APPENDIX D
TO NEW MEXICO'S REGIONAL HAZE SIP
UNDER 40 C.F.R. § 51.309(g)

New Mexico Environment Department
Air Quality Bureau
Revised BART Determination

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

May 21, 2013
Revised June 27, 2013

PREFACE

This document is a revised version of the BART Determination for Public Service Company of New Mexico (PNM) San Juan Generating Station Units 1-4 that was attached as Appendix D to New Mexico's June 2011 Regional Haze State Implementation Plan (SIP), submitted pursuant to 40 CFR § 51.309(g). As explained within, it has been revised to incorporate new information submitted by PNM in April 2013. The new information was submitted in accordance with the terms of a tentative agreement between NMED, EPA, and PNM, which when fully implemented would resolve a dispute over the determination of Best Available Retrofit Technology (BART) for Nitrogen Oxides (NOx) for the San Juan Generating Station.

Regulatory Background and Introduction:

In 1999, the U.S. Environmental Protection Agency (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; and (3) 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 certain other 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 SO_2 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, unless it is determined that an alternative control level is justified based on consideration of the statutory factors. 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 guidelines provide that the threshold for determining whether a source "contributes" to visibility impairment should be set no higher than 0.5 deciview (dv).

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 SO_2, NOx and primary PM emissions were calculated. PM emissions were modeled as $PM_{2.5}$.
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 to assess visibility impacts from SO_2, NOx, and PM emissions.

Of the 11 source complexes analyzed, only one source complex's visibility impacts at any Class I area due to combined SO_2, NOx, and PM emissions exceeded the 0.5 dv threshold. This source was PNM San Juan Generating Station, Boilers #1-4 ("SJGS"). Of the 10 other source complexes, none exceed a 0.33 dv impact. Therefore, for the SJGS only, the separate contribution to visibility at Class I areas was assessed for SO_2 alone (SO_4), NOx alone (NO_3), PM alone (PMF), and combined NOx plus PM emissions (NO_3 + PMF).[2]

On November 9, 2006, the Department informed PNM that the modeling performed by the WRAP indicated the visibility impairment from the SJGS was over the 0.5 dv threshold, and SJGS 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 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 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 installed 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 a 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, 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 the 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 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 SO_3 removal of the SO_3 formed from the catalyst oxidation of SO_2 to SO_3.[3]

February 15, 2011

A revised analysis of SNCR technology was submitted after PNM received a lower vendor-guaranteed emission rate from Fuel Tech, a vendor of SNCR technology. The analysis also included updated cost estimates for SCR, SNCR/SCR Hybrid, ROFA/Rotamix, Rotamix (SNCR), ROFA, and SNCR (Fuel Tech) technologies.

The submittal further included a ratepayer impact analysis which estimated the cost impact to residential ratepayers from installation of SNCR and SCR technologies.

One modeling analysis was performed to provide SJGS plant-wide and unit specific regional haze visibility impacts at 16 Class I areas assuming the revised SNCR control technology on all four units.[3]

April 1, 2013

This submittal compares new information as contained in a non-binding term sheet signed by the EPA, NMED and PNM on February 15, 2013. This update considers the emissions reductions and economic analysis of three specific control scenarios at SJGS, as contained in the EPA's Federal Implementation

Plan, issued August 22, 2011 (SCR on all four units, or 4 SCR); the State of New Mexico's State Implementation Plan, approved by the State Environmental Improvement Board on June 2, 2011 (SNCR on all four units, or 4 SNCR); and an alternative entitled the State Alternative Plan, not previously analyzed, which considers the voluntary retirement of Units 2 and 3 (SNCR on Units 1 and 4 and the shutdown of Units 2 and 3, or 2 SNCR/2 Shutdown).

An updated cost analysis of installing SCR control on all four units, SNCR control on all four units, and installing SNCR on Units 1 and 4 was prepared by Sargent & Lundy (S&L) at the request of PNM. This analysis reflected the approach described in the EPA's Control Cost Manual.

An updated visibility analysis based on the installation of SCR on all four units, SNCR on all four units, and SNCR on Units 1 and 4 and a two-unit shut down scenario was also submitted. This analysis is included in addition to the previous modeling analysis and is presented as the Updated Visibility Modeling Assessment Submitted April 1, 2013 of Step 5 of this document.

The updated visibility analysis for the installation of SCR on all four units and SNCR on all four units incorporated the SO_2 and total particulate matter (TPM) emission rates of 0.15 lb/MMBtu and 0.034 lb/MMBtu, respectively, from the current NSR Permit issued August 31, 2012. The updated visibility analysis for the installation of SNCR on Units 1 and 4 and a two-unit retirement incorporated the new TPM emission rate of 0.034 lb/MMBtu and an SO_2 emission rate of 0.10 lb/MMBtu. This new SO_2 emission rate will be incorporated into the facility's NSR Permit as a federally-enforceable permit condition should this scenario be determined as BART for the source.

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 reduces 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]

Sorbent injection removes SO_3 in the flue gas by reaction of the SO_3 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 SO_3 in the flue gas by reaction of the SO_3 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 ECO 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 (SO_2), nitrogen oxides (NOx), oxidized mercury, and fine particulate matter.[3]

10) Phenix Clean Combustion

The Phenix Clean Combustion System is an advanced hybrid coal gasification/combustion process that prevents the formation of NOx and SO_2 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 SO_3 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, an updated analysis of Fuel Tech's SNCR on February 11, 2011, and an additional updated analysis on April 1, 2013.

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) Nalco Mobotec 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 to 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 solid 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 a report in a subsequent submittal dated August 28, 2008.

<u>Step 3 of the BART Analysis: Evaluate Control Effectiveness of Remaining Control Technologies</u>

PNM contracted with B&V and S&L 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
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	83	4140	3450	0.05	690

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
SNCR	23	4119	961	0.23	3158
ROFA/Rotamix	33	4119	1373	0.20	2746
SCR/SNCR Hybrid	40	4119	1648	0.18	2471
SCR	83	4119	3432	0.05	687

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
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	83	6431	5359	0.05	1072

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	6309	841	0.26	5468
Rotamix (SNCR)	23	6309	1472	0.23	4837
SNCR	23	6309	1472	0.23	4837
ROFA/Rotamix	33	6309	2103	0.20	4206
SCR/SNCR Hybrid	40	6309	2524	0.18	3786
SCR	83	6309	5257	0.05	1052

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 and S&L prepared the design parameters and developed estimates of capital and annual costs for applications of SCR, SNCR, 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, SCR and SNCR 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, SNCR 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, except for the 2013 analysis for 4 SCR, 4 SNCR and 2 SNCR/2

Shutdown which used a remaining useful life of 30 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 SO_3 from both the SCR and SCR/SNCR Hybrid technology.

SCR Costs

The Department reviewed the original cost analysis for SCR technology and subsequently requested that PNM 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.

In April, 2013, PNM submitted an updated cost analysis of SCR prepared by S&L. PNM contracted with S&L to prepare a conceptual design, project cost estimate and technical portions of an Engineer, Procurement, and Construction plan. S&L used budgetary quotes from equipment vendors for the major components and S&L's in-house database of equipment and material costs for similar projects. For the revised 2013 analysis for 4 SCR, 4 SNCR, and 2 SNCR/2 Shutdown, the capital cost estimates are stated in 2013 dollars. The previously submitted cost analyses for other alternatives used 2010 dollars. Because the rate of inflation between 2013 and 2010 was minimal (1.07 percent), the costs are comparable.

Consideration of SO_3 Control

PNM's initial analysis of SCR and SCR/SNCR technology took into consideration additional oxidation of SO_2 to SO_3 across the SCR catalyst bed. The Department requested PNM to consider inherent removal of SO_3 emissions from existing air pollution control equipment, and removal of SO_3 emissions through installation of sorbent injection. PNM responded with an amended submittal addressing both inherent and add-on removal of SO_3. PNM's submittal provided cost estimates of the sorbent injection system and updated visibility modeling for both SCR and SCR/SNCR Hybrid technologies.

The updated 2013 analysis of 4 SCR, 4 SNCR, and 2 SNCR/2 Shutdown uses EPA estimates of SO_3 emissions from the 2011 EPA Federal Implementation Plan (FIP) 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. Please refer to the Chronology of Submissions located earlier in this document for an overview of the specific updates to these technologies.

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 Effectiveness ($/ton)	Incremental Cost Effectiveness ($/ton)	Energy Impacts (1,000$)	Non-Air Impacts (1,000$)
Unit 1									
SCR + sorbent (FIP)	0.05	690	3,450	180,862	22,165	6,425	6,749	746	NA[1]
SNCR/SCR Hybrid	0.18	2,484	1,656	110,683	16,816	10,154	35,917	706	1,762
ROFA/Rotamix	0.20	2,760	1,380	30,790	6,902	5,001	7,982	1,413	3
Rotamix (SNCR)	0.23	3,174	966	11,822	3,597	3,723	116	51	4
SNCR	0.23	3,174	966	17,392	5,400	5,590	80	43	NA[1]
ROFA	0.26	3,588	552	19,256	3,549	6,429	--	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 (FIP)	0.05	687	3,433	203,360	24,562	7,157	7,755	729	NA[1]
SNCR/SCR Hybrid	0.18	2,471	1,648	115,151	17,306	10,503	37,887	346	1,762
ROFA/Rotamix	0.20	2,746	1,373	30,790	6,902	5,027	8,024	1,413	3
Rotamix (SNCR)	0.23	3,158	961	11,822	3,597	3,742	117	51	4
SNCR	0.23	3,158	961	17,392	5,400	5,618	80	43	NA[1]
ROFA	0.26	3,570	549	19,256	3,549	6,462	--	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 (FIP)	0.05	1,072	5,359	264,208	32,585	6,080	6,313	1,107	NA[1]
SNCR/SCR Hybrid	0.18	3,859	2,572	178,759	26,604	10,342	39,171	507	2,658
ROFA/Rotamix	0.20	4,287	2,144	35,724	9,810	4,576	7,498	2,810	5
Rotamix (SNCR)	0.23	4,931	1,501	13,919	4,988	3,324	-378	84	5
SNCR	0.23	4,931	1,501	17,163	8,224	5,480	-578	51	NA[1]
ROFA	0.26	5,574	857	22,081	5,231	6,100	--	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 (FIP)	0.05	1,052	5,257	235,940	29,508	5,613	5,623	1,102	NA[1]
SNCR/SCR Hybrid	0.18	3,786	2,524	171,412	25,808	10,226	38,034	507	2,658
ROFA/Rotamix	0.20	4,206	2,103	35,724	9,810	4,664	7,643	2,810	5
Rotamix (SNCR)	0.23	4,837	1,472	13,919	4,988	3,388	-385	84	5
SNCR	0.23	4,837	1,472	17,163	8,224	5,587	-590	51	NA[1]
ROFA	0.26	5,468	841	22,081	5,231	6,218	--	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.

<u>Step 5 of the BART Analysis: Visibility Impacts Analysis of Remaining Control Technologies</u>

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). Based on 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 CALPUFF modeling system is described below, followed by a description of the modeling analysis performed in 2011, and, finally, by a description of the updated modeling performed in 2013 that takes into consideration the State Alternative (2 SNCR/2 Shutdown), and compares it to the state's 2011 NOx BART determination of 4 SNCRs and the EPA FIP BART determination of 4 SCRs.

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 combines the concentrations, wet and dry deposition flux files created by CALPUFF to calculate the total nitrogen and total sulfur deposition fluxes from nitrogen dioxide (NO_2), nitrates (NO_3^-), nitric acid (HNO_3), sulfur dioxide (SO_2) and sulfates (SO_4^{2-}). CALPOST is a post-processing program that can read the CALPUFF (or POSTUTIL or CALSUM) output files and calculate the impacts to visibility.

The 2011 refined CALPUFF modeling was conducted with the version of the CALPUFF system recommended by the WRAP BART modeling protocol. The 2013 refined CALPUFF modeling was conducted with the version of the CALPUFF system recommended by the EPA Version designations of the key programs listed in Table 12.

Table 12: CALPUFF System Used

	2011 Modeling		2013 Modeling	
	Version	Level	Version	Level
CALMET	6.211	060414	5.8	070623
CALPUFF	6.112	060412	5.8	070623
POSTUTIL	1.52	060412	1.56	070627
CALSUM	1.33	051122	1.33	051122
CALPOST	6.131	060410	6.221	080724

Meteorological Data Processing (CALMET)

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 for the 2011 analysis. In the 2013 updated analysis, surface, upper air, precipitation, and MM5 data were provided by EPA. Locations of the observations that were input to CALMET for both the 2011 analysis and the 2013 analysis, 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.

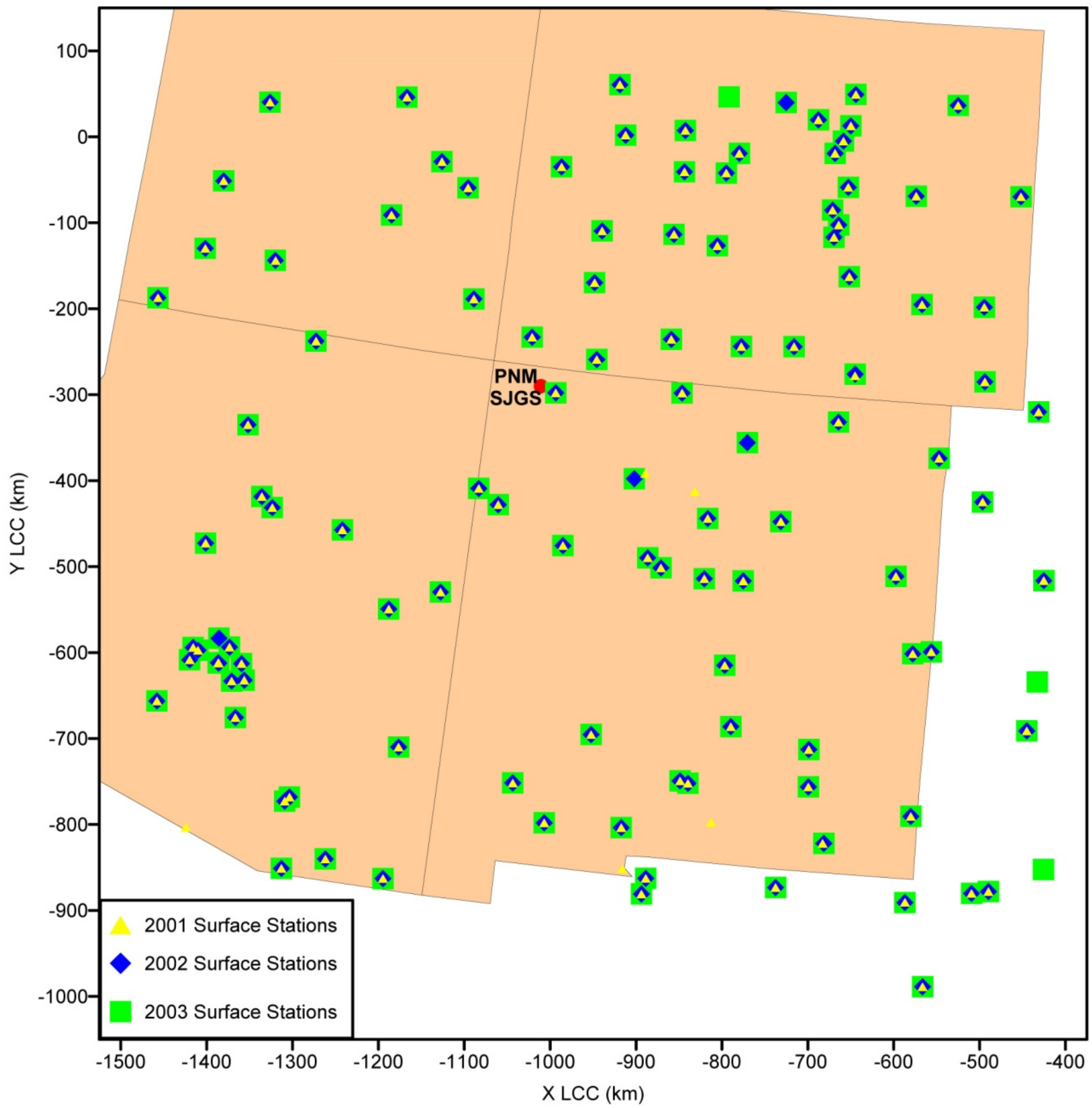

Figure 1: Surface Stations

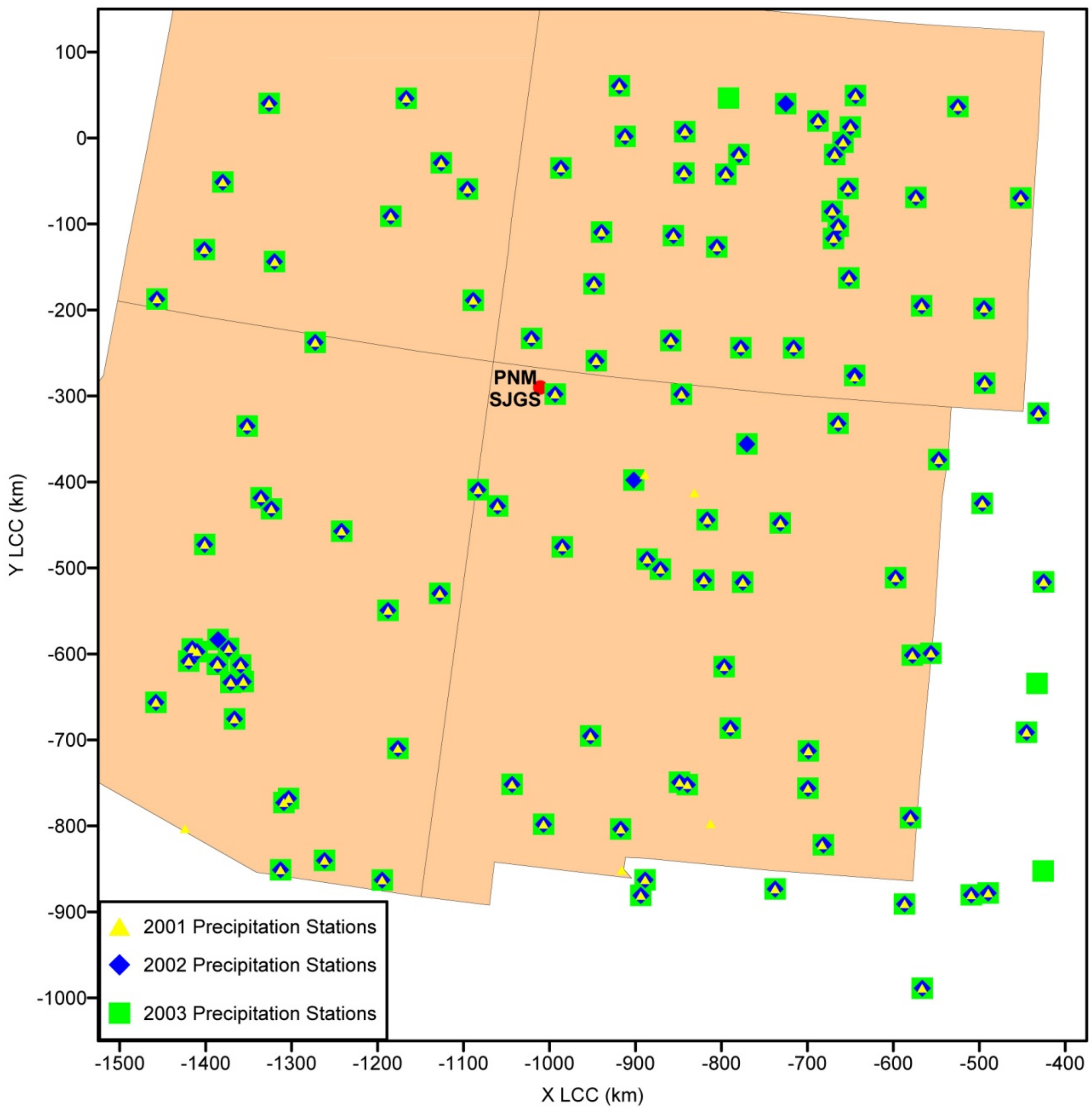

Figure 2: Precipitation Stations

Table 13: Key User-Defined CALMET Settings

Variable	Description	Value	
		2011 Analysis	2013 Analysis
PMAP	Map projection	LCC	LCC
DGRIDKM	Grid spacing (km)	4	4
NZ	Number of layers	11	11
ZFACE	Cell face heights (m)	0, 20, 100, 200, 350, 500, 750, 1000, 2000, 3000, 4000, 5000	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	0
IEXTRP	Extrapolate surface wind obs to upper level	1	-4
RMIN2	Minimum distance for extrapolation	4	4
IPROG	Use gridded prognostic model output	14	14
RMAX1	Maximum radius of influence (surface layer, km)	50	100
RMAX2	Maximum radius of influence (layers aloft, km)	100	200
TERRAD	Radius of influence for terrain (km)	10	10
R1	Relative weighting of first guess wind field and observation (km)	100	50
R2	Relative weighting aloft (km)	200	100
ITPROG	3D temperature from observations or from MM5	1	0

<u>CALPUFF Modeling Setup</u>

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 SO_2 and NOx to SO_4 and NO_3, respectively. In the 2011 analysis, 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. In the 2013 analysis, the hourly ozone concentrations files that came directly from EPA were used and the ozone concentration of 80 ppb was used for the missing hours in the ozone data files.

For ammonia, in the 2011 analysis, 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

In the 2013 analysis, a constant ammonia background concentration of 1.0 ppb was used.

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 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 2011 and 2013 modeling analyses for each Class I area is provided in Appendix 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).

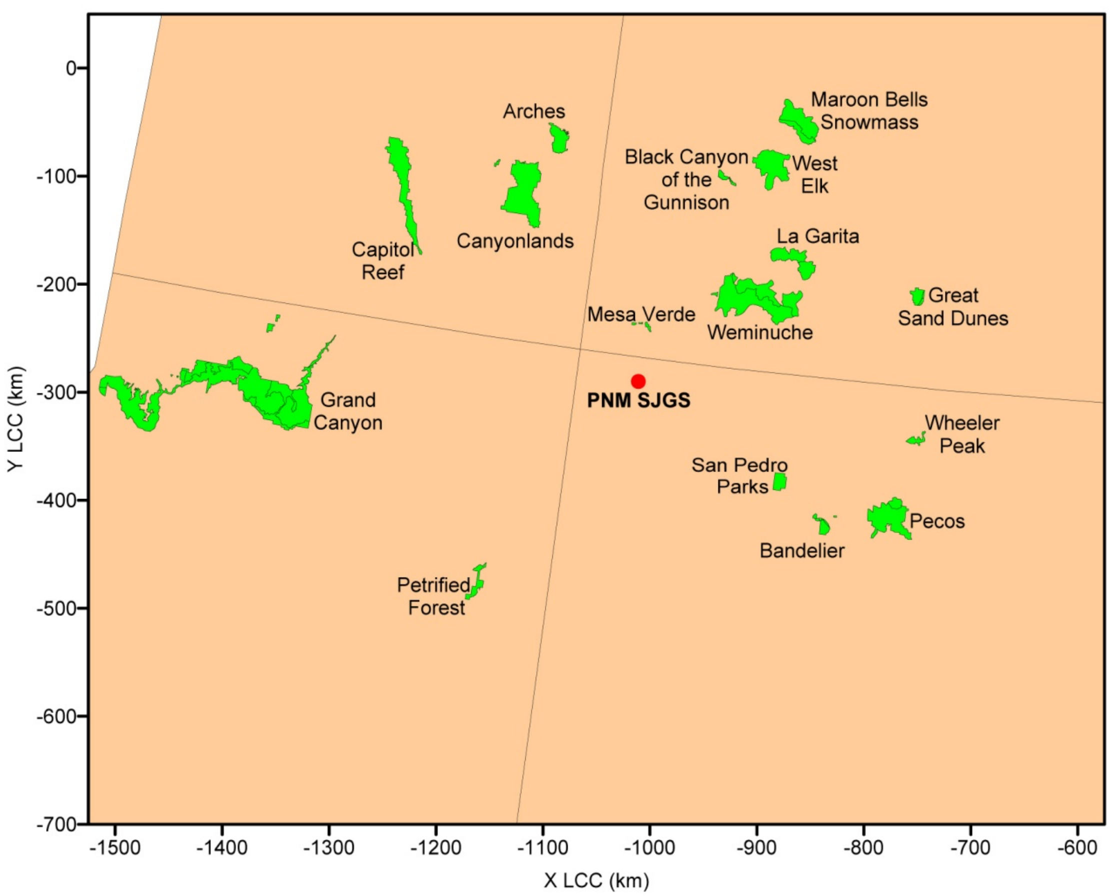

Figure 3: Location of SJGS and the Class I Area

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)

<u>CALPUFF Inputs – Pre-Consent Decree, Baseline and Control Options</u>

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

(1) Emissions levels (lb/MMBtu) are shown on an annual average basis.
(2) Emissions (lb/hr) calculations were based on the emissions level (lb/MMBtu) and design heat basis.
(3) Emissions levels listed were based on performance guarantees provided by the equipment vendor.
(4) For the 2011 analysis, H_2SO_4 is assumed to be 100 percent of the SO_4 emissions calculated by the NPS Speciation Spreadsheet. The 2013 analysis utilizes the Electric Power Research Institute (EPRI) methodology.

Table 16: CALPUFF Inputs for Unit 1

Model Input Data	2011 Analysis							2013 Analysis			
	Pre-Consent Decree	Consent Decree	Rotamix or SNCR	ROFA/ Rotamix	ROFA	SCR/SNCR Hybrid	SCR with Sorbent	Baseline	4 SCR	4 SNCR	2 SNCR/2 Shutdown
Hourly Heat Input (MMBtu/hour)	3707	3707	3707	3707	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	0.15	0.15	0.15	0.10
Sulfur Dioxide (SO_2) (lb/hr)	877.8	667.3	667.3	667.3	667.3	667.3	667.3	556.1	556.1	556.1	370.7
Nitrogen Oxide (NOx) (lb/MMBtu)	0.43	0.33	0.23	0.2	0.26	0.18	0.07	0.30	0.05	0.23	0.23
Nitrogen Oxide (NOx) (lb/hr)	1592	1223.3	852.6	741.4	963.8	667.3	259.5	1112.1	185.4	852.6	852.6
PM (lb/MMBtu)	0.05	0.015	0.015	0.015	0.015	0.015	0.015	0.034	0.034	0.034	0.034
PM (lb/hr)	185.4	55.6	55.6	55.6	55.6	55.6	55.6	126.04	126.04	126.04	126.04
SO_3 as Sulfuric Acid (H_2SO_4) (lb/MMBtu)	0.013	0.011	0.011	0.011	0.011	0.031	0.004	4.6E-05	0.00026	4.6E-05	4.6E-05
SO_3 as Sulfuric Acid (H_2SO_4)[(a)] (lb/hr)	50	40.5	40.5	40.5	40.5	114.2	16.1	0.17	0.96	0.17	0.17
Stack Conditions											
Stack Height (meters)	121.92	121.92	121.92	121.92	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	6.10	6.10	6.10	6.10
Stack Exit Temp. (Kelvin)	336	322.83	322.83	322.83	322.83	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	21.34	21.34	21.34	21.34

Table 17: CALPUFF Inputs for Unit 2

Model Input Data	2011 Analysis							2013 Analysis			
	Pre-Consent Decree	Consent Decree	Rotamix or SNCR	ROFA/ Rotamix	ROFA	SCR/SNCR Hybrid	SCR with Sorbent	Baseline	4 SCR	4 SNCR	2 SNCR/2 Shutdown
Hourly Heat Input (MMBtu/hour)	3688	3688	3688	3688	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	0.15	0.15	0.15	0
Sulfur Dioxide (SO_2) (lb/hr)	844	663.8	663.8	663.8	663.8	663.8	663.8	553.2	553.2	553.2	0
Nitrogen Oxide (NOx) (lb/MMBtu)	0.45	0.33	0.23	0.2	0.26	0.18	0.07	0.30	0.05	0.23	0
Nitrogen Oxide (NOx) (lb/hr)	1649.3	1217	848.2	737.6	958.9	663.8	258.2	1106.4	184.4	848.2	0
PM (lb/MMBtu)	0.05	0.015	0.015	0.015	0.015	0.015	0.015	0.034	0.034	0.034	0
PM (lb/hr)	184.4	55.3	55.3	55.3	55.3	55.3	55.3	125.39	125.39	125.39	0
SO_3 as Sulfuric Acid (H_2SO_4) (lb/MMBtu)	0.013	0.011	0.011	0.011	0.011	0.031	0.004	4.6E-05	0.00026	4.6E-05	0
SO_3 as Sulfuric Acid (H_2SO_4)[(a)] (lb/hr)	49.7	40.3	40.3	40.3	40.3	113.6	16	0.17	0.96	0.17	0
Stack Conditions											
Stack Height (meters)	121.92	121.92	121.92	121.92	121.92	121.92	121.92	121.92	121.92	121.92	0
Stack Exit Diameter (meters)	6.096	6.096	6.096	6.096	6.096	6.096	6.096	6.10	6.10	6.10	0
Stack Exit Temp. (Kelvin)	338	322.83	322.83	322.83	322.83	322.83	322.83	322.83	322.83	322.83	0
Stack Exit Velocity (m/s)	23.5	21.34	21.34	21.34	21.34	21.34	21.34	21.34	21.34	21.34	0

Table 18: CALPUFF Inputs for Unit 3

Model Input Data	2011 Analysis							2013 Analysis			
	Pre-Consent Decree	Consent Decree	Rotamix or SNCR	ROFA/ Rotamix	ROFA	SCR/SNCR Hybrid	SCR with Sorbent	Baseline	4 SCR	4 SNCR	2 SNCR/2 Shutdown
Hourly Heat Input (MMBtu/hour)	5758	5758	5758	5758	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	0.15	0.15	0.15	0
Sulfur Dioxide (SO_2) (lb/hr)	1591.1	1036.4	1036.4	1036.4	1036.4	1036.4	1036.4	863.7	863.7	863.7	0
Nitrogen Oxide (NOx) (lb/MMBtu)	0.42	0.33	0.23	0.2	0.26	0.18	0.07	0.3	0.05	0.23	0
Nitrogen Oxide (NOx) (lb/hr)	2405.5	1900.1	1324.3	1151.6	1497.1	1036.4	403.1	1727.4	287.9	1324.3	0
PM (lb/MMBtu)	0.05	0.015	0.015	0.015	0.015	0.015	0.015	0.034	0.034	0.034	0
PM (lb/hr)	287.9	86.4	86.4	86.4	86.4	86.4	86.4	195.77	195.77	195.77	0
SO_3 as Sulfuric Acid (H_2SO_4) (lb/MMBtu)	0.013	0.011	0.011	0.011	0.011	0.031	0.004	4.6E-05	0.00026	4.6E-05	0
SO_3 as Sulfuric Acid (H_2SO_4)[(a)] (lb/hr)	77.7	62.9	62.9	62.9	62.9	177.3	25	0.26	1.50	0.26	0
Stack Conditions											
Stack Height (meters)	121.92	121.92	121.92	121.92	121.92	121.92	121.92	121.92	121.92	121.92	0
Stack Exit Diameter (meters)	8.534	8.534	8.534	8.534	8.534	8.534	8.534	8.53	8.53	8.53	0
Stack Exit Temp. (Kelvin)	335	322.83	322.83	322.83	322.83	322.83	322.83	322.83	322.83	322.83	0
Stack Exit Velocity (m/s)	17.07	17.07	17.07	17.07	17.07	17.07	17.07	17.07	17.07	17.07	0

Table 19: CALPUFF Inputs for Unit 4

Model Input Data	2011 Analysis							2013 Analysis			
	Pre-Consent Decree	Consent Decree	Rotamix or SNCR	ROFA/ Rotamix	ROFA	SCR/SNCR Hybrid	SCR with Sorbent	Baseline	4 SCR	4 SNCR	2 SNCR/2 Shutdown
Hourly Heat Input (MMBtu/hour)	5649	5649	5649	5649	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	0.15	0.15	0.15	0.10
Sulfur Dioxide (SO_2) (lb/hr)	1662.4	1016.8	1016.8	1016.8	1016.8	1016.8	1016.8	847.4	847.4	847.4	564.9
Nitrogen Oxide (NOx) (lb/MMBtu)	0.42	0.33	0.23	0.2	0.26	0.18	0.07	0.3	0.05	0.23	0.23
Nitrogen Oxide (NOx) (lb/hr)	2399.6	1864.2	1299.3	1129.8	1468.7	1016.8	395.4	1694.7	282.5	1299.3	1299.3
PM (lb/MMBtu)	0.05	0.015	0.015	0.015	0.015	0.015	0.015	0.034	0.034	0.034	0.034
PM (lb/hr)	282.5	84.7	84.7	84.7	84.7	84.7	84.7	192.07	192.07	192.07	192.07
SO_3 as Sulfuric Acid (H_2SO_4) (lb/MMBtu)	0.013	0.011	0.011	0.011	0.011	0.031	0.004	4.6E-05	0.00026	4.6E-05	4.6E-05
SO_3 as Sulfuric Acid (H_2SO_4)[(a)] (lb/hr)	76.2	61.7	61.7	61.7	61.7	174	24.5	0.26	1.47	0.26	0.26
Stack Conditions											
Stack Height (meters)	121.92	121.92	121.92	121.92	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	8.53	8.53	8.53	8.53
Stack Exit Temp.(Kelvin)	331	322.83	322.83	322.83	322.83	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	16.76	16.76	16.76	16.76

Visibility Post-Processing (CALPOST)

In the 2011 analysis, visibility (or 98th percentile delta deciview (dv)) was calculated using Method 6 in CALPOST and Annual Average Natural Conditions, as recommended by the WRAP RMC protocol.

The 2013 analysis used the revised IMPROVE equation (Method 8) and the Annual Average Natural Conditions, as recommended by EPA. The Annual Average Natural Conditions used in the 2011 and 2013 analyses are shown in Table 20. They are specifically 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).*

Table 20: 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 of 2011 Analysis

Using the air dispersion modeling methodology outlined in the previous section, a CALPUFF model run was conducted, with meteorological data for the years 2001-2003, for the following control technologies for each unit: for NOx, pre-consent decree, Consent Decree, SNCR or 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); and for PM, pre-consent decree, Consent Decree, 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, the expected degree of visibility impact for each control technology was determined as the difference between the projected visibility impact after installation of that control and annual average natural visibility conditions, for each receptor at each of the 16 Class I areas. The difference is given as delta-deciview (delta-dv).

Visibility Impact of NOx Control Technology

The results of the visibility modeling for Unit 1, Unit 2, Unit 3, and Unit 4 for each of the NOx control technologies are summarized in Figures 4-7:

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 demonstrated a net improvement of 0.62 dv at Mesa Verde National Park and a 0.14 dv improvement at San Pedro Parks Wilderness Area. 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.

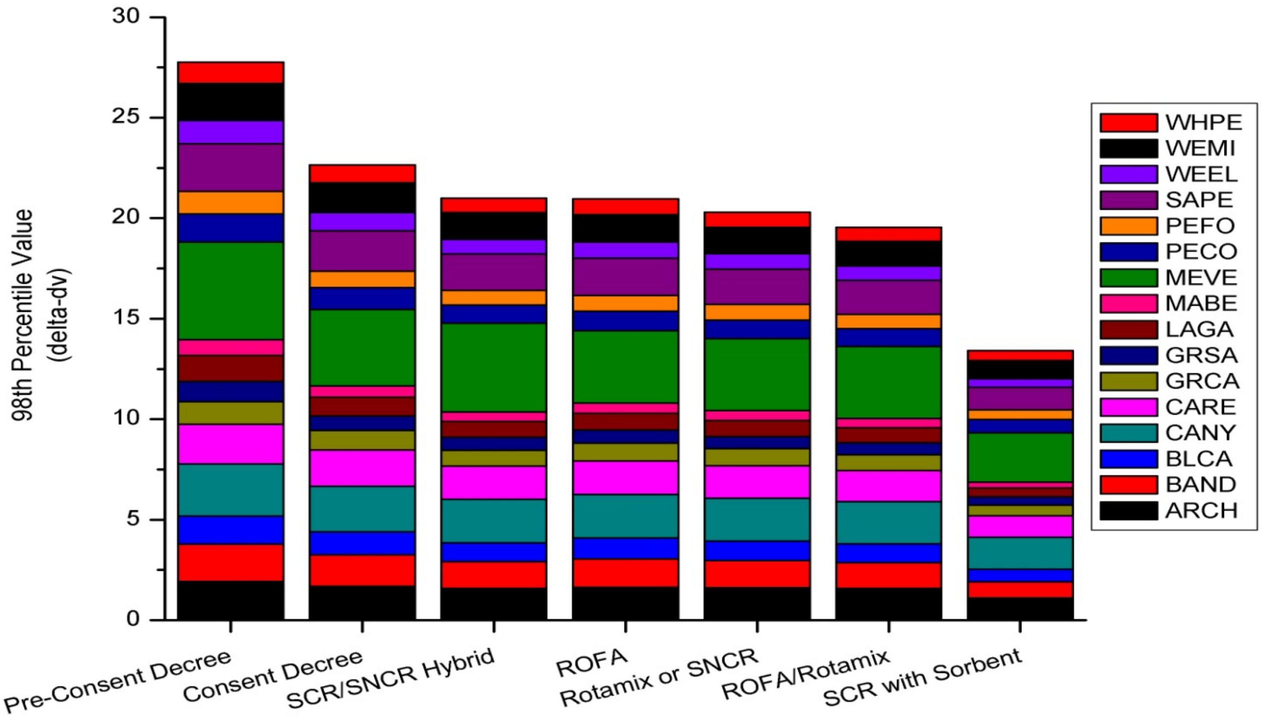

Figure 4: Total Amount of the Visibility Impacts at All 16 Class I Areas Using 2001-2003 Meteorological Data (facility-wide impact) (2011 Analysis)

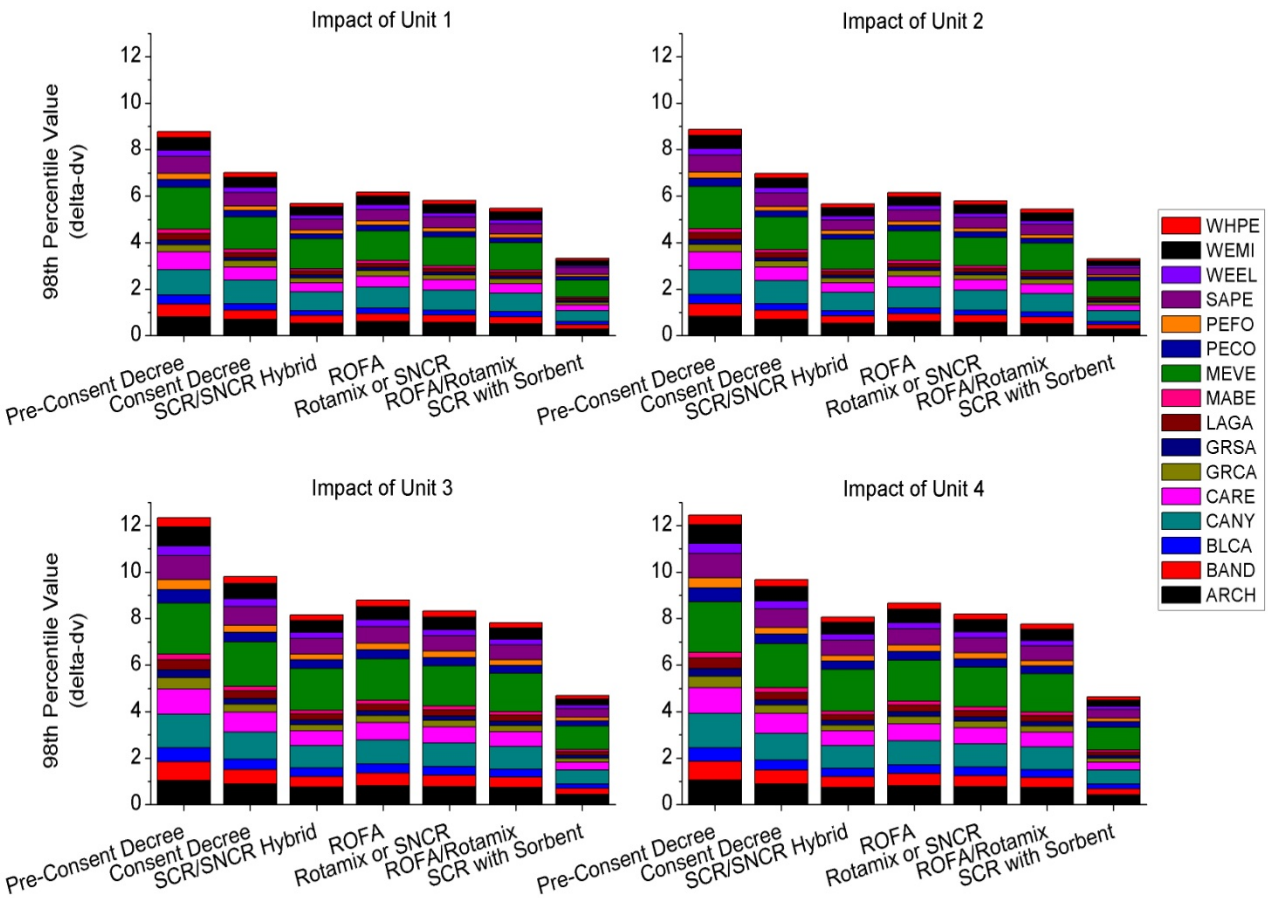

Figure 5: Total Amount of the Visibility Impacts at All 16 Class I Areas Using 2001-2003 Meteorological Data (units 1, 2, 3, and 4) (2011 Analysis)

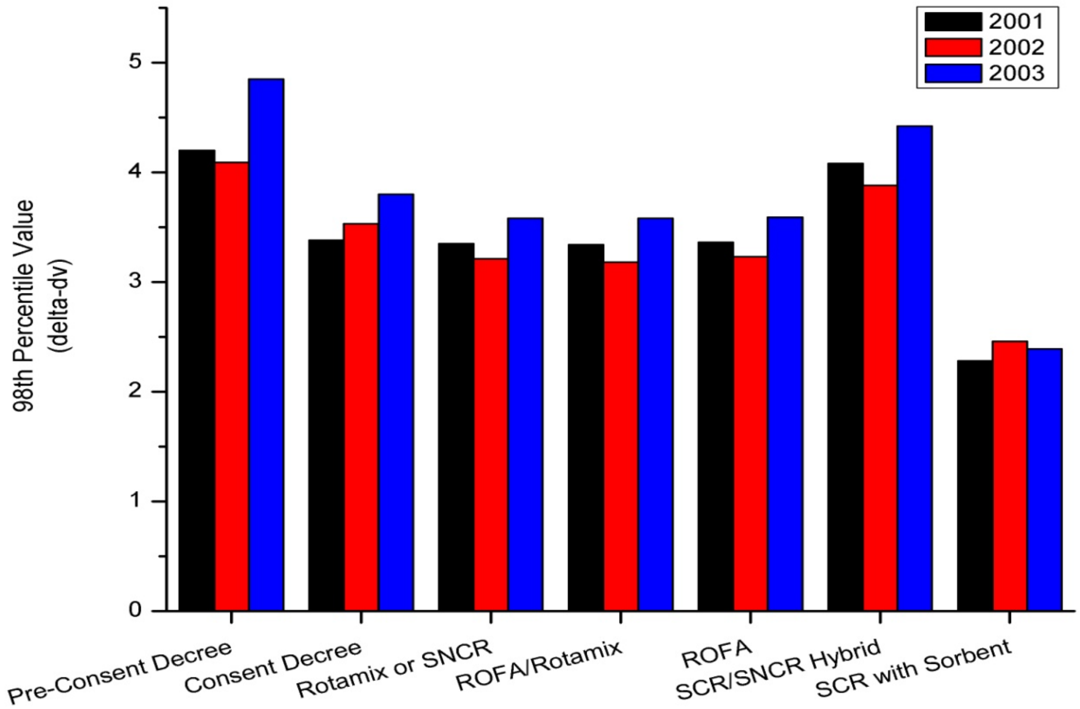

Figure 6: Visibility Impact at Mesa Verde National Park Using 2001-2003 Meteorological Data (facility-wide impact) (2011 Analysis)

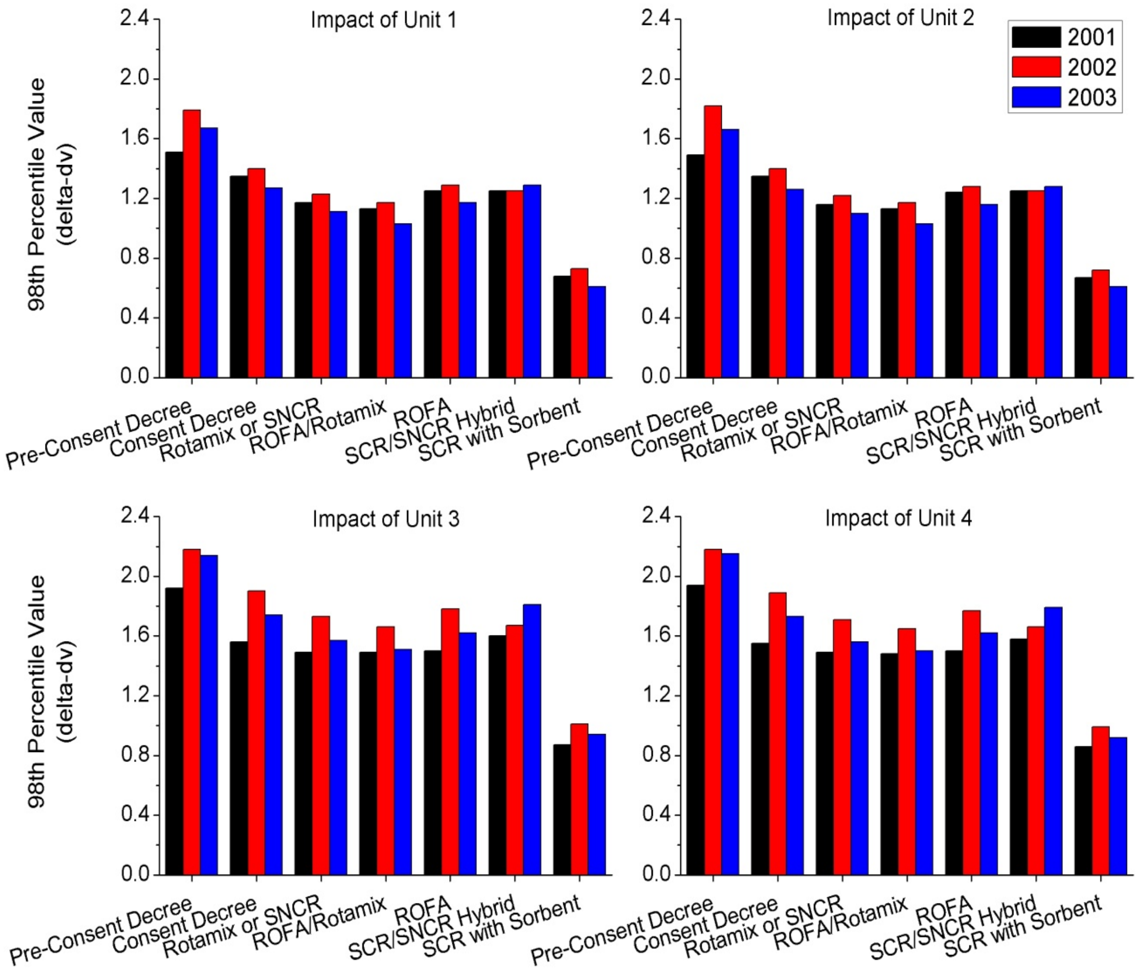

Figure 7: Visibility Impact at Mesa Verde National Park Using 2001-2003 Meteorological Data (units 1, 2, 3, and 4) (2011 Analysis)

Updated Visibility Modeling Assessment Submitted April 1, 2013

PNM submitted updated visibility modeling for SJGS with revised emission estimates for sulfur dioxide (SO_2), sulfuric acid (H_2SO_4), and total particulate matter (TPM). The modeling analysis compared available nitrogen oxide (NOx) control technologies including selective catalytic reduction (SCR), selective non-catalytic reduction (SNCR), as well as unit retirements as an alternative operating scenario that had not previously been analyzed, as described in Table 21 below. The previously evaluated alternatives (e.g., Consent Decree, ROFA/Rotamix, SCR/SNCR Hybrid, and ROFA) were not further evaluated in the 2013 analysis. The results of the analysis for those alternatives are included in Steps 1 through 5 above. PNM's updated BART modeling incorporated SJGS's new SO_2 and total particulate matter (TPM) emission rates of 0.15 lb/MMBtu and 0.034 lb/MMBtu, respectively, from the current NSR permit effective August 31, 2012. These emission limits have been incorporated into the Baseline modeling scenario, including the EPA's FIP scenario representing four SCRs, and the NMED's 2011 SIP scenario representing four SNCRs. The updated BART modeling also incorporated H_2SO_4 emission rates of 0.00026 lb/MMBtu and 0.000046 lb/MMBtu for SCR and non-SCR, respectively, for the scenarios detailed in Table 21.

PNM utilized the EPA-approved CALPUFF version 5.8, the CALMET data set originally created by EPA, and modeling input files as modified by EPA to reflect the source specific parameters for the specific modeling scenarios. The modeled CALPUFF domain, receptors, ozone data, and CALMET data used in this analysis came directly from EPA. Additionally, the surface, upper air, and precipitation stations used to make the CALMET files were also directly delivered from the EPA.

The NMED approved the use of all of the input parameters and data compiled by EPA for the updated modeling analysis. The condensable particulate matter (PM) emission rates used in the 2013 modeling were based on the facility's total particulate matter emission limit as established in the NSR permit effective August 31, 2012. PNM utilized the default ammonia background concentration of 1 ppb and the revised IMPROVE equation (Method 8) to calculate the 98th percentile delta deciview (dv) from modeled pollutant concentrations.

The meteorology used for the SJGS BART analysis followed EPA's methodology described in the Technical Support Document (TSD) and included with EPA's proposed 2011 FIP[7]. The modeling analysis was performed on a year-by-year basis for the facility-wide impact for the four scenarios. Ammonia slip (ammonia that is not fully reacted and is emitted to atmosphere) associated with combustion NOx reduction systems may be higher than 1 ppb. However, ammonia slip was not considered in the modeling analysis. Considering the 1 ppb ammonia background and the reductions in NOx, ammonia slip would have a negligible impact on visibility from any of the scenarios. EPA had determined in the FIP that ammonia slip would not significantly impact visibility improvement due to reductions in NOx and SO_2 anticipated in the 4-SCR scenario. The CALPUFF system used for the 2011 modeling and the updated modeling is summarized in Table 12. The emissions and stack parameters for the updated modeling are shown in Tables 16 through 19.

Table 21: Target Emissions for Modeling Scenarios

Scenario	Operation and Target Emissions
Baseline	Units 1-4 operating only with existing air pollution control technology and new permitted SO_2 and Total Particulate Matter (TPM) emission rates of 0.15 lb/MMBtu and 0.034 lb/MMBtu, respectively. Sulfuric Acid (H_2SO_4) emission rate of 0.000046 lb/MMBtu
4 SCR	Units 1-4 operating with existing air pollution control technology and with new SCR installation; NOx at 0.05 lb/MMBtu and new permitted SO_2 and TPM emission rates of 0.15 lb/MMBtu and 0.034 lb/MMBtu, respectively. Sulfuric Acid (H_2SO_4) emission rate of 0.00026 lb/MMBtu
4 SNCR	Units 1-4 operating with existing air pollution control technology and with new SNCR installation; NOx at 0.23 lb/MMBtu and new permitted SO_2 and TPM emission rates of 0.15 lb/MMBtu and 0.034 lb/MMBtu, respectively. Sulfuric Acid (H_2SO_4) emission rate of 0.000046 lb/MMBtu
2 SNCR/2 Shutdown	Units 2 & 3 retired, Units 1 & 4 operating with existing air pollution control technology and with new SNCR installation; NOx at 0.23 lb/MMBtu, permitted TPM emission rate of 0.034 lb/MMBtu, and a reduced SO_2 emission rate of 0.10 lb/MMBtu. Sulfuric Acid (H_2SO_4) emission rate of 0.000046 lb/MMBtu

Discussions and Conclusions

PNM remodeled the visibility impacts of SJGS using the revised emission estimates, the EPA-approved CALPUFF version 5.8, and the meteorological data provided by EPA as previously discussed. PNM provided NMED with all the modeling results performed on a year-by-year basis for the facility-wide impact for the four scenarios. NMED explored the modeling results to present the visibility improvement in two ways: 98^{th} percentile deciview (dv) at each Class I area for the four scenarios and deciview improvement at each Class I area with addition NOx control technologies on the existing air pollution control technology.

CALPOST, the postprocessor for CALPUFF, calculates the maximum visibility impacts of all locations (receptors) in the 16 Class I areas for each day. Each modeled day and location has an associated delta deciview, which is the difference between deciviews and includes the impact at the SJGS and natural background, and deciviews of the natural background alone. From these daily values, the value of the 98^{th} percentile (approximately equivalent to the 8^{th} highest day) recommended by the BART guidelines is used for comparing the effects of each scenario in improving visibility. The line and symbol graph in Figure 8 shows the 98^{th} percentile at the 16 Class I areas and the impact of each scenario.

As illustrated in Figure 8, the EPA FIP and State Alternative Plan reduce visibility impairment more than the NMED SIP submitted in July 2011 for the three years from 2001 through 2003. Mesa Verde National Park shows the highest 98^{th} percentile among the 16 Class I areas and is the nearest Class I area, located approximately 40 km north of the facility. Grand Canyon National Park shows the lowest 98^{th} percentile and is located in the most distant area, located approximately 300 km west of the SJGS. When the frequency of the occurrence of the peak 98^{th} percentile is compared to each BART technology scenario, the figure depicts that the State Alternative Plan and the EPA FIP more significantly reduce the peak 98^{th} percentiles than the NMED SIP scenario does. The 98^{th} percentile value of the sixteen Class I areas is added up for each scenario separately for the comparison of a general visibility improvement, as shown in Figure 9.

The days exceeding a 0.5 dv threshold are determined at each Class I area for each BART technology scenario for each of the three years. The average and maximum days exceeding the threshold value are calculated and graphed in Figure 10. Figure 10 shows that the State Alternative Plan and the EPA FIP significantly improve visibility as compared to the Baseline and NMED SIP scenarios. The State Alternative Plan closely matches the EPA FIP scenario.

The visibility improvement from additional NOx control technologies beyond the base case is shown in Figure 11 and Table 22. The results indicate that the State Alternative Plan (2 SNCR/2 Shutdown) and the EPA FIP (4 SCR) achieve greater visibility improvement than projected for the NMED SIP scenario of 4 SNCR. The State Alternative Plan provides for nearly the same visibility improvement as the EPA FIP in improving visibility. The largest average differences in visibility improvement from the 4 SCR (FIP) and 2 SNCR/2 Shutdown (State Alternative) scenarios are 0.28 dv at Mesa Verde National Park, and 0.16 dv at Canyonlands National Park.

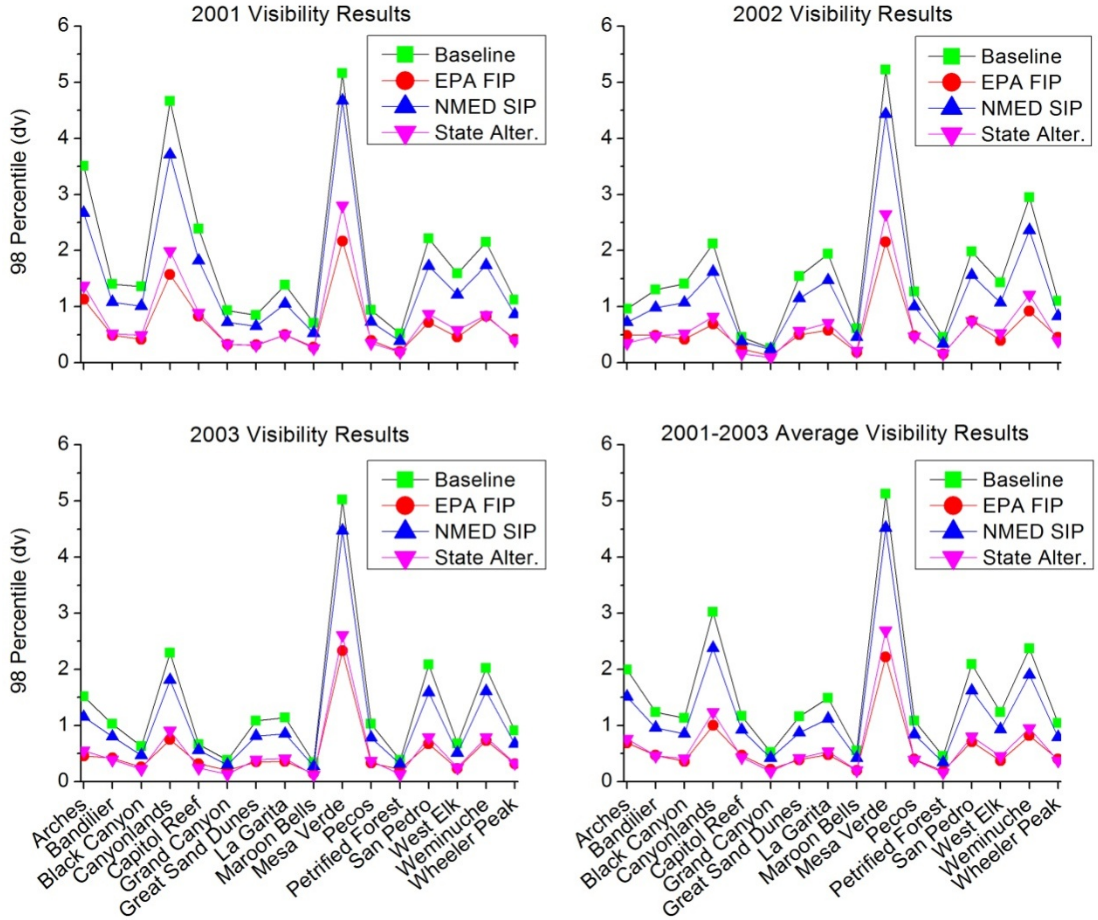

Figure 8: Visibility Impact of the EPA FIP, NMED SIP, and State Alternative Scenarios (2013 Analysis)*

*EPA FIP = 4 SCR; NMED SIP = 4 SNCR; State Alter. = 2 SNCR/2 Shutdown

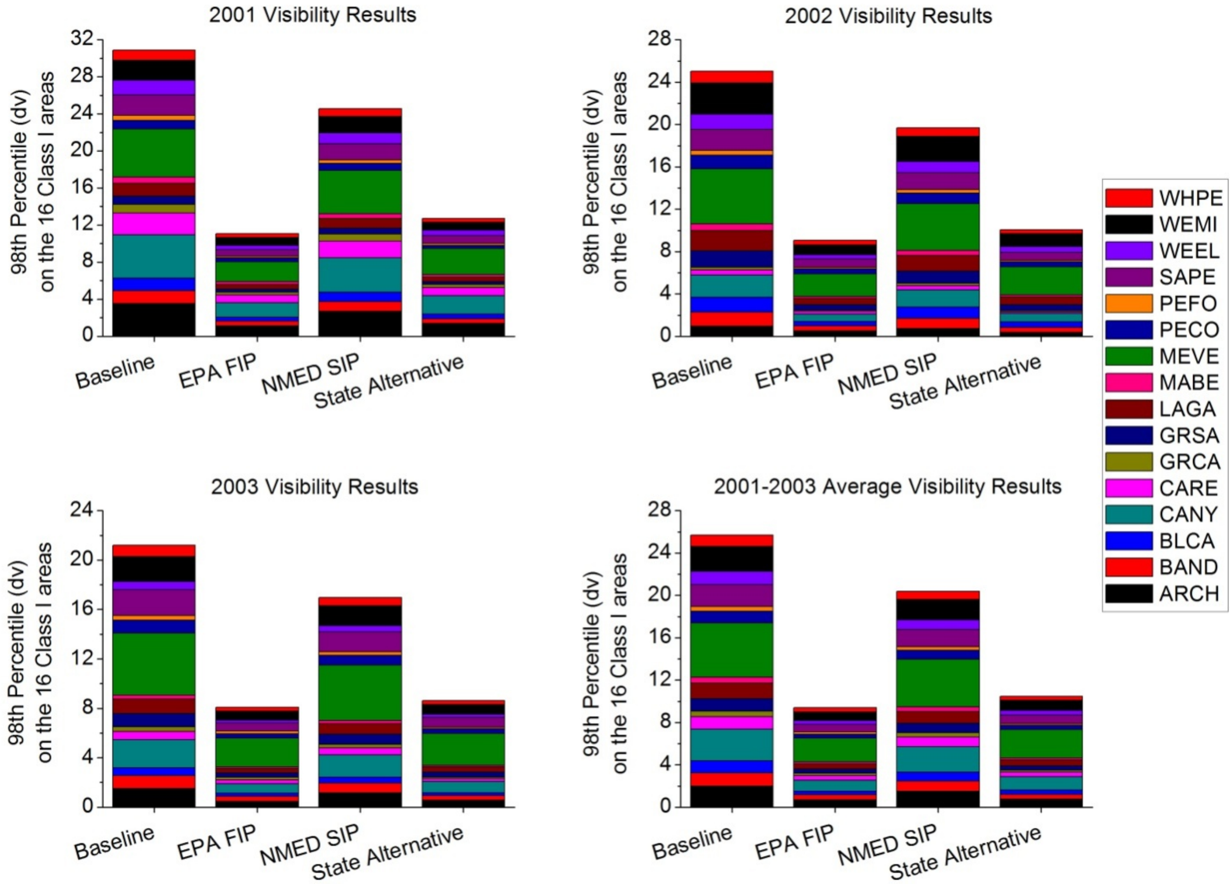

Figure 9: Visibility Impact Results (2013 Analysis)*

*EPA FIP = 4 SCR; NMED SIP = 4 SNCR; State Alternative = 2 SNCR/2 Shutdown

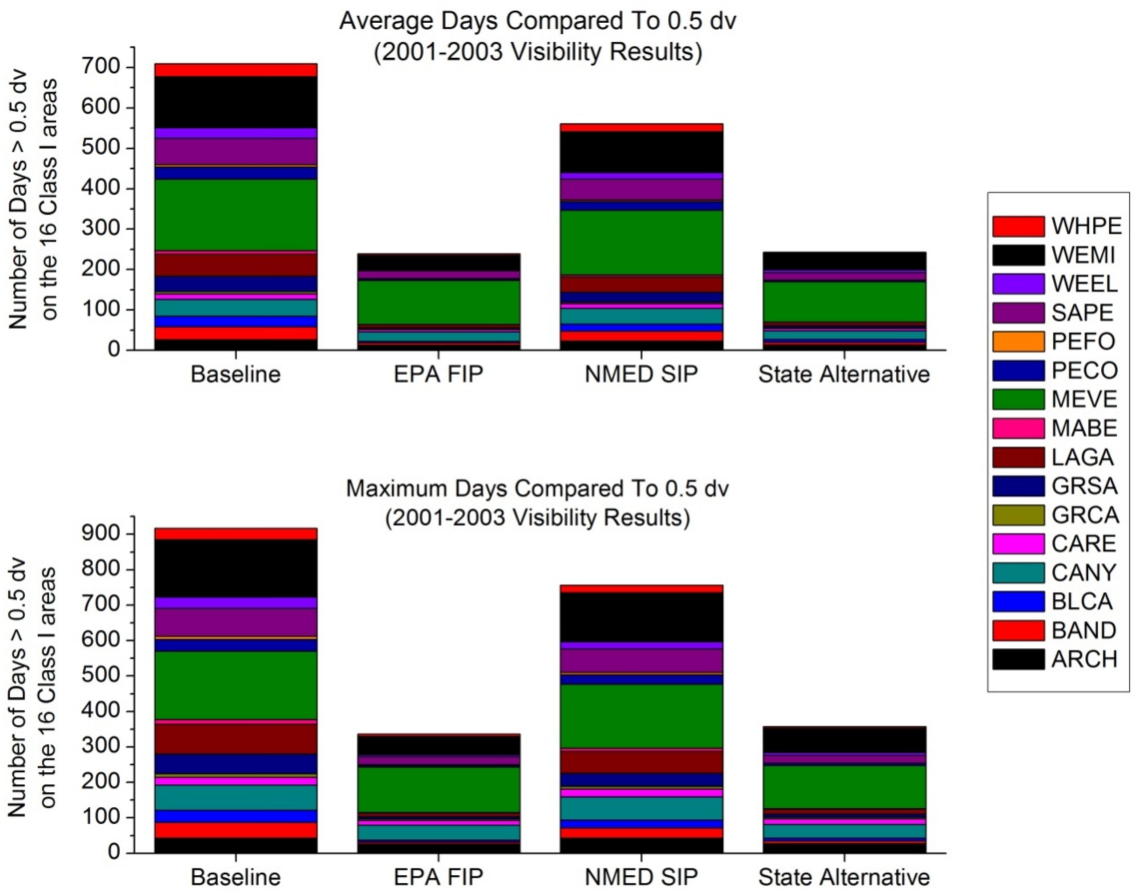

Figure 10: Average and Maximum Days Compared to 0.5 dv (2013 Analysis)*

*EPA FIP = 4 SCR; NMED SIP = 4 SNCR; State Alter. = 2 SNCR/2 Shutdown

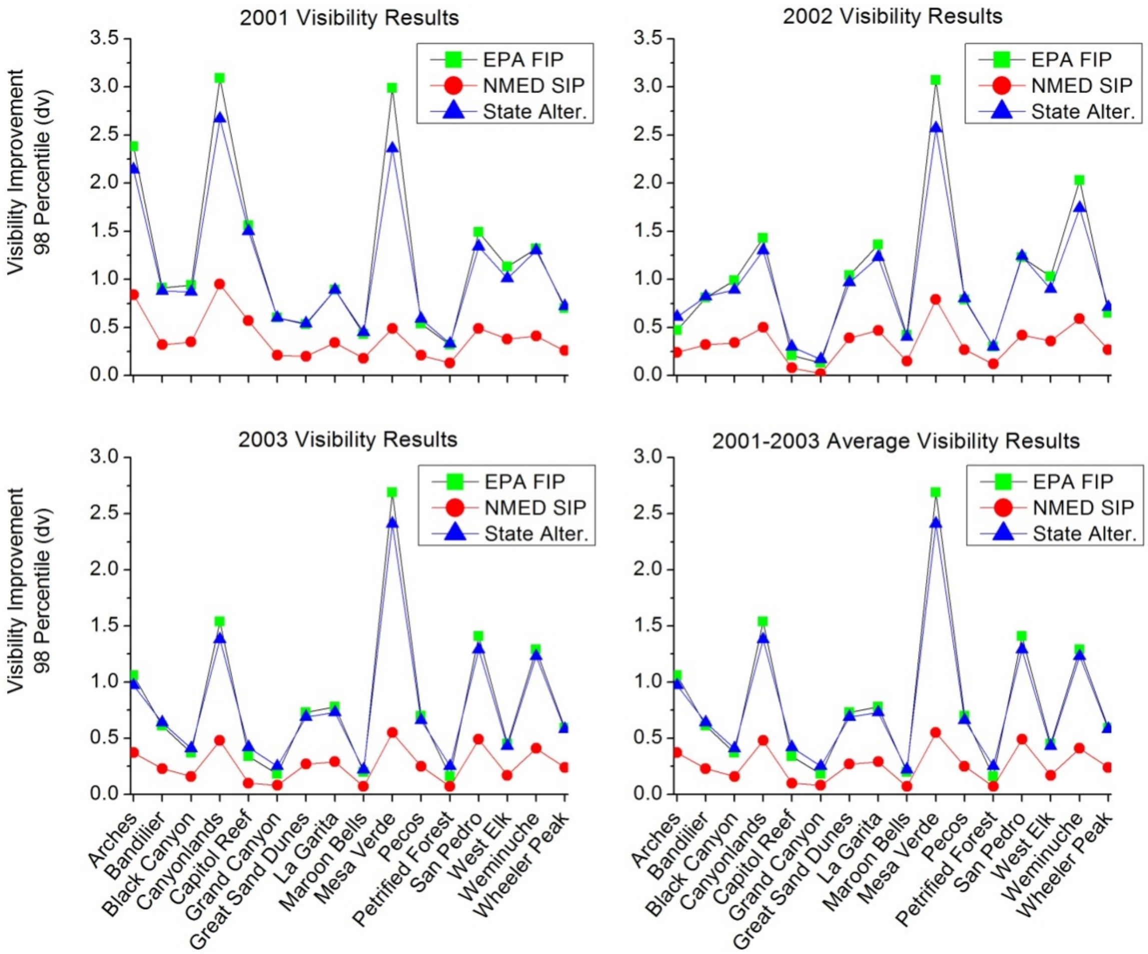

Figure 11: Visibility Improvement of the EPA FIP, NMED SIP, and State Alternative Scenarios (2013 Analysis)*

*EPA FIP = 4 SCR; NMED SIP = 4 SNCR; State Alter. = 2 SNCR/2 Shutdown

Table 22: 2001-2003 Average Visibility Improvement for 4 SCR, 4 SNCR and 2 SNCR/2 Shutdown Scenarios

Class I Area	4 SCR	4 SNCR	2 SNCR/2 Shutdown	Difference 4 SCR to 4 SNCR	Difference 4 SCR to 2 SNCR/2 Shutdown
Arches	1.06	0.37	0.97	0.69	0.09
Bandelier	0.61	0.23	0.64	0.38	-0.03
Black Canyon	0.37	0.16	0.41	0.21	-0.04
Canyonlands	1.54	0.48	1.38	1.06	0.16
Capitol Reef	0.34	0.10	0.42	0.24	-0.08
Grand Canyon	0.18	0.08	0.25	0.10	-0.07
Great Sand Dunes	0.73	0.27	0.69	0.46	0.04
La Garita	0.78	0.29	0.73	0.49	0.05
Maroon Bells	0.20	0.07	0.22	0.13	-0.02
Mesa Verde	2.69	0.55	2.41	2.14	0.28
Pecos	0.70	0.25	0.66	0.45	0.04
Petrified Forest	0.16	0.07	0.25	0.09	-0.09
San Pedro	1.41	0.49	1.29	0.92	0.12
West Elk	0.45	0.17	0.43	0.28	0.02
Weminuche	1.29	0.41	1.23	0.88	0.06
Wheeler Peak	0.59	0.24	0.58	0.35	0.01

<u>Department Assessment of BART for NOx and PM</u>

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.

<u>PM BART Assessment</u>

Based on the 2011 five factor analysis, the Department has determined that BART for Units 1, 2, 3, and 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, 2, 3 and 4 are equipped with PJFF and are 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.

<u>2011 NOx BART Determination</u>

Based on the five factor analysis, the Department determined in 2011 that, for the Facility comprising Units 1, 2, 3, and 4, BART for NOx is SNCR technology at an emission rate of 0.23 lb/MMBtu on a 30-day rolling average. The Department's determination of BART was based on the following results of the five factor analysis:

1) SNCR technology was considered cost-effective at an average cost of $3,494 per ton of NOx removed. SNCR technology will reduce the facility annual NOx emissions by 4,900 tons. (In the updated 2013 analysis, the cost estimate increased to $5,589 per ton. While still cost effective, this higher cost makes the State Alternative more attractive.)

2) The SNCR technology would result in additional energy impacts and non-air impacts from a new reagent system and a reagent storage system. The Department considered these additional costs in the review of the overall cost-effectiveness of SNCR and found these costs to be reasonable.

3) The Department reviewed the visibility improvement that resulted from the installation of the SNCR technology on Units 1, 2, 3 and 4. The Department determined that on a facility-wide basis the visibility improved by 0.25 dv at San Pedro, 0.22 dv at Mesa Verde, and 0.21 dv at Bandelier.

4) An emission limit of 0.23 lb NOx/MmBtu at each of Units 1, 2, 3 and 4 equals the EPA's established presumptive limit for dry-bottom, wall-fired boilers burning sub-bituminous coal.

5) The Department reviewed additional economic information provided by PNM that analyzed the economic impact to ratepayers in New Mexico. The PNM estimates indicate the cost of control technology beyond SNCR would be financially burdensome and cause economic hardship to low-income New Mexicans. According to the US Census Bureau, as of 2009, 18% of New Mexicans were living below the poverty line, as defined by the federal poverty standards. PNM estimates a rate increase of $11.50 per year per residential ratepayer from the installation of SNCR versus an estimated rate increase of $82.00 per year from the installation of SCR.

6) The Department has determined that in light of the unreasonable costs of SCR, particularly as reflected in the impact on ratepayers, requiring controls to achieve reductions beyond the most stringent presumptive standard prescribed by the EPA is not justified.

2013 BART Determination

The Department considered the terms of the non-binding agreement between the EPA, NMED and PNM, signed February 15, 2013 (the "State Alternative"), and the resulting significant environmental improvements of this alternative and compared this scenario to the 4 SNCR and 4 SCR scenarios previously evaluated. The Department's determination of BART was based on consideration of the BART statutory factors in the context of the following elements of the State Alternative (2 SNCR/2 Shutdown).

1) PNM will retire Units 2 and 3 by December 31, 2017. These retirements do not give rise to control equipment costs requiring amortization. The remaining useful life of the source is defined as 30 years for the three scenarios described (4 SCR, 4 SNCR, 2 SNCR/2 Shutdown). Therefore, the statutory factor of the remaining useful life of the source does not weigh in favor of any option over another.

2) PNM will obtain the necessary construction permit modification to limit the SO_2 emission rates at Units 1 and 4 to 0.10 lb/MMBtu on a daily rolling 30-day average basis. These SO_2 emission reductions occur separately and apart from the SO_2 backstop trading program that EPA has already approved as satisfying BART. In addition to increased visibility improvement, these SO_2 reductions will lead to non-air quality environmental benefits, such as decreased acid deposition.

3) The retirement of Units 2 and 3 will reduce the facility annual NOx emissions by an additional 10,550 tons. When added to the controlled emission rate of Units and 1 and 4, total annual NOx emission will be reduced by 12,989 tons. Additionally, PNM will conduct performance testing to determine if the SNCRs installed on Units 1 and 4 can achieve significantly less than 0.23 lb/MMBtu.

4) The 2 SNCR/2 Shutdown scenario would result in less material usage than the 4 SCR and 4 SNCR scenarios. See Table 23. This will result in less limestone required to be transported and mined, less diesel fuel that would need to be refined for this power plant, less coal mined and less carbon that would need to be activated. Closure of two units will result in up to 53 percent less water used, from 21,000 acre-feet to 10,161 acre-feet; wastewater generated will be reduced by up to 50 percent, from 41 million gallons to 21 million gallons; and solid waste generated will be reduced by up to 50 percent, from 1.71 million tons per year to 854,130 tons per year.

Table 23: Raw Material Usage Comparison

Raw Material	2 SNCR/2 Shutdown (TPY)	Baseline, 4 SNCR, and 4 SCR
Limestone(1)	86,052	172,104
Activated Carbon(1)	130	261
Coal(2)	2,667,364	5,334,729
No. 2 Diesel Oil(2)	1,007,336	2,014,671

(1) Based on 2012 material usage data
(2) Based on 2011 material usage data

The energy and non-air quality environmental benefit of these resource savings weighs heavily in favor of the 2 SNCR/2 Shutdown scenario over the 4 SCR and 4 SNCR scenarios.

5) The two-unit retirement scenario will result in a substantial decrease in particulate matter emissions from coal processing, handling and transportation, as well as a substantial reduction in greenhouse gas emissions, mercury and other hazardous air pollutant emissions, and acid gas emissions as detailed in Table 24 below. The non-air quality environmental benefits of these reductions, such as less impact on climate and less deposition of mercury to waterways, weigh heavily in favor of the 2 SNCR/2 Shutdown scenario

6) Table 22 shows the average visibility improvement between the three scenarios of 4 SCR, 4 SNCR and 2 SNCR/2 unit shutdown. The 2 SNCR/2 Shutdown scenario achieves significant visibility improvements as compared to the baseline and installation of SNCR on Units 1-4. The visibility improvements from the State Alternative of SNCR on two units and two units shutdown compare very closely with the SCR installation scenario as contained in the FIP (less than 0.3 dv impact at any Class I area). For the 4 SCR and 2 SNCR/2 Shutdown scenarios, the average difference over three years is 0.28 dv at Mesa Verde and 0.16 dv at Canyonlands.

   Therefore, with respect to the statutory factor of the degree of visibility improvement anticipated, the 2 SNCR/2 unit shutdown scenario is superior to the 4 SCR scenario, and substantially equivalent to the 4 SCR scenario.

7) Table 10 includes the cost in dollars per ton for SCR and SNCR, as well as other scenarios. The total capital investment of the FIP 4 SCR scenario is estimated at nearly $861,871,000, as compared to $34,556,000 for the installation of SNCR at Units 1 and 4. This additional and significant capital expenditure that would be required to comply with the 4 SCR scenario is not justified given the slight improvement in visibility of the 4 SCR scenario over the 2 SCR/2 Shutdown scenario.

8) Finally, with respect to the statutory requirement to consider existing pollution controls at the source, such existing pollution control equipment was evaluated for all alternatives beginning in Step 1 of the analysis, and is outlined in Table 10. NMED determined that existing control equipment is not sufficient to meet BART requirements for NOx at San Juan Generating Station. This factor has no further relevance in selecting among the control options in this case .

Weighing all the above considerations as required by CAA § 169A, the Department has determined that the State Alternative (2 SNCR/2 Shutdown), which achieves substantial environmental benefits beyond the requirements of the FIP (4 SCR), the SIP (4 SNCR) and the requirements of the BART Guidelines at 40 CFR Part 51 Appendix Y at a significantly lower cost than the FIP scenario of 4 SCRs, satisfies the statutory and regulatory requirements of BART.

Table 24: Pollutant Emissions from 2 SNCR/2 Shutdown, 4 SNCR and 4 SCR

Scenario	NOx	SO_2	PM	CO	CO_2	VOC	Mercury	Non-Hg	Acid Gases
Current	21,000	10,500	2,380	33,507	14,669,968	210	0.0842	5.4	1,488
2 SNCR/2 Shutdown	8,011	3,483	1,184	18,615	7,314,801	104	0.042	2.7	744
2 SNCR/2 Shutdown % Reduction	62%	67%	50%	44%	50%	50%	50%	50%	50%
4 SNCR	16,100	10,500	2,380	33,507	14,699,968	210	0.0842	5.4	1,488
4 SNCR % Reduction	23%	0%	0%	0%	0%	0%	0%	0%	0%
4 SCR	3,502	10,500	2,380	33,507	14,699,968	210	0.0842	5.4	1,488
4 SCR % Reduction	83%	0%	0%	0%	0%	0%	0%	0%	0%

References

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

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5. EPA. (2003). Air Pollution Control Technology Fact Sheet (SCR). Retrieved from http://www.epa.gov/ttn/catc/dir1/fscr.pdf

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