EXHIBIT D

Attached to Conservation Groups'
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Submitted in EIB 11-01 (R) and EIB 11-02 (R)

New Mexico
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APPENDIX A:

New Mexico Environment Department
Air Quality Bureau
BART Determination

Public Service Company of New Mexico
San Juan Generating Station, Units 1-4

June 21, 2010

Regulatory Background and Introduction:

In 1999, the EPA published a final rule to address a type of visibility impairment known as regional haze (64 FR 35714, July 1, 1999). This rule requires States to submit state implementation plans (SIPs) to address regional haze visibility impairment in 156 Federally-protected parks and wilderness areas. The 1999 rule was issued to fulfill a long-standing EPA commitment to address regional haze under the authority and requirements of sections 169A and 169B of the Clean Air Act (CAA).[1]

As required by the CAA, the EPA included in the final regional haze rule a requirement for Best Available Retrofit Technology (BART) for certain large stationary sources. The regulatory requirements for BART were codified at 40 CFR 50.308(e) and in definitions that appear in 40 CFR 50.301.

The BART-eligible sources are those sources which (1) have the potential to emit 250 tons per year or more of a visibility impairing air pollutant, (2) were put in place between August 7, 1962 and August 7, 1977, (3) and whose operations fall within one or more of 26 specifically listed source categories. Under the CAA, BART is required for any BART-eligible source which a State determines "emits any air pollutant which may reasonably be anticipated to cause or contribute to any impairment of visibility in any such area." Accordingly, for stationary sources meeting these criteria, States must address the BART requirement when they develop their regional haze SIPs.[1]

The EPA published a second Regional Haze rulemaking on June 6, 2005 that made changes to the Final Rule published July 1, 1999. This second rulemaking was in response to a U.S. District Court of Appeals ruling that vacated part of the regional haze rule. The June 6, 2005 Final Rule (1) required the BART analysis to include an analysis of the degree of visibility improvement resulting from the use of control technology at BART-subject sources; (2) revised the BART provisions; (3) included new BART Guidelines contained in a new Appendix Y to Part 51 (Guidelines); and (4) added the requirement that States use the Guidelines for determining BART at certain large electrical generating units (EGUs).[1]

The Guidelines also contained specific presumptive limits for SO2 and NOx for certain large EGUs based on fuel type, unit size, cost effectiveness, and presence or absence of pre-existing controls. For NOx emissions, the EPA directs states to generally require owners and operators to meet the presumptive limits at coal-fired EGUs greater than 200 MW with a total facility-wide generating capacity greater than 750 MW. The presumptive limits for NOx are based on coal type, boiler type and whether SCR or SNCR are already installed at the source.

Analysis of BART Eligible Sources in NM:

In May 2006, the New Mexico Environment Department, Air Quality Bureau (Department) conducted an internal review of sources potentially subject to the BART rule.

Section II of the Guidelines prescribes how to identify BART-eligible sources. States are required to identify those sources that satisfy the following criteria: (1) sources that fall within the 26 listed source categories as listed in the CAA, (2) sources that were "in existence" on August 7, 1977 but were not "in operation" before August 7, 1962, and (3) sources that have a current potential to emit that is greater than 250 tons per year of any single visibility impairing pollutant. New Mexico identified 11 sources as BART-eligible sources as part of this review.[2]

The Guidelines then prescribe to the states how to identify those sources that are subject to BART. At this point, states are directed to either (1) make BART determinations for all BART-eligible sources, or

(2) to consider exempting some of the sources from BART because they may not reasonably be anticipated to cause or contribute to any visibility impairment in a Class I area. New Mexico opted to perform an initial screening model on each of these BART-eligible sources to determine whether each source did cause or contribute to any visibility impairment. The Guidelines direct States that if the analysis shows that an individual source or group of sources is not reasonably anticipated to cause or contribute to any visibility impairment in a Class I area, then the States do not need to make a BART determination for that source or group of sources. [1]

The Western Regional Air Partnership (WRAP) performed the initial BART modeling for the state of New Mexico. The procedures used are outlined in the WRAP Regional Modeling Center (RMC) BART Modeling Protocol that is available at:

http://pah.cert.ucr.edu/aqm/308/bart/WRAP_RMC_BART_Protocol_Aug15_2006.pdf

The basic assumptions in the WRAP BART CALMET/CALPUFF modeling used for New Mexico are as follows:

i. Use of three years of modeling of 2001, 2002, and 2003.
ii. Visibility impacts due to emissions of SO2, NOx and primary PM emissions were calculated. PM emissions were modeled as PM2.5.
iii. Visibility was calculated using the Original IMPROVE equation and Annual Average Natural Conditions.

Initial modeling was performed for the 11 source complexes in New Mexico with visibility estimated from the sources' SO2, NOx, and PM emissions. Then for those sources whose 98th percentile visibility impacts at any Class I area due to their combined SO2, NOx, and PM emissions exceeded the 0.5 dv significance threshold, the separate contribution to visibility at Class I areas was assessed for SO2 alone (SO4), NOx alone (NO3), PM alone (PMF) and combined NOx plus PM emissions (NO3 + PMF).[2]

Of the 11 source complexes analyzed, only one source complex's visibility impacts at any Class I area due to combined SO2, NOx, and PM emissions exceeded the 0.5 dv threshold (PNM San Juan Generating Station Boilers #1-4). Of the 10 other source complexes, none exceed a 0.33 dv impact. Consequently, only the PNM San Juan Boilers #1-4 were evaluated for visibility impacts.[2]

On November 9, 2006, the Department informed PNM that the modeling performed by the WRAP indicated the visibility impairment from the San Juan Generating Station (SJGS) was over the 0.5 dv threshold, and was therefore subject to a BART analysis. In response, Black & Veatch (B&V), on behalf of PNM, submitted the BART Modeling Protocol document which described the CALPUFF modeling methodology to be used as part of the BART engineering evaluation for Units 1-4 at the SJGS.

SJGS Source Description:

The SJGS consists of four coal-fired generating units and associated support facilities. Each coal-fired unit burns pulverized coal and No. 2 diesel oil (for startup) in a boiler and produces high-pressure steam which powers a steam turbine coupled with an electric generator. Electric power produced by the units is supplied to the electric power grid for sale. Coal for the units is supplied by the adjacent San Juan Mine and is delivered to the facility by conveyor.

The SJGS Boiler Units 1 and 2 have a unit capacity of 350 and 360 MW, respectively. The units are equipped with Foster Wheeler subcritical, wall-fired boilers that operate in a forced draft mode. The SJGS Boiler Units 3 and 4 each have a unit capacity of 544 MW and are equipped with a B&W subcritical, opposed wall-fired boilers that operate in a forced draft mode.

Consent Decree:

On March 5, 2005, PNM entered into a consent decree with the Grand Canyon Trust, the Sierra Club, and the Department to settle alleged violations of the CAA. The consent decree required PNM to meet a PM average emission rate of 0.015 pounds per million British thermal units (lb/MMbtu) (measured using EPA Reference Method 5), and a 0.30 lb/MMbtu emission rate for NOx (daily rolling, thirty day average), for each of Units 1, 2, 3, and 4. As a result, PNM has installed new Low NOx burners (LNB) with overfire air (OFA) ports and a neural network (NN) system to reduce NOx emissions, and pulse jet fabric filters (PJFF) to reduce the PM emissions (See Table 1).

Table.1: SJGS Characteristics

SJGS Characteristics				
Unit	**SJGS 1**	**SJGS 2**	**SJGS 3**	**SJGS 4**
Fuel Type	Sub-bituminous	Sub-bituminous	Sub-bituminous	Sub-bituminous
HHV of Fuel (btu/lb)	9692	9692	9692	9692
Unit Rating, MW (gross)	360	350	544	544
Boiler Heat Input (Mbtu/hr)	3707	3688	5758	5649
Type of Boiler	Wall-fired	Wall-fired	Opposed Wall-fired	Opposed Wall-fired
Steam Cycle	Subcritical	Subcritical	Subcritical	Subcritical
Draft of Boiler	Forced	Forced	Forced	Forced
Existing Emissions Controls				
PM	PJFF	PJFF	PJFF	PJFF
SO_2	Wet FGD	Wet FGD	Wet FGD	Wet FGD
NOx	LNB/OFA/NN	LNB/OFA/NN	LNB/OFA/NN	LNB/OFA/NN

BART Analysis Overview:

Per 40 CFR 51.308 *Regional haze program requirements*, the determination of BART must be based on an analysis of the best system of continuous emission control technology available and associated emission reductions achievable for each BART-eligible source that is subject to BART within the State. In this analysis, the State must take into consideration each available technology, the associated costs of compliance of each, 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.[1]

The determination of BART for fossil-fuel power plants having a total generating capacity in excess of 750 megawatts must be made pursuant to the Guidelines.[1]

PNM's BART Analysis for NOx and PM:

PNM submitted the BART analysis for the SJGS to the Department on June 6, 2007. The BART analysis was performed in two stages. First, a BART analysis was performed for the consent decree technologies being implemented at the SJGS. In the second stage of the BART analysis, additional control technology alternatives to the consent decree technologies were identified and evaluated. To determine the visibility improvements from both the consent decree technology upgrades and additional control technology, the Department determined it was appropriate to review both pre-consent decree to consent decree visibility improvement and improvement projected from consent decree plus additional control technologies.

Per Appendix Y to 40 CFR Part 51 – Guidelines, PNM followed the 5 Step Process in the SJGS BART Analysis:

Step 1 – Identify All 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
- a) Costs of Compliance
- b) Energy Impacts
- c) Air quality environmental impacts
- d) Non-air environmental impacts
- e) Remaining useful life

Step 5 – Evaluate Visibility Impacts

In response to the Department's requests, PNM has submitted multiple amendments to the original June 2007 BART Analysis application. What follows is a summary of the original and additional submittals:

June 6, 2007
The original BART analysis application included a five factor analysis of NOx technology. Modeling analyses were performed to provide SJGS plant-wide regional haze visibility impacts at 16 Class I areas. These analyses were based on a constant 1 ppb background ammonia concentration and no nitrate repartitioning. The NOx control technologies analyzed were the Selective Catalytic Reduction (SCR) and SNCR/SCR Hybrid.[3]

November 6, 2007
Modeling analyses were performed to provide SJGS plant-wide regional haze visibility impacts at 16 Class I areas. The analysis was based on refinements which included using the nitrate repartitioning methodology and monthly variable background ammonia concentrations. Again, the NOx control technologies analyzed were the SCR and SNCR/SCR Hybrid.[3]

March 29, 2008
PNM submitted an additional discussion of cost estimation methods used to determine costs of SCR installation and a discussion of Nalco Mobotec ROFA and Rotamix technology.[3]

March 31, 2008
Two modeling analyses were performed to provide SJGS plant-wide and unit specific regional haze visibility impacts at 16 Class I areas for the SCR NOx control technology only. One of the analyses, believed by PNM to be the more representative of ammonia chemistry of the area, was based on the

November 6, 2007 refinements which included using nitrate repartitioning methodology and monthly variable background ammonia concentrations. The other analysis included nitrate repartitioning and a constant background ammonia concentration as requested by the Department.[3]

May 30, 2008
Two modeling analyses were performed to provide SJGS plant-wide and unit specific regional haze visibility impacts at 16 Class I areas for the SNCR NOx control technology only. Similar to the March 31, 2008 analyses, one of the analyses was based on the November 6, 2007 refinements which included using nitrate repartitioning methodology and monthly variable background ammonia concentrations. The other analysis used nitrate repartitioning methodology and constant background ammonia concentration. It should be noted that PNM modeled all variants of SNCR together (including Fuel Tech and Nalco Mobotec) as one technology called SNCR. This is the same approach that is used for modeling SCR control technology, where all variants are modeled generically as SCR.[3]

At the request of the Department, PNM and B&V also provided a five-factor BART analysis for SNCR technology and a discussion of coal characteristics of the coal burned at the SJGS.

August 29, 2008
Three modeling analyses were performed to provide SJGS plant-wide and unit specific regional haze visibility impacts at 16 Class I areas for the ROFA with Rotamix, Rotamix, ROFA, and WESP PM control technologies (the NOx and PM analyses were submitted separately). Similar to the May 30, 2008 analyses, these analyses were also based on the November 6, 2007 refinements which included using the nitrate repartitioning methodology and monthly variable background ammonia concentrations.[3]

At the request of the Department, PNM and B&V also provided a five-factor BART analysis of Nalco Mobotec control technology, including ROFA, Rotamix and ROFA/Rotamix and a five-factor BART analysis of additional PM control technology.[3]

March 16, 2009
Four modeling analyses were performed to provide SJGS plant-wide and unit specific regional haze visibility impacts at 16 Class I areas. These include SCR technology, SCR/SNCR Hybrid technology; SCR technology with sorbent injection; and SCR/SNCR Hybrid technology with sorbent injection. As requested by the Department, for each of these cases, the modeling also took into consideration inherent SO3 removal of the SO3 formed from the catalyst oxidation of SO2 to SO3.[3]

Step 1 of the BART Analysis: Identification of All Available Retrofit Emissions Control Technologies

NOx Control Technologies

The main strategies for reducing NOx emissions take two forms: 1) modification to the combustion process to control fuel and air mixing and reduce flame temperatures, and 2) post-combustion treatment of the flue gas to remove NOx. PNM and B&V identified the following available NOx control technologies and a discussion of each of the technologies:

1) Low NOx Burners, Overfire Air, and Neural Network

   Low NOx burners slow and control the rate of fuel and air mixing, thereby reducing the oxygen availability in the ignition and main combustion zones. Overfire Air uses low excess air levels in the primary combustion zone with the remaining (overfire) air added higher in the furnace to complete combustion. Neural Network provides improvements in the heat rate and reduce combustion-related emissions by fine-tuning the combustion process.[3]

2) Selective Non Catalytic Reduction (SNCR)

SNCR is based on the chemical reduction of the NO molecule into molecular nitrogen and water vapor. A nitrogen based reducing agent (reagent), such as ammonia or urea, is injected into the post combustion flue gas. The reduction with NO is favored over other chemical reaction processes at temperatures ranging between 1600F and 2100F (870C to 1150C), therefore, it is considered a selective chemical process.[4]

3) Selective Catalytic Reduction (SCR)

The SCR process chemically reduces the NO molecule into molecular nitrogen and water vapor in the presence of a reducing catalyst. A nitrogen based reducing reagent such as ammonia or urea is injected into the ductwork, downstream of the combustion unit. The waste gas mixes with the reagent and enters a reactor module containing catalyst. The hot flue gas and reagent diffuse through the catalyst. The reagent reacts selectively with the NO within a specific temperature range and in the presence of the catalyst and excess oxygen.[5]

SCR plus Sorbent Injection

Sorbent injection removes SO3 in the flue gas by reaction of the SO3 with an alkaline sorbent material to form a particulate that is subsequently removed in a particulate control device. The alkaline material injected can be a magnesium, sodium, or calcium-based sorbent. The injection points for the reagents may vary. For this analysis, hydrated lime was selected.[4]

4) SNCR/SCR Hybrid

The SNCR/SCR hybrid systems use components and operating characteristics of both SNCR and SCR systems. Hybrid systems were developed to combine the low capital cost and high ammonia slip associated with SNCR systems with the high reduction potential and low ammonia slip inherent in the catalyst of SCR systems.[3]

SNCR/SCR Hybrid plus Sorbent Injection

Sorbent injection removes SO3 in the flue gas by reaction of the SO3 with an alkaline sorbent material to form a particulate that is subsequently removed in a particulate control device. The alkaline material injected can be a magnesium, sodium, or calcium-based sorbent. The injection points for the reagents may vary. For this analysis, hydrated lime was selected.[4]

5) Gas Reburn

The gas reburn process combusts auxiliary natural gas, along with coal, in the boiler. Three separate combustion zones in the boiler are manipulated to reduce NOx emissions.[4]

6) Nalco Mobotec ROFA and Rotamix

ROFA and Rotamix are proprietary control technologies developed by Nalco Mobotec. ROFA, or Rotating Opposed Firing Air, is a modified overfire air technology that utilizes rotation of flue gases and turbulent mixing to reduce NOx emissions. Rotamix is a version of SNCR technology and operates under the same principles as other SNCR technology.[3]

7) NOxStar

NOxStar is the trademarked name for a NOx control technology that involves the injection of ammonia and a hydrocarbon (typically natural gas) into the flue gas path of a coal-fired boiler at around 1600F to 1800F for the reduction of NOx.[3]

8) ECOTUBE

The ECOTUBE system utilizes retractable lance tubes that penetrate the boiler above the primary combustion burner zone and inject high-velocity air as well as reagents. The lance tubes work to create turbulent airflow and to increase the residence time for the air/fuel mixture. In principle, the OFA and SNCR processes are combined in this technology.[3]

9) PowerSpan ECO

The PowerSpan ECO system is a multi-pollutant technology with limited experience. The PowerSpan 5ECO system is located downstream of an existing particulate control device and treats the power plant's flue gas in three process steps to achieve multi-pollutant removal of sulfur dioxide (SO2), nitrogen oxides (NOX), oxidized mercury, and fine particulate matter.[3]

10) Phenix Clean Combustion

Phenix Clean Combustion System is an advanced hybrid coal gasification/combustion process that prevents the formation of NOx and SO2 emissions when burning coal.[3]

11) e-SCRUB

The e-SCRUB process is similar to the PowerSpan technology in that it uses an energy source to oxidize pollutants in the flue gas. However, there are some variations in the oxidation energy source and the byproduct recovery systems.

PM Control Technologies

Particulate matter emissions can only be controlled by post-combustion control technologies. PNM identified the following technologies as available in their BART analysis for PM.

1) Flue Gas Conditioning with Hot-Side ESP

Flue gas conditioning improves the collection efficiency of particulate matter in the ESP. Flue gas leaving the air heater into the ESP can be conditioned by addition of ionic compounds, such as SO3 or ammonia. These compounds combine with the moisture in the flue gas and are deposited on the surface of the fly ash particles. This will increase the conductivity of the fly ash and make it more suitable for capture.[3]

2) Pulse Jet Fabric Filter (PJFF)

In PJFFs, the flue gas typically enters the compartment hopper and passes from the outside of the bag to the inside of the bag, depositing particulate on the outside of the bag. To prevent collapse of the bag, a metal cage is installed on the inside of the bag. The flue gas passes up through the center of the bag into the output plenum. Cleaning is performed by initiating a downward pulse of air into the top of the bag. The pulse causes a ripple effect along the length of the bag. This releases the dust cake from the bag's exterior surface, allowing the dust to fall into the hopper.[3]

3) Compact Hybrid Particulate Collector

A variant of the PJFF is the compact hybrid particulate collector. This is a high air to cloth (A/C) ratio fabric filter installed downstream of existing particulate collection devices where the majority of PM has been removed.[3]

4) Max-9 Electrostatic Fabric Filter

The Max-9 filter is essentially a high-efficiency PJFF utilizing a discharge electrode as in an ESP. However, there are no collector plates. When the dust particles are charged, they are attracted to the grounded metal cage inside the filter element, just as they would be attracted to the collecting plates in an ordinary precipitator.[3]

Step 2 of the BART Analysis: Eliminate Technically Infeasible Control Technologies

NOx Control Technologies

PNM excluded several of the identified NOx controls due to technical infeasibility. In the BART analysis application, PNM excluded the following NOx control technologies:

1) Selective Non Catalytic Reduction

PNM determined in its submittal of June 6, 2007 that SNCR technology was technically infeasible because the technology was unable to meet the presumptive limits for NOx; determined by EPA to be 0.23 lb NOx/MMbtu for dry bottom wall-fired boilers burning sub-bituminous coal. A vendor estimated that the technology could only achieve 0.24 lb NOx/MMbtu. In order for the technology to achieve the presumptive limit, PNM stated that ammonia slip limit would need to be raised from 5 ppm to 10 ppm, and that this higher ammonia slip posed additional operational problems.

The Department did not agree with PNM's argument that because SNCR could not meet the presumptive limits the technology should be eliminated as technically infeasible. Therefore the Department requested PNM to perform the complete 5-factor BART analysis required by the Guidelines on SNCR. PNM submitted the five-factor analysis of SNCR in a subsequent submittal dated May 30, 2008.

2) Natural Gas Reburn

PNM determined that the current boiler space inhibits sufficient residence time for the natural gas reburn zone. The Department accepts PNM's elimination of this technology due to space limitations.

3) NalcoMobotec ROFA and Rotamix

PNM determined the Rotamix technology was technically infeasible due to limited application at coal-fired boilers equivalent to the size of Units 1-4 at SJGS. PNM determined ROFA technology was technically infeasible because ROFA is a variant of OFA, which at the time was being installed at Units 1-4 at SJGS.

The Department did not agree with PNM's position that Rotamix has limited application at coal-fired boilers equivalent the size of Units 1-4 at SJGS. The Department did not agree that because ROFA is a variant of OFA, the technology can be eliminated as technically infeasible. Therefore the Department requested PNM perform the complete 5-factor analysis for ROFA and Rotamix. PNM performed the analysis and submitted the analysis in two subsequent submittals dated March 29, 2008 and August 29, 2008.

4) NOxStar

NOxStar currently has only one major installation in the US. In addition, PNM stated that in recent discussions the supplier has identified limited ability and willingness to market the commercial technology. The Department agrees that this technology has limited application to large coal-fired boilers and is not technically feasible.

5) ECOTUBE

The ECOTUBE technology has been demonstrated on industrial/small boilers firing sold waste, wood, and biomass.[3] ECOTUBE has limited application to boilers similar to Units 1-4 at the SJGS. The Department agrees that this technology has limited application to large coal-fired boilers and is not technically feasible.

6) PowerSpan

PowerSpan has not been demonstrated on large boilers, such as Units 1-4 at SJGS. The Department agrees that this technology has limited application to large coal-fired boilers and is not technically feasible.

7) Phenix Clean Combustion

PNM determined that the Phenix Clean Combustion system is still in the demonstration and testing stage, and there are no commercial retrofits at facilities similar to SJGS. The Department agrees that this technology has no demonstrated application to the source type and is not technically feasible.

8) e-SCRUB

PNM determined that the e-SCRUB technology has only one known medium scale installation with limited data. The Department agrees that the technology should be considered technically infeasible due to limited demonstrated applications.

PM Control Technologies

PNM excluded the following PM control technologies as technically infeasible:

1) Flue Gas Conditioning with Hot-Side ESP

Flue gas conditioning does improve collection efficiencies, but will not achieve an emission limit lower than the current PM limit in their air quality permit. The Department agrees that flue gas conditioning control technology should not be considered in the BART analysis. Because the vendor was unable to guarantee a lower emission rate, the technology does not need to undergo the three additional factors of the five factor analysis.

2) Compact Hybrid Particulate Collector

The compact hybrid particulate collector does not provide a performance guarantee lower than the current permitted limit for PM. The Department agrees that the compact hybrid PM control technology should not be considered in the BART analysis. Because the vendor was unable to guarantee a lower emission rate, the technology does not need to undergo the three additional factors of the five factor analysis.

3) Max-9 Electrostatic Fabric Filter

The Max-9 electrostatic fabric filter has been installed in a small-sized utility boiler, but there are no commercial installations of a similar size to Units 1-4 at SJGS. The Department agrees that the limited application of this technology to large utility boilers justifies removing the technology as technically infeasible.

During the Department review of available PM control technologies, the Department requested PNM to perform a complete five-factor BART analysis on Wet Electrostatic Precipitator (WESP). The Department believes this technology should have been identified as technically feasible in Step 1 of the PM BART analysis. PNM performed a complete five-factor BART analysis on WESP and PJFF and submitted report in a subsequent submittal dated August 28, 2008.

Step 3 of the BART Analysis: Evaluate Control Effectiveness of Remaining Control Technologies

PNM contracted with B&V to determine the control effectiveness of each remaining available NOx and PM control technology for Units 1-4. The control efficiencies of each of the NOx control technologies are summarized in Tables 2 – 5, and the control efficiencies of the PM control technologies are summarized in Tables 6 – 9.

Table 2: **NOx** Control Effectiveness for Unit 1

Control Technology	Control Efficiency (%)	Baseline Emissions (tpy)	Emissions Reduction (tpy)	Controlled Emission Rate (lb/MMbtu)	Controlled Emission Rate (tpy)
Pre-Consent Decree (Pre-CD)	NA	NA	NA	0.43	5394
CD	23	5394	1254	0.30	4140
ROFA	13	4140	552	0.26	3588
Rotamix (SNCR)	23	4140	966	0.23	3174
ROFA/Rotamix	33	4140	1380	0.20	2760
SCR/SNCR Hybrid	40	4140	1656	0.18	2484
SCR + Sorbent	77	4140	3174	0.07	966

Table 3: **NOx** Control Effectiveness for Unit 2

Control Technology	Control Efficiency (%)	Baseline Emissions (tpy)	Emissions Reduction (tpy)	Controlled Emission Rate (lb/MMbtu)	Controlled Emission Rate (tpy)
Pre-Consent Decree (Pre-CD)	NA	NA	NA	0.45	6179
CD	33	6179	2060	0.30	4119
ROFA	13	4119	549	0.26	3570
Rotamix (SNCR)	23	4119	961	0.23	3158
ROFA/Rotamix	34	4119	1373	0.20	2746
SCR/SNCR Hybrid	40	4119	1648	0.18	2471
SCR + Sorbent	77	4119	3158	0.07	961

Table 4: **NOx** Control Effectiveness for Unit 3

Control Technology	Control Efficiency (%)	Baseline Emissions (tpy)	Emissions Reduction (tpy)	Controlled Emission Rate (lb/MMbtu)	Controlled Emission Rate (tpy)
Pre-Consent Decree (Pre-CD)	NA	NA	NA	0.42	9004
CD	29	9004	2573	0.30	6431
ROFA	13	6431	857	0.26	5574
Rotamix (SNCR)	23	6431	1500	0.23	4931
ROFA/Rotamix	33	6431	2144	0.20	4287
SCR/SNCR Hybrid	40	6431	2572	0.18	3859
SCR + Sorbent	77	6431	4930	0.07	1501

Table 5: **NOx** Control Effectiveness for Unit 4

Control Technology	Control Efficiency (%)	Baseline Emissions (tpy)	Emissions Reduction (tpy)	Controlled Emission Rate (lb/MMbtu)	Controlled Emission Rate (tpy)
Pre-Consent Decree (Pre-CD)	NA	NA	NA	0.42	8833
CD	29	8833	2524	0.30	6309
ROFA	15	6431	963	0.26	5468
Rotamix (SNCR)	25	6431	1594	0.23	4837
ROFA/Rotamix	35	6431	2225	0.20	4206
SCR/SNCR Hybrid	41	6431	2645	0.18	3786
SCR + Sorbent	77	6431	4959	0.07	1472

Table 6: **PM** Control Effectiveness for Unit 1

Control Technology	Control Efficiency (%)	Baseline Emissions (tpy)	Emissions Reduction (tpy)	Controlled Emission Rate (lb/MMbtu)	Controlled Emission Rate (tpy)
Pre-Consent Decree (Pre-CD)	NA	NA	NA	0.050	690
PJFF (CD)	70	690	483	0.015	207
WESP	33	207	69	0.010	138

Table 7: **PM** Control Effectiveness for Unit 2

Control Technology	Control Efficiency (%)	Baseline Emissions (tpy)	Emissions Reduction (tpy)	Controlled Emission Rate (lb/MMbtu)	Controlled Emission Rate (tpy)
Pre-Consent Decree (Pre-CD)	NA	NA	NA	0.050	687
PJFF (CD)	70	687	481	0.015	206
WESP	33	206	69	0.010	137

Table 8: **PM** Control Effectiveness for Unit 3

Control Technology	Control Efficiency (%)	Baseline Emissions (tpy)	Emissions Reduction (tpy)	Controlled Emission Rate (lb/MMbtu)	Controlled Emission Rate (tpy)
Pre-Consent Decree (Pre-CD)	NA	NA	NA	0.050	1072
PJFF (CD)	70	1072	750	0.015	322
WESP	33	322	108	0.010	214

Table 9: **PM** Control Effectiveness for Unit 4

Control Technology	Control Efficiency (%)	Baseline Emissions (tpy)	Emissions Reduction (tpy)	Controlled Emission Rate (lb/MMbtu)	Controlled Emission Rate (tpy)
Pre-Consent Decree (Pre-CD)	NA	NA	NA	0.050	1052
PJFF (CD)	70	1052	737	0.015	315
WESP	33	315	105	0.010	210

Step 4 of the BART Analysis: Perform Impacts Analysis of Remaining Control Technologies

The Guidelines require states to consider four types of impact analysis in Step 4 of the BART analysis. These four types of impacts consider the costs of compliance, energy impacts, non-air quality environmental impacts, and remaining useful life of the facility. These impacts are included in the cost-effectiveness of each additional control technology and allow comparisons to be made between the remaining controls. B&V performed an impact analysis for the remaining NOx and PM control technologies in accordance with the Guidelines.

B&V prepared the design parameters and developed estimates of capital and annual costs for applications of SCR, SCR/SNCR Hybrid, ROFA, Rotamix, ROFA/Rotamix, PJFF, and WESP technologies. B&V relied on a number of sources to prepare the design parameters, including information from the Nalco Mobotec equipment vendors, EPA cost manuals, engineering and performance data, and B&V's own in-house engineering estimates.

PNM evaluated the energy impacts, non-air quality environmental impacts, and remaining useful life of all additional technically feasible control options for NOx and PM. Energy impacts from control equipment that consume auxiliary power during operation were considered for all control options. For SCR and SCR/SNCR Hybrid technology, the non-air quality environmental impacts included the consideration of water usage and waste generated from each control technology. For WESP technology, PNM considered the auxiliary power consumption to operate the WESP and fans, and the additional water consumption and waste water disposal requirements from operating the WESP. Lastly, the remaining useful life was defined as 20 years. Therefore, no additional cost adjustments for a short remaining useful boiler life need to be considered. The results of the impact analyses for additional NOx and PM control technologies are summarized in Tables 10 and 11 on the following pages.

Following the initial submittal, the Department made additional requests for information on the impact analysis for SCR, SNCR, ROFA, Rotamix and WESP, and for further consideration of inherent and additional control of SO3 from both the SCR and SCR/SNCR Hybrid technology.

SCR Costs

The Department reviewed the original cost analysis for SCR technology and subsequently requested PNM to provide additional information on the basis of their cost analysis of SCR technology. In response to the request, B&V provided additional clarification for the cost analysis for SCR technology and submitted it to the Department on March 29, 2008. The submittal discussed how the OAQPS cost control manual is an insufficient method for determining actual costs of retrofitting the SJGS with SCR and provided a comparison between cost estimation based on the OAQPS manual and the B&V provided estimate.

Consideration of SO3 Control

PNM's initial analysis of SCR and SCR/SNCR technology took into consideration additional oxidation of SO2 to SO3 across the SCR catalyst bed. The Department requested PNM to consider inherent removal of SO3 emissions from existing air pollution control equipment, and removal of SO3 emissions through installation of sorbent injection. PNM responded with an amended submittal addressing both inherent and add-on removal of SO3. PNM's submittal provided cost estimates of the sorbent injection system and updated visibility modeling for both SCR and SCR/SNCR Hybrid technologies.

The Department understands that there are SCR catalysts now on the market that are capable of a much smaller SO2 to SO3 conversion (around 0.5%) as opposed to the assumed 1%. The Department believes use of such a catalyst will minimize SO3 oxidation to less than what was represented in PNM's analysis.

SNCR, WESP, ROFA, and Rotamix Review

PNM provided additional impact analyses of SNCR, WESP, ROFA, and Rotamix technologies and submitted those updates to the Department.

Table 10: Impact Analysis and Cost Effectiveness of Additional NOx Control Technologies

Control Technology	Emission Performance Level (lb/MMbtu)	Expected Emission Rate (tpy)	Expected Emission Reduction (tpy)	Total Capital Investment (TCI) (1,000$)	Total Annualized Cost (TAC) (1,000$)	Cost Effectivenes s ($/ton)	Incremental Cost Effectivenes s ($/ton)	Energy Impacts (1,000$)	Non-Air Impacts (1,000$)
Unit 1									
SCR + sorbent	0.07	966	3,174	164,732	21,998	6,931	3,815	1,596	NA[1]
SNCR/SCR Hybrid	0.18	2,484	1,656	104,436	16,207	9,786	34,218	706	1,762
ROFA/Rotamix	0.20	2,760	1,380	29,350	6,762	4,900	7,765	1,413	3
Rotamix (SNCR)	0.23	3,174	966	11,306	3,547	3,672	222	51	4
ROFA	0.26	3,588	552	18,293	3,455	6,259	--	1,363	NA[1]
Consent Decree	0.30	4,140	1,254	14,580	1,422	1,134	NA	NA[1]	NA[1]
Pre-CD	0.43	5,394	NA	NA	NA	NA	NA	NA	NA[1]
Unit 2									
SCR + sorbent	0.07	961	3,158	177,178	23,364	7,398	4,431	1,565	NA[1]
SNCR/SCR Hybrid	0.18	2,471	1,648	108,628	16,670	10,117	36,029	346	1,762
ROFA/Rotamix	0.20	2,746	1,373	29,350	6,762	4,925	7,803	1,413	3
Rotamix (SNCR)	0.23	3,158	961	11,306	3,547	3,690	223	51	4
ROFA	0.26	3,570	549	18,293	3,455	6,291	--	1,363	NA[1]
Consent Decree	0.30	4,119	2,060	14,126	1,378	669	NA	NA[1]	NA[1]
Pre-CD	0.45	6,179	NA	NA	NA	NA	NA	NA	NA[1]
Unit 3									
SCR + sorbent	0.07	1,501	4,931	227,774	30,527	6,191	2,086	2,267	NA[1]
SNCR/SCR Hybrid	0.18	3,859	2,572	168,507	25,606	9,954	37,285	507	2,658
ROFA/Rotamix	0.20	4,287	2,144	34,070	9,648	4,501	7,339	2,810	5
Rotamix (SNCR)	0.23	4,931	1,501	13,316	4,929	3,285	--	84	5
ROFA	0.26	5,574	857	20,983	5,124	5,976	--	2,725	NA[1]
Consent Decree	0.30	6,431	2,573	12,715	1,240	482	NA	NA[1]	NA[1]
Pre-CD	0.42	9,004	NA	NA	NA	NA	NA	NA	NA[1]
Unit 4									
SCR + sorbent	0.07	1,472	4,837	211,764	28,760	5,946	1,691	2,288	NA[1]
SNCR/SCR Hybrid	0.18	3,786	2,524	161,572	24,849	9,846	36,107	507	2,658
ROFA/Rotamix	0.20	4,206	2,103	34,070	9,648	4,587	7,479	2,810	5
Rotamix (SNCR)	0.23	4,837	1,472	13,316	4,929	3,348	--	84	5
ROFA	0.26	5,468	841	20,983	5,124	6,091	--	2,725	NA[1]
Consent Decree	0.30	6,309	2,524	12,870	1,256	498	NA	NA[1]	NA[1]
Pre-CD	0.42	8,833	NA	NA	NA	NA	NA	NA	NA[1]

[1] PNM performed an impact analysis for these technologies and incorporated any monetized energy or non-air environmental impacts into the cost analysis.

Table 11: Impact Analysis and Cost Effectiveness of Additional PM Control Technologies

Control Technology	Emission Performance Level (lb/MMbtu)	Expected Emission Rate (tpy)	Expected Emission Reduction (tpy)	Total Capital Investment (TCI) (1,000$)	Total Annualized Cost (TAC) (1,000$)	Incremental Cost Effectiveness ($/ton)	Cost Effectiveness ($/ton)	Energy Impacts (1,000$)	Non-Air Impacts (1,000$)
Unit 1									
WESP	0.010	138	69	99,308	11,855	20,696	171,812	1,112	NA[1]
PJFF (CD)	0.015	207	483	67,072	10,427	NA	21,588	4,488	NA[1]
Pre-CD	0.050	690	NA	NA	NA	NA	NA	NA	NA
Unit 2									
WESP	0.010	137	70	99,663	11,895	16,157	169,929	1,112	NA[1]
PJFF (CD)	0.015	207	480	69,840	10,764	NA	22,425	4,488	NA[1]
Pre-CD	0.050	687	NA	NA	NA	NA	NA	NA	NA
Unit 3									
WESP	0.010	214	108	129,565	15,558	28,741	144,056	1,728	NA[1]
PJFF (CD)	0.015	322	750	72,696	12,454	NA	16,605	6,895	NA[1]
Pre-CD	0.050	1072	NA	NA	NA	NA	NA	NA	NA
Unit 4									
WESP	0.010	210	105	130,012	15,609	29,352	148,657	1,728	NA[1]
PJFF (CD)	0.015	315	737	73,328	12,527	NA	16,997	6,895	NA[1]
Pre-CD	0.050	1052	NA	NA	NA	NA	NA	NA	NA

[1] PNM performed an impact analysis for these technologies and incorporated any monetized energy or non-air environmental impacts into the cost analysis.

Step 5 of the BART Analysis: Visibility Impacts Analysis of Remaining Control Technologies

The Guidelines require states to assess visibility improvement based on the modeled change in visibility impacts for the pre-control and post-control emission scenarios.

The objective of this source-specific, refined modeling analysis report is to describe the methodologies and procedures of visibility modeling to support the BART engineering analysis for PNM's SJGS Units 1, 2, 3, and 4. These units were identified as subject-to-BART by the Department based on BART screening exemption modeling conducted by the Western Regional Air Partnership's (WRAP) Regional Modeling Center (RMC). Because of the results of the WRAP screening modeling, PNM SJGS was required to conduct a refined BART analysis that included CALPUFF visibility modeling for the facility.

The modeling approach followed the requirements described in the WRAP's BART modeling protocol, *CALMET/CALPUFF Protocol for BART Exemption Screening Analysis for Class I Areas in the Western United States dated August 15, 2006*. The refined modeling methodology is described in detail below.

CALPUFF System

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-varying 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 the 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 computer 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 recommended by the WRAP BART modeling protocol. Version designations of the key programs are listed in Table 12.

Table 12: CALPUFF System Used

Program	WRAP Protocol		PNM Analyses	
	Version	Level	Version	Level
CALMET	6.211	060414	6.211	060414
CALPUFF	6.112	060412	6.112	060412
POSTUTIL	N/A	N/A	1.52	060412
CALSUM	N/A	N/A	1.33	051122
CALPOST	6.131	060410	6.131	060410

Meteorological Data Processing (CALMET)

As required by the WRAP modeling protocol, the CALMET model was used to construct an initial three-dimensional windfield using data from the MM5 model. Surface and upper-air data were input to CALMET to adjust the initial windfields. Because the MM5 data were afforded to simulate atmospheric variables on the CALMET windfields, the daily MM5 meteorological data files provided by the WRAP RMC for the years 2001, 2002, and 2003 were utilized as input into CALMET. These variables were processed into the appropriate format and introduced into the CALMET model through the utilization of additional meteorological data files. Locations of the observations that were input to CALMET, including surface and precipitation stations, are shown in Figures 1 and 2. Default settings were used in the CALMET input files for most of the technical options. Table 13 lists the key user-defined CALMET settings that were selected.

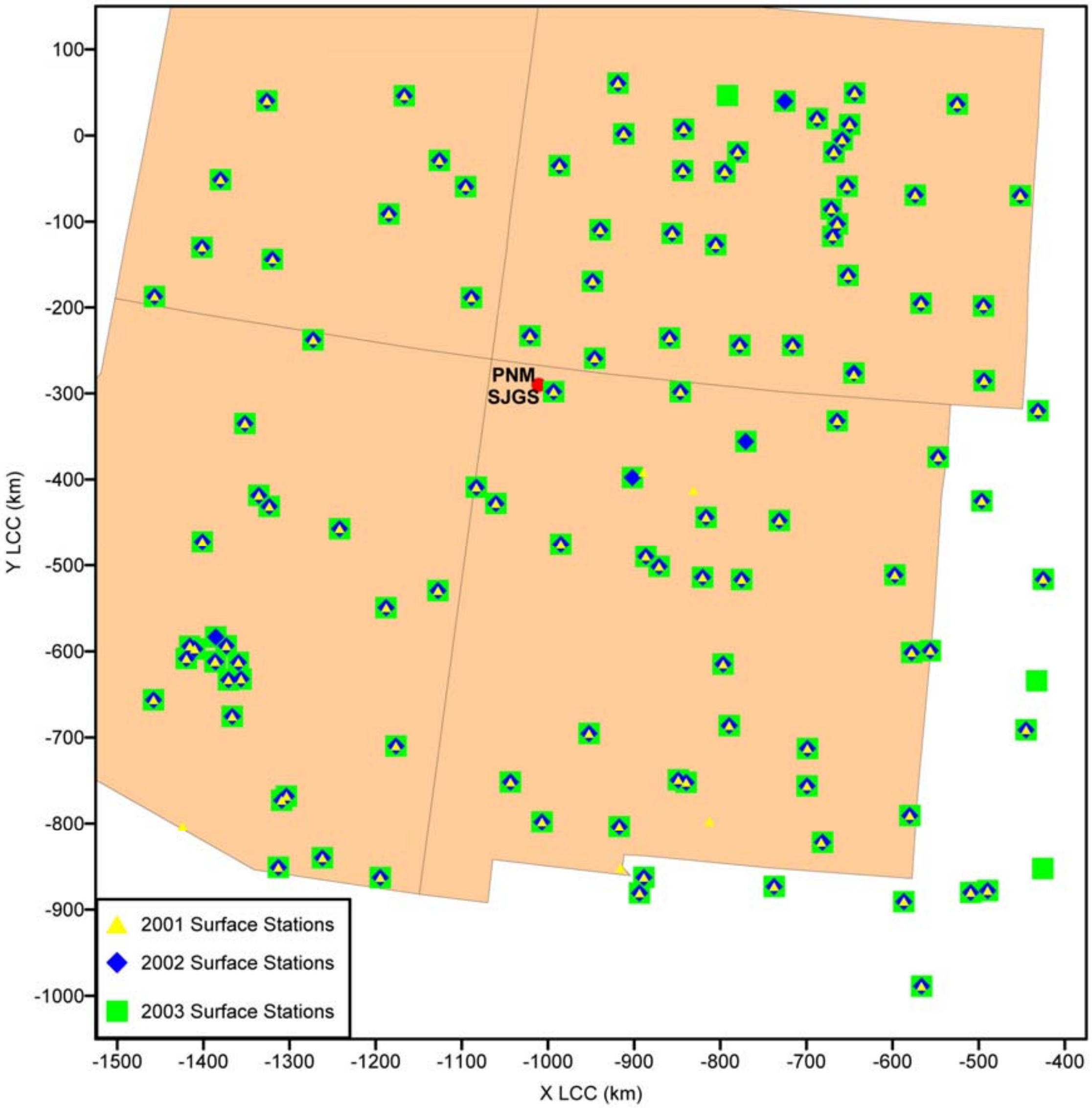

Figure 1: Surface Stations

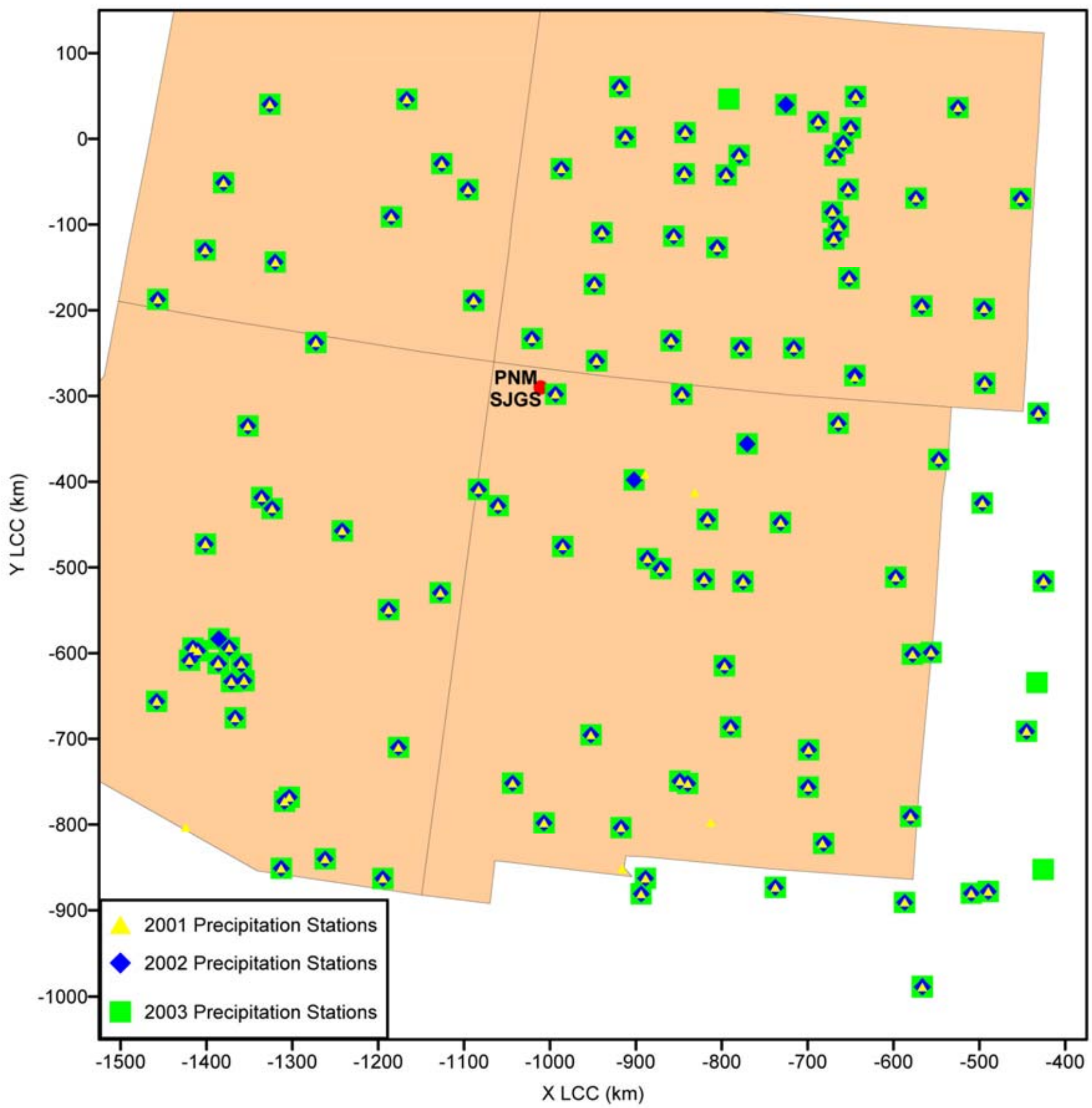

Figure 2: Precipitation Stations

Table 13: 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, 100, 200, 350, 500, 750, 1000, 2000, 3000, 4000, 5000
NOOBS	1=Use of surface and precipitation (no upper air observations); use MM5 for upper air data	1
IEXTRP	Extrapolate surface wind obs to upper level	1
RMIN2	Minimum distance for extrapolation	4
IPROG	Use gridded prognostic model output	14
RMAX1	Maximum radius of influence (surface layer, km)	50
RMAX2	Maximum radius of influence (layers aloft, km)	100
TERRAD	Radius of influence for terrain (km)	10
R1	Relative weighting of first guess wind field and observation (km)	100
R2	Relative weighting aloft (km)	200
ITPROG	3D temperature from observations or from MM5	1

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. Background ozone concentrations are important for the photochemical conversion of SO2 and NOx to SO4 and NO3, respectively. For ozone, the hourly ozone concentration files that were used by the WRAP RMC in the initial modeling were used for the BART technology evaluation. In addition to the hourly ozone data, the same monthly average background ozone value of 80 ppb that was used in the initial modeling was used in this modeling for times when hourly ozone data were not available. For ammonia, the monthly variable background ammonia concentrations were used for the BART modeling analysis. They are as follows:

Table 14: Ammonia Background Concentration (ppb)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.2	0.2	0.5	0.5	1.0	1.0	1.0	1.0	1.0	0.5	0.5	0.2

There are many Class I areas within and surrounding New Mexico. On the basis of distance from BART applicable sources, topography, and meteorology, the screening modeling conducted by WRAP RMC determined that 16 Class I areas needed to be addressed in the BART analysis. The applicable Class I areas included in the BART analysis are located within 300 km of the SJGS facility. As shown in Figure 3, the nearest Class I area is Mesa Verde National Park, located approximately 40 km north of the facility and the most distant Class I area is Grand Canyon National Park, located approximately 300 km of west of the facility. All Class I area distances from the facility fall within the range recommended for CALPUFF application. The 16 Class I areas are identified in Table 15 and an illustration of the receptors used in the modeling analysis for each Class I area is provided in Attachment B. The CALPUFF analyses used an array of discrete receptors with receptor elevations for the Class I areas, which were created and distributed by the National Park Service (NPS).

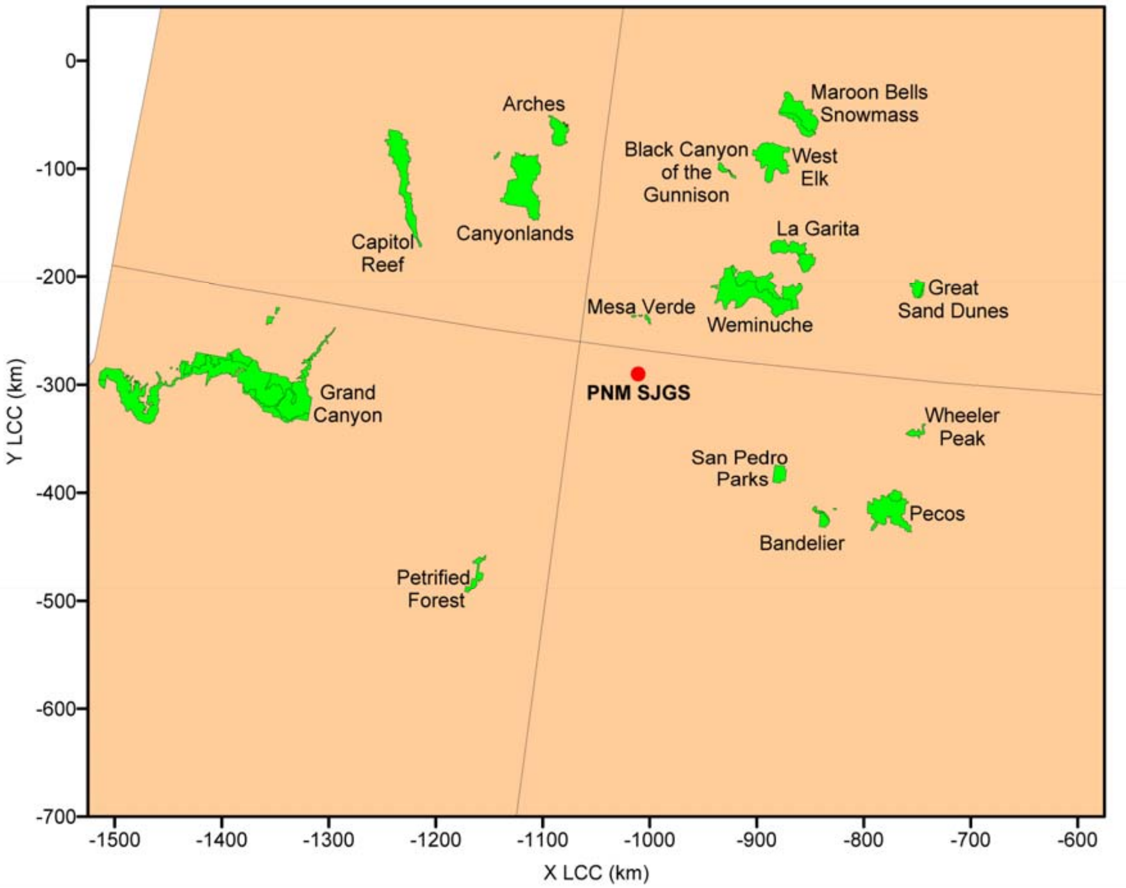

Figure 3: Location of SJGS and the Class I Area

Table 15: Class I Areas

1. Mesa Verde National Park (MEVE)	9. West Elk Wilderness (WEEL)
2. Weminuche Wilderness (WEMI)	10. Arches National Park (ARCH)
3. San Pedro Parks Wilderness (SAPE)	11. Capitol Reef National Park (CARE)
4. La Garita Wilderness (LAGA)	12. Pecos Wilderness (PECO)
5. Canyonlands National Park (CANY)	13. Wheeler Peak Wilderness (WHPE)
6. Black Canyon of the Gunnison National Park (BLCA)	14. Great Sand Dunes National Park (GRSA)
7. Bandelier National Monument (BAND)	15. Maroon Bells-Snowmass Wilderness (MABE)
8. Petrified Forest National Park (PEFO)	16. Grand Canyon National Park (GRCA)

CALPUFF Inputs – Pre-Consent Decree, Baseline and Control Options

Source release parameters and emissions for pre-consent decree, baseline and control options for each unit are shown in Tables 16 through 19.

Table 16: CALPUFF Inputs for Unit 1

Model Input Data	Pre-Consent Decree	Consent Decree	Rotamix	ROFA/ Rotamix	ROFA	SCR/SNCR Hybrid	SCR with Sorbent
Hourly Heat Input (MMbtu/hour)	3707	3707	3707	3707	3707	3707	3707
Sulfur Dioxide (SO_2) (lb/MMbtu)	0.24	0.18	0.18	0.18	0.18	0.18	0.18
Sulfur Dioxide (SO_2) (lb/hr)	877.8	667.3	667.3	667.3	667.3	667.3	667.3
Nitrogen Oxide (NOx) (lb/MMbtu)	0.43	0.33	0.23	0.20	0.26	0.18	0.07
Nitrogen Oxide (NOx) (lb/hr)	1592.0	1223.3	852.6	741.4	963.8	667.3	259.5
PM (lb/MMbtu)	0.050	0.015	0.015	0.015	0.015	0.015	0.015
PM (lb/hr)	185.4	55.6	55.6	55.6	55.6	55.6	55.6
SO_3 as Sulfuric Acid (H_2SO_4) (lb/MMbtu)	0.013	0.011	0.011	0.011	0.011	0.031	0.004
SO_3 as Sulfuric Acid (H_2SO_4)[(a)] (lb/hr)	50.0	40.5	40.5	40.5	40.5	114.2	16.1
Stack Conditions							
Stack Height (meters)	121.92	121.92	121.92	121.92	121.92	121.92	121.92
Stack Exit Diameter (meters)	6.096	6.096	6.096	6.096	6.096	6.096	6.096
Stack Exit Temperature (Kelvin)	336	322.83	322.83	322.83	322.83	322.83	322.83
Stack Exit Velocity (m/s)	22.6	21.34	21.34	21.34	21.34	21.34	21.34

[(a)] H_2SO_4 assumed to be 100 percent of the SO_4 emissions calculated by the NPS Speciation Spreadsheet.

Table 17: CALPUFF Inputs for Unit 2

Model Input Data	Pre-Consent Decree	Consent Decree	Rotamix	ROFA/ Rotamix	ROFA	SCR/SNCR Hybrid	SCR with Sorbent
Hourly Heat Input (MMbtu/hour)	3688	3688	3688	3688	3688	3688	3688
Sulfur Dioxide (SO_2) (lb/MMbtu)	0.23	0.18	0.18	0.18	0.18	0.18	0.18
Sulfur Dioxide (SO_2) (lb/hr)	844.0	663.8	663.8	663.8	663.8	663.8	663.8
Nitrogen Oxide (NOx) (lb/MMbtu)	0.45	0.33	0.23	0.20	0.26	0.18	0.07
Nitrogen Oxide (NOx) (lb/hr)	1649.3	1217.0	848.2	737.6	958.9	663.8	258.2
PM (lb/MMbtu)	0.050	0.015	0.015	0.015	0.015	0.015	0.015
PM (lb/hr)	184.4	55.3	55.3	55.3	55.3	55.3	55.3
SO_3 as Sulfuric Acid (H_2SO_4) (lb/MMbtu)	0.013	0.011	0.011	0.011	0.011	0.031	0.004
SO_3 as Sulfuric Acid (H_2SO_4)[(a)] (lb/hr)	49.7	40.3	40.3	40.3	40.3	113.6	16.0
Stack Conditions							
Stack Height (meters)	121.92	121.92	121.92	121.92	121.92	121.92	121.92
Stack Exit Diameter (meters)	6.096	6.096	6.096	6.096	6.096	6.096	6.096
Stack Exit Temperature (Kelvin)	338	322.83	322.83	322.83	322.83	322.83	322.83
Stack Exit Velocity (m/s)	23.5	21.34	21.34	21.34	21.34	21.34	21.34
[(a)] H_2SO_4 assumed to be 100 percent of the SO_4 emissions calculated by the NPS Speciation Spreadsheet.							

Table 18: CALPUFF Inputs for Unit 3

Model Input Data	Pre-Consent Decree	Consent Decree	Rotamix	ROFA/ Rotamix	ROFA	SCR/SNCR Hybrid	SCR with Sorbent
Hourly Heat Input (MMbtu/hour)	5758	5758	5758	5758	5758	5758	5758
Sulfur Dioxide (SO_2) (lb/MMbtu)	0.28	0.18	0.18	0.18	0.18	0.18	0.18
Sulfur Dioxide (SO_2) (lb/hr)	1591.1	1036.4	1036.4	1036.4	1036.4	1036.4	1036.4
Nitrogen Oxide (NOx) (lb/MMbtu)	0.42	0.33	0.23	0.20	0.26	0.18	0.07
Nitrogen Oxide (NOx) (lb/hr)	2405.5	1900.1	1324.3	1151.6	1497.1	1036.4	403.1
PM (lb/MMbtu)	0.050	0.015	0.015	0.015	0.015	0.015	0.015
PM (lb/hr)	287.9	86.4	86.4	86.4	86.4	86.4	86.4
SO_3 as Sulfuric Acid (H_2SO_4) (lb/MMbtu)	0.013	0.011	0.011	0.011	0.011	0.031	0.004
SO_3 as Sulfuric Acid (H_2SO_4)[(a)] (lb/hr)	77.7	62.9	62.9	62.9	62.9	177.3	25
Stack Conditions							
Stack Height (meters)	121.92	121.92	121.92	121.92	121.92	121.92	121.92
Stack Exit Diameter (meters)	8.534	8.534	8.534	8.534	8.534	8.534	8.534
Stack Exit Temperature (Kelvin)	335	322.83	322.83	322.83	322.83	322.83	322.83
Stack Exit Velocity (m/s)	17.07	17.07	17.07	17.07	17.07	17.07	17.07

[(a)] H_2SO_4 assumed to be 100 percent of the SO_4 emissions calculated by the NPS Speciation Spreadsheet.

Table 19: CALPUFF Inputs for Unit 4

Model Input Data	Pre-Consent Decree	Consent Decree	Rotamix	ROFA/ Rotamix	ROFA	SCR/SNCR Hybrid	SCR with Sorbent
Hourly Heat Input (MMbtu/hour)	5649	5649	5649	5649	5649	5649	5649
Sulfur Dioxide (SO_2) (lb/MMbtu)	0.29	0.18	0.18	0.18	0.18	0.18	0.18
Sulfur Dioxide (SO_2) (lb/hr)	1662.4	1016.8	1016.8	1016.8	1016.8	1016.8	1016.8
Nitrogen Oxide (NOx) (lb/MMbtu)	0.42	0.33	0.23	0.20	0.26	0.18	0.07
Nitrogen Oxide (NOx) (lb/hr)	2399.6	1864.2	1299.3	1129.8	1468.7	1016.8	395.4
PM (lb/MMbtu)	0.050	0.015	0.015	0.015	0.015	0.015	0.015
PM (lb/hr)	282.5	84.7	84.7	84.7	84.7	84.7	84.7
SO_3 as Sulfuric Acid (H_2SO_4) (lb/MMbtu)	0.013	0.011	0.011	0.011	0.011	0.031	0.004
SO_3 as Sulfuric Acid (H_2SO_4)[(a)] (lb/hr)	76.2	61.7	61.7	61.7	61.7	174.0	24.5
Stack Conditions							
Stack Height (meters)	121.92	121.92	121.92	121.92	121.92	121.92	121.92
Stack Exit Diameter (meters)	8.534	8.534	8.534	8.534	8.534	8.534	8.534
Stack Exit Temperature (Kelvin)	331	322.83	322.83	322.83	322.83	322.83	322.83
Stack Exit Velocity (m/s)	17.4	16.76	16.76	16.76	16.76	16.76	16.76
[(a)]H_2SO_4 assumed to be 100 percent of the SO_4 emissions calculated by the NPS Speciation Spreadsheet.							

Visibility Post-Processing (CALPOST)

Light extinction must be computed to calculate visibility. CALPOST has seven methods for computing light extinction. As recommended by the WRAP RMC protocol, this BART technology analysis used Method 6, which computes extinction from speciated PM with monthly Class I area-specific relative humidity adjustment factors. Relative humidity is an important factor in determining light extinction (and therefore visibility) because sulfate and nitrate aerosols, which absorb moisture from the air have greater extinction efficiencies with greater relative humidity. This BART analysis used relative humidity correction factors [f(RH)s], obtained from Table A-3 of the EPA's *Guidance for Estimating Natural Visibility Conditions under the Regional Haze Rule* (EPA, 2003), to determine sulfate and nitrate concentrations outputs from CALPUFF. The f(RH) values for each Class I area that was assessed are provided in Table 20. The default Rayleigh scatter value (bray) of 10 Mm-1 was also used. The light extinction equation is as follows:

$$b_{ext} = 3 * f(RH) * [(NH_4)_2SO_4] + 3* f(RH) * [NH_4NO_3] + 4*[OC] + 1* [PM_f] + 0.6*[PM_c] + 10* [EC] + b_{ray}$$

Table 20: Monthly Relative Humidity Factors[a] for CALPOST

Class I Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Arches	2.6	2.3	1.8	1.6	1.6	1.3	1.4	1.5	1.6	1.6	2.0	2.3
Bandelier	2.2	2.1	1.8	1.6	1.6	1.4	1.7	2.1	1.9	1.7	2.0	2.3
Black Canyon of the Gunnison	2.4	2.2	1.9	1.9	1.9	1.6	1.7	1.9	2.0	1.8	2.1	2.3
Canyonlands	2.6	2.3	1.7	1.6	1.5	1.2	1.3	1.5	1.6	1.6	2.0	2.3
Capitol Reef	2.7	2.4	2.0	1.7	1.6	1.4	1.4	1.6	1.6	1.7	2.1	2.5
Grand Canyon	2.4	2.3	1.9	1.5	1.4	1.2	1.4	1.7	1.6	1.6	1.9	2.3
Great Sand Dunes	2.4	2.3	2.0	1.9	1.9	1.8	1.9	2.3	2.2	1.9	2.4	2.4
La Garita	2.3	2.2	1.9	1.8	1.8	1.6	1.7	2.1	2.0	1.8	2.2	2.3
Maroon Bells	2.2	2.1	2.0	2.0	2.1	1.7	1.9	2.2	2.1	1.8	2.1	2.1
Mesa Verde	2.5	2.3	1.9	1.5	1.5	1.3	1.6	2.0	1.9	1.7	2.1	2.3
Pecos	2.3	2.1	1.8	1.7	1.7	1.5	1.8	2.1	2.0	1.7	2.0	2.2
Petrified Forest	2.4	2.2	1.7	1.4	1.3	1.2	1.5	1.8	1.7	1.6	1.9	2.3
San Pedro Parks	2.3	2.1	1.8	1.6	1.6	1.4	1.7	2.0	1.9	1.7	2.1	2.2
West Elk	2.3	2.2	1.9	1.9	1.9	1.7	1.8	2.1	2.0	1.8	2.1	2.2
Weminuche	2.4	2.2	1.9	1.7	1.7	1.5	1.6	2.0	1.9	1.7	2.1	2.3
Wheeler Peak	2.3	2.2	1.9	1.8	1.8	1.6	1.8	2.2	2.1	1.8	2.2	2.3

[a]Table A-3 of the EPA's *Guidance for Estimating Natural Visibility Conditions under the Regional Haze Rule*

According to the final BART rule, the EPA's default average annual aerosol concentrations for the western half of the United States, included in Table 2-1 of EPA's *Guidance for Estimating Natural Visibility Conditions Under Regional Haze Rule (EPA-454/B-03-005, September 2003),* were used to determine the natural background conditions representative of the Annual Average Natural Visibility Conditions in each Class I area used as a reference for determination of the modeled Δdv change. Table 21 provides the Average Natural Levels of Aerosol Components.

Table 21: Average Annual Natural Background Levels[a]

Component	Average Annual Natural Background ($\mu g/m^3$)
Ammonium Sulfate	0.12
Ammonium Nitrate	0.10
Organic Carbon Mass	0.47
Elemental Carbon	0.02
Soil	0.50
Coarse Mass	3.00
[a]Table 2-1 of the EPA's *Guidance for Estimating Natural Visibility Conditions under the Regional Haze Rule.*	

Modeling Results

From the air dispersion modeling methodology outlined in the previous section, a CALPUFF model run was conducted for the following control technologies for each unit during the BART engineering analysis, including the pre-consent decree: Consent Decree, Rotamix, ROFA/Rotamix, ROFA, SCR/SNCR Hybrid (SCR/SNCR Hybrid with Inherent SO_3 Removal), SCR with Sorbent (SCR with Inherent SO_3 Removal and Sorbent Injection), PJFF, and WESP. To simplify the quantity of the modeling results, total visibility impacts at all 16 Class I areas were used to make comparisons of each control technology's performance.

For both the facility-wide and unit-by-unit modeling analysis conducted with the 2001-2003 years of meteorological data, the expected degree of visibility impact for each control technology was determined by the difference between the visibility impaired by the facility sources and annual average natural visibility conditions for each receptor at each of the 16 Class I area which is indicative of delta-deciview (delta-dv).

Visibility Impact of NOx Control Technology

The results of the facility-wide analysis indicate the installation of SCR with sorbent control technology results in maximum visibility improvement at all of the 16 Class I areas when compared to the impact of the other control options. It is important to note that SCR with sorbent control technology improves visibility more significantly than the other control options at Mesa Verde National Park, which is the closest Class I area to the facility.

Similar to the results seen in the facility-wide analysis, the visibility improvement at Mesa Verde National Park for each of the four units is maximized with SCR with sorbent control technology as shown in Figure 7. The results also indicate that by adding SCR with sorbent injection, visibility improvement is maximized at all the Class I areas over the three years of the modeled period.

The results of the visibility modeling for Unit 1, Unit 2, Unit 3, and Unit 4 for each of the NOx control technologies are illustrated in Attachment A, Tables 1-28. These tables summarize the 98^{th} percentile visibility impact for the pre-consent decree, baseline, and control scenarios, and the average and maximum number of days exceeding 0.5 dv threshold estimated at each of the Class I areas.

A summary of each graph representing the results of the visibility modeling is provided as follows:
Figure 4 illustrates the maximum visibility deciview impact for each NOx control technology seen at **each Class I area** for the years 2001-2003 on a **facility-wide basis**.

Figure 5 illustrates the maximum visibility deciview impact for each NOx control technology seen at **each Class I area** for the years 2001-2003 on a **unit-by-unit basis**.

Figure 6 illustrates the maximum visibility deciview impact for each NOx control technology seen at **Mesa Verde National Park** for the years 2001-2003 on a **facility-wide basis**.

Figure 7 illustrates the maximum visibility deciview impact for each NOx control technology seen at **Mesa Verde National Park** for the years 2001-2003 on a **unit-by-unit basis**.

Visibility Impact of PM Control Technology

The visibility modeling performed for the WESP control option was performed on a facility-wide and unit-by-unit basis. The results of the facility-wide analysis demonstrate a net improvement of 0.62 dv at Mesa Verde National Park and 0.14 dv improvement at San Pedro Parks Wilderness. The amount of visibility improvement at all other Class I areas was equal to or less than 0.1 dv improvement.

The results of the unit-by-unit impact analysis demonstrate a 0.21 dv improvement for Units 3 and 4 at Mesa Verde National Park. However, all other impact analyses show less than a 0.1 dv improvement at any of the Class I areas for Units 1-4.

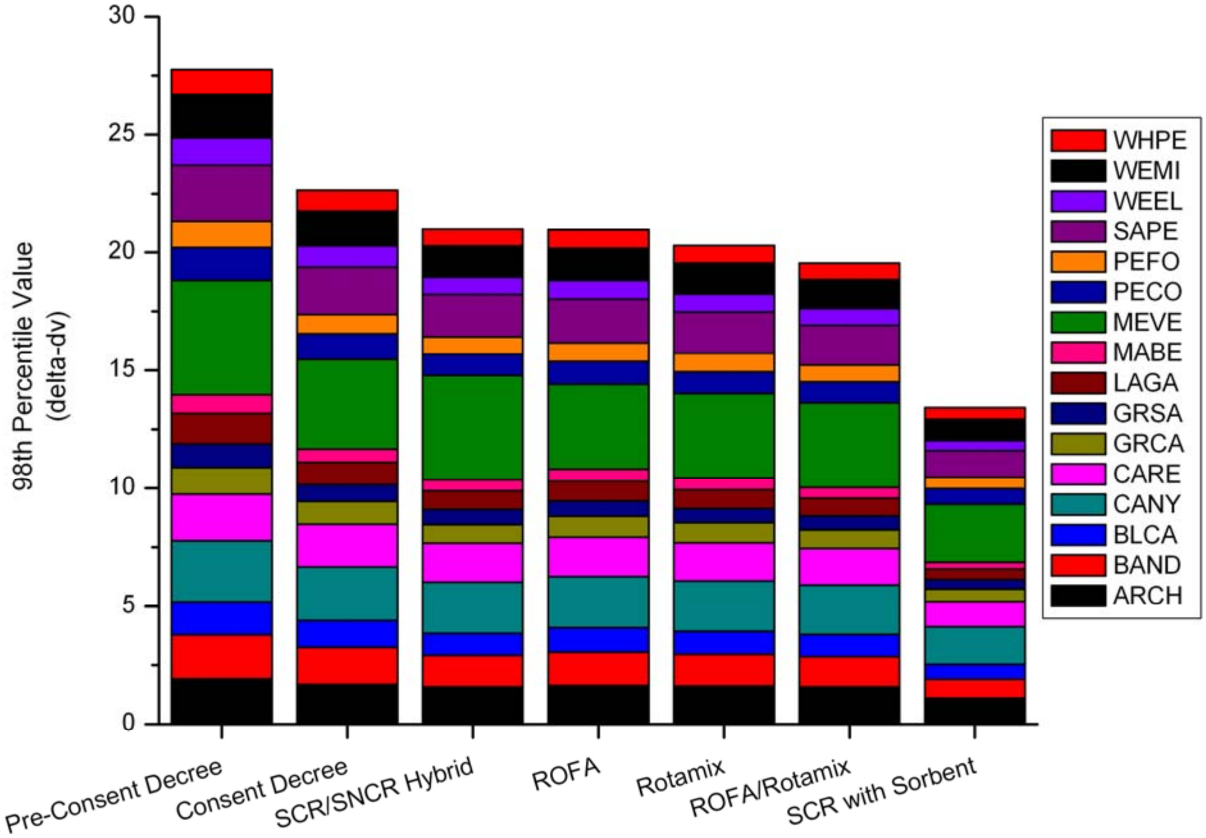

Figure 4: Total Amount of the Visibility Impacts at All 16 Class I Areas Using 2001-2003 Meteorological Data (facility-wide impact)

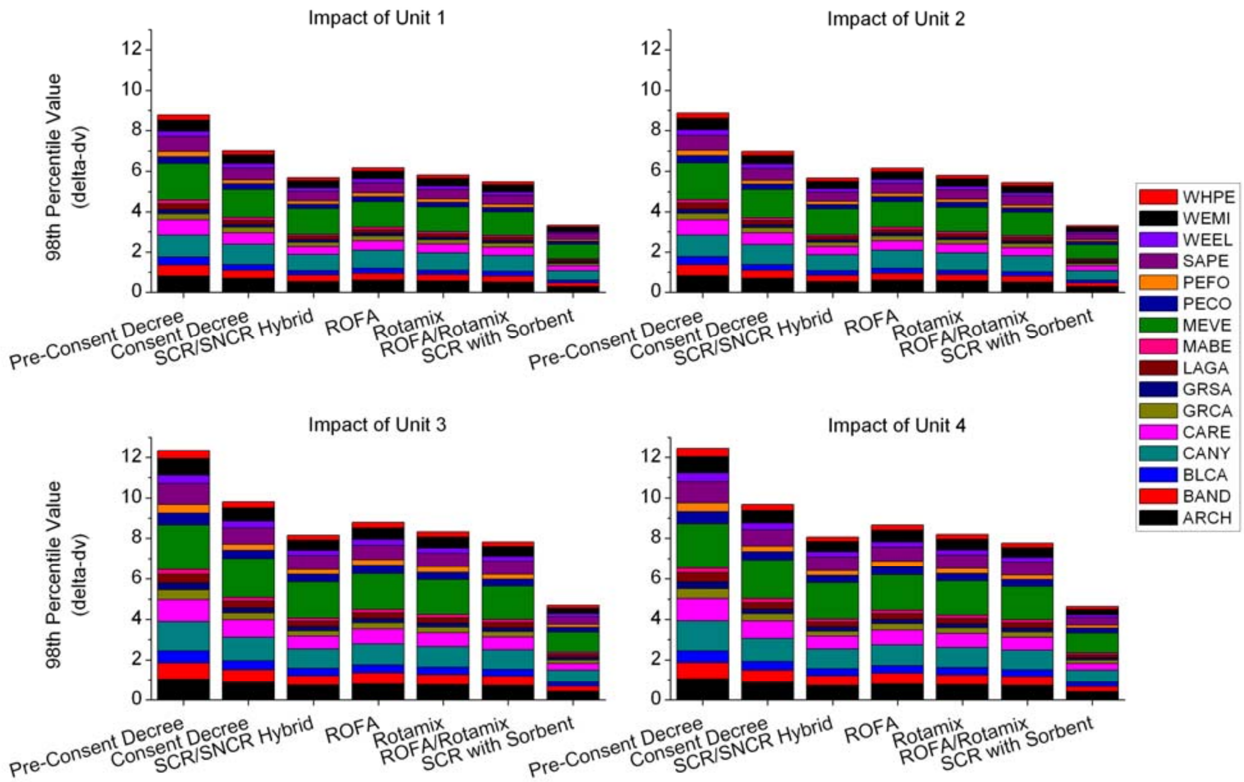

Figure 5: Total Amount of the Visibility Impacts at All 16 Class I Areas Using 2001-2003 Meteorological Data (units 1, 2, 3, and 4)

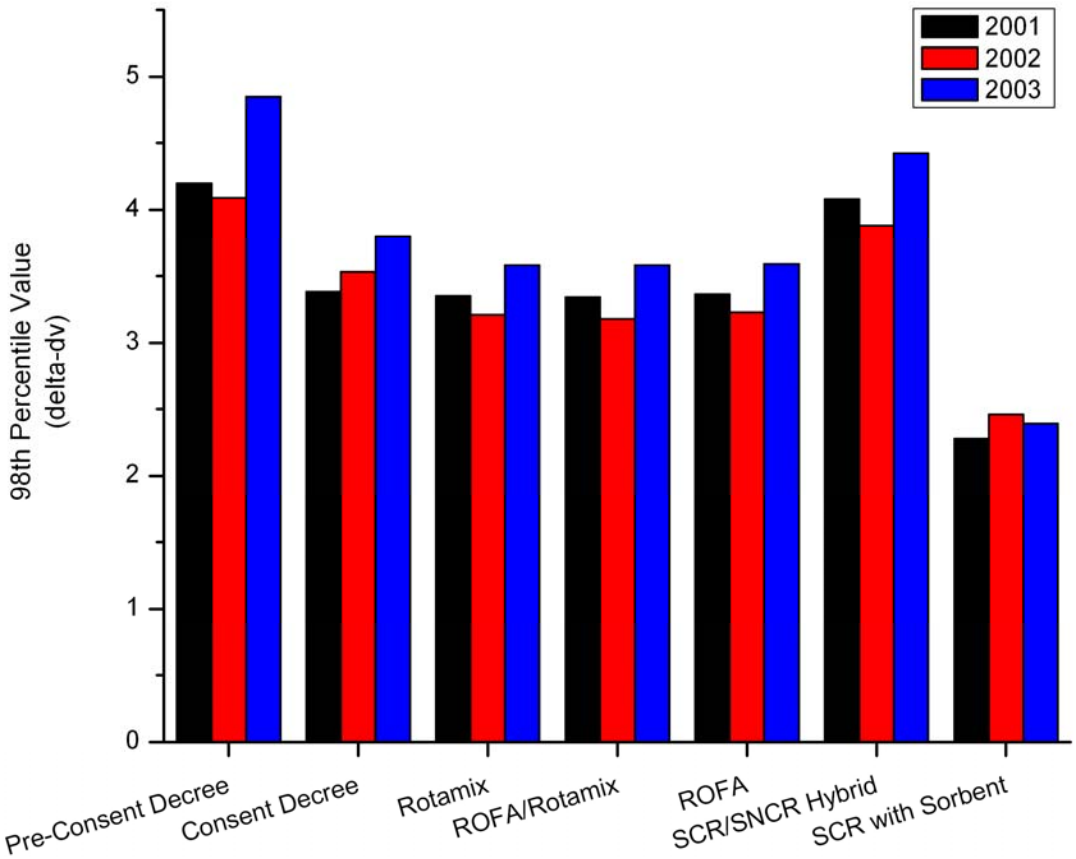

Figure 6: Visibility Impact at Mesa Verde National Park Using 2001-2003 Meteorological Data (facility-wide impact)

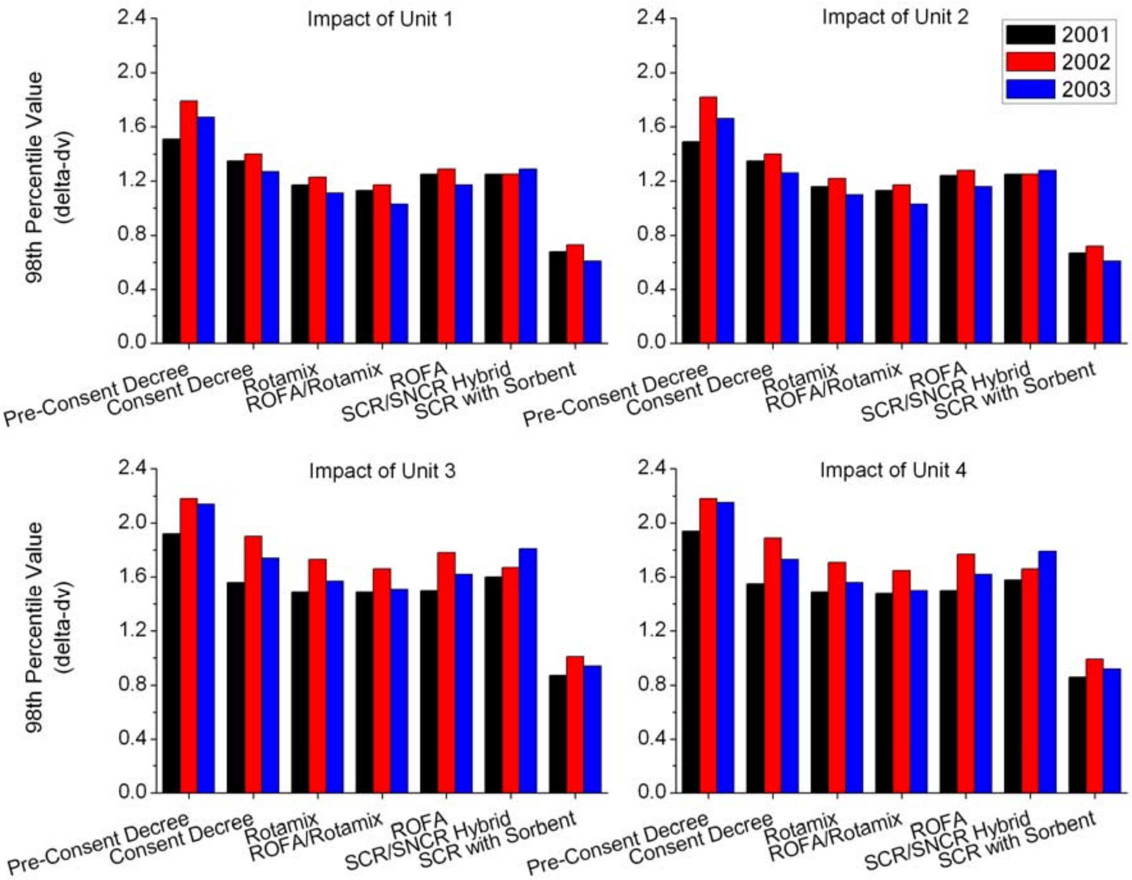

Figure 7: Visibility Impact at Mesa Verde National Park Using 2001-2003 Meteorological Data (units 1, 2, 3, and 4)

Department Selection of BART for NOx and PM

In accordance with Section 169A(g)(7) of the Clean Air Act, the Department considered the following five statutory factors in the BART analysis for the SJGS: (1) the costs of compliance; (2) energy and non-air quality environmental impacts of compliance; (3) any existing pollution control technology in use at the source; (4) the remaining useful life of the source; and (5) the degree of improvement in visibility which may reasonably by anticipated to result from the use of such technology.

PM BART Determination

Based on the five factor analysis, the Department has determined that BART for Units 1-4 for PM is existing PJFF technology and the existing emission rate of 0.015 lb/MMbtu. The Department's determination of BART was based on the following results of the full five factor analysis:

1) Each of Units 1-4 is equipped with PJFF and is subject to a federally-enforceable emission limit of 0.015 lb PM/MMbtu.

2) The Department reviewed both the cost-effectiveness and incremental cost-effectiveness of additional control technology (WESP) and found these costs to be excessive. See Table 11.
3) There are additional energy impacts associated with the WESP technology and the Department considers these costs to be reasonable.
4) The Department reviewed the visibility improvement that resulted from the installation of the consent decree technology (PJFF and LNB/OFA) and that would result from the addition of WESP technology. The Department determined that on a facility-wide basis the visibility improved by 1.06 deciviews (dv) from the installation of the consent decree technology at Mesa Verde National Park (Mesa Verde). The installation of WESP would result in a facility-wide improvement of 0.62 dv at Mesa Verde. Improvements on a unit-by-unit basis at all Class I areas showed very minor improvements, usually less than 0.1 dv.

NOx BART Determination

Based on the five factor analysis, the Department has determined that BART for Units 1-4 for NOx is SCR plus sorbent injection and an emission rate between 0.03 and 0.07 lb/MMbtu. The Department's determination of BART was based on the following results of the five factor analysis:

1) The PNM cost-effectiveness of SCR + sorbent technology ranges from $5,946/ton for Unit 4 to $7,398/ton for Unit 2, and the incremental cost-effectiveness of SCR + sorbent ranges from $1,691/ton for Unit 4 to $4,431/ton for Unit 2. Although the Department finds these values acceptable, they are conservative as demonstrated by the following evidence. These values are based on: (a) implementing the SCR projects separately at each unit (expected synergies between the construction projects should lower these costs); (b) incorporating the cost of SCR bypass at each unit without sufficient justification for why alternative fuels cannot be considered thus eliminating the need of the bypass altogether, or why the bypass for Units 3 and 4, two baseload units, could not be retrofitted with a catalyst that could accommodate occasional startups, eliminating their bypass; (c) including the cost of a full balanced-draft conversion at each unit without sufficient justification of the 10 inches of additional pressure drop; (d) including labor costs at the rates reflective of pre-recession 2007 values; (e) including the cost of purchase power for 5 full weeks at each unit, despite lack of detailed schedule provided by PNM; (f) PNM's inclusion of various over-head and other factors without appropriate basis; and (g) an SCR removal efficiency of 77%, which significantly underestimates the tons of NOx that can be removed (SCR can typically achieve 90% removal efficiency). Additionally, PNM assumed that SO2 to SO3 conversion of 1% due to the SCR catalyst. Lower conversion catalysts are available, leading to lower sorbent and capital costs.

   The Department does not necessarily agree with the cost-estimates supplied in the impact analysis and finds some of the costs have not been fully justified. Cost estimates for SCR supplied by the NPS were consistently three to over four times lower than the cost estimates supplied by PNM. The Department expects the actual costs of SCR technology to be between the two cost-estimates supplied by PNM and NPS.

2) The above notwithstanding, the cost-effectiveness and incremental cost-effectiveness of SCR plus sorbent technology calculated by PNM is considered reasonable by the Department. These costs are in line with acceptable cost-effectiveness values for BACT determinations, which involve a similar control technology evaluation process. With the considerations highlighted above, the cost-estimates would likely be lower. Thus, the price per ton of NOx removal would be lower.

3) The Guidelines state that regulatory agencies should require utility boilers to meet the presumptive limits, unless an agency determines that an alternative control is justified based on the consideration of statutory factors. The presumptive limit for NOx at Units 1-4 at the SJGS is 0.23 lb/MMbtu. However, in light of the reasonable cost-effectiveness and incremental cost-effectiveness, acceptable energy impacts and non-air quality environmental impacts, and visibility improvement resulting from installation of SCR plus sorbent, the Department has determined BART as SCR plus sorbent injection. See Table 10 and Visibility Results Section.

4) Annual NOx emissions from the facility will be reduced by 16,100 tons from SCR plus sorbent, at the assumed 0.07 lb/MMbtu value used by PNM. At 0.03 lb/MMBtu, the NOx emissions from the facility will be greater still.

5) The Department reviewed the visibility improvement that resulted from the installation of the SCR plus sorbent technology at the 0.07 lb/MMbtu NOx level. The Department determined that on a facility-wide basis the visibility improved by 1.34 deciviews (dv) from the installation of SCR plus sorbent technology at Mesa Verde, 0.88 dv at San Pedro, 0.75 dv at Bandalier, 0.73 dv at Capital Reef, 0.67 dv at Canyonlands, 0.59 dv at Arches, 0.59 dv at Weminuche, 0.52 dv at Black Canyon, 0.49 dv at La Garita, 0.49 dv at West Elk, 0.44 dv at Grand Canyon, 0.43 dv at Pecos, 0.40 dv at Wheeler Peak, 0.34 dv at Petrified Forest, 0.31 at Great Sand Dunes, and 0.28 dv at Maroon Bells. Visibility improvements will be greater using a NOx level of 0.03 lb/MMBtu.

6) Again using a NOx value of 0.07 lb/MMbtu, SCR plus sorbent technology reduced the number of days that each Unit exceeded a 0.5 dv impact. For Unit 1, the number of days exceeding 0.5 dv was reduced from 46 days to 16 days; Unit 2's impact decreased from 46 days to 16 days; Unit 3's impact decreased from 68 days to 31 days; and Unit 4's impact decreased from 67 days to 29 days. Impacts would be further reduced at a NOx limit of 0.03 lb/MMBtu.

7) The installation of SCR plus sorbent technology will result in additional energy impacts and non-air environmental impacts, and the remaining useful life of 20 years did not further impact costs. None of the additional energy or non-air environmental impacts prohibit selection of this technology.

References

1. 40 CFR 51 – Regional Haze Regulations and Guidelines for Best Available Retrofit Technology (BART) Determinations

2. Summary of WRAP RMC BART Modeling for New Mexico (April 21, 2006)

3. Public Service Company of New Mexico BART Technology Analysis for the San Juan Generating Station (June 6, 2007 and submittal updates)

4. EPA. (2003). Air Pollution Control Technology Fact Sheet (SNCR). Retrieved from http://www.epa.gov/ttn/catc/dir1/fsncr.pdf

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6. EPA. (2003). Guidance for Estimating Natural Visibility Conditions under the Regional Haze Rule. http://www.epa.gov/ttncaaa1/t1/memoranda/rh_envcurhr_gd.pdf