United States Department of the Interior
NATIONAL PARK SERVICE
Air Resources Division
P.O. Box 25287
Denver, CO 80225

TAKE PRIDE IN AMERICA

IN REPLY REFER TO:

July 24, 2009

N3615 (2350)

Ms. Deborah Jordan
Director, Air Division, Region 9
U.S. Environmental Protection Agency
75 Hawthorne Street
San Francisco, California 94105

Dear Ms. Jordan:

The Navajo Generating Station (NGS) is operated by the Salt River Project Agricultural Improvement and Power District (SRP) and consists of three, 750 MW Electric Generating Units that began operation between 1974 and 1976. Due to the size of the facility and the period during which these units began operation, all three units are eligible for Best Available Retrofit Technology (BART) analysis. NGS is located on the Navajo Nation and approximately 20 km from Grand Canyon National Park (NP). The plant is located within 300 km of 11 Class I areas, which also include Arches, Bryce Canyon, Canyonlands, Capitol Reef, Mesa Verde, Petrified Forest, and Zion NPs (areas also administered by the National Park Service). Our detailed comments on the SRP BART analysis for NGS are enclosed. Based on our review, we believe that Selective Catalytic Reduction (SCR) is BART for nitrogen oxides (NO_x) emissions for all three units at NGS.

According to EPA's Clean Air Markets (CAM) database, NGS NO_x emissions have averaged 34,460 tons per year (tpy) and 0.36 lb/mmBtu during 2000 – 2007. Also, according to the CAM database, NGS was the fifth largest stationary source of NO_x in the U.S. in 2007 at 35,253 tons of NO_x emitted. Our analyses indicate that **NGS causes visibility impairment in all eleven Class I areas within 300 km, and that SCR control of these emissions is technically feasible, cost effective, and will substantially improve visibility in these protected areas.**

SRP also states "application of additional particulate controls to NGS would not be expected to produce substantial additional reductions in PM emissions, and an evaluation of PM controls is not included in this document. BART for PM is considered to be the current control configuration."

While current PM controls might prove to be BART, SRP cannot make such assertions at this time. SRP has effectively pre-empted the required five-step BART analysis by saying that its current PM controls are equivalent to BART. This approach is only allowed if SRP demonstrates that the source has in place, or is committing to, federally-enforceable limits that represent the **most stringent level of control**. NGS does not meet that criterion. SRP must model PM emissions to determine their impact and evaluate options to reduce impacts if they are significant. Our review of the modeling that SRP did conduct indicates that PM_{10} may be significant at Grand Canyon NP.

On a related topic, you may be aware that the National Parks Conservation Association, et al., petitioned the Department of the Interior to certify to the EPA that visibility impairment in Grand Canyon NP is reasonably attributable to NO_x and PM emissions from NGS. Once you conclude your BART determination process for NGS, we will be able to make a more informed decision regarding the need to certify visibility impairment attributable to NGS. Therefore, we will defer action on the NPCA petition until the EPA makes its BART determination for NGS, and we will follow-up with you at that time.

Over the past several months, we have worked with your staff to evaluate NGS under EPA's BART Guidelines, and we are very appreciative of their expertise and assistance. We look forward to continuing this cooperative working relationship as this process advances. We believe that good communication and sharing of information will help expedite this process, and suggest that you contact Don Shepherd (don_shepherd@nps.gov, 303-969-2075) if you have any questions or comments.

Sincerely,

John Bunyak
Chief, Policy, Planning and Permit Review Branch

Enclosures

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National Park Service (NPS) Comments on
Salt River Project (SRP)'s Proposed
Best Available Retrofit Technology (BART) Determination for
Navajo Generating Station (NGS)
July 24, 2009

Present Unit Operation

The Navajo Generating Station (NGS) is operated by Salt River project (SRP) and includes three dry-bottom, tangentially-fired boilers burning pulverized bituminous coal (10,909 Btu/lb, 0.53% sulfur, 9.35% ash) and is rated at 2,250 MW. These Electric Generating Units (EGUs) are equipped with Close-Coupled Over-Fire Air (CCOFA) to reduce nitrogen oxides (NO_x); hot-side Electrostatic Precipitators (ESPs) to control particulate matter (PM_{10}), and wet scrubbers for sulfur dioxide (SO_2) control.

A BART[1] review was previously conducted for NGS in the 1990s as part of the Reasonably Attributable BART Program, involving effects on visibility in Grand Canyon National Park (NP). This review concluded that sulfates were the major contributors to visibility impairment in the Grand Canyon. As a result, NGS installed flue gas desulfurization (FGD) equipment on all three units by 1999. With reference to a recent Federal Implementation Plan (FIP) for the Four Corners Power Plant, EPA also discussed BART issues for the Navajo Generating Station in the May 7, 2007, issue of the *Federal Register*, stating that "EPA determined previously that the SO_2 emission limits in the 1991 FIP for the Navajo Generating Station provide for greater reasonable progress toward the national visibility goal than would BART."[2]

Particulate Matter emissions are controlled by hot-side ESPs followed by wet scrubbers. SRP states (p. ES-1) that "PM is not believed to be a substantial contributor to regional haze in regional class I areas, so a BART analysis of further retrofit controls for PM_{10} emissions in not included in this report. Because of limited historical performance test data, SRP is recommending a short-term PM BART limit of 0.05 lb/mmBtu." SRP also states (p1-2) that "application of additional particulate controls to NGS would not be expected to produce substantial additional reductions in PM emissions, and an evaluation of PM controls is not included in this document. BART for PM is considered to be the current control configuration." We disagree with SRP's conclusions, and will address those issues later in this report. Nevertheless, for its reasons discussed above, SRP has focused its BART analysis on NO_x.

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[1] The final outcome of that process was not considered to be a "BART determination" in the regulatory sense of the term.
[2] 71 FR at 53633 and 72 FR at 25698 and 25700.

Current Actual NO_x Emission Rates

Baseline emission rates proposed by SRP for the cost evaluation steps are 0.03 lb Filterable PM_{10}/mmBtu and 0.45 – 0.50 lb NO_x/mmBtu. Based upon our review of EPA's Clean Air Markets (CAM) data for this facility, these estimates of **maximum** actual NO_x emissions appear reasonable for short-term visibility modeling purposes, but not for the annual cost analyses. According to the CAM database, facility NO_x emissions have averaged 34,460 tons per year (tpy) and 0.36 lb/mmBtu during 2000 – 2007.[3]

BART analysis for NOx

Consistent with EPA's BART Guidelines, the five steps for a case-by-case BART analysis were followed.

Step 1 – Identify all available retrofit control technologies
SRP: The NO_X control technologies that are feasible at NGS include: Low-NO_X burners and Separated Over-Fire Air (LNB/SOFA), flue gas recirculation, ECOTUBE™ ROFA™/ROTAMIX™, Selective Non-Catalytic Reduction (SNCR), and Selective Catalytic Reduction (SCR).

NPS: SRP evaluated a reasonable suite of options.

Step 2 – Eliminate technically infeasible options
SRP: Flue gas recirculation (FGR) has been demonstrated on units of the same scale as NGS Units 1 through 3 but has not been demonstrated to achieve NO_X reduction that is more effective than staged combustion techniques such as LNB/SOFA. ECOTUBE has not been demonstrated on units of the same scale and design as NGS Units 1 through 3. The Mobotec ROFA/ROTAMIX system has not been demonstrated on units of the same scale and design as NGS Units 1 through 3.

NPS: We agree with SRP's selections.

Step 3 – Evaluate the control effectiveness of the remaining technologies
SRP: Based on information provided by equipment vendors, it is estimated that Option 1[a], LNB/SOFA will reduce NO_X emissions to an emission level of approximately 0.24 lb/mmBtu.[4] Due to the lower inlet NO_X concentrations, it is estimated that the addition of SNCR will reduce NO_X emissions by another 15%, which corresponds to a NO_X emission level of approximately 0.20 lb/mmBtu. SCR is estimated to reduce NO_X emissions to approximately 0.080 lb/mmBtu.

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[3] It is these annual average values that are to be used to evaluate annual costs and cost-effectiveness.
[4] SRP sometimes refers to this scenario as Option 1 or Option 1a. For consistency and clarity, we shall refer to the combustion control scenario @ 0.24 lb/mmBtu as "Option 1a."

An alternative Control Option 1[b][5] is also evaluated assuming LNB/SOFA can achieve a NO_X emission rate of 0.20 lb/mmBtu. This emission rate represents an optimal outcome for LNB/SOFA technology at NGS which may not be realized. The uncertainty associated with this rate is largely based on the very limited practical experience with LNB/SOFA retrofits at plants burning western bituminous fuels comparable to that which is burned at NGS. In addition, the units at NGS are relatively small[6] and do not provide adequate residence time for effective staging of combustion and achieving lower NO_X rates.

NPS: SRP has **underestimated the ability of Selective Catalytic Reduction (SCR) to reduce emissions.** For example, for the LNB/SOFA+SCR option, SRP assumed 0.08 lb/mmBtu; this represents a 67% reduction from the LNB/SOFA emission estimate. However, EPA's Clean Air Markets (CAM) data[7] (Appendix A) and vendor guarantees[8] show that SCR can typically meet 0.05 lb/mmBtu (or lower) on an annual average basis. SRP has not provided any documentation or justification to support the higher values used in its analyses. If one applies the SRP statement that, "NO_X reductions of approximately 80 - 90% may be achieved with SCR systems" to the NO_X emission rate predicted for the LNB/SOFA option, outlet emissions would be reduced to 0.05 – 0.02 lb/mmBtu. Our review of operating data (Appendix A)[9] suggests that a NO_X limit of 0.06 lb/mmBtu is appropriate for LNB/SOFA+SCR for a 30-day rolling average, and 0.07 lb/mmBtu for a 24-hour limit and for modeling purposes, but a lower rate (e.g., 0.05 lb/mmBtu or lower) should be used for annual average and annual cost estimates.

STEP 4 –Evaluate Impacts and Document the Results

NPS: SRP has estimated that the cost of its proposed BART control strategy LNB/SOFA (SRP Option 1a) would be $4.9 million/year and reduce emissions by 26,753 tons/year. SRP estimates cost-effectiveness at $182/ton. However, SRP has overestimated the amount of NO_x reduction because it also overestimated the baseline NO_x emissions from which those reductions would occur. Instead of the 55,735 tpy of NO_x that would have to be emitted currently for SRP's predicted 48% emission reduction to produce the 26,753 tons/year reduction it estimated, EPA CAM data show that 2007 emissions were "only"

[5] SRP sometimes refers to this scenario as Option 1a, Option 1b or Option 1-alt. For consistency and clarity, we shall refer to the combustion control scenario @ 0.20 lb/mmBtu as "Option 1b."

[6] These are each 750 MW units and each would constitute a BART-eligible facility by itself. We therefore question SRP's assertion that these are "relatively small" units.

[7] We found 20 examples (Please see enclosed Table A.1.) of boilers similar to those at NGS that have been retrofitted with SCR and are achieving annual[7] emission rates below 0.06 lb/mmBtu. We were able to find 2006 hourly emissions in EPA's CAM database for ten of those EGUs, and charts showing those emissions are included in Appendix A. We believe that inspection of the data leads to the conclusion that these SCRs retrofit to eastern EGUs burning bituminous coal can typically reduce NO_x emissions by 90% and achieve 0.05 lb/mmBtu (or lower) on a 30-day rolling average basis during the eastern ozone season. A discussion of this data is also provided in Appendix A.

[8] Minnesota Power has stated in its Taconite Harbor BART analysis that "The use of an SCR is expected to achieve a NO_X emission rate of 0.05 lb/mmBtu based on recent emission guarantees offered by SCR system suppliers."

[9] Referenced appendices and other supporting information are included on the compact disk that accompanies this report.

34,803 tons.[10] Unless NGS is otherwise limited, the proposed 0.24 lb/mmBtu emission limit would still yield potential annual emissions of 29,378 tons, just 5,875 tons/year less than it emitted in 2007. If we assume that actual reductions would be 32% from 2007 emissions,[11] and would incur the same annual costs, we estimate that the true reductions would be 11,390 tons @ $427/ton.

According to our evaluation of information provided by SRP:

- Option 1a LNB/SOFA would reduce NO_x by 32% from the current 0.36 lb/mmBtu and result in an emission rate of 0.24 lb/mmBtu.
- Option 1a LNB/SOFA capital cost would be $19/kW.
- Option 1a Total Direct Annual Costs would be nil.
- The Option 1a Total Annual Cost to remove 11,390 tons/yr would be $4.9 million or $427 /ton.
- The Option 1a controlled NO_x emission rate would be 23,863 tpy, and NGS would become the 20th largest NO_x source in the U.S.

SRP has overestimated the cost of SCR. According to SRP, "costs are based upon an analysis conducted by Sargent & Lundy (2008)." The 2008 costs and schedules for SCR were developed using Sargent & Lundy's (S&L—SRP's engineering consultant) internal proprietary database. Instead of internal and proprietary databases, the BART Guidelines recommend use of the OAQPS Control Cost Manual:

> The basis for equipment cost estimates also should be documented, either with data supplied by an equipment vendor (i.e., budget estimates or bids) or by a referenced source (such as the OAQPS Control Cost Manual, Fifth Edition, February 1996, 453/B-96-001). In order to maintain and improve consistency, cost estimates should be based on the OAQPS Control Cost Manual, where possible. The Control Cost Manual addresses most control technologies in sufficient detail for a BART analysis. The cost analysis should also take into account any site-specific design or other conditions identified above that affect the cost of a particular BART technology option.

EPA's belief that the Control Cost Manual should be the primary source for developing cost analyses that are transparent and consistent across the nation and provide a common means for assessing costs is further supported by this November 7, 2007, statement from EPA Region 8 to the North Dakota Department of Health:

> The SO_2 and PM cost analyses were completed using the CUECost model. According to the BART Guidelines, in order to maintain and improve consistency, cost estimates should be based on the OAQPS Control Cost Manual. Therefore, these analyses should be revised to adhere to the Cost Manual methodology.

SRP did not provide adequate justification or documentation for its cost estimates. We were not provided with any vendor estimates or bids, and SRP did not use the Control Cost Manual. As a result, we believe that capital and annual costs are overestimated. For example, the SRP estimates for SCR on Units #1 and #3 equate to capital costs of $264/kW compared to the $50 - $267/kW cost of SCR found in survey data (Appendix B). SRP has stated that, "The extent of the modification work required and the limited access to the immediate work area will most likely require an extended outage to

[10] SRP also estimated annual NO_x emissions at 0.48 lb/mmBtu versus 2007 emissions of 0.36 lb/mmBtu according to CAM data.

[11] 0.24 lb/mmBtu proposed versus 0.36 lb/mmBtu in 2007

complete." Even if we account for the $23 million cost of the extended outage, the remaining cost/kW is unusually high at $220/kW, with no justification or explanation.

Unit #2 presents some unique problems. According to SRP:

> S&L looked at various alternatives on Unit 2, but with Unit 2 located between Units 1 and 3 and with other equipment including the coal conveyor and it's supports located immediately adjacent to Unit 2, the construction of an SCR in an economical configuration similar to that for Units 1 and 3 is not possible. With limited room for the SCR and with limited access for construction cranes and equipment, the installation of an SCR on Unit 2 would be extremely difficult. The limited access for construction equipment would limit the size of pre-fabricated assemblies that can be set directly in place and would drive up the cost of construction considerably. In addition, in order to make room for the SCR's and fans on Unit 2, it is expected that the remainder of the old Unit 2 chimney would have to be demolished.
>
> The SCR's would be located adjacent to the existing old chimney (which would be demolished) and above the existing ID fan outlet ductwork. Tie-ins would be made to the precipitator outlet ductwork on each side of the unit. New booster fans would be installed in the area vacated by the demolition of the old chimney. Note that rework of the ID fan outlet ductwork may be required in order to provide clearance for maintenance work on the new booster fans. With the limited access for construction equipment, and the close proximity of the coal conveyor, it is expected that the modification/tie-in work would require on the order of 12-15 weeks to complete, primarily due to extreme care that must be taken to avoid any damage to the coal conveyor. For purposes of the capital cost estimate, it is assumed that the retrofit would occur during a major outage, and extend such outage by 6 weeks.

As a result, SRP estimated the capital cost to install SCR on Unit #2 at $356/kW (and $311/kW without the $34 million extended outage cost).

According to information provided by SRP:

- SCR would reduce NO_x by 67% from the 0.24 lb/mmBtu it has proposed for Option 1a LNB+OFA and result in an emission rate of 0.08 lb/mmBtu.
- SCR capital cost would be $264 - $356/kW.
- Total Direct Annual Costs would be $13.2 million.
- Based upon information provided by SRP, the Total Annual Cost to remove 46,446 tons/yr[12] would be $94.8 million or $2,041 /ton.
- The controlled NO_x emission rate would be 9,289 tpy, and NGS would become the 123rd largest NO_x source in the U.S.

We now understand that the problem of installing SCR on Unit #2 is not as difficult as portrayed by SRP. Instead of locating both SCR reactor chambers above the ESP outlet ducts as proposed by SRP, it is believed that one SCR reactor chamber could be located adjacent to the ESP, with the other above the ESP outlet duct. This should reduce both

[12] EPA CAM data shows that 2007 emissions were "only" 35,253 tons, and that the recent maximum annual emissions from the plant were 37,297 tpy in 2000. SRP says that LNB+OFA would reduce NO_x emissions by 48% or 26,753 tpy. That means that SRP had to have assumed that uncontrolled NO_x emissions were 55,735 tpy. (Because it is unlikely that the plant ever actually emitted this much NO_x, it appears that SRP extrapolated annual emission rates from the 24-huor maximum emissions rates.) SRP estimates that addition of SCR would remove an additional 15,491 tpy. Total NO_x reductions from LNB+OFA+SCR would be 46,446 tpy.

construction costs and outage time. If we assume that such a system would represent a cost-scenario midway between that for Units #1 & #3 and #2, then the total capital cost. Based upon SRP's estimates, should be about $310/kW to install SCR on Unit #2.

As recommended by the BART Guidelines, we applied the OAQPS Control Cost manual to NGS. (Please see the workbooks in Appendix B.) with the assumption that LNB/SOFA+SCR would reduce NO_x to an annual emission rate of 0.05 lb/mmBtu.[13] Using as much of the SRP information as was relevant, we estimated:

- SCR capital cost for Units #1 & #3 each would be $73 - $77/kW. Even after we applied an "extra retrofit factor,"[14] SCR capital cost would be $88/kW for Unit #2. This result is much more consistent with available literature (see Appendix B) which suggests SCR costs ranging from $50 - $267/kW.
- Total Direct Annual Costs would be $12.8 million.
- The Total Annual Cost to remove 29,952 tons/yr would be $38.5 million or $1,286/ton.
- The controlled NO_X emission rate would be 6,071 tpy, and NGS would become the 173rd largest NO_x source in the U.S.

A unit-by-unit comparison of the cost estimates is presented in Appendix B.

There is a wide discrepancy between the estimates presented by SRP and by NPS using the EPA Control Cost Manual. Following is a breakdown of the specific areas where SRP's results differ substantially from ours:

- SRP based its estimates upon an uncontrolled NO_x emission rate of 0.48 lb/mmBtu. CAM data for 2007 show an annual average of 0.36 lb/mmBtu.
- SRP's estimates are based upon achieving 0.08 lb/mmBtu, which represents 67% NO_x reduction from the Option 1a 0.24 lb/mmBtu to be achieved by combustion controls. Although modern SCR systems are typically designed to achieve 90+% NO_x reductions, we assumed a 0.05 lb/mmBtu (a 79% reduction) "target" for SCR based upon the performance of the eastern boiler retrofits discussed above.
- SRP estimated that SCR would have a Total Capital Cost of $663 million. When we applied the Cost Manual approach to the NGS boilers, we estimated a Total Capital Cost of $179 million. SRP should provide detailed descriptions of how its SCR Total Capital Costs were derived.
- SRP estimated that combustion controls plus SCR would have Annual Operation and Maintenance (O&M) Costs of $13.2 million. SRP should provide detailed descriptions of how these costs were derived.
- SRP estimated that Option 1a combustion controls plus SCR would have a Total Annual Cost of $94.8 million (This yields a cost-effectiveness value of $2,041/ton.) SRP should provide detailed descriptions of how these costs were derived.

[13] Our review of CAM data (see **Appendix A**) for eastern wall-fired EGUs retrofitted with SCR indicates that they can meet 0.05 lb/mmBtu on an annual average basis.

[14] The EPA Control Cost Manual already provides for adding a retrofit cost, which we included. However, due to the difficulty in erecting SCR on Unit #2, we added another 1.5 retrofit factor to each of the "Indirect Installation" and "Project Contingency" costs for that unit.

- When we applied the Cost Manual to the NGS boilers, we estimated a Total Annual Cost of $38.5 million. This yields a cost-effectiveness value of $1,286/ton.

As a result of higher emission reductions and lower annual operating costs,[15] our cost-effectiveness estimate is much lower than the $2,041/ton SRP estimate. We believe that our results are more consistent with EPA's BART Guidelines.

STEP 5 – Evaluate Visibility Impacts[16]

Base Case: According to SRP, Capitol Reef NP is the most-impacted Class I area with an average 98th percentile value of 2.68 deci-View (dV), and the cumulative impact across all eleven Class I areas is 19.21 dV. NPS conducted its own modeling analysis and essentially duplicated the SRP results when we used SRP's emissions and other input parameters; this confirmed that SRP was running CALPUFF correctly.

It is likely that SRP underestimated visibility impacts, especially at the nearby Grand Canyon NP, because it incorrectly assumed that the only Inorganic Condensable Particulate Matter (IOR CPM) is sulfuric acid mist (H_2SO_4) at an emission rate of 13 lb/hr (total for all three boilers). The major difference arises when one estimates IOR CPM instead of only its H_2SO_4 component, as discussed below.[17]

EPA's Compilation of Air Pollutant Emission Factors (AP-42) predicts that PC boilers of this type with Flue Gas Desulfurization (FGD) scrubbers would emit 0.02 lb/mmBtu of CPM, or 548 lb/hr (total for all three NGS boilers). We have modified the AP-42 estimate to adjust it for actual stack test data,[18] and estimate total CPM emissions at 396 lb/hr.

The problem is that AP-42 provides no estimates for determining how much of this CPM is IOR versus Organic (OR) for a PC boiler with an FGD. Discussions with EPA R-9 led to an agreement to base our estimates of CPM IOR and OR on the AP-42 factors for "All PM controls (without FGD controls)," but assume that the FGD scrubbers at NGS remove 50% of the IOR CPM.[19] Therefore, instead of the 80% IOR/20% OR split provided by AP-42 for PC boilers **without** FGD scrubbers, we arrived at 40% of the CPM being IOR for a PC boiler **with** an FGD scrubber. We estimate total IOR CPM emissions at 158 lb/hr.

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[15] For example, SRP estimated annual power costs on the basis of $0.06/kWhr versus the $0.045/kWhr cost of replacement power cited on page 8 of the Sargent & Lundy report.

[16] A summary of the SRP and NPS modeling analyses is contained in Appendix C.

[17] Our emission estimates are contained in Appendix D.

[18] The difference is due to the over-prediction of filterable (and therefore, total) particulate emissions by AP-42 relative to actual stack test results for these boilers. Our workbook (http://www.nature.nps.gov/air/permits/ect/ectCoalFiredBoiler.cfm) compensates for that over-prediction by taking the stack test data into account.

[19] This is approximately equal to the amount of sulfuric acid mist capture (53%) in the existing Flue Gas Desulphurization scrubbers as is predicted by the Electric Power Research Institute in its report, "Estimating Total Sulfuric Acid Emissions from Stationary Power Plants", Technical Update, March, 2008 and Hardman et al., 1998.

Because H_2SO_4 must be reported as a hazardous air pollutant, the Electric Power Research Institute (EPRI) has developed a widely-accepted method[20] for estimating those emissions. We have created an Excel workbook (in Appendix D.) derived from that EPRI method and used it to predict that total H_2SO_4 emissions from NGS are about 7 lb/hr (versus 13 lb/hr estimated by SRP).

We believe that most of the difference between SRP's estimate and that produced by our modified application of AP-42 lies in the other IOR CPM besides H_2SO_4. For example, AP-42 estimates hydrogen chloride (HCl) emissions at 1.2 lb/ton of coal fired, and hydrogen fluoride (HF) at 0.15 lb/ton of coal fired. Discussions with EPA led to our agreement that, considering the coal burned at NGS and the emission controls present, these emissions are more likely closer to:

HCl (lb/ton)	HCl (lb/mmBtu)	HF (lb/ton)	HF (lb/mmBtu)
0.052	0.0025	0.018	0.00086

The resulting emission estimates for the total of the three NGS boilers are 68 lb HCl/hr and 24 lb HF/hr. We suggest that, because of the hygroscopic nature of HCl, and the affinity of HF for atmospheric water vapor,[21] both should be included in the modeling analysis and treated as IOR CPM because of their reactive natures.

Thus, we have so far accounted for 99 lb/hr of the 158 lb/hr estimated when we apply our particulate matter speciation workbook,[22] (versus the 13 lb/hr modeled by SRP) for all three boilers. It may be that the "missing" 59 lb/hr can be attributed to errors in our estimates and to other CPM IOR emitted by the coal combustion process with its many other ingredients. Because of the large difference between SRP's estimate and our estimate, we suggest that SRP conduct stack tests to determine the nature and quantity of all of its PM emissions. In the meantime, we believe that our estimates are more accurate than those used by SRP, and are consistent with our Congressional mandate to "err on the side of protecting the resource."

SRP did use AP-42 factors to estimate its OR CPM at 0.004 lb/mmBtu and 110 lb/hr.[23] Our workbook estimate is 237 lb/hr because we re-apportioned the CPM to estimate less

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[20] "Estimating Total Sulfuric Acid Emissions from Stationary Power Plants", Electric Power Research Institute, Technical Update, March, 2008 and Hardman et al., 1998

[21] "Hydrogen Fluoride Study, Final Report, Report to Congress, Section 112(n)(6), Clean Air Act as Amended"

[22] The workbook can be found at http://www.nature.nps.gov/air/permits/ect/ectCoalFiredBoiler.cfm. Our results are contained in Appendix A of this report. As a result of discussions between NPS and EPA, we revised our PM speciation workbook for these boilers to reflect the same amount of sulfuric acid mist capture (53%) in the existing Flue Gas Desulphurization scrubbers as is predicted by the Electric Power Research Institute in its report, "Estimating Total Sulfuric Acid Emissions from Stationary Power Plants", Technical Update, March, 2008 and Hardman et al., 1998.

[23] SRP first applied the AP-42 factor for PC boilers with Flue Gas Desulphurization scrubbers and then applied the AP-42 IOR/OR apportionment for unscrubbed boilers.

IOR CPM and thus more OR CPM to maintain some consistency with the AP-42 estimate for PC boilers **with** Flue Gas Desulphurization scrubbers.

We estimate Total PM_{10} emissions for all three boilers of 872 lb/hr versus the 599 lb Total PM_{10} /hr modeled by SRP. Virtually all of the difference resides in our estimates of CPM.

We then re-ran CALPUFF using our estimates for emissions and background ammonia. (Please see Appendix C "NPS CALPUFF modeling for Navajo BART.doc" for a description of NPS' assumptions and techniques.) Our results were consistently double those of SRP, especially at Grand Canyon, which becomes the most-impacted at 6.61 dV (vs. 2.56 estimated by SRP) and the cumulative impact across all eleven Class I areas is 39.24 dV.

SRP: **Option 1a:** "The results show that the averaged regional haze changes will improve visibility by about 0.37 delta-deciviews (relative to the baseline case) with the installation of LNB/SOFA controls. These controls result in a NO_X emission rate that is below the presumptive limit, thus complying with the requirements of the BART Guidelines for large electric generating plants."

NPS: Meeting the presumptive BART limits does not necessarily satisfy the requirements of the BART Guidelines for large electric generating plants. And, in addition to the problems discussed regarding Base Case CPM emissions, SRP has used an approach that is unlike any we have seen anywhere else in the U.S. SRP has presented the average visibility improvement across the eleven Class I areas it modeled. Instead, as discussed below, we believe that SRP should have evaluated its impacts on the most-impacted Class I area as well as its cumulative (not average) impacts across all eleven Class I areas. According to SRP, Option 1a would reduce NGS' impacts by 0.37 dV at Capitol Reef and by 4.07 dV across the eleven Class I areas.

We re-ran CALPUFF (as described in Appendix C) using our estimates for Option 1a emissions and background ammonia. Our results were consistently higher than those of SRP, especially at Grand Canyon, which is the most-impacted at 5.48 dV (vs. 2.29 estimated by SRP) and the cumulative impact across all eleven Class I areas is 28.18 dV, which would be the second-highest cumulative impact of any BART proposal we have seen.[24] The greatest improvement would be at Arches NP, the most-distant Class I area,[25] at 1.36 dV. The improvement at Grand Canyon NP would be 1.13 dv, and the cumulative improvement would be 11.06 dV.

SRP: **Option 1[b] Alternative**: "The results show that the averaged regional haze changes will improve visibility by about 0.47 delta-deciviews (relative to the baseline case) with the installation of LNB/SOFA controls and optimization over time. This level of improvement is somewhat higher than that from Option 1[a]. These controls also result

[24] TransAlta has proposed use of PRB coal as BART at its Centralia, WA EGUs and this would result in a cumulative impact of 33 dV.

[25] This may be due to the time required for the relatively small reduction in NO_X to show up in the model.

in a NO_X emission rate that is well below the presumptive limit, thus complying with the requirements of the BART Guidelines for large electric generating plants."

NPS: SRP is calling its Option 1-alternative (combustion controls at 0.20 lb/mmBtu) "Option 1a"[26] and is comparing all of the more-effective emission controls to that option in a *de facto* incremental analysis. However, because SRP is not actually proposing to implement combustion controls at 0.20 lb/mmBtu, it cannot compare those more-effective (and expensive) options to a hypothetical "straw man" option it will not commit to.[27]

SRP: **Option 3**: "The modeling results averaged over all 11 Class I areas show that installation of SCR on Units 1 and 3 in addition to the Option 1[a] NO_X controls will improve visibility by about 0.57 delta-deciviews over the baseline case. However, the average visibility improvement over BART Option 1a[b] is only 0.10 delta-deciviews. It is noteworthy that the installation of SCR would create new emissions of primary sulfates (H_2SO_4 and ammonium bisulfate), and would lead to increased gross generation to run the SCR equipment, which has not even been factored into the modeling analysis. The increased emissions of sulfates due to SCR operation will cause additional visibility impairment in all seasons of the year, especially during the high visitation season of summer. In contrast, the NO_X reductions will generally have a benefit only during the wintertime months due to the nature of the nitrate equilibrium that is discussed in Appendix B. Therefore, NO_X emission controls involving SCR are relatively ineffective for improving visibility in this case, especially taking into account the very high cost of the controls..."

NPS: As noted above, we believe that this is another "straw man" created by SRP. EPA has advised us that the obstacles raised by SRP to installation of SCR on all three units have been over-stated. We therefore have not evaluated this option further.

However, we do want to clarify several issues raised by SRP. First, our mission is to preserve and protect our national parks for the enjoyment of all visitors, not just those who come during the peak visitation seasons. And, the visitation to Grand Canyon NP in January 2008, the lowest month of that year, still exceeded **total** 2008 visitation for 163 NPS units, including such National Parks as Congaree NP, Dry Tortugas NP, Gates of the Arctic NP & PRES, Great Basin NP, Isle Royale NP, Katmai NP & PRES, Kobuk Valley NP, Lake Clark NP & PRES, North Cascades NP, and Wrangell-St. Elias NP & PRES.

While it is true that addition of SCR will increase direct sulfate emissions, our application of the EPRI method leads to an estimated increase of 42 lb H_2SO_4 /hr instead of the 77 lb/hr modeled by SRP. And, when the 76 lb/hr reduction in SO_2 that oxidizes to produce the H_2SO_4 is considered, addition of SCR and the subsequent oxidation of SO_2 and

[26] We are calling it "Option 1b."

[27] SRP's analysis of this option perpetuates the problems discussed regarding Base Case CPM emissions,

capture of that oxidized H_2SO_4 in the downstream air-preheater and FGD scrubber results in a net reduction of atmospheric sulfate.[28]

SRP: **Option 4**: "The modeling results averaged over all 11 Class I areas show that addition of SCR on all three units in addition to the Option 1 controls will improve visibility by about 0.70 delta-deciviews over the baseline case. The average visibility improvement over BART Option 1a[b] is about 0.22 delta-deciviews, which is less than one-third of this overall improvement. This incremental improvement in visibility over Option 1a is imperceptible in spite of the NO_X emission reductions, for the same reasons stated above for BART Option 3. Therefore, as noted above, NO_X emission controls involving SCR produce low incremental improvements in visibility in this case, especially taking into account the very high cost of the controls for retrofitting Unit 2 in addition to the other units, as discussed in Section 5.3."

NPS: Once again, SRP has misrepresented the benefits of SCR by averaging impacts across all eleven Class I areas and by comparing Option 4 to its Option 1b "straw man."

We applied CALPUFF (as described in Appendix C) using our estimates for emissions and background ammonia. Although our results predicted impacts that were consistently higher than those of SRP for the full-SCR option, so were our predicted improvements. Instead of the maximum improvement of 1.1 dV predicted by SRP at Canyonlands NP, we predict a 3.4 dv improvement there, as well as a 2.89 dV improvement at Grand Canyon, and 23.20 dV of improvement across the eleven Class I areas when the improvements on the eighth-highest days are summed.

Even though we estimated 128 lb/hr more OR CPM than SRP, our greater (than SRP) estimates of visibility improvement are probably due to several factors:

- Our use of a higher background ammonia concentration[29] would increase the transformation of NO_x to visibility-impairing ammonium nitrate particles. In addition to increasing the impacts of NO_x emissions from each scenario, the higher background ammonia also increases the predicted improvements.
- We assumed that SCR would reduce 24-hour NO_x emissions to 0.07 lb/mmBtu versus SRP's assumed 0.08 lb/mmBtu; we estimated 274 lb/hr lower NO_x emissions.
- Although we estimated much less H_2SO_4 emissions than SRP, SRP's omission of the other CPM-IOR (e.g., HCl, HF) essentially neutralized that difference. However, SRP failed to apply conservation of mass principles and did not adjust its predicted SO_2 emissions to reflect the increased oxidation of SO_2 to H_2SO_4; we estimated that 76 lb/hr of "potential" SO_2 would be emitted as H_2SO_4.

[28] If that 76 lb SO_2/hr had been emitted, it is likely that it would have eventually oxidized to 114 lb/hr of sulfate.

[29] The NPS used a different monthly background ammonia value of 1.0 parts per billon which is the recommended value in the Western Regional Air Partnership BART protocol and the recommended value found in the EPA Interagency Workgroup on Air Quality Modeling for arid areas.

Near-Field, Discrete Plume Analyses for Grand Canyon NP

NGS presents another unique situation due to its high NO_x and PM_{10} emissions so close to a Class I area. While the BART Guidelines propose use of CALPUFF in most situations, they also allow for alternative analyses as the situation warrants. In this case, we suggest that, in addition to CALPUFF, SRP should run a discrete plume model such as VISCREEN and/or PLUVUE; these models are especially suited for sources of PM_{10}, primary sulfate, and NO_x within 50 km of a Class I area. For example, when NPS ran a Level 1 VISCREEN analysis for NGS' baseline NO_x emissions, our results (Please see Appendix C for additional details.) showed gross exceedances of the perception criteria in Grand Canyon National Park.[30]

Base Case NO_x R E S U L T S

```
Asterisks (*) indicate plume impacts that exceed screening criteria
        Maximum Visual Impacts INSIDE Class I Area
           Screening Criteria ARE Exceeded
                                          Delta E        Contrast
                                        ===========    ============
Background Theta Azi Distance Alpha Crit  Plume      Crit  Plume
======== ===== === ======== ===== ====  =====      ====  =====
 SKY       10. 135.   25.5     34.  2.00 45.174*    .05  -.328*
 SKY      140. 135.   25.5     34.  2.00 36.160*    .05  -.328*
 TERRAIN   10. 130.   24.5     39.  2.00 22.714*    .05   .031
 TERRAIN  140. 130.   24.5     39.  2.00 17.891*    .05   .031
```

Application of VISCREEN Level 1 to SRP's proposed combustion control Option 1a yielded lower, but still very perceptible, impacts:

SRP Proposed Option 1a NO_x R E S U L T S

```
Asterisks (*) indicate plume impacts that exceed screening criteria
          Maximum Visual Impacts INSIDE Class I Area
             Screening Criteria ARE Exceeded
                                          Delta E        Contrast
                                        ===========    ============
 Backgrnd Theta Azi Distance Alpha Crit  Plume     Crit  Plume
 ======== ===== === ======== ===== ====  =====     ====  =====
  SKY       10. 140.   26.7     29.  2.00 40.371*   .05  -.287*
  SKY      140. 140.   26.7     29.  2.00 32.305*   .05  -.287*
  TERRAIN   10. 135.   25.5     34.  2.00 16.897*   .05   .026
  TERRAIN  140. 135.   25.5     34.  2.00 13.327*   .05   .026
```

And, with SCR on all three EGUs, VISCREEN Level 1 predicts NO_x plume perceptibility would diminish, but that emissions would still greatly exceed perception thresholds:

[30] VISCREEN at Level 1 is a simple screening tool that consistently over-predicts impacts. When VISCREEN predicts a perceptible plume at Level 1, it is typically re-run at Level 2, or the more-sophisticated PLUVUE model is run.

```
                  Full SCR NOx R E S U L T S
Asterisks (*) indicate plume impacts that exceed screening criteria
         Maximum Visual Impacts INSIDE Class I Area
            Screening Criteria ARE Exceeded
                                  Delta E       Contrast
                                ===========   ============
Backgrnd Theta Azi Distance Alpha Crit  Plume   Crit  Plume
======== ===== === ======== ===== ====  =====   ====  =====
 SKY      10. 145.    28.5    24.  2.00 35.903*   .05  -.262*
 SKY     140. 145.    28.5    24.  2.00 28.726*   .05  -.262*
 TERRAIN  10. 140.    26.7    29.  2.00 12.115*   .05   .024
 TERRAIN 140. 140.    26.7    29.  2.00  9.576*   .05   .024
```

According to the VISCREEN Level 1 results, reducing NO_x emissions reduces plume impact, but further analysis is needed with more refined models (e.g., PLUVUE) to determine if a perceptible plume would still persist even after significant emission reductions.

Receptor-Specific Comparisons in Grand Canyon NP[31]

Because of the unusual situation with NGS located so close to Grand Canyon NP, SRP asserted that addition of SCR would generate additional PM_{10} emissions that would degrade visibility in the near-field and result in a visibility "dis-benefit." We also suspected that NO_x reductions would not show as much visibility improvement in the near-field; where the highest impacts typically occur, as compared to more-distant receptors where transport times are sufficient to allow for the transformation of NO_x to visibility-impairing nitrates. Because the primary purpose of BART is to improve visibility, we decided to try to find where that maximum visibility improvement might occur within Grand Canyon NP.

We selected nine days based upon the 8th highest impacts for each year modeled from the three control scenarios (Base Case, SRP Combustion Control Option 1a, Full SCR Option 4) discussed above. (Please see Table 1.a.)

Table 1.a. Grand Canyon 8th High Impact Days

	8th High Delta dV								
	2001			2002			2003		
Control Option	Julian Day	Receptor	Delta dV	Julian Day	Receptor	Delta dV	Julian Day	Receptor	Delta dV
Base Case	16	335	6.671	342	614	7.231	88	569	5.924
LNB+SOFA (1a)	359	569	5.304	38	438	6.049	19	791	5.079
Full SCR #4	3	791	3.504	42	791	4.131	294	617	3.512

[31] Details can be found in Appendix C.

For each of those nine "98th percentile days," we compared controlled emission impacts to baseline emission impacts on a receptor-by-receptor basis[32] in order to evaluate the effects of receptor location within Grand Canyon NP on changes in visibility. (Please see Table 1.b.)

Table 1.b. Greatest Impacts on Grand Canyon 8th High Days

	2001 8th High Delta dV Days								
Control Option	Julian Day	Receptor	Delta dV	Julian Day	Receptor	Delta dV	Julian Day	Receptor	Delta dV
Base Case	16	335	**6.670**	359	438	5.930	3	771	5.172
LNB+SOFA (1a)	16	334	5.701	359	569	**5.304**	3	791	4.166
Full SCR #4	16	569	3.860	359	747	3.724	3	791	**3.504**
	2002 8th High Delta dV Days								
Control Option	Julian Day	Receptor	Delta dV	Julian Day	Receptor	Delta dV	Julian Day	Receptor	Delta dV
Base Case	342	614	**7.231**	38	720	7.357	42	791	5.304
LNB+SOFA (1a)	342	614	5.597	38	438	**6.049**	42	791	4.866
Full SCR #4	342	614	3.156	38	438	3.298	42	791	**4.131**
	2003 8th High Delta dV Days								
Control Option	Julian Day	Receptor	Delta dV	Julian Day	Receptor	Delta dV	Julian Day	Receptor	Delta dV
Base Case	88	569	**5.924**	19	791	6.534	294	617	4.479
LNB+SOFA (1a)	88	569	4.366	19	791	**5.079**	294	617	4.137
Full SCR #4	88	569	2.743	19	791	2.749	294	617	**3.512**

For example, we generated impacts for all GRCA receptors for 2002 Day 38, which was the 98th percentile day for SRP's Combustion Control Option 1a run by NPS. Under the NPS base case, the **most-impacted** receptor on Day 38 was #720 at 7.4 dV. Application of Option 1a resulted in the **most-improved** receptor (Please see Table 1.c.) on Day 38 moving to receptor #778, where visibility improved by 2.2 dV. **This is better than the 1.1 dV improvement predicted by NPS for Option 1a when one simply compares the three-year averages of the 98th percentile values.**

Table 1.c. Greatest Improvements on Grand Canyon 8th High Days

	2001 8th High Delta dV Days								
Control Option	Julian Day	Receptor	Delta dV	Julian Day	Receptor	Delta dV	Julian Day	Receptor	Delta Dv
LNB+SOFA (1a)	16	38	1.645	359	181	1.344	3	728	1.612
Full SCR #4	16	118	3.383	359	340	3.260	3	771	3.254
	2002 8th High Delta dV Days								
Control Option	Julian Day	Receptor	Delta dV	Julian Day	Receptor	Delta dV	Julian Day	Receptor	Delta dV
LNB+SOFA (1a)	342	420	2.024	38	778	**2.174**	42	615	0.858
Full SCR #4	342	425	4.245	38	774	**4.552**	42	778	2.134
	2003 8th High Delta dV Days								

[32] The locations of the 791 receptors evaluated in the Grand Canyon are provided in Appendix C.

Control Option	Julian Day	Receptor	Delta dV	Julian Day	Receptor	Delta dV	Julian Day	Receptor	Delta dV
LNB+SOFA (1a)	88	432	1.573	19	785	1.679	294	501	0.683
Full SCR #4	88	569	3.180	19	791	3.786	294	457	1.488

Next, we generated impacts for all GRCA receptors for 2002 Day 38 for the full SCR Option 4 run by NPS. Application of Option 4 resulted in the most-improved receptor on Day 38 moving to #744, and **visibility improved there by 4.6 dv, which is better than the 2.9 dV improvement predicted by NPS for Option 4 when one simply compares the three-year averages of the 98th percentile values.** (There was no visibility "dis-benefit" at any receptor. The smallest visibility benefit was 0.114 dV at receptor #264.)

The results of this analysis show greater improvements on seven of the nine days evaluated than would have been estimated by applying the typical approach of comparing the averages of the 98th percentile days. While we continue to recommend use of the averages of the 98th percentile days for most situations involving far-field impacts, we believe that the approach applied in this situation for a source 20 km from Grand Canyon NP can provide a more useful assessment of the benefit of reducing emissions of a pollutant that requires time to transform to a particle.

The BART Determination

Cost-Effectiveness Metrics

BART is not necessarily the most cost-effective solution. Instead, it represents a broad consideration of technical, economic, energy, and environmental (including visibility improvement) factors. We believe that it is appropriate to consider both the degree of visibility improvement in a given Class I area as well as the cumulative effects of improving visibility across all of the Class I areas affected. It simply does not make sense to use the same metric to evaluate the effects of reducing emissions from a BART source that impacts only one Class I area as for a BART source that impacts multiple Class I areas. And, it does not make sense to evaluate impacts at one Class I area, while ignoring others that are similarly significantly impaired. If we look at only the most-impacted Class I area, we ignore that the other Class I areas are all suffering from impairment to visibility "caused" by the BART source. It follows that, if emission from the BART source are reduced, the benefits will be spread well beyond only the most impacted Class I area, and this must be accounted for.[33]

The BART Guidelines represent an attempt to create a workable approach to estimating visibility impairment. As such, they require several assumptions, simplifications, and shortcuts about when visibility is impaired in a Class I area, and how much impairment is occurring. The Guidelines do not attempt to address the geographic extent of the impairment, but assume that all Class I areas are created equal, and that there is no difference between widespread impacts in a large Class I area and isolated impacts in a

[33] For example, our analysis, which is described later, indicates that the cumulative benefits of reducing NO_x emissions from NGS are seven times greater than the benefit at the most-impacted Class I area.

small Class I area. To address the problem of geographic extent, we have been looking at the cumulative impacts of a source on all Class I areas affected, as well as the cumulative benefits from reducing emissions. While there are certainly more sophisticated approaches to this problem, we believe that this is the most practical, especially when considering the modeling techniques and information available.

One of the options suggested by the BART Guidelines to evaluate cost-effectiveness is cost/deciview. Compared to the typical control cost analysis in which estimates fall into the range of $2,000 - $10,000 per ton of pollutant removed, spending millions of dollars per deciview (dV) to improve visibility may appear extraordinarily expensive. However, our compilation[34] of BART analyses across the U.S. reveals that the **average cost per dV proposed by either a state or a BART source is $10 - $17 million,**[35] with a maximum of almost $50 million per dV proposed by Colorado at the Martin Drake power plant in Colorado Springs.

In this case, we applied this cumulative approach to the NGS analysis and found that the cumulative impact from the baseline condition on visibility is 39.24 dV across the eleven Class I areas modeled. We compared the visibility improvement resulting from combustion controls and SCR to the range of costs we generated and found that SCR @ 0.07 lb/mmBtu (24-hour average) at a Total Annual Cost of $38.5 million (@ 0.05 lb/mmBtu). This yields a cost-effectiveness estimate of $1.5 million/dV, which is more cost-effective than the $10 - 17million per deciview that, on average, states and sources have determined was cost-effective for their chosen BART strategies.

We also have a concern with the way in which the incremental cost analysis is used by SRP, especially the way that SRP compared all of its more stringent options to its Option 1-alternative to which it will not commit. According to EPA's BART Guidelines, "You should consider the incremental cost effectiveness **in combination with the average cost effectiveness** [*emphasis added*] when considering whether to eliminate a control option...You should exercise caution not to misuse these [average and incremental cost effectiveness] techniques... [but consider them in situations where an option shows]...slightly greater emission reductions..." Reviewing agencies are quite familiar with the concept of total average cost and expect to see costs in the $2,000 – $12,000 per ton range. However, incremental costs are rarely estimated and evaluated, so the much higher numbers that result appear quite high at first glance. For this reason, rigid use of incremental cost effectiveness will always result in the choice of the cheapest option if carried to the extreme. (For example, if only incremental costs were used to evaluate PM controls, it is likely that all controls more expensive than a multiple cyclone would be rejected.) To use incremental costs properly, they must be compared to incremental costs for similar situations. Despite the EPA guidance, SRP estimates only the **incremental** costs and effectiveness relative to its current "Baseline" condition, and makes no mention of **average** cost-effectiveness.

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[34] http://www.wrapair.org/forums/ssjf/bart.html

[35] For example, PacifiCorp has stated in its BART analysis for its Bridger Unit #2 that "The incremental cost effectiveness for Scenario 1 compared with the baseline for the Bridger WA, for example, is reasonable at $580,000 per day and $18.5 million per deciview."

NO_x BART[36]

SRP estimates that LNB/SOFA will reduce NO_x to 0.24 lb/mmBtu. SRP estimates the Total Capital Cost (TCC) and Total Annual Cost (TAC) for installation of LNB/SOFA at $42 million and $4.9 million, respectively, for all three units. SRP provides no documentation or justification for any of its estimates. SRP estimated that this strategy would improve visibility by 0.37 dV averaged over the eleven closest Class I areas. SRP did not discuss in any significant detail the affects of this strategy on any particular Class I area, nor did it consider cumulative benefits. Nevertheless, if one uses the SRP data, the resulting cost-effectiveness of its BART proposal is $13.1 million/dV.

SRP estimates the TCC and TAC for installation of LNB/SOFA plus SCR for all three units at $705 million and $94.8 million, respectively. SRP provides no documentation or justification for any of its estimates. SRP estimated that this strategy would improve visibility by 0.70 dV averaged over the eleven closest Class I areas. SRP did not discuss in any significant detail the affects of this strategy on any particular Class I area, nor did it consider cumulative benefits.

Using the methods recommended by EPA's BART Guidelines, NPS estimates the TCC and TAC for installation of LNB/SOFA plus SCR for all three units at $207 million and $38.5 million, respectively. In accordance with the BART Guidelines, NPS has provided full explanation and justification for its estimates. NPS estimated that this strategy would improve visibility by 4.6 dV at Grand Canyon NP and by almost 25 dV across the eleven closest Class I areas. NPS estimates a cost-effectiveness of $8.5 million/dV at Grand Canyon NP, and $1.5 million/dV on a cumulative basis. This is more cost-effective than the $10 - 17million per deciview that, on average, states and sources have determined was cost-effective for their chosen BART strategies, and more cost-effective than SRP's proposed BART..

NO_x BART Conclusions

We believe that a valid "top-down" approach to reducing NO_x demonstrates that SCR is BART for all three units at NGS. We have conducted our own analysis using the procedures described in EPA's BART Guidelines and in EPA's OAQPS Control Cost Manual.

- SRP has underestimated the ability of modern NO_x control systems. SCR is capable of reducing emissions below SRP's target, and the amount of the reductions and consequent visibility improvements will increase.
- SRP's SCR costs are overestimated. EPA guidance advises that the OAQPS Control Cost Manual should be used; SRP should follow this guidance. Use of EPA guidance and data results in a cost-effectiveness value for combustion modifications plus SCR of $1,000 - $1,600/ton, which appears reasonable for a source that impacts so many Class I areas.

[36] The presumptive BART limit for dry-bottom tangentially-fired boilers burning bituminous coal is 0.28 lb/mmBtu.

- SRP has underestimated the visibility benefits of SCR. SRP should consider the cumulative effects of improving visibility across all of the Class I areas affected. Our results estimate a cost-effectiveness value for combustion modifications plus SCR of $1.5 million/dV, which is an order of magnitude less than the average cost-effectiveness accepted by the states and sources we have surveyed.
- Because none of the NO_x control strategies evaluated would eliminate NGS' significant impact upon visibility, additional analyses should be conducted to evaluate the costs and benefits of more comprehensive control strategies (e.g., upgraded SO_2 and/or particulate controls) to reduce visibility impacts from NGS at Grand Canyon NP.
- Because our screening level analysis predicts that a plume will be perceptible in the Grand Canyon under all of the control scenarios evaluated, SRP should conduct a discrete plume analysis to determine what level of control would be required to eliminate a perceptible plume.

SO_2 BART[37]

SRP states that "A BART review was previously conducted for the Navajo Generating Station in the 1990s as part of the Reasonably Attributable BART program..." While this is not correct, in its May 7, 2007 *Federal Register* Notice[38] regarding its Federal Implementation Plan (FIP) for the Four Corners Power Plant, EPA states that "[it] determined previously that the SO_2 emission limits in the 1991 FIP for the Navajo Generating Station provide for greater reasonable progress toward the national visibility goal than would BART."

PM BART

As noted earlier, the proximity of NGS to Grand Canyon NP presents a unique situation that requires additional analyses. SRP states (p ES-1) that "PM is not believed to be a substantial contributor to regional haze in regional class I areas, so a BART analysis of further retrofit controls for PM_{10} emissions in not included in this report. Because of limited historical performance test data, SRP is recommending a short-term PM BART limit of 0.05 lb/mmBtu." SRP also states (p1-2) that "application of additional particulate controls to NGS would not be expected to produce substantial additional reductions in PM emissions, and an evaluation of PM controls is not included in this document. BART for PM is considered to be the current control configuration."

SRP also states "application of additional particulate controls to NGS would not be expected to produce substantial additional reductions in PM emissions, and an evaluation of PM controls is not included in this document. BART for PM is considered to be the current control configuration."

SRP cannot make such assertions without supporting evidence. SRP has effectively pre-empted the required five-step BART analysis by saying that its current PM controls are

[37] EPA's presumptive SO_2 BART limit for similar boilers is 0.15 lb/mmBtu.
[38] 71FR at 53633 and 72FR at 25698 and 25700

equivalent to BART. This approach is only allowed if SRP demonstrates that the source has in place, or is committing to, federally-enforceable limits that represent the **most stringent level of control**.[39] NGS does not meet that criterion.[40]

SRP must model PM emissions to determine their impact and evaluate options to reduce impacts—such as ESP upgrades—if they are significant. In fact, the modeling that SRP did conduct indicates that PM_{10} may be significant at Grand Canyon NP. On page 5-2, SRP notes that, "the primary sulfates become visibility impairing particles immediately and have an important and adverse effect on visibility in the closest Class I areas..." SRP cites (p5-3) increased PM_{10} emissions as a reason to reject Selective Catalytic Reduction (SCR), "...at Grand Canyon National Park, the visibility would degrade (compared with Option 1a) with SCR installation due to addition of primary sulfates and excess ammonia." And, as we will show later, our analyses of NGS's discrete plume impacts at Grand Canyon NP indicate that current PM_{10} emissions alone may cause a perceptible plume there.

Not only must SRP determine the impact of PM emissions from NGS, if they are significant, then SRP must evaluate options to reduce those impacts—such as ESP upgrades and/or the addition of controls for condensable emissions.[41] Our Level 1 VISCREEN analysis of **only** the **actual** PM_{10} emissions **modeled by NPS** produced the results shown below.[42]

Base Case PM_{10} R E S U L T S

Asterisks (*) indicate plume impacts that exceed screening criteria
Maximum Visual Impacts INSIDE Class I Area
Screening Criteria ARE Exceeded

					Delta E		Contrast	
Backgrnd	Theta	Azi	Distance	Alpha	Crit	Plume	Crit	Plume
SKY	10.	150.	31.1	19.	2.00	79.631*	.05	3.277*
SKY	140.	150.	31.1	19.	2.00	28.061*	.05	-.651*
TERRAIN	10.	84.	20.0	84.	2.00	68.198*	.05	.781*
TERRAIN	140.	84.	20.0	84.	2.00	18.088*	.05	.181*

[39] According to the BART Guidelines, "If you find that a BART source has controls already in place which are the most stringent controls available (note that this means that all possible improvements to any control devices have been made), then it is not necessary to comprehensively complete each following step of the BART analysis in this section. As long as these most stringent controls available are made federally enforceable for the purpose of implementing BART for that source, you may skip the remaining analyses in this section, including the visibility analysis in step 5. Likewise, if a source commits to a BART determination that consists of the most stringent controls available, then there is no need to complete the remaining analyses in this section."

[40] For example, the permit issued by EPA for the Desert Rock power plant limits filterable PM_{10} to 0.010 lb/mmBtu.

[41] For example, East Kentucky Power is installing wet ESPs to control condensable PM emissions at its Cooper and Spurlock facilities.

[42] Details can be found in Appendix C.

These results show the potential for a perceptible plume in Grand Canyon NP from just the actual PM_{10} emissions (0.03 lb/mmBtu) from NGS alone. SRP is proposing that its BART limit for PM_{10} be set at 0.05 lb/mmBtu.

Furthermore, SRP's assertion that its current configuration is BART is contradicted by the facts which show that modern particulate control systems should be capable of controlling filterable PM_{10} emissions to below 0.010 lb/mmBtu instead of the 0.05 lb/mmBtu proposed by SRP. For example, EPA has proposed that the Desert Rock power plant will meet a filterable PM_{10} limit of 0.010 lb/mmBtu. (Sithe Global Energy and Two Elk Expansion have also proposed 0.010 lb/mmBtu for their NV and WY PC projects. We also have stack test data from the East Kentucky Power Spurlock Unit #3 that show filterable PM_{10} emissions below 0.005 lb/mmBtu.)

SRP must conduct a BART analysis for PM_{10}.

Other Environmental Issues

Although Glen Canyon National Recreation Area is not a Class I area, we have responsibilities under our Organic Act to protect Air Quality Related Values (AQRVs) in Class II Federal areas. In addition to the frequent plumes seen emanating from NGS and hovering over Glen Canyon NRA, we also have concerns about mercury emission from NGS and its impacts upon the ecosystems of Lake Powell, Lake Mead, and other water bodies in the Four Corners region. For example, the State of Colorado has human health advisories in place at three reservoirs in the Four Corners Area for fish consumption due to mercury exceeding EPA's risk thresholds of 0.3 ppm for women of childbearing years. In addition, 2005 data from Lake Powell indicated that five out of 11 fish (striped bass) sampled, exceeded this threshold. Mercury in wet deposition measured by the Mercury Deposition Network often shows higher concentrations in the Four Corners area (sites at Sycamore Canyon, AZ and Mesa Verde, CO and Navajo Lake, NM) than anywhere else in the country (http://nadp.sws.uiuc.edu/mdn/). We understand that SCR may produce a co-benefit by oxidizing elemental mercury to a form that can be removed by the existing scrubbers at NGS.