop Trading Program. §308(e)(2) provides States with the option to implement or require participation in an emissions trading program or other alternative measure rather than to require sources subject to BART to install, operate, and maintain additional control technology to meet an established emission limit on a continuous basis. However, the alternate program must achieve greater reasonable progress than would be accomplished by installing BART. A demonstration that the alternate program can achieve greater reasonable progress is prescribed by §308(e)(2)(i). Since the pollutant of concern is SO_2, this demonstration has been performed under §309 as part of the state implementation plan. §309(d)(4)(i) requires that the SO_2 milestones established under the plan "…must be shown to provide for greater reasonable progress than would be achieved by application of BART pursuant to §51.308(e)(2)."

Wyoming participated in creating a detailed report entitled **Demonstration that the SO_2 Milestones Provide Greater Reasonable Progress than BART** covering SO_2 emissions from all states participating in the Regional SO_2 Milestone and Backstop Trading Program. The document was submitted to EPA in support of the §309 Wyoming Regional Haze SIP in November of 2008.

As part of the §309 program, participating states, including Wyoming, must submit an annual Regional Sulfur Dioxide Emissions and Milestone Report that compares actual emissions to pre-established milestones. Participating states have been filing these reports since 2003. Each year, states have been able to demonstrate that actual SO_2 emissions are well below the milestones. The actual emissions and their respective milestones are shown in Table 20.

Table 20: Regional Sulfur Dioxide Emissions and Milestone Report Summary

Year	Reported SO_2 Emissions (tons)	3-year Milestone Average (tons)
2003	330,679	447,383
2004	337,970	448,259
2005	304,591	446,903
2006	279,134	420,194
2007	273,663	420,637

In addition to demonstrating successful SO_2 emission reductions, §309 states have also relied on visibility modeling conducted by the WRAP to demonstrate improvement at Class I areas. The complete modeling demonstration showing deciview values was included as part of the visibility improvement section of the §309 SIP, but the SO_2 portion of the demonstration has been included as Table 21 to underscore the improvements associated with SO_2 reductions.

Table 21: Visibility - Sulfate Extinction Only

Class I Area Monitor (Class I Areas Represented)	**20% Worst Visibility Days (Monthly Average, Mm^{-1})**		**20% Best Visibility Days (Monthly Average, Mm^{-1})**	
	2018 [1] Base Case (Base 18b)	**2018 [2] Preliminary Reasonable Progress Case (PRP18a)**	**2018 [1] Base Case (Base 18b)**	**2018 [2] Preliminary Reasonable Progress Case (PRP18a)**
Bridger, WY (Bridger WA and Fitzpatrick WA)	5.2	4.3	1.6	1.3
North Absaroka, WY (North Absaroka WA and Washakie WA)	4.8	4.5	1.1	1.1
Yellowstone, WY (Yellowstone NP, Grand Teton NP and Teton WA)	4.3	3.9	1.6	1.4
Badlands, SD	17.8	16.0	3.5	3.1
Wind Cave, SD	13.0	12.1	2.7	2.5
Mount Zirkel, CO (Mt. Zirkel WA and Rawah WA)	4.6	4.1	1.4	1.3
Rocky Mountain, CO	6.8	6.2	1.3	1.1
Gates of the Mountains, MT	5.3	5.1	1.0	1.0
UL Bend, MT	9.7	9.6	1.8	1.7
Craters of the Moon, ID	5.8	5.5	1.5	1.5
Sawtooth, ID	3.0	2.8	1.2	1.1
Canyonlands, UT (Canyonlands NP and Arches NP)	5.4	4.8	2.1	1.9
Capitol Reef, UT	5.7	5.4	1.9	1.8

[1] Represents 2018 Base Case growth plus all established controls as of Dec. 2004. No BART or SO_2 Milestone assumptions were included.
[2] Represents 2018 Preliminary Reasonable Progress growth estimates and established SO_2 limits.

All Class I areas in the surrounding states show a projected visibility improvement for 2018 with respect to SO_2 on the worst days and no degradation on the best days. More discussion on the visibility improvement of the §309 program can be found in the Wyoming §309 Regional Haze SIP revision submitted to EPA in November 2008.

Therefore, in accordance with §308(e)(2), Wyoming's §309 Regional Haze SIP, and WAQSR Chapter 6, Section 9, PacifiCorp will not be required to install the company-proposed BART technology and meet the corresponding achievable emission limit. Instead, PacifiCorp is required to participate in the Regional SO_2 Milestone and Backstop Trading Program authorized under Chapter 14 of the WAQSR.

LONG-TERM STRATEGY FOR REGIONAL HAZE:

In this BART analysis, the technology available, the costs of compliance, the energy and non-air quality environmental impacts of compliance, any pollution control equipment in use 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 were taken into consideration when determining BART. When evaluating the costs of compliance the Division recognized a time limitation to install BART-determined controls imposed by the Regional Haze Rule. In addressing the required elements, including documentation for all required analyses, to be submitted in the state implementation plan, 40 CFR

51.308(e)(1)(iv) states: "A requirement that each source subject to BART be required to install and operate BART as expeditiously as practicable, but in no event later than 5 years after approval of the implementation plan revision." As a practical measure, the Division anticipates the requirement to install the BART-determined controls to occur as early as 2015.

PacifiCorp used the **EPA Air Pollution Control Cost Manual**, which is identified in 40 CFR part 51 Appendix Y(IV)(D)(4)(a)(5) as a reference source, to estimate capital costs and calculate cost effectiveness. Section 1 Chapter 2 of the **EPA Air Pollution Control Cost Manual - Sixth Edition** (EPA 452/B-02-001) describes the concepts and methodology of cost estimation used in the manual. Beginning on page 2-28 of Chapter 2.5.4.2, the manual discusses retrofit cost consideration including the practice of developing a retrofit factor to account for unanticipated additional costs of installation not directly related to the capital cost of the controls themselves. However, PacifiCorp did not present a retrofit factor in their cost analyses. PacifiCorp estimated that the installation of SCR requires a minimum of 6 years of advanced planning and engineering before the control can be successfully installed and operated. This planning horizon would necessarily be considered in the scheduled maintenance turnarounds for existing units to minimize the installation costs of the pollution control systems.

PacifiCorp's BART-eligible or subject-to-BART power plant fleet is shown in Table 22. While the majority of affected units are in Wyoming, there are four units in Utah and one in Arizona. Since the 5-year control installation requirement is stated in the federal rule it applies to all of PacifiCorp's units requiring additional BART-determined controls. Although BART is determined on a unit-by-unit basis taking into consideration the statutory factors, consideration for additional installation costs related to the logistics of managing more than one control installation, which are indirect retrofit costs, was afforded under the statutory factor: costs of compliance.

Table 22: PacifiCorp's BART-Eligible/Subject Units

Source	State
Hunter Unit 1 [a]	Utah
Hunter Unit 2 [a]	Utah
Huntington Unit 1 [a]	Utah
Huntington Unit 2 [a]	Utah
Cholla Unit 4 [b]	Arizona
Dave Johnston Unit 3	Wyoming
Dave Johnston Unit 4	Wyoming
Jim Bridger Unit 1	Wyoming
Jim Bridger Unit 2	Wyoming
Jim Bridger Unit 3	Wyoming
Jim Bridger Unit 4	Wyoming
Naughton Unit 1	Wyoming
Naughton Unit 2	Wyoming
Naughton Unit 3	Wyoming
Wyodak	Wyoming

(a) Units identified in Utah's §308 Regional Haze SIP.
(b) Unit identified on the Western Regional Air Partnership's BART Clearinghouse.

Based on the cost of compliance and visibility improvement presented by PacifiCorp in the BART application for Wyodak Unit 1, and taking into consideration the logistical challenge of managing multiple pollution control installations within the regulatory time allotted for installation of BART by the Regional Haze Rule, the Division is not requiring additional controls under the Long-Term Strategy of the Wyoming Regional Haze State Implementation Plan in this permitting action. Additional controls may be required in future actions related to the Long-Term Strategy of the Wyoming Regional Haze State Implementation Plan.

CHAPTER 6, SECTION 4 – PREVENTION OF SIGNIFICANT DETERIORATION (PSD):

PacifiCorp's Wyodak Power Plant is a "major emitting facility" under Chapter 6, Section 4, of the Wyoming Air Quality Standards and Regulations because emissions of a criteria pollutant are greater than 100 tpy for a listed categorical source. PacifiCorp should comply with the permitting requirements of Chapter 6, Section 4 as they apply to the installation of controls determined to meet BART.

CHAPTER 5, SECTION 2 – NEW SOURCE PERFORMANCE STANDARDS (NSPS):

The installation of controls determined to meet BART will not change New Source Performance Standard applicability for Wyodak Unit 1.

CHAPTER 5, SECTION 3 – NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS (NESHAPs) AND CHAPTER 6, SECTION 6 – HAZARDOUS AIR POLLUTANT (HAP) EMISSIONS AND MAXIMUM AVAILABLE CONTROL TECHNOLOGY (MACT):

The installation of controls determined to meet BART will not change Nation Emission Standards For Hazardous Air Pollutants applicability for Wyodak Unit 1.

CHAPTER 6, SECTION 3 – OPERATING PERMIT:

The Wyodak Power Plant is a major source under Chapter 6, Section 3 of the Wyoming Air Quality Standards and Regulations. The most recent Operating Permit, 3-2-101, was issued for the facility on February 18, 2009. In accordance with Chapter 6, Section 3 of the Wyoming Air Quality Standards and Regulations, PacifiCorp will need to modify their operating permit to include the changes authorized in this permitting action.

CONCLUSION:

The Division is satisfied that PacifiCorp's Wyodak Power Plant will comply with all applicable Wyoming Air Quality Standards and Regulations. The Division proposes to issue a BART Air Quality Permit for modification to install new LNB with advanced OFA and a new full-scale fabric filter on Unit 1.

PROPOSED PERMIT CONDITIONS:

The Division proposes to issue an Air Quality Permit to PacifiCorp for the modification of the Wyodak Power Plant with the following conditions:

1. Authorized representatives of the Division of Air Quality be given permission to enter and inspect any property, premise or place on or at which an air pollution source is located or is being constructed or installed for the purpose of investigating actual or potential sources of air pollution, and for determining compliance or non-compliance with any rules, standards, permits or orders.

2. All substantive commitments and descriptions set forth in the application for this permit, unless superseded by a specific condition of this permit, are incorporated herein by this reference and are enforceable as conditions of this permit.

3. That PacifiCorp shall modify their Operating Permit in accordance with Chapter 6, Section 9(e)(iv) and Chapter 6, Section 3 of the WAQSR.

4. All notifications, reports and correspondence associated with this permit shall be submitted to the Stationary Source Compliance Program Manager, Air Quality Division, 122 West 25th Street, Cheyenne, WY 82002 and a copy shall be submitted to the District Engineer, Air Quality Division, 1866 South Sheridan Avenue, Sheridan, WY 82801.

5. Effective upon completion of the initial performance tests to verify the emission levels below, as required by Condition 6 of this permit, emissions from Wyodak Unit 1 shall not exceed the levels below. The NO_x limits shall apply during all operating periods. PM/PM_{10} lb/hr and tpy limits shall apply during all operating periods. PM/PM_{10} lb/MMBtu limits shall apply during all operating periods except startup. Startup begins with the introduction of fuel oil into the boiler and ends no later than the point in time when the flue gas desulfurization system on Unit 1 reaches a temperature of 275°F and three (3) coal pulverizers have been placed in service.

Pollutant	lb/MMBtu	lb/hr	tpy
NO_x	0.23 (30-day rolling)	1,081.0 (30-day rolling)	4,735
PM/PM_{10}[(a)]	0.015	71.0	309

[(a)] Filterable portion only

6. That initial performance tests be conducted, in accordance with Chapter 6, Section 2(j) of the WAQSR, within 30 days of achieving a maximum design rate but not later than 90 days following initial start-up, and a written report of the results be submitted. If a maximum design rate is not achieved within 90 days of start-up, the Administrator may require testing be done at the rate achieved and again when a maximum rate is achieved.

7. Performance tests shall consist of the following:

   Coal-fired Boiler (Wyodak Unit 1):

   NO_x Emissions – Compliance with the NO_x 30-day rolling average shall be determined using a continuous emissions monitoring system (CEMS) certified in accordance with 40 CFR part 60.

   PM/PM_{10} Emissions – Testing shall follow 40 CFR 60.46 and EPA Reference Test Methods 1-4 and 5.

   Testing required by the Chapter 6, Section 3, Operating Permit may be submitted to satisfy the testing required by this condition.

8. Prior to any testing required by this permit, a test protocol shall be submitted to the Division for approval, at least 30 days prior to testing. Notification should be provided to the Division at least 15 days prior to any testing. Results of the tests shall be submitted to this office within 45 days of completing the tests.

9. PacifiCorp shall comply with all requirements of the Regional SO_2 Milestone and Backstop Trading Program in accordance with Chapter 14, Sections 2 and 3, of the WAQSR.

10. Compliance with the NO_x limits set forth in this permit for the coal-fired boiler (Wyodak Unit 1) shall be determined with data from the continuous monitoring system required by 40 CFR Part 75 as follows:

    a. Exceedances of the NO_x limits shall be defined as follows:

       i. Any 30-day rolling average of NO_x emissions which exceeds the lb/MMBtu limits calculated in accordance with the compliance provisions and monitoring requirements of §60.48Da and §60.49Da. The definition of "boiler operating day" shall be consistent with the definition as specified in 40 CFR part 60, subpart Da.

       ii. Any 30-day rolling average calculated using valid data (output concentration and average hourly volumetric flowrate) from the existing CEM equipment which exceeds the lb/hr NO_x limit established in this permit. Valid data shall meet the requirements of WAQSR, Chapter 5, Section 2(j) and follow the compliance provisions and monitoring requirements of §60.48Da and §60.49Da. The 30-day average emission rate shall be calculated as the arithmetic average of hourly emissions with valid data during the previous 30-day period. The definition of "boiler operating day" shall be consistent with the definition as specified in 40 CFR part 60, subpart Da.

b. PacifiCorp shall comply with all reporting and record keeping requirements as specified in WAQSR, Chapter 5, Section 2(g) and 40 CFR part 60, subpart D. All excess emissions shall be reported using the procedures and reporting format specified in WAQSR, Chapter 5, Section 2(g).

11. PacifiCorp shall use EPA's Clean Air Markets reporting program to convert the monitoring system data to annual emissions. PacifiCorp shall provide substituted data according to the missing data procedures of 40 CFR, Part 75 during any period of time that there is not monitoring data. All monitoring data must meet the requirements of WAQSR, Chapter 5, Section 2(j).

12. Compliance with the PM/PM_{10} limits set forth in this permit for the coal-fired boiler (Wyodak Unit 1) shall be determined with data from testing for PM conducted annually, or more frequently as specified by the Administrator, following 40 CFR 60.46 and EPA Reference Test Methods 1-4 and 5. Testing required by the Chapter 6, Section 3, Operating Permit may be submitted to satisfy the testing required by this condition.

13. Records required by this permit shall be maintained for a period of at least five (5) years and shall be made available to the Division upon request.

14. PacifiCorp shall install new low NO_x burners with advanced overfire air and a new full-scale fabric filter on Unit 1, in accordance with the Division's BART determination, and conduct the initial performance tests required in Condition 6 no later than December 31, 2011.

December 31, 2009

Mr. Gary L. Harris
Plant Managing Director
PacifiCorp
48 Wyodak Road - Garner Lake Route
Gillette, WY 82716

Re: Air Quality Permit MD-6043
BART Permit: Wyodak Power Plant

Dear Mr. Harris:

The Division of Air Quality of the Wyoming Department of Environmental Quality has enclosed a copy of the Best Available Control Technology (BART) permit for PacifiCorp's Wyodak Power Plant, dated December 31, 2009. Comments received during the public comment period and the public hearing were considered in the final permit. A copy of the decision document for the permit is also enclosed. No permit conditions required revision as a result of the public comment period.

If you have any questions, please feel free to contact this office.

Sincerely,

David A. Finley
Administrator
Air Quality Division

cc: Tanner Shatto/AQD Sheridan

December 31, 2009

Mr. Gary L. Harris
Plant Managing Director
PacifiCorp
48 Wyodak Road - Garner Lake Route
Gillette, WY 82716

Permit No. **MD-6043**
(BART Permit for the Wyodak Plant)

Dear Mr. Harris:

The Division of Air Quality of the Wyoming Department of Environmental Quality has completed final review of PacifiCorp's application for a Best Available Retrofit Technology (BART) permit for a coal-fired boiler (Unit 1) at the Wyodak Power Plant. The Wyodak Power Plant is located in Section 27, T50N, R71W, approximately five miles east of Gillette in Campbell County, Wyoming.

Following the Division's proposed approval of the permit as published June 4, 2009, a 63-day public notice period ran from June 4, 2009 to August 5, 2009, and a public hearing was held on August 5, 2009 at 6 p.m. in the George Amos Memorial Building, located at 412 South Gillette Avenue in Gillette, Wyoming. Comments were received on the proposed permit and those comments have been considered by the Division in the final permit. Therefore, on the basis of the information provided to the Division, a BART permit is hereby granted pursuant to Chapter 6, Sections 2 and 9 of the Wyoming Air Quality Standards and Regulations (WAQSR) with the following conditions:

1. Authorized representatives of the Division of Air Quality be given permission to enter and inspect any property, premise or place on or at which an air pollution source is located or is being constructed or installed for the purpose of investigating actual or potential sources of air pollution, and for determining compliance or non-compliance with any rules, standards, permits or orders.

2. All substantive commitments and descriptions set forth in the application for this permit, unless superseded by a specific condition of this permit, are incorporated herein by this reference and are enforceable as conditions of this permit.

3. That PacifiCorp shall modify their Operating Permit in accordance with Chapter 6, Section 9(e)(vi) and Chapter 6, Section 3 of the WAQSR.

4. All notifications, reports and correspondence associated with this permit shall be submitted to the Stationary Source Compliance Program Manager, Air Quality Division, 122 West 25th Street, Cheyenne, WY 82002 and a copy shall be submitted to the District Engineer, Air Quality Division, 1866 South Sheridan Avenue, Sheridan, WY 82801.

5. Effective upon completion of the initial performance tests to verify the emission levels below, as required by Condition 6 of this permit, emissions from Wyodak Unit 1 shall not exceed the levels below. The NO_x limits shall apply during all operating periods. PM/PM_{10} lb/hr and tpy limits shall apply during all operating periods. PM/PM_{10} lb/MMBtu limits shall apply during all operating periods except startup. Startup begins with the introduction of fuel oil into the boiler and ends no later than the point in time when the flue gas desulfurization system on Unit 1 reaches a temperature of 275°F and three (3) coal pulverizers have been placed in service.

Pollutant	lb/MMBtu	lb/hr	tpy
NO_x	0.23 (30-day rolling)	1,081.0 (30-day rolling)	4,735
PM/PM_{10} [a]	0.015	71.0	309

[a] Filterable portion only

6. That initial performance tests be conducted, in accordance with Chapter 6, Section 2(j) of the WAQSR, within 30 days of achieving a maximum design rate but not later than 90 days following initial start-up, and a written report of the results be submitted. If a maximum design rate is not achieved within 90 days of start-up, the Administrator may require testing be done at the rate achieved and again when a maximum rate is achieved.

7. Performance tests shall consist of the following:

    Coal-fired Boiler (Wyodak Unit 1):

    NO_x Emissions – Compliance with the NO_x 30-day rolling average shall be determined using a continuous emissions monitoring system (CEMS) certified in accordance with 40 CFR part 60.

    PM/PM_{10} Emissions – Testing shall follow 40 CFR 60.46 and EPA Reference Test Methods 1-4 and 5.

    Testing required by the Chapter 6, Section 3, Operating Permit may be submitted to satisfy the testing required by this condition.

8. Prior to any testing required by this permit, a test protocol shall be submitted to the Division for approval, at least 30 days prior to testing. Notification should be provided to the Division at least 15 days prior to any testing. Results of the tests shall be submitted to this office within 45 days of completing the tests.

9. PacifiCorp shall comply with all requirements of the Regional SO_2 Milestone and Backstop Trading Program in accordance with Chapter 14, Sections 2 and 3, of the WAQSR.

10. Compliance with the NO_x limits set forth in this permit for the coal-fired boiler (Wyodak Unit 1) shall be determined with data from the continuous monitoring system required by 40 CFR Part 75 as follows:

   a. Exceedances of the NO_x limits shall be defined as follows:

      i. Any 30-day rolling average of NO_x emissions which exceeds the lb/MMBtu limits calculated in accordance with the compliance provisions and monitoring requirements of §60.48Da and §60.49Da. The definition of "boiler operating day" shall be consistent with the definition as specified in 40 CFR part 60, subpart Da.

      ii. Any 30-day rolling average calculated using valid data (output concentration and average hourly volumetric flowrate) from the existing CEM equipment which exceeds the lb/hr NO_x limit established in this permit. Valid data shall meet the requirements of WAQSR, Chapter 5, Section 2(j) and follow the compliance provisions and monitoring requirements of §60.48Da and §60.49Da. The 30-day average emission rate shall be calculated as the arithmetic average of hourly emissions with valid data during the previous 30-day period. The definition of "boiler operating day" shall be consistent with the definition as specified in 40 CFR part 60, subpart Da.

   b. PacifiCorp shall comply with all reporting and record keeping requirements as specified in WAQSR, Chapter 5, Section 2(g) and 40 CFR part 60, subpart D. All excess emissions shall be reported using the procedures and reporting format specified in WAQSR, Chapter 5, Section 2(g).

11. PacifiCorp shall use EPA's Clean Air Markets reporting program to convert the monitoring system data to annual emissions. PacifiCorp shall provide substituted data according to the missing data procedures of 40 CFR, Part 75 during any period of time that there is not monitoring data. All monitoring data must meet the requirements of WAQSR, Chapter 5, Section 2(j).

12. Compliance with the PM/PM_{10} limits set forth in this permit for the coal-fired boiler (Wyodak Unit 1) shall be determined with data from testing for PM conducted annually, or more frequently as specified by the Administrator, following 40 CFR 60.46 and EPA Reference Test Methods 1-4 and 5. Testing required by the Chapter 6, Section 3, Operating Permit may be submitted to satisfy the testing required by this condition.

13. Records required by this permit shall be maintained for a period of at least five (5) years and shall be made available to the Division upon request.

14. PacifiCorp shall install new low NO_x burners with advanced overfire air and a new full-scale fabric filter on Unit 1, in accordance with the Division's BART determination, and conduct the initial performance tests required in Condition 6 no later than December 31, 2011.

It must be noted that this approval does not relieve you of your obligation to comply with all applicable county, state, and federal standards, regulations or ordinances. Special attention must be given to Chapter 6, Section 3 of the Wyoming Air Quality Standards and Regulations, which details the requirements for compliance with condition 3. Attention must be given to Chapter 14, Sections 2 and 3 of the Wyoming Air Quality Standards and Regulations, which detail the requirements for compliance with condition 9. Any appeal of this permit as a final action of the Department must be made to the Environmental Quality Council within sixty (60) days of permit issuance per Section 16, Chapter I, General Rules of Practice and Procedure, Department of Environmental Quality.

If we may be of further assistance to you, please feel free to contact this office.

Sincerely,

David A. Finley
Administrator
Air Quality Division

John V. Corra
Director
Dept. of Environmental Quality

cc: Tanner Shatto/AQD Sheridan

IN THE MATTER OF A PERMIT APPLICATION (AP-6043) FROM PACIFICORP FOR A BEST AVAILABLE RETROFIT TECHNOLOGY (BART) PERMIT FOR THE WYODAK POWER PLANT

DECISION

I. Introduction:

The Air Quality Division received a BART permit application from PacifiCorp for the coal-fired boiler (Unit 1) that operates at their Wyodak Power Plant in Campbell County, Wyoming. Regulations governing the BART program have been established by the U.S. EPA in 40 CFR Part 51 - Appendix Y. As stated in the regulations, a source is eligible for BART if it belongs within a particular group of stationary source categories, was not in operation prior to August 7, 1962, was in existence on August 7, 1977, and has the potential to emit 250 tons per year (tpy) or more of any visibility impairing air pollutant. Fossil fuel boilers with more than 250 million Btu (MMBtu) per hour heat input are listed as an eligible source type. Unit 1 at the Wyodak plant has a heat input of 4,100 MMBtu per hour and was in existence on August 7, 1977. Potential emissions from each boiler for two visibility impairing air pollutants, nitrogen oxides (NO_x) and sulfur dioxide (SO_2), exceed 250 tpy and therefore the units are eligible for BART.

The Division conducted an analysis of the BART permit application for the Wyodak plant and on June 4, 2009, published in the Gillette News-Record a public notice and notice of public hearing of the proposed intent to issue BART determinations. Copies of the BART application and the Division's analysis were placed in the Campbell County Clerk's office in Gillette, Wyoming in accordance with regulations. A 63-day public notice period ran from June 4, 2009 to August 5, 2009, and a public hearing was held on August 5, 2009, at 6 p.m. in the George Amos Memorial Building, located at 412 South Gillette Avenue in Gillette, Wyoming.

The Division received numerous comment letters on the proposed permit during the public comment period: 1) a letter dated July 21, 2009 from the USDA Forest Service; 2) a letter dated August 3, 2009 from EPA Region 8; 3) a letter dated August 4, 2009 from PacifiCorp; 4) a letter dated August 4, 2009 from the National Park Service; 5) a letter dated August 4, 2009 from the Powder River Basin Resource Council, et al.; 6) a letter dated August 5, 2009 from the Powder River Basin Resource Council; 7) a letter received July 20, 2009 from Joanna Taylor; 8) a letter dated July 16, 2009 from Andrew H. Salter; 9) a letter received July 20, 2009 from Evelyn and Marvin Griffin; 10) a letter received July 23, 2009 from Mimi McMillen; 11) a letter received July 24, 2009 from William M. Anderson; 12) a letter received July 24, 2009 from Rebekah Smith; 13) a letter dated July 24, 2009 from Mike Shonsey; 14) a letter dated July 24, 2009 from Susie Mohrmann; 15) a letter dated July 28, 2009 from Janice H. Harris; 16) a letter dated July 28, 2009 from M. Christensen; 17) a letter dated July 27, 2009 from Clint Morrison; 18) a letter dated August 3, 2009 from Ann Fuller; 19) a letter dated August 3, 2009 from Mary Fenton; 20) 725 unsigned letters received under a signed cover letter dated July 28, 2009 from Brad Mohrmann, Sierra Club Associate Regional Representative; and 21) 89 signatures received under a signed cover letter dated July 24, 2009 from Brad Mohrmann, Sierra Club Associate Regional Representative.

Due to the number of public comments with similar concerns, the Division grouped individual comments and developed summary comments and responses. Comments from the EPA, Forest Service, National Park Service, Powder River Basin Resource Council, et al., and PacifiCorp are addressed individually. The comments and responses are presented on the following pages. The Division also received positive comments supporting this project. The Division appreciates these comments but they are not included in this document as no response is required.

The Division received numerous comments that were descriptive of environmental impacts other than the impacts from BART-eligible sources in Wyoming on Class I area visibility. The Division's responses are limited to the comments that dealt with the State's BART analyses.

The Division is also preparing a revised Wyoming State Implementation Plan (SIP) for Regional Haze, and has solicited comments on that SIP. Some comments have been received which were submitted as comments on the Regional Haze SIP, but were principally directed at the Division's BART analyses. These comments will be addressed by the Division as it prepares the response to comments on the Regional Haze SIP.

II. Analysis of Comments from the USDA Forest Service:

II.1 **BART Conclusions for NO_x Controls: SCR** – The Forest Service commented that based on their review of the five statutory BART factors, Selective Catalytic Reduction (SCR) should be BART for NO_x control for all units at plants such as the Jim Bridger power plant. The Forest Service applauds the proposal to install SCR at the four units at the Jim Bridger plant for a long-term strategy, but SCRs at Jim Bridger should be installed as BART on all units by 2015-2016.

Response – The Division determined BART for NO_x control at power plants in Wyoming based on consideration of all five statutory BART factors, as required by EPA's Appendix Y BART guidance. No single factor was weighted as being more important than another, because the Division looked at all five statutory factors in their entirety.

Regarding the installation of additional control equipment at the Jim Bridger plant, PacifiCorp is required by the BART permit to install SCR on Jim Bridger Unit 3 in 2015 and Jim Bridger Unit 4 in 2016 as well as add-on NO_x control on Units 1 and 2 no later than 2023. The schedule for installation is based on the incorporation of SCR add-on control on these units under the long-term strategy component of Wyoming's State Implementation Plan (SIP) for regional haze as well as PacifiCorp's construction plan for pollution control projects. The schedule for the installation of SCR controls at other plants is uncertain at this point due to the demands on PacifiCorp for compliance with BART and other regulatory programs. PacifiCorp operates 19 coal-fired units, 14 of which are BART-eligible. Additional BART-eligible units are owned or partly owned in Arizona, Colorado, and Montana. Table 1 presents a summary of the pollution control projects that are included in PacifiCorp's construction plan through 2014.

Table 1: Status of Pollution Control Projects Undertaken by PacifiCorp

Power Plant	Location	SO_2 Scrubbers New = N Upgrade = U	LNB Installations	Baghouse Installations	SO_2/LNB Project Status
Hunter 3	Utah	Installed	2008	Installed	Completed
Huntington 2	Utah	2007 – N	2007	2007	Completed
Cholla 4	Arizona	2008 – U	2008	2008	Completed
Jim Bridger 4	Wyoming	2008 – U	2008	n/a	Completed
Jim Bridger 2	Wyoming	2009 – U	2005	n/a	Completed
Dave Johnston 3	Wyoming	2010 – N	2010	2010	Under Construction
Huntington 1	Utah	2010 – U	2010	2010	Permitted
Jim Bridger 1	Wyoming	2010 – U	2010	n/a	Under Construction
Naughton 2	Wyoming	2011 – N	2011	n/a	Under Construction
Hunter 2	Utah	2011 – U	2011	2011	Permitted
Jim Bridger 3	Wyoming	2011 – U	2007	n/a	Under Construction
Wyodak	Wyoming	2011 – U	2011	2011	Permitted
Dave Johnston 4	Wyoming	2012 – N	2009	2012	Under Construction
Naughton 1	Wyoming	2012 – N	2012	n/a	Under Construction
Hunter 1	Utah	2014 – U	2014	2014	Permitted
Naughton 3	Wyoming	2013 – U	2013	2013	Permitted

II.2 **NO_x Step 5: Visibility Improvement Determination (Class I areas modeled)** – The Forest Service commented that all Class I areas within 300 km of a given source should be modeled and the cost of each BART alternative divided by the sum of the deciview (dv) improvement at all impacted Class I areas. If modeling exists for Class I areas that yield impacts above 0.5 dv just beyond 300 km, those results should be considered also. Savage Run Wilderness Area should also be modeled and considered.

Response – Only those Class I areas most likely to be impacted by sources subject to BART at a given facility were modeled, as determined by source/Class I area locations, distances to each Class I area, and professional judgment considering meteorological and terrain factors. The Division recognizes that more distant Class I areas may yield modeled impacts of some magnitude, but the Division is also satisfied that Class I areas at a greater distance and in directions of less frequent plume transport would not yield modeled impacts greater than those yielded by the Class I areas chosen for BART modeling. The modeling results for the Class I areas chosen for analysis allowed the Division to make an informed decision on the effect on visibility from the various BART control options. Additionally, EPA's Appendix Y BART guidance does not include any requirements for modeling distance.

EPA's Appendix Y BART guidance does mention that "dollars per deciview" ($/dv) is a metric that could be used to evaluate the cost of BART compliance, but by no means identifies $/dv as an essential or required metric. The Division considered capital cost, annual cost, cost effectiveness, and incremental cost effectiveness in the cost evaluation of each proposed BART control option. The Division chose not to use a hybrid metric such as \$/dv primarily because of the lack of historical precedent regarding reasonable/acceptable levels for such a metric. Additionally, the use of a hybrid cost metric such as \$/deciview can introduce uncertainty as to how the value was calculated. The value of "/deciview" could be based on the highest modeled value in a given area or the 98th percentile modeled value. It could be based on the 98th percentile value for any one modeled year or it could be an average for multiple years. It could even be based on an average modeled value across an entire Class I area or the sum of deciview changes across multiple areas. The Division has found that \$/dv values are often presented without explanation of the basis for the calculation. To avoid these confounding factors, the Division chose to evaluate and present the cost analyses and visibility analyses separately.

EPA's Regional Haze Rule affects sources that may cause or contribute to visibility impairment at any mandatory, federal Class I Area. Because Savage Run is a state-designated Class I area, the Division was not required to include it in the BART modeling. Additionally, the Division did not include Savage Run in any of its analyses for the State's Regional Haze Visibility SIP. For BART, the Division did model the impacts at several mandatory Class I areas that are located in the same general plume transport direction downwind of Savage Run, including Mt. Zirkel Wilderness, Rawah Wilderness, and Rocky Mountain National Park. Based on the modeling results for these Class I Areas in the proximity of Savage Run, the Division anticipates similar improvements in visibility from the analyzed emission reductions.

II.3 **NO_x Step 5: Visibility Improvement Determination (significant impact)** – The Forest Service commented that it is incorrect to dismiss a control strategy on the basis that the modeled visibility improvement is not perceptible or significant.

Response – The Division used 0.5 dv as the threshold level to exempt a source from BART or to deem modeled impacts as insignificant. EPA's *Regional Haze Regulations and Guidelines for Best Available Retrofit Technology (BART) Determinations* (Appendix Y to 40 CFR part 51), suggest that 0.5 dv can represent the level at which a source "contributes" to visibility impairment. This is also consistent with the rules which are being applied by most states in the Western Regional Air Partnership (WRAP) region.

II.4 **NO_x Controls: SCR** – The Forest Service commented that significant, cumulative visibility improvements modeled for SCR installations at the Jim Bridger and Naughton plants indicate that SCR should be BART for all units at those two plants. The Forest Service questions why DEQ chose SCR as BART only for Naughton Unit 3 when SCR costs for other Naughton units and all Jim Bridger units are similar. Also, environmental degradation from the operation of SCR should not be a factor in the BART determinations and energy impacts from SCR should not be a factor because they have already been considered in the cost analysis.

Response – The costs for SCR controls, as described in the Division's BART analyses, were deemed by the Division to be reasonable for all units at the Jim Bridger and Naughton plants, but the Division's BART determinations for the two plants were based on consideration of all five statutory BART factors, as required by EPA's Appendix Y BART guidance. PacifiCorp proposed a BART limit for NO_x emissions from Naughton Unit 3 of 0.37 lb/MMBtu, which would be achieved by tuning the existing LNB/OFA system. For Naughton Units 1 and 2, PacifiCorp proposed a BART limit for NO_x of 0.26 lb/MMBtu for each unit using new LNB/OFA. Visibility modeling showed that the NO_x emission level proposed by PacifiCorp for

Naughton Unit 3 provided less in terms of modeled visibility reductions from baseline as compared to other units at the two plants. For example, Naughton Units 1 and 2 showed a 72% to 73% reduction in the number of days with predicted impacts of 0.5 dv or more at the nearest Class I area (Bridger Wilderness) for LNB/OFA as compared to baseline. The reduction for Naughton Unit 3 for LNB/OFA vs. baseline was only 31%. Appendix A includes graphs of the modeled results at the Class I area that yielded the highest modeled impacts for the Jim Bridger and Naughton plants (Bridger Wilderness) and the Class I area that yielded the highest modeled impacts for the Wyodak, Dave Johnston, and Laramie River Station plants (Wind Cave National Park). As shown in the graphs, the LNB/OFA option reduces the 98th percentile result to less than 1.0 dv for every unit with the exception of Naughton Unit 3 (1.4 dv). The predicted number of days above 0.5 dv for the LNB/OFA option was 40 for Naughton Unit 3, and 16 or less for each of the other twelve units. The Division determined that SCR would be required on Naughton Unit 3 to bring about additional NO_x emissions reductions and modeled visibility improvement, and these factors differentiated the Naughton Unit 3 BART analysis from the others.

It was the full consideration of all five statutory BART factors, principally the pronounced visibility improvement for LNB/OFA as compared to baseline and the lack of non-air quality environmental impacts that led the Division to conclude that LNB/OFA would be BART for NO_x control at the Wyodak plant. In comparison, modeled visibility impacts for Naughton Unit 3 were reduced to levels comparable to those yielded by LNB/OFA controls on Naughton Units 1 and 2 only through the addition of SCR as BART on Naughton Unit 3. Potential energy losses and environmental impacts from the operation of SCR were mentioned in the Division's BART analysis for all PacifiCorp plants, but were only part of the larger evaluations that considered all five statutory factors.

II.5 **NO_x Controls: SCR Efficiencies** – The Forest Service commented that greater SCR control efficiencies should be factored into the cost and visibility analyses.

Response – The Division conducted a search of the EPA RACT/BACT/LAER Clearinghouse (RBLC) to find NO_x emission limits as BACT associated with SCR control in recently issued permits. Table 2 presents a summary of the Division's RBLC search. Two plants have limits of 0.05 lb/MMBtu NO_x with a 12-month rolling average, which is significantly longer than a 30-day averaging period. Because the 0.05 lb/MMBtu limits are based on a 12-month averaging period, they are not comparable to the 30-day limits established by the Division. The two plants with 30-day averaging periods will be subjected to either a 0.08 lb/MMBtu or 0.07 lb/MMBtu limit, and the limits established by the Division meet these lower limits. A spreadsheet compiled by the National Park Service with a summary of nationwide BART determinations shows that both units outside of Wyoming for which SCR is proposed as BART will be subject to a NO_x emission limit of 0.07 lb/MMBtu, and both will be based on a 30-day averaging period.

The RBLC search showed two plants that will be subject to 24-hour NO_x limits of less than 0.07 lb/MMBtu (0.067 lb/MMBtu), but these limits are for newly constructed plants which have been engineered to meet these levels. BART will require the retrofit of significant controls at plants that were not designed to meet these lower levels. Based on the Division's evaluation, the Division is satisfied that the NO_x emission limit of 0.07 lb/MMBtu (30-day rolling average) that was evaluated for SCR control under BART is the most stringent control level likely to be achieved in a retrofit.

Table 2: SCR Permit Limits from the RBLC				
Facility/Location	**Size of Source**	**Source Description**	**NO_x Permit Limit(s) for SCR Control**	**Permit Date**
John W. Turk Power Plant/Arkansas	600 MW	6,000 MMBtu/hr PC Boiler (PRB Coal)	1) 0.067 lb/MMBtu (24-hr rolling) 2) 0.05 lb/MMBtu (12-month rolling) [SCR, BACT]	Nov 2008
Dry Fork Station/Wyoming	385 MW	PC Boiler	0.05 lb/MMBtu (12-month rolling) [SCR, BACT]	Oct 2007
WYGEN3/Wyoming	100 MW	1,300 MMBtu/hr PC Boiler	0.05 lb/MMBtu (12-month rolling) [SCR, BACT]	Feb 2007
Iatan Station/Missouri	--	PC Boiler	0.08 lb/MMBtu (30-day rolling) [SCR, BACT]	Jan 2006
Big Cajun II Power Plant/Louisiana	675 MW	PC Boiler	0.07 lb/MMBtu (annual average) [SCR, BACT]	Aug 2005
TS Power Plant/Nevada	200 MW	PC Boiler	0.067 lb/MMBtu (24-hour rolling) [SCR, BACT]	May 2005
OPPD – Nebraska City Station/Nebraska	--	--	0.07 lb/MMBtu (30-day rolling) [SCR, BACT]	Mar 2005

Note: "--" indicates that this value was not provided in the RBLC

II.6 **SO_2 Controls (Section 309)** – The Forest Service understands the role of Section 309 in exempting the State of Wyoming from making BART determinations for SO_2 controls based on the demonstration that the benefits from SO_2 emissions reductions under Section 309 exceed those that would have resulted from BART. Are the existing SO_2 controls in place at the Jim Bridger and Naughton plants at least equivalent to the control scenario used in the demonstration, i.e., are the existing controls needed to accomplish the "Better than BART" demonstration for Section 309? They also note that the 309 program sunsets in 2018 and added SO_2 controls may be needed for reasonable progress at that time.

Response – The State of Wyoming submitted a 309 SIP as is allowed by the Regional Haze Rule. Part of the SIP submittal is a "Better than BART" demonstration, required by rule, which does not require that each and every unit demonstrate emission controls that are "Better than BART". The demonstration is a regional demonstration. The Division is aware than the 309 program only establishes milestones through 2018, and that following 2018 another strategy may be necessary to reduce visibility-impairing pollutants. Additional strategies will be addressed in future SIP revisions.

II.7 **Visibility Impairment** – The Forest Service commented that because EPA BART guidelines state that 0.5 dv "contributes" to visibility impairment, and 1.0 dv "causes" visibility impairment, the discussion from Ronald Henry regarding perceptibility in the BART applications from PacifiCorp is irrelevant and used in an improper context.

Response – The Division did not attempt to endorse a particular threshold for human eye "perceptibility" since the level of perceptibility has long been disputed. Instead, the Division has relied on EPA's Appendix Y BART guidance, which suggests a value of 0.5 dv as the level that a source "contributes" to visibility impairment. One of the metrics used by the Division to evaluate the relative benefit of a given BART control option was the number of days yielding a modeled impact of 0.5 dv or more.

III. Analysis of Comments from EPA Region 8:

III.1 **Background Ozone Concentration in CALPUFF** – EPA Region 8 commented that the Division's visibility modeling used 44 ppb as a background ozone concentration as the default value for periods when measured data was missing. This value appears to be too low based on the average annual concentrations at sites near the facilities (Thunder Basin = 50-55 ppb, Jonah = 55-58 ppb). DEQ should provide an analysis of how higher ozone background concentrations would affect results.

Response – The default ozone background concentration is used by CALPUFF as a domain-wide substitute for any hour for which all measured ozone concentrations are missing. For the Division's visibility modeling for BART, hourly ozone concentrations measured at seven monitoring stations spaced across the modeling domain were input to CALPUFF. A visual inspection of the ozone files that were input to CALPUFF reveals that at least one valid ozone observation was available for every hour of the modeled period (2001-2003), making it unnecessary for the model to use the default background of 44 ppb.

Although the model did not use the default background value for the BART analyses, the Division calculated annual average concentrations for recent years (2007-2008) and all available data for 2009 for many of the stations that were used for input to CALPUFF, including Thunder Basin, Jonah, Rocky Mountain National Park, Centennial, and Pinedale. Annual average values for these stations ranged from 35 ppb to 49 ppb, with an overall average of approximately 40 ppb. The Division is confident that the default background value of 44 ppb was appropriate for the BART modeling, and that there is no need for additional analyses to explore alternate background concentrations.

III.2 **Weight of Visibility Modeling Results in BART Determinations** – EPA Region 8 commented that DEQ should provide an explanation of how modeled visibility improvements were weighed in making BART determinations.

Response – The Division's BART determinations were based on consideration of all five statutory factors, as required by EPA's Appendix Y BART guidance. The modeled visibility improvements for a given control strategy were one of the five factors that were considered. No single factor was weighted as being more important than another, because the Division looked at all five statutory factors in their entirety. EPA guidance did not provide a quantification of the amount of modeled visibility improvement that would be acceptable or significant. The Division used two metrics that were mentioned in the EPA BART guidance, the 98th percentile result for a given year and the level at which a source "contributes" to visibility degradation (0.5 Δdv), to present the results of the BART visibility modeling. Also see the response to USDA Forest Service comment II.4.

III.3 **Cumulative Modeled Impacts** – EPA Region 8 commented that cumulative, modeled Class I impacts from all units at a facility (or combined impacts from multiple facilities) should be presented in addition to the results for individual units.

Response – The visibility impacts from BART-eligible sources are to be modeled separately. As stated in the EPA's Appendix Y guidance, relative to the use of the CALPUFF model for BART determinations, "*We believe that CALPUFF is an appropriate application for States to use for the particular purposes of this rule, to determine if an individual source is reasonably anticipated to cause or contribute to impairment of visibility in Class I areas, and to predict the degree of visibility improvement which could reasonably be anticipated to result from the use of retrofit technology* ***at an individual source****. We encourage States to use it for these purposes.*" [emphasis added]

III.4 **Language from BART Determinations** – EPA Region 8 commented that the Division should clarify the statements of "3-year average visibility improvements". Are dv improvements calculated for each Class I area added together? If so, what is the meaning of the number? Are three Class I areas sufficient to quantify cumulative impacts? Were all Class I areas within 300 km considered?

Response – To arrive at the "3-year average visibility improvements" that were reported in the Division's BART analyses, the modeled 98^{th} percentile dv change or the number of days above 0.5 dv predicted for a given year of meteorology was averaged with the similar result from the other two years of meteorology. These 3-year average values were determined for each modeled Class I area separately, and were devised to allow a straightforward, direct comparison of one control option to another. Regarding the sufficiency of the number of modeled Class I areas and the question of other Class I areas within 300 km, see response to USDA Forest Service comment II.2.

III.5 **NO_x Controls** – EPA Region 8 commented that the most stringent emission control levels for NO_x controls have not been evaluated, resulting in inflated calculated cost effectiveness values. Lower emission limits should be evaluated for selective non-catalytic reduction (SNCR) and SCR.

Response – The Division has analyzed the most stringent levels for SNCR and SCR, and does not agree that the cost effectiveness numbers have been inflated. See response to USDA Forest Service comment II.5. Furthermore, the Division has deemed the costs associated with all analyzed BART NO_x control options, including SNCR and SCR, to be reasonable (see the conclusions listed under the section: **NOx: EVALUATE IMPACTS AND DOCUMENT RESULTS** in each of the five BART Application Analyses).

III.6 **12-Month Average for NO_x** – EPA Region 8 commented that there is no formula to calculate if the 12-month rolling emission limit has exceeded the permit condition. A permit condition to match condition 12.a.iii from the Laramie River Station analysis should be created.

Response – The BART limits for NO_x emissions from the PacifiCorp plants include 30-day rolling limits in terms of lb/MMBtu and lb/hr. The ton per year limit is based on a calendar year rather than a rolling average, and therefore the formula associated with the annual BART limit for NO_x at the Laramie River Station is not relevant.

III.7 **PM Controls: Averaging Periods** – EPA Region 8 commented that the BART conclusions and the permit conditions should include associated averaging periods for all PM/PM_{10} limits.

Response – The averaging periods for the PM/PM_{10} limits are dictated by the performance test requirements in the BART permits. Compliance with the lb/MMBtu and lb/hr PM/PM_{10} limits is based on the average of three 1-hour tests per 40 CFR 60.46.

III.8 **PM Controls: Control Effectiveness** – EPA Region 8 commented that the Division should explain why 0.015 lb/MMBtu for baghouse/fabric filter control effectiveness is acceptable, when 0.012 lb/MMBtu has been approved by the Division for other permits and 0.010 lb/MMBtu was approved for the Desert Rock project. The BART determinations should include analyses of electrostatic precipitators (ESPs) and baghouses at lower control levels.

Response – Recent Prevention of Significant Deterioration (PSD) permits issued by the Division did include PM/PM_{10} limits of 0.012 lb/MMBtu for fabric filter controls, but those limits (and PM/PM_{10} limits established for the Desert Rock Project in New Mexico) were determined through Best Available Control Technology (BACT) analyses for new sources. The BART process deals with retrofit controls on existing units, and therefore is not directly comparable to BACT determinations. Additionally, visibility modeling described in the Division's BART analysis for the Jim Bridger plant showed that the addition of a fabric filter to replace an Electrostatic Precipitator (ESP) provided very little in the way of visibility improvement, with predicted cumulative improvements across three Class I areas of only 0.03 to 0.1 Δdv for Units 1-4. These results indicate that requiring more stringent control levels for a fabric filter would not provide significant visibility improvement.

As described on page 12 of the Division's BART analysis for the Wyodak plant, flue gas conditioning (FGC) was considered for enhancement of the existing ESP on Unit 1. The existing ESP is well designed and provides adequate space and residence time for the flue gas particles to gain an electric charge and migrate to the collection plate. The application of FGC was not expected to significantly improve PM/PM_{10} removal efficiency.

III.9 **PM Controls: Permit Exemption** – EPA Region 8 commented that Condition 5 in the proposed EGU BART permits contains an inappropriate exemption for startup. The exemption from the lb/MMBtu PM limit during startup should be removed or it may be appropriate to analyze the need for a startup BART limit.

Response – For each EGU subject to BART in Wyoming, only the BART limits for PM/PM_{10} that are expressed in lb/MMBtu will not apply during startup. The BART limits for PM/PM_{10} that are expressed in lb/hr and tpy (as based on the lb/MMBtu limits) will apply during all operating periods including startup.

The Division considers the BART limits expressed in terms of lb/hr and tpy to be appropriate limits for startup. For the four units at the Jim Bridger plant, PacifiCorp calculated that the particulate emissions from the startup fuel (fuel oil) would be no greater than 10.9 lb/hr per unit, conservatively assuming that the ESP controls had zero control efficiency during the startup process. As a comparison, the BART limit that would apply for each unit during startup is 180 lb/hr. Further, PacifiCorp has agreed to minimize startup emissions from the four units at the plant by placing the ESPs in service prior to the introduction of coal to the boilers, which is contrary to the manufacturer's recommendation to energize the ESP only after the unit is at full operating temperature and combustion of fuel oil has ceased.

Similarly for Unit 1 at Wyodak, particulates are controlled by an ESP and startup is accomplished with fuel oil. The maximum emissions estimated for startup (8.9 lb/hr) would be well below the BART limit of 71 lb/hr. The three units at LRS are also started on fuel oil and controlled with ESPs, and the particulate emissions during startup are expected to be well below the BART limits, which are set at 193 lb/hr to 198 lb/hr for the three units.

For units with baghouse controls for particulate matter such as Dave Johnston Units 3 and 4, emissions from fuel oil during the startup process are also estimated to be well below the allowable lb/hr BART limits.

In the case of the Naughton plant, particulate controls will include a mixture of ESPs (Units 1 and 2) and a fabric filter/baghouse (Unit 3). Natural gas is the startup fuel for each of these units, and particulate emissions during startup are expected to be well below the established lb/hr BART limits.

III.10 **SO_2 Controls: Reasonable Progress** – EPA Region 8 commented that the Division must evaluate the visibility impacts of SO_2 controls and demonstrate reasonable progress for the Class I areas away from the Colorado Plateau.

Response – Wyoming, along with other 309 states in the WRAP region, evaluated the impact of the 309 program on all Class I areas in the west, even though the requirement by rule was to demonstrate improvement in Class I areas on the Colorado Plateau. The WRAP modeling for sulfates shows that all Class I areas in and around Wyoming sources are benefiting from the sulfur dioxide emission reductions instituted in the 309 program. Sulfate extinction levels show improvement on the 20% worst days and improvement or at least no degradation on the 20% best days. Furthermore, the Regional Haze rule allows a state to take full credit for strategies implemented under 309 when addressing Class I Areas away from the Colorado Plateau (51.309(g)(4)(i)).

III.11 **PM Control Level** – EPA Region 8 commented that because the Division recently issued a PSD permit for the Wyodak plant, it is inappropriate for the BART analysis options to be less protective than the permitted enforceable controls. Controls already permitted through PSD should be viewed as baseline for the BART analysis.

Response – The permit limit for PM/PM_{10} emissions from the Wyodak plant established under the recent permit (MD-7487, issued 5/20/09) is 0.015 lb/MMBtu, and the control technology is a fabric filter baghouse. The emission limit of 0.015 lb/MMBtu was confirmed through the BART analysis that was conducted for the facility. Recent Prevention of Significant Deterioration (PSD) permits issued by the Division did include PM/PM_{10} limits of 0.012 lb/MMBtu for fabric filter controls, but those limits were determined through Best Available Control Technology (BACT) analyses. The BART process deals with retrofit controls, and therefore is not directly comparable to BACT determinations. The fabric filter controls added at Wyodak under MD-7487 were not subject to BACT.

40 CFR 51.309(b)(7) states that "Base year means the year for which data for a source included within the program were used by the WRAP to calculate emissions as a starting point for

development of the milestone required by paragraph (d) (4) (i) of this section." Because the Western Regional Air Partnership (WRAP) used 2003 as the starting point for development of milestones for SO_2 emissions, the emission control configuration in place at a given facility in 2003 was considered by the Division to be the baseline configuration for BART. Additionally, the period for establishing the baseline visibility conditions under the Regional Haze Rule is 2000 to 2004 [40 CFR 51.308(d)(2)]. The fabric filter configuration for the Wyodak plant that was permitted in May of 2009 was therefore considered a control strategy option rather than a baseline configuration.

Additionally, visibility modeling conducted by the Division has shown that the addition of a fabric filter as an upgrade to an ESP provides very little in the way of modeled visibility improvement, and these results indicate that requiring more stringent control levels for a fabric filter would not provide significant visibility improvement. Also see response to EPA Region 8 comment III.8.

III.12 **NO_x Controls** – EPA Region 8 commented that the most stringent emission control levels have not been evaluated, resulting in inflated calculated cost effectiveness values. Lower emission limits should be evaluated for SNCR and SCR. A revised cost analysis should indicate that SCR is cost effective at Wyodak.

Response – See response to USDA Forest Service comment II.5 and EPA Region 8 comment III.5.

IV. Analysis of Comments from PacifiCorp:

IV.1 **General Comments: Cost Metrics** – PacifiCorp commented that EPA's Appendix Y BART guidance states that a proper BART evaluation should include "other cost-effectiveness measures (such as \$/deciview)". Thus, any BART determination that is limited to use only cost effectiveness and incremental cost effectiveness may be unacceptably narrow.

Response – EPA's Appendix Y BART guidance does mention that "dollars per deciview" (\$/dv) is a metric that could be used to evaluate the cost of BART compliance, but by no means identifies \$/dv as an essential or required metric. The Division considered capital cost, annual cost, cost effectiveness, and incremental cost effectiveness in the cost evaluation of each proposed BART control option. The Division chose not to use a hybrid metric such as \$/dv primarily because of the lack of historical precedent regarding reasonable/acceptable levels for such a metric. Additionally, the use of a hybrid cost metric such as \$/deciview can introduce uncertainty as to how the value was calculated. The value of "/deciview" could be based on the highest modeled value in a given area or the 98th percentile modeled value. It could be based on the 98th percentile value for any one modeled year or it could be an average for multiple years. It could even be based on an average modeled value across an entire Class I area or the sum of deciview changes across multiple areas. The Division has found that \$/dv values are often presented without explanation of the basis for the calculation. To avoid these confounding factors, the Division chose to evaluate and present the cost analyses and visibility analyses separately.

IV.2 **General Comments: Cost Effectiveness** – PacifiCorp commented that any BART determination requiring a source to install post-combustion controls like SCR or spend more than \$1,500 per ton of NO_x removed would be contrary to EPA Appendix Y BART guidance.

Response – The EPA's Appendix Y guidance describes the EPA's selection of presumptive NO_x limits for coal-fired EGUs, and provides approximate cost levels for meeting the presumptive limits with current combustion controls and a somewhat higher cost level for a subset of units that would require advanced combustion controls such as rotating opposed fire air (ROFA). The EPA guidance does not attempt to establish cost thresholds that would be considered unreasonable for a given control technology, nor does it present the approximate costs associated with the presumptive levels as absolute limits above which cost should be deemed unreasonable. The guidance also states that states may in specific cases find that the use of SCR is appropriate. As stated previously, the Division established NO_x emission limits for BART based on consideration of all five statutory factors in their entirety, as required by the Appendix Y guidance.

IV.3 **General Comments: Power Plants More Than 750 MW** – PacifiCorp commented that Appendix Y indicates that states must follow Appendix Y guidelines in making BART determinations on a source-by-source basis for 750 MW plants. Wyoming rules impose similar requirements for power plants greater than 750 MW.

Response – The Division followed EPA and State of Wyoming rules for the BART analyses. Specifically, the Division followed WAQSR Chapter 6, §9(c)(ii), which states that power plants with generating capacities greater than seven hundred fifty megawatts shall comply with EPA Appendix Y, and that Appendix Y should be used as guidance for preparing BART analyses for all other facilities.

IV.4 **General Comments: Post-Combustion Controls** – PacifiCorp commented that EPA never contemplated the use of post-combustion controls to meet BART limits for tangentially-fired boilers, and that it is nearly impossible under Appendix Y guidance to show that anything other than combustion controls should be required as BART.

Response – See response to PacifiCorp comment IV.2.

IV.5 **General Comments: Visibility Improvement** – PacifiCorp commented that a BART determination that only relied on the 98th percentile, three-year average results from CALPUFF may be too narrow to satisfy Appendix Y.

Response – The Division did not rely solely on the three-year average of the 98^{th} percentile CALPUFF results to evaluate the expected visibility changes for the BART control options. The 98^{th} percentile values and the number of days with predicted results above 0.5 dv were presented in the Division's BART analyses for each of three modeled years, for each Class I area, and for each control option. The three-year average of the 98^{th} percentile results and the number of days above 0.5 dv were chosen for graphical representation and were mentioned prominently in the Division's conclusions because they offered the clearest comparison of one control option to another (see graphs in Appendix A).

IV.6 **General Comments: Modeling** – PacifiCorp commented that visibility modeling contains inherent bias or exaggeration because it assumes that a particular source will operate at its maximum capacity 100% of the time and that each unit at a facility operates in the same way.

Response – The results from BART visibility modeling, as required by EPA guidance, are based on daily (24-hour) averages. Reported results for a given control scenario, expressed in units of deciviews, represent the predicted change in visibility as compared to natural background over the course of 24-hour periods of meteorology. The modeled emission rates for a given unit at a power plant should reflect the highest rate that could be achieved over a 24-hour period, and therefore the assumption that a given unit is operating at its maximum operating capacity is appropriate for each unit at a base-load power plant such as Wyodak. Additionally, the conclusions drawn from BART visibility modeling primarily involve comparisons between control scenarios for which the emissions are determined similarly.

IV.7 **General Comments: NO_x Emissions** – PacifiCorp commented that emissions of NO_x during the 20% best and 20% worst days at Class I areas in Wyoming are not a significant contributor to regional haze as compared to other emissions, and therefore the Division should consider this before requiring extreme NO_x control measures such as SCR as BART.

Response – For the 20% worst days during the years 2000-2004 at the Bridger Wilderness Area, 6.21% of the total visibility degradation was attributable to nitrates. Source apportionment modeling provided by the WRAP showed that 19% of the nitrates come from Wyoming sources. The Division recognizes that pollutants other than nitrates contribute more toward the total visibility degradation at the Bridger Wilderness Area, but the Division has concluded that the contribution from Wyoming sources toward the formation of nitrates at the Bridger Wilderness Area and other Class I areas warrants a full consideration of prospective NO_x controls under the BART process.

IV.8 **Perceptibility** – PacifiCorp commented that credible studies indicate that only changes in visibility as high as 1.5-2.0 dv are perceptible to the human eye. The Division should consider this while drawing conclusions based on the results of the visibility modeling and before requiring extreme NO_x control measures such as SCR.

Response – See response to USDA Forest Service comment II.7.

IV.9 **Presumptive BART for Wyodak** – PacifiCorp commented that the Division correctly identified the presumptive BART limit of 0.23 lb/MMBtu for the Wyodak plant, but they do not agree with the statement in the Division's BART analysis that the limit is "not applicable".

Response – The statement on page 6 of the Division's BART analysis that presumptive BART levels do not apply to Wyodak is based on the fact that the cumulative generating capacity of the facility is less than 750 MW. In accordance with the EPA's Appendix Y guidance for BART, the presumptive NO_x levels apply to EGUs greater than 200 MW located at power plants with total capacity of 750 MW or more. Because the Wyodak plant has a total capacity of only 335 MW, the presumptive limits do not strictly apply.

V. Analysis of Comments from the National Park Service:

V.1 **NO_x Step 3: Evaluate Effectiveness of Remaining Control Technologies (SCR capabilities)** – The NPS commented that the Division underestimated the ability of SCR to reduce emissions. The proposed NO_x limit for SCR (0.07 lb/MMBtu) is not low enough. SCR can achieve greater reductions. NPS suggests 0.06 lb/MMBtu for 30-day limit, 0.05 lb/MMBtu or lower for an annual limit.

Response – See response to USDA Forest Service comment II.5.

V.2 **NO_x Step 4: Evaluate Impacts and Document Results (SCR costs)** – The NPS commented that SCR costs were generally overestimated because the OAQPS Control Cost Manual was not used for cost estimates.

Response – PacifiCorp developed cost estimates for SCR control using a combination of the OAQPS Control Cost Manual, vendor-obtained price quotes, and a database developed by the engineering firm Sargent & Lundy. The degree to which the SCR costs may have been overestimated does not require further review because the Division has concluded that the estimated costs are reasonable and that costs alone would not preclude the use of SCR.

V.3 **NO_x Step 4: Evaluate Impacts and Document Results (incremental costs for SCR)** – The NPS commented that the Division over-emphasized the incremental costs for the addition of SCR in the BART determinations. The Division should consider the average costs calculated for combustion controls plus SCR.

Response – See response to PacifiCorp comment IV.1 and NPS comment V.2.

V.4 **NO_x Step 4: Evaluate Impacts and Document Results (basis for costs)** – The NPS commented that cost estimates should be documented by vendor or by the EPA Control Cost Manual.

Response – See response to NPS comment V.2.

V.5 **NO_x Step 5: Visibility Improvement Determination (Class I Areas Modeled)** – The NPS commented that the Division should consider visibility impacts at all Class I areas within 300 kilometers (km) of a source.

Response – See response to USDA Forest Service comment II.2.

V.6 **NO_x Step 5: Visibility Improvement Determination (incremental benefits of SCR)** – The NPS commented that the Division placed too much emphasis on the incremental improvement in visibility that was predicted for the addition of SCR. The total predicted visibility improvement resulting from a combination of control options should have been presented.

Response – The incremental improvement in modeled visibility with the addition of SCR was mentioned prominently in the summary of the Division's BART conclusions, but all visibility modeling results were considered. For more information on the presentation of the visibility modeling results in the Division's BART analyses, see the response to EPA Region 8 comment III.2 and PacifiCorp's comment IV.5.

V.7 **NO$_x$ Step 5: Visibility Improvement Determination (sulfuric acid mist emissions)** – The NPS commented that the modeled sulfuric acid mist emissions increased for the SCR control scenario, and the Division should provide a detailed explanation of how the sulfuric acid mist emissions were calculated by PacifiCorp.

Response – PacifiCorp's consultant, CH2M HILL, used the following methodology to calculate sulfate emissions for SCR for the PacifiCorp coal-fired power plants (as provided in a letter from PacifiCorp that was submitted to the Division on September 16, 2009):

- 1.0% of the SO_2 in the boiler is converted to SO_3
- An additional 1.0% of the SO_2 is converted to SO_3 in an SCR unit
- The SO_3 is converted to H_2SO_4 mist in the flue gas
- 50% of the H_2SO_4 mist is removed in a wet FGD unit
- 95% of the H_2SO_4 mist is removed in a dry FGD unit
- An SCR unit has 2.0 ppmvd NH_3 slip
- 50% of the NH_3 slip is converted to ammonium sulfate and 50% is converted to ammonium bisulfate
- 50% of the ammonium sulfate and bisulfate are removed in a wet FGD unit and 90% of the ammonium sulfate and bisulfate are removed in a dry FGD unit
- Total sulfate emissions are made up of H_2SO_4 mist, ammonium sulfate and ammonium bisulfate

V.8 **BART Conclusions for NO$_x$ Controls: $/dv** – The NPS commented that the Division should use $/dv as an additional metric for evaluating BART controls.

Response – See response to PacifiCorp response IV.1.

V.9 **BART Conclusions for NO$_x$ Controls: Cost Benchmarks** – The NPS commented that the Division determined that the costs for SCR were reasonable, yet rejected SCR for BART control. DEQ should explain why and provide the cost benchmarks used to determine reasonable costs.

Response – The Division established NO$_x$ emission limits for BART based on consideration of all five statutory factors (as required by EPA's Appendix Y BART guidance) and not merely based on cost. The Division relied on past experience with BACT determinations for similar sources/control options to determine the range of control costs that were reasonable.

V.10 **BART Conclusions for NO$_x$ Controls: Non-Air Quality Impacts** – The NPS commented that the Division mentioned non-air quality impacts as reasons to reject SCR for BART controls. Recent PSD permits issued by DEQ and requiring SCR did not mention such impacts. Why were such impacts mentioned in these particular cases? SCR has been used at many facilities with minimal problems with transport and storage of ammonia, why would this be a particular problem for SCR as BART control?

Response – The Division's BART determinations for the Wyodak plant was based on consideration of the five statutory factors, including the cost of compliance and the energy and non-air quality environmental impacts of compliance. Potential energy losses and environmental impacts from the operation of SNCR and SCR were mentioned in the Division's BART analysis, but were only part of the larger evaluation that considered all five statutory factors in their entirety.

V.11 **BART Conclusions for NO_x Controls: Parasitic Power Loss** – The NPS commented that the Division mentioned parasitic power loss in association with the operation of OFA and SCR. Parasitic power loss associated with SCR has already been accounted for in the cost analysis for NO_x and should not be "double-counted" by using it to draw conclusions for BART control unless it would cause a power shortage.

Response – See response to NPS comment V.10.

V.12 **BART Conclusions for NO_x Controls: Fly Ash Sales** – The NPS commented that the Division stated that the operation of SCR could impact the "salability" of fly ash. Evidence should be presented and the economic impact quantified.

Response – See response to NPS comment V.10.

V.13 **BART Conclusions for NO_x Controls: Ammonia Injection** – The NPS commented that the Division stated that SCR could create "blue plume" if the ammonia injection rate is not well controlled. NPS states that it assumes that PacifiCorp can properly control the injection rate.

Response – See response to NPS comment V.10.

V.14 **BART Conclusions for NO_x Controls: SCR Installation** – The NPS commented that PacifiCorp states that SCR would take a minimum of six years to plan and install. NPS states that Minnesota Power plans to install SCR, fabric filter, and a new chimney on the 330 MW Boswell Unit #3 in half of that time. PacifiCorp should explain why so much extra time is needed.

Response – A letter provided to the Division by PacifiCorp dated September 16, 2009 provided information on the time needed to plan, design, and install SCR:

- Develop and Permit: 18-24 months
- Design: 9-12 months
- Procurement: 9-13 months
- Construct: 18-24 months
- Start, Tune, and Test 4-6 months
- Total (including overlap of individual tasks): 60-66 months

V.15 **BART Conclusions for PM_{10} Controls: Control Effectiveness** – The NPS commented that the Division should explain why 0.015 lb/MMBtu was acceptable to the Division as a control effectiveness for a ESP/polishing fabric filter combination, when 0.012 lb/MMBtu has been approved by the Division for other recent permits involving fabric filters and limits as low as 0.010 lb/MMBtu have recently been approved for fabric filters (e.g., Desert Rock Project).

Response – See response to EPA Region 8 comment III.8.

V.16 **BART Conclusions for PM_{10} Controls: Fabric Filters** – NPS believes that PacifiCorp would not have agreed to install fabric filters unless it finds the option to be reasonable or is compelled to do so. DEQ should accept fabric filters as a reasonable BART alternative in the context of the PM reductions and associated costs, or state what it considers reasonable average and incremental costs for a fabric filter.

Response – The Division concluded that the costs of a fabric filter for Wyodak Unit 1 was not reasonable. However, as stated on page 36 of the Division's BART analysis for Wyodak: "...PacifiCorp is committed to installing this control device and has permitted the installation of a full-scale fabric filter on Unit 1 in a recently issued New Source Review construction permit. A full-scale fabric filter is the most stringent PM/PM_{10} control technology and therefore the Division will accept it as BART."

VI. Analysis of Comments from the Powder River Basin Resource Council:

VI.1 **SCR as BART** – The Powder River Basin Resource Council commented that SCR is the best available retrofit technology and should be required as BART at all of the Wyoming power plants under consideration.

Response – The Division determined BART for the control of NO_x emissions from power plants in Wyoming based on a full consideration of all five statutory factors in their entirety, as required by EPA's Appendix Y BART guidance. The BART guidance does not dictate that a state require the control technology with the highest level of control in all cases.

VII. Analysis of Comments from the Powder River Basin Resource Council, et al.:

VII.1 **Modeled Class I Areas** – The Powder River Basin Resource Council, et al. commented that all Class I areas within 300 km of a given source should be modeled for visibility impacts.

Response – See response to USDA Forest Service comment II.2.

VII.2 **SCR as BART** – The Powder River Basin Resource Council, et al. commented that SCR is BART and must be required for all units at all coal-fired power plants.

Response – See responses to USDA Forest Service comments II.1, II.4 and II.5.

VII.3 **Section 309 Milestone Program** – The Powder River Basin Resource Council, et al. commented that DEQ should impose BART limits for SO_2 because participation in the Section 309 program only excuses DEQ from setting BART limits if the State's 309 SIP is approved by the EPA and if the 309 SIP demonstrates that emissions levels would result in greater visibility improvement than source-specific BART limits.

Response – The Regional Haze Rule allows the State of Wyoming to submit a 309 SIP in lieu of establishing BART limits for SO_2. The 309 SIP submittal includes a "Better than BART" demonstration. The entire submittal is currently undergoing EPA review and the State has no control over how long the EPA takes to review the SIP. The State, however, does not wait for EPA to complete its review before implementing a SIP. All of the 309 states have been participating in the 309 program, collecting SO_2 inventories, allowing independent audits of the information, comparing the regional totals to the milestones, and taking public comment on the regional figures and the comparisons with the milestone figures. The SO_2 levels have shown compliance with the milestones and continue to demonstrate declining SO_2 emissions levels. Also see responses to USDA Forest Service comment II.6 and EPA comment III.10.

VII.4 **SCR for Long-Term Strategy** – The Powder River Basin Resource Council, et al. commented that the BART limits for NO_x determined by the Division for Wyodak meet presumptive BART, but further reductions are warranted to reduce Class I impacts. The Division should require SCR under Long-Term Strategy.

Response – See response to USDA Forest Service comment II.1.

VIII. Analysis of Comments from the Sierra Club and Citizens Associated with the Sierra Club:

VIII.1 **Air Quality Laws and Regulations** – The Sierra Club commented that it is important that air quality laws and regulations are strictly complied with to preserve park resources for present and future generations.

Response – The Division followed federal regulations and guidance as well as state regulations in assessing the BART applications and for making the BART determination for all sources eligible for BART in the State of Wyoming. The BART rules and guidance used by the Division included:

- Section 308 of the Regional Haze Rule [40 CFR 51.308(e)]
- *Guidelines for BART Determinations Under the Regional Haze Rule* [Appendix Y to part 51]
- Chapter 6, Section 9 of the Wyoming Air Quality Standards and Regulations (WAQSR), *Best Available Retrofit Technology*

VIII.2 **Regional Haze Rule** – The Sierra Club commented that the State of Wyoming can and should do more to protect air quality as the Regional Haze Rule is implemented.

Response – The Division's BART determinations for Wyoming sources, as well as additional air pollution controls that will be required to further reduce regional haze, will be addressed in the Wyoming State Implementation Plan (SIP) for regional haze. The SIP incorporates the emissions reductions associated with the Long-Term Strategy for regional haze.

VIII.3 **Control of Emissions of Nitrogen Oxides** – The Sierra Club commented that the State of Wyoming should require the coal plants to install devices to reduce emissions of nitrogen oxides.

Response – All of the Division's BART determinations for coal-fired power plants in the State of Wyoming include pollution control equipment that will substantially reduce emissions of nitrogen oxides.

VIII.4 **20-Year Trend** – A commenter stated that the amount of air and water pollution has clearly escalated in the past 20 years, with little relief for citizens or for the health of forests and the environment.

Response – The Division's BART determinations and other requirements under the regional haze program will result in large, state-wide emission reductions for three visibility-impairing pollutants; nitrogen oxides (NO_x), particulate matter (PM/PM_{10}), and sulfur dioxide (SO_2). As an example, BART controls at the Jim Bridger plant will result in a total annual reduction in potential NO_x emissions of approximately 13,500 tons per year.

VIII.5 **Wind Power** – A commenter stated that Wyoming can readily replace aging coal-fired power plants with wind power to protect public health and to protect our national parks and wilderness areas.

Response – The BART program is designed to assess Best Available Retrofit Technology on existing sources of air pollution, including the existing power plants in Wyoming. The Division's BART determinations will result in significant reductions in air pollutants from several power plants in Wyoming, but complete replacement of the power plants with an alternate source of energy is well beyond the scope of the BART program.

VIII.6 **Pollution Reduction from Power Plants** – A commenter stated that Wyoming has an obligation to protect treasured public spaces by adhering to federal air quality laws. The State must reduce air pollutants from the old coal plants that are federally required to utilize the most advanced technical developments in ensuring that air pollution is minimized.

Response – The Division determined BART controls based on the five statutory factors developed by the EPA. Various control technologies were evaluated for each source subject to BART, including the "most advanced technical developments", but the ultimate BART determinations were made based on a full consideration of all five statutory factors in their entirety.

VIII.7 **SCR Controls** – Several commenters stated that BART for NO_x control should be SCR for all plants.

Response – See responses to USDA Forest Service comments II.1 and II.4.

IX. Analysis of Public Comments:

IX.1 **SCR Controls** – Several commenters stated that BART for NO_x control should be SCR for all plants.

Response – See responses to USDA Forest Service comments II.1 and II.4.

X. Decision:

On the basis of comments received during the public comment period, an analysis of those comments, and representations made by PacifiCorp, the Department of Environmental Quality has determined that the permit application filed by PacifiCorp complies with all applicable Wyoming Air Quality Standards and Regulations and that a BART permit will be issued for the Wyodak Power Plant. All of the conditions proposed in the Division's analysis will be included in the permit. No permit conditions required revision as a result of the public comment period.

Dated this 31st day of December, 2009.

David A. Finley
Administrator
Wyoming Air Quality Division

John V. Corra
Director
Wyoming Department of Environmental Quality