National Park Service (NPS) Comments on
Alaska Department of Environmental Conservation (ADEC)'s Proposed
Best Available Retrofit Technology (BART) Determination for
Golden Valley Electric Association (GVEA), Healy Power Plant, Unit 1
June 15, 2009

Present Unit Operation

Healy 1 is a nominal 25-MW unit located in Healy, Alaska, approximately 6 kilometers from Denali National Park and Preserve (DNPP). The unit is a wall-fired, dry-bottom boiler manufactured by Foster Wheeler. The BART presumptive nitrogen oxide (NO_x) limit for dry-bottom, wall-fired boilers burning sub-bituminous coal is 0.23 lb/mmBtu.

Low-NO_x burners (LNB) and over-fired air (OFA) ports were installed in 1996. Particulate Matter (PM) emissions are collected by a reverse gas fabric filter (FF) installed in the early 1970s. Sulfur dioxide (SO_2) is controlled by a dry sorbent injection system installed in 1999. At the present time sodium bicarbonate is the sorbent which is injected into the flue gas after the air heater.

BART Analysis for NO_x

STEP 1 – Identify all available retrofit emissions control techniques
NPS: GVEA evaluated a reasonable spectrum of control options.

STEP 2 – Eliminate technically infeasible options
NPS: No NO_x control options were eliminated.

STEP 3 – Evaluate control effectiveness of remaining control options
NPS: **GVEA has underestimated the ability of Selective Catalytic Reduction (SCR) to reduce emissions.** For example, for the LNB+OFA+SCR option, GVEA assumed 0.07 lb/mmBtu. However, EPA's Clean Air Markets (CAM) data (Appendix A) and vendor guarantees[1] show that SCR can typically meet 0.05 lb/mmBtu (or lower) on an annual average basis. GVEA has not provided any documentation or justification to support the higher values used in its analyses. Our review of operating data (Appendix B) suggests that a NO_x limit of 0.06 lb/mmBtu is appropriate for LNB+OFA+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 – Impact analysis
NPS: **GVEA has overestimated the cost of SCR.** Costs and schedules for SCR were developed using CH2M HILL's **internal proprietary database**, and supplemented by

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[1] 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."

vendor-obtained price estimates. However, 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.

GVEA did not provide justification or documentation for its cost estimates. We were not provided with any vendor estimates or bids, and GVEA did not use the Control Cost Manual. As a result, we believe that capital and annual costs are overestimated. The GVEA estimates for SCR equate to capital costs of $351/kW, compared to the $50 - $267/kW cost of SCR found in survey data (Appendix C).

Remaining Useful Life: Healy 1 began operation in 1967. **GVEA's analysis is based on the unit operating with a remaining useful life of 15 years.** While that coincides with the expected life of a scrubber, it is less than the 20-year life assumed for SCR, and therefore affects the capital recovery factor part of the cost analysis. For example, if we reduce the life of the SCR from 20 years to 15 years, the cost/ton for the SCR alone rises from $2,551 to $2,862 using our Control Cost Manual approach (discussed below). The BART Guidelines allow for consideration of remaining useful life, but there must be conditions attached to prevent a source from abusing this approach. **Because both GVEA and ADEC/Enviroplan conducted their analyses on the basis of a 15-year remaining useful life, we will use that value with the caveat that it must become an enforceable condition of any final permit if this factor becomes important in the final BART determination.**

As recommended by the BART Guidelines, we applied the OAQPS Control Cost manual to Healy 1. **(Please see the workbook in Appendix D.)** Following is a comparison of critical results:

According to information provided by GVEA:

- SCR would reduce NO_x by 72% and result in an emission rate of 0.07 lb/mmBtu.
- SCR capital cost would be $8.8 million, or $351/kW.
- The Total Annual Cost to remove 266 tons/yr would be $1.3 million or $4,748/ton.The controlled NO_x emission rate would be 104 tpy.
- Visibility at DENA would improve by 0.8 dv at a cost of $1.6 million/dv.

The following information was generated by NPS using the EPA Control Cost Manual and the assumption that LNB+OFA+SCR would reduce NO_x by 80% and result in an annual emission rate of 0.05 lb/mmBtu.[2]

- Even after we applied an "extra retrofit factor,"[3] SCR capital cost would be $6 million, or $240/kW. This result is much more consistent with available literature (see Appendix C) which suggests SCR costs ranging from $50 - $267/kW.
- The Total Annual Cost to remove 296 tons/yr would be $0.85 million or $2,862/ton. The controlled NOx emission rate would be 74 tpy.

As a result of higher emission reductions and lower annual operating costs, our cost-effectiveness estimate is slightly lower than the $3,374/ton produced by Enviroplan, and much lower than the $4,748/ton GVEA estimate. Considering the degree of uncertainty inherent in these survey estimates, we believe that our results and those of ADEC/Environplan complement and support one another.

STEP 5 – Determine visibility impacts

In general, there is a linear relationship between CALPUFF modeled visibility impacts and emission rates. The visibility improvement resulting from BART installation is expected to be proportional to the difference in modeled emissions. However, if one inspects the results in GVEA's Table 4-3 for NO_x reductions and Table 5-1 for visibility improvement, it can be seen that, if, for example, a 73.3 pound per hour (lb/hr) reduction due to optimization of the LNBw/OFA produces an improvement of 0.560 dv at DENA, then a reduction of 127 lb/hr after application of LNBw/OFA+SCR should produce more than the 0.786 dv improvement presented by GVEA.[4] The GVEA data require further explanation.

Even though the amount of annual NO_x reduction would increase in our analysis, the maximum visibility improvement would not. Although the economics of reducing NO_x to 0.05 lb/mmBtu on an annual basis improve, visibility at DENA would still only improve by 0.8 dV at our estimated cost of $1.2 million/dV. This is because the visibility improvement modeling is based upon the short-term 0.07 lb/mmBtu emission rate modeled by GVEA, which we agree is an appropriate 24-hour limit.

In its BART analysis, ADEC/Enviroplan estimates that OFA+SCR result in 0.786 deciviews improvement at DENA. As presented in ADEC/Enviroplan's BART analysis, that equates to approximately $1.6 million per deciview (dv) of improvement, which is well within the range of what was selected or proposed for BART controls at EGUs in other states. **Our (ongoing) analysis of BART proposals from around the U.S. (http://www.wrapair.org/forums/ssjf/bart.html) are leading us to the conclusion that a cost per dv of $10 – $20 million represents a reasonable average cost-effectiveness**

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[2] 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.

[3] The EPA Control Cost Manual already provides for adding a retrofit cost, which we included. However, due to the difficulty in transporting and erecting large projects in the Alaskan environment, we added another 1.5 retrofit factor to each of the "Indirect Installation" and "Project Contingency" costs.

[4] Similar inconsistencies can be found throughout the analyses. For example, the GVEA model results indicate that a one lb/hr reduction by optimizing LNB/OFA will improve visibility 23% more than a one lb/hr reduction resulting from LNB/OFA+SCR.

for improving visibility at the most-impacted Class I area. The ADEC/Enviroplan analysis suggests that Healy 1 could install SCR at a much-more-favorable cost-effectiveness ratio than the typical state or EGU proposing BART. Therefore, we support the ADEC's conclusion that LNB+OFA+SCR is BART for NO_x emissions from Healy 1, but suggest that a NO_x limit of 0.06 lb/mmBtu is appropriate for LNB+OFA+SCR for a 30-day rolling average.

BART Analysis for SO_2

STEP 1 – Identify all available retrofit emissions control techniques
NPS: GVEA evaluated a reasonable spectrum of control options.

STEP 2 – Eliminate technically infeasible options
NPS: No SO_2 control options were eliminated.

STEP 3 – Evaluate control effectiveness of remaining control options
NPS: GVEA has underestimated the ability of a lime spray dryer Flue Gas Desulfurization (FGD) system to reduce SO_2. GVEA bases its estimates on an uncontrolled SO_2 emission rate of 0.60 lb/mmBtu.[5] GVEA's lime spray dryer (LSD) FGD system with the existing baghouse is projected by GVEA to achieve up to 75% SO_2 removal at Healy 1. This would result in an estimated controlled SO_2 emission rate of 0.15 lb/mmBtu. However, a properly- designed and operated LSD can achieve a much lower emission rate. For example, the combination of low sulfur coal and the existing fabric filter (FF) should allow a LSD system to achieve 90% removal or 0.06 lb/mmBtu on an annual average basis.[6]

GVEA estimates that installation of a wet limestone FGD system at Healy 1 is expected to achieve approximately 88% SO_2 removal which equates to an SO_2 outlet emission rate of 0.07 lb/mmBtu. A wet scrubber can achieve a much lower emission rate.[7]

Because the existing FF lends itself very well to addition of the LSD upstream by enhancing the effectiveness of the LSD,[8] and by capturing the additional particulate matter generated by the LSD, we have assumed that this would be the optimum choice for improving SO_2 control. (The LSD/FF combination also results in a hotter exhaust plume than the wet FGD, which may be beneficial to enhance plume rise so close to DENA.)

[5]GVEA should explain how uncontrolled emissions were calculated.
[6] On May 5, 2005, Nevada issued a PSD permit to Newmont Nevada for construction and operation of a 200 MW coal-fired boiler. That boiler would burn coal with a heating value of 8,400 Btu/lb and a sulfur content of 0.45%. The permit limited 24-hour average emission to 0.065 lb/mmBtu from the LSD. This equates to 93% SO_2 control.
[7] On July 31, 2008, EPA issued a PSD permit to Sithe Global Energy for construction and operation of the 1500 MW Desert Rock facility. That boiler would burn coal with a heating value of 8,910 Btu/lb and a sulfur content of 0.82%. The permit limited 24-hour average emission to 0.060 lb/mmBtu from the wet FGD. This equates to 96% SO_2 control.
[8] The FF provides additional SO_2 removal on the filter cake.

STEP 4 – Impact analysis

The GVEA and ADEC/Enviroplan cost analyses are flawed. Despite the EPA BART Guidelines advice to use average cost **and** incremental cost, and to avoid over-reliance upon incremental cost,[9] both the GVEA January 2009 analysis and the ADEC/Enviroplan analysis rely solely upon incremental costs. The entire premise upon which GVEA and ADEC/Enviroplan have based their analyses is to estimate the incremental cost of adding LSD to the existing sodium bicarbonate injection system to reduce SO_2 emissions by an incremental 50%.[10]

Instead, we recommend that the LSD option be analyzed as a replacement for the current injection system, as discussed in GVEA's July 2008 BART report.[11] Because that July 2008 report is the only report that evaluates both the total average cost and the incremental cost, and provides enough supporting information to allow for a reasonable review, we have used it as the basis for our comments. (We believe that the two GVEA reports are based upon similar data and that the July 2008 report is more complete.)

Although GVEA has not provided any information in its July 2008 report to support its $334/kW capital cost estimate for the LSD option, its estimate appears to be reasonable when compared to the $447/kW that Colorado Springs Utilities would spend to install a LSD at its 85 MW Martin Drake Unit #6. Using the GVEA capital cost estimate plus other relevant company data and default data from the OAQPS Control Cost Manual (Section 5.2) where necessary to fill gaps, and scaling costs to reflect the additional SO_2 removed at 90% control, we arrived at an estimated annual cost of $1.7 million to remove almost 800 tpy at a cost-effectiveness of $2,130/ton. (Please see Appendix E.) GVEA estimated an annual cost of $1.6 million to remove 665 tpy at a cost-effectiveness of $1,494/ton. (We believe that GVEA erred in its calculation of cost-effectiveness and it should have arrived at $2,417/ton based upon its cost and reduction estimates.)

STEP 5 – Determine visibility impacts

GVEA's modeling analysis is flawed. GVEA has concluded that addition of either a LSD or wet scrubber would cause visibility to deteriorate at DENA. We believe that such a conclusion should have led GVEA to investigate the reason(s) for such a counter-intuitive

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[9]According to the BART Guidelines, "You should consider the incremental cost effectiveness in combination with the average cost effectiveness when considering whether to eliminate a control option."p343: "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…"

[10]We also have a concern with the way in which the incremental cost analysis was conducted. Because, in most cases, the cost of pollution control rises exponentially with control efficiency, the slope of the curve will also increase. For this reason, rigid use of incremental cost effectiveness will always result in the choice of the cheapest option if carried to this extent. (For example, if this approach were used to evaluate PM controls, it is likely that all controls more expensive than a multiple cyclone would be rejected.) According to the NSR Workshop manual, "As a precaution, differences in incremental costs among dominant alternatives cannot be used by itself to argue one dominant alternative is preferred to another." Instead, it should be used to compare closely performing options.

[11] A proper incremental cost analysis would have considered the cost savings that would be realized by GVEA when the injection system is discontinued.

result, and document its findings. Instead, GVEA simply states that, "Visibility impacts are greater with this option because of lower plume rise resulting from colder and wetter plume."

We encountered a similar claim by a BART source near the Grand Canyon and found that, if one looks beyond the most-impacted receptor, which is also likely to be the nearest, then one finds that visibility actually improves where the local effects of reduced plume rise and primary particulate were diminished. We suspect that the GVEA results for the LSD option are also flawed because:

- GVEA underestimated the ability of the LSD to reduce SO_2, and thus overestimated the remaining emissions and their impacts.
- GVEA did not evaluate the 122-foot stack to determine if it meets the criteria for "Good Engineering Practice." A taller stack would enhance dispersion and reduce the impacts on nearby receptors.

We have additional concerns with the modeling analysis as discussed below. We believe that a FF+LSD FGD system may represent BART for SO_2 emissions from Healy 1 and request both the modeling information requested in this correspondence and the time to evaluate it.

<u>BART Analysis for PM_{10}</u>

According to GVEA, "A baghouse is a state-of-the-art technology for PM_{10} control for Healy 1. Other control technologies such as a mechanical collector, hot or cold electrostatic precipitators, or wet particulate scrubbers could be considered as additional feasible PM_{10} control options. However, none of these alternative technologies are considered to have the potential of matching the consistent PM_{10} removal performance of a baghouse. Therefore, the existing baghouse is considered BART for Healy 1, and completion of the five-step BART process is not required."

While we agree that the baghouse is BART for filterable PM_{10}, GVEA must also evaluate controlling condensable PM_{10}, which typically equals or exceeds filterable PM_{10} emissions, and is likely to be especially important with respect to near-field impacts to the closest receptors at DENA.

BART Modeling Analysis

We would like to review the actual modeling files that were used in the GVEA BART analysis. This would include the input CALMET, CALPUFF, POSTUTIL, and CALPOST files. We would also like to receive the meteorological data files that were used for creating the CALMET file which would include the 15 km MM5 data and the surface and precipitation data. The FLMs have requested this type of data from other states for other BART analyses because it allows a more-thorough and timely review.

We disagree with the statement on page 4-5 of the Golden Valley Final BART Report, "In accordance with the WRAP Protocol elemental carbon stack emissions and organic aerosol emissions were not modeled." On page 1-2 of the *WRAP CALMET/CALPUFF Protocol for BART Exemption Screening Analysis for Class I Areas in the Western*

United States it states that "In addition, the PM_{10} emissions should be broken down by PM species as follows: SO_4, NO_3, EC, OC, PMF, PMC; EC is defined as elemental carbon and OC is defined as organic carbon." Also on page 1-4 of that document, both the masses of elemental carbon and organic carbon are included in the visibility extinction equation to be used in the visibility calculations.

We would like to know if building downwash for the main stack was applied in the CALPUFF model. Also we would like to obtain information of the building dimensions to determine if the 122 foot stack meets good engineering practice (GEP) height. We would also like to obtain the UTM coordinates of the Healy Unit 1 stack.

Figure 4-2 of the GVEA Final BART Report shows a dense receptor grid for DENA and Tuxedni National Wildlife Refuge. The NPS would like to know if these receptors were obtained from the NPS web site of fixed Class I receptors.[12]

Just-Noticeable Differences in Atmospheric Haze

GVEA states that, "Studies have been conducted that demonstrate only dV differences of approximately 1.5 to 2.0 dV or more are perceptible by the human eye. Deciview changes of less than 1.5 cannot be distinguished by the average person. Therefore, the modeling analysis results indicate that based on the above, no observable visibility improvements at DENA would be expected under any of the control options. Therefore, the current plant controls for SO2 [and NOx] are considered BART."

In the development of deciview, those early calculations showed that changes of 1.5 to 2.0 deciviews are always perceptible by the average viewer looking at photographs. In the real world, depending on scene characteristics and sun angle (among other factors), changes as low as 0.2 to 0.3 deciviews can be perceptible, just as in some limited cases changes at 2.0 deciviews might not be. However, a simple daily or hourly change in deciview and whether that is "perceptible" is not the only factor regarding a calculation of changes. Haze is caused by a multitude of sources and in some cases no single source may have a perceptible impact, much like the multitude of sources contributing to ozone in an urban area do not individually have a "significant" impact.

The Clean Air Act states that if the State finds that if ANY source is "reasonably anticipated to cause OR CONTRIBUTE" to visibility impairment, and the source meets the definition of a BART sources (by type, age, emissions, etc.) the source MUST install best available retrofit technology as determined by the State. EPA and RPO guidance is using 0.5 deciview (8th high for any year out of three) and 1.0 deciview (8th high for any year out of three) as accepted test for cause or contribute and moving the source into BART assessment. For assessing the BART controls, we feel that the amount of improvement on all days, even those improved as low as 0.1 deciview, and at all Class I areas showing this level of improvement or more should be considered as the source's CONTRIBUTION to regional haze when also looking at costs in the five factor analysis.

Economic Impacts – Rate Payer Analysis

[12] http://www.nature.nps.gov/air/maps/receptors/index.cfm

According to ADEC/Enviroplan:

> 40 CFR 51, Appendix Y, Section IV.D, Step 4, does allow for unusual circumstances that exist for a source that might lead to unreasonable cost-effectiveness estimates. Further, 40 CFR 51, Appendix Y, Section IV.E provides for summarization of costs of compliance using cost-effective measures relevant to the source…The BART rule provides that the energy impacts analysis may consider whether a particular control alternative would result in a significant economic disruption within the area or region of the affected source. As such, the unique geographic and economic characteristics affecting the business community within Alaska, including power producers, justify that the potential control costs consider the economic impact on each customer, expressed in units of cost per kilowatt-hour.

We suggest that a review of the complete text of the referenced BART Guidelines will provide a different perspective upon the issue of economic impacts. We have **bolded** text referring to plant-specific impacts.

Appendix Y to Part 51 - Guidelines for BART Determinations under the Regional Haze Rule
IV. The BART Determination: Analysis of BART Options
E. How do I select the "best" alternative, using the results of Steps 1 through 5?
3. In selecting a "best" alternative, should I consider the affordability of controls?
1. Even if the control technology is cost effective, there may be cases where the installation of controls would affect the viability of continued plant operations.
2. There may be unusual circumstances that justify taking into consideration the **conditions of the plant** and the economic effects of requiring the use of a given control technology. These effects would include **effects on product prices, the market share, and profitability of the source**. Where there are such unusual circumstances that are judged to affect plant operations, you may take into consideration the **conditions of the plant** and the economic effects of requiring the use of a control technology. Where these effects are judged to have a severe **impact on plant operations** you may consider them in the selection process, but you may wish to provide an economic analysis that demonstrates, in sufficient detail for public review, the specific economic effects, parameters, and reasoning. (We recognize that this review process must preserve the confidentiality of sensitive business information). Any analysis may also consider whether other **competing plants** in the same industry have been required to install BART controls if this information is available.

It is clear that the section of the BART Guidelines to which ADEC/Enviroplan refers deals with the impact of the proposed control option on the plant, its affordability, its profitability, and its competitiveness. GVEA has made no showing that any control option would jeopardize its ability to continue operating, and it is not in a competitive market.

We do not agree that an evaluation of the potential control costs should consider the economic impact on each customer served by GVEA. DENA is a **National** Park and any benefits to DENA would benefit the entire nation, not just the customers served by GVEA. Likewise, if we are to consider the costs of improving visibility in this national asset, it is therefore appropriate to spread them across the nation as a whole. The well-being of a national park should not be sacrificed to provide lower electricity rates to a small group. Therefore, we believe that there is no allowance in statute or rule for impacts upon the "rate payers" to determine whether a utility should install BART controls if the State finds that it contributes and the five factors as assessed by the State using EPA guidance show controls are warranted as BART. The State can consider costs of the technology, and EPA has addressed that and other factors in its rules and guidance. Clearly this source contributes to visibility impairment at DENA and is subject to the BART determination based on EPA guidance and the five statutory factors.

Mercury Emissions

GVEA has expressed concern that increasing the sodium bicarbonate injection rate could result in increased mercury emissions. The proposed addition of SCR is likely to promote oxidation of elemental mercury such that it could be more readily removed if an FGD were added downstream. We suggest that this additional environmental benefit of SCR+FGD should be considered by ADEC.

Conclusions

- We support the ADEC's conclusion that LNB+OFA+SCR is BART for NO_x emissions from Healy 1, but suggest that a NO_x limit of 0.06 lb/mmBtu is appropriate for LNB+OFA+SCR for a 30-day rolling average.
- A proper BART analysis may conclude that a FF+LSD FGD system represents BART for SO_2 emissions from Healy 1.
- We have significant concerns with the modeling analysis and request both the modeling information requested in this correspondence and the time to evaluate it.
- For assessing the BART controls, we feel that the amount of improvement on all days, even those improved as low as 0.1 deciview, should be considered as the source's CONTRIBUTION to regional haze when also looking at costs in the five factor analysis.
- There is no allowance in statute or rule for impacts upon the "rate payers" to determine whether a utility should install BART controls if the State finds that it contributes and the five factors as assessed by the State using EPA guidance show controls are warranted as BART.