Nevada Division of Environmental Protection-Bureau of Air Quality Planning (NDEP-BAQP) BART Determination Review of Nevada Energy's Reid Gardner Generating Station Units 1, 2 and 3

BOLD text below identifies the Guidelines for BART Determinations under the Regional Haze Rule in Appendix Y of 40 CFR 51

Background
A BART analysis was completed by CH2M HILL at the request of Nevada Energy (NVE) for Units 1, 2 and 3 at the Reid Gardner Generating Station (Reid Gardner) dated October 3, 2008. Reid Gardner consists of three BART-eligible units with a generating capacity of 110 megawatts (MW) each. A fourth unit (265 MW) is not BART-eligible. The units are wall-fired boilers which burn primarily bituminous coal. NVE's BART analysis is summarized below organized according to the five step analysis contained in Appendix Y of 40 CFR 51of control options for sources subject to BART.

STEP 1 – Identify all available retrofit emissions control techniques; alternatives can be categorized in three ways:

- **Pollution prevention (use of inherently lower-emitting processes/practices);**
- **Use of (and where already in place, improvement in the performance of) add-on controls; or**
- **Combination of pollution prevention and add-on controls.**

NVE identified the following emission reduction scenarios:

Potential NO_x Control Options – (Current controls consist of LNB and OFA)

- Low NO_x Burners (LNB) with Over-Fire Air (OFA)
- LNB with Selective Non-Catalytic Reduction (SNCR) System
- Rotating Opposed Fire Air (ROFA) with Rotamix
- LNB with Selective Catalytic Reduction (SCR) System
- ROFA with SCR

Potential SO_2 Control Options – (Existing soda ash scrubber for SO_2)

- Dry Flue Gas Desulfurization (FGD) System
- Dry Sorbent Injection
- Furnace Sorbent Injection
- New Wet FGD System
- Improve or upgrade wet soda ash FGD system operation

Cost-effective scrubber upgrades considered:

- Eliminate bypass reheat
- Install liquid distribution rings
- Install perforated trays
- Use organic acid additives
- Improve or upgrade scrubber auxiliary system equipment

- Redesign spray header or nozzle configuration

<u>Potential PM_{10} Control Options</u> – (Current controls consist of a mechanical collector and a venturi /tray wet soda ash scrubber for both particulate and SO_2 control. As part of the planned environmental upgrade pursuant to a 2007 consent decree, the mechanical collector is being removed and new fabric filter is being installed for Units 1 through 3)

- Fabric Filter (presently planned for installation by July 1, 2010)
- Upgrade the Existing Mechanical Collector
- Electrostatic Precipitator

STEP 2 – Eliminate technically infeasible options based on:

- **Availability (commercial availability); and**
- **Applicability (has it been used on the same or a similar source type).**

<u>NO_x</u>

Technical feasibility for the proposed control options was based on physical constraints, boiler configuration and emission reduction potential. Enhancing the existing or installing new LNBs and OFA is considered to be a capital cost, combustion technology retrofit that may require boiler water wall tube replacement. Neural Net Boiler Controls should be considered as a supplementary or polishing technology, but not a stand-alone basis. No control options were eliminated.

<u>SO_2</u>

With the fabric filter installation, the scrubber venturi section will be opened further to reduce draft loss through the equipment, and the scrubber operation will be improved to primarily remove SO_2 in the scrubber vessel. Only scrubber upgrades and new lime / limestone wet scrubber technology options can equal or exceed the removal efficiency of the current wet soda ash scrubber. Therefore, only these two alternatives were considered technically feasible. The new wet lime / limestone scrubber option is eliminated because little additional scrubber capital or operating cost is required by improving the current wet soda ash scrubber.

<u>PM_{10}</u>

Removal of the mechanical collector will eliminate the pressure drop and allow the full range of particulate sizing to the fabric filter. Upgrade to the mechanical collector will not yield as great a level of emission reduction as fabric filter, and therefore, the option is not technically feasible. The new electrostatic precipitator is not technically feasible either because the potential level of emissions reduction is not as great with the fabric filter installation already planned.

STEP 3 – Evaluate control effectiveness of remaining control options:

- **Make sure you express the degree of control using a metric that ensures an "apples to apples" comparison of emissions performance levels among options (e.g., lb SO_2/MMBtu); and**
- **Give appropriate treatment and consideration of control techniques that can operate over a wide range of emission performance levels (evaluate most**

stringent control level that the technology is capable of achieving plus other scenarios).

<u>NO_x</u>
NVE estimates the following control efficiencies with each control option:

1) LNB with OFA - Unit 1 at 21.3 percent, Unit 2 at 23.7 percent, and Unit 3 at 6.5 percent and an emission level of 0.39 lb/MMBtu – annual average.
2) LNB with OFA and SNCR – Unit 1 at 40.9 percent, Unit 2 at 42.7 percent, and Unit 3 at 29.9 percent and an emission level of 0.23 lb/MMBtu.
3) ROFA with Rotamix – Unit 1 at 57.7 percent, Unit 2 at 59.0 percent, and Unit 3 at 38.3 percent and an emission level of 0.16 lb/MMBtu.
4) LNB with OFA and SCR – Unit 1 at 81.6 percent, Unit 2 at 82.2 percent, Unit 3 at 78.2 percent and an emission level of 0.07 lb/MMBtu.
5) ROFA with SCR – Unit 1 at 81.6 percent, Unit 2 at 82.2 percent, Unit 3 at 78.2 percent and an emission level of 0.07 lb/MMBtu.

<u>SO_2</u>
The projected emission rate for an upgraded wet soda ash FGD system is 95 percent SO_2 removal or less than 0.15 lb/MMBtu.

<u>PM</u>
The guaranteed PM_{10} control technology emission rate is 0.015 lb/MMBtu with installation of fabric filter.

STEP 4 – Impact analysis

- **Cost of compliance (identify emission units, design parameters, develop cost estimates);**
  - **Baseline emissions rate should represent a realistic depiction of anticipated annual emissions for the source. In general, for the existing sources subject to BART, you will estimate the anticipated annual emissions based upon actual emissions from a baseline period.**
- **Energy impacts;**
  - **Direct energy consumption for the control device, not indirect energy impacts.**
- **Non-air quality environmental impacts;**
  - **Solid or hazardous waste generation or discharges of polluted water from a control device.**
- **Remaining useful life;**
  - **Can be included in the cost analysis.**

<u>Costs of Compliance</u>
Control cost comparisons are presented in Tables 3-2, 3-3 and 3-4 of each NVE BART determination report for Units 1 through 3 at Reid Gardner. An economic analysis for NO_x is presented in the appendix to each NVE BART determination report. There will be no economic impacts due to improving the current wet soda ash scrubber operation for

SO_2. A comparison of technologies on the basis of costs, design control efficiencies, and tons of PM_{10} removed was not done because fabric filter is considered to be BART.

Energy Impacts

The installation of LNB with OFA for NO_x control is not expected to impact the boiler efficiency to a large degree or force draft fan power usage. Upgrading the existing wet soda ash FGD system operation for SO_2 control will not require additional power. The energy impacts are included in the economic analysis presented in the appendix to each NVE BART determination report. Fabric filter installation for PM_{10} control is expected to result in a net energy reduction due to removal of the mechanical collector.

Environmental Impacts

CO emissions would be the same or lower than prior levels and could create a visible stack plume. SNCR and SCR installation could impact the salability and disposal of fly ash due to ammonia levels and could potentially create a visible stack plume. Transport of ammonia to the site may be an issue in the event of an accidental release. No environmental impacts are anticipated in improving the wet soda ash scrubber operation. The environmental impacts have not been quantified in the economic analysis presented in the appendix to each NVE BART determination report.

Remaining Useful Life

The remaining useful life is estimated to be 20 years from the installation of BART controls for Units 1, 2 and 3.

STEP 5 – Determine visibility impacts (improvements):

- **Run the model at pre-control and post-control emission rates; and**
- **Determine net visibility improvement;**
  - **Compare 98^{th} percentile.**

Modeling for pre-control and post-control emission rates demonstrates an improvement in visibility based on the BART conclusions presented by NVE for Units 1 through 3 at Reid Gardner. The NO_x emission rate (0.46 lb/MMBtu) modeled is in excess of the proposed NVE BART limit (0.39 lb/MMBtu - annual). Subsequently, the modeling results represent worst case visibility impacts at the higher rate. Modeling results for other technically feasible control options were not presented

NDEP Analysis:

Based on the information provided in the NVE October 3, 2008 BART determination reports, NDEP concurs with each BART determination for Units 1, 2 and 3 at Reid Gardner, with the exception of the installation of LNB with OFA for control of NO_x emissions. For all units, BART for SO_2 is wet soda ash FGD with an emission limit of 0.40 lb/MMBtu, based on a 24-hr average. For PM_{10}, BART is a fabric filter with an emission limit of 0.015 lb/MMBtu, 3-hr average.

For NO_x, NDEP established a baseline emissions scenario using Acid Rain Data from calendar years 2001 through 2007. NDEP used the average of the highest two consecutive NO_x annual emissions to establish the baseline NO_x emissions. NVE's cost and control efficiencies presented for each control technology were taken at face-value and used in NDEP's BART determination. The control technologies were ordered in range of efficiency from highest to lowest control efficiency. NDEP's economic analysis summary is presented in Table 1.

TABLE 1

NDEP ECONOMIC ANALYSIS SUMMARY

Reid-Gardner Unit 1						
		NOx Control				
	Current Operation (Uncontrolled)	ROFA w/SCR	LNB w/OFA & SCR	ROFA w/Rotamix	LNB w/OFA & SNCR	LNB w/OFA
Capital Cost	$0	$38,484,900	$35,048,000	$7,884,900	$6,945,500	$4,448,000
First Year O&M Cost	$0	$1,313,191	$1,029,801	$613,952	$396,248	$80,000
First Year Debt Service	$0	$4,081,555	$3,717,051	$836,241	$736,612	$471,737
Total Annual Cost	$0	$5,394,746	$4,746,852	$1,450,193	$1,132,860	$551,737
Base Heat Input (MMBtu)	9,815,313					
Total Heat Input allowed (MMBtu)	10,643,400					
Base emissions (tons)	2,267					
NOx Removal Rate %	0.0%	81.6%	81.6%	57.7%	40.9%	21.3%
NOx Removed (Tons)	0	1850	1850	1308	927	483
NOx Emission Rate (Tons)	2267	417	417	959	1340	1784
NOx Emission Rate (lb/MMBtu)		0.085	0.085	0.195	0.273	0.364
First Year Cost ($/ton removed)		**$2,916**	**$2,566**	**$1,109**	**$1,222**	**$1,143**
Incremental Cost ($/ton)		**$7,280**	**$6,085**	**$833**	**$1,308**	**$1,143**

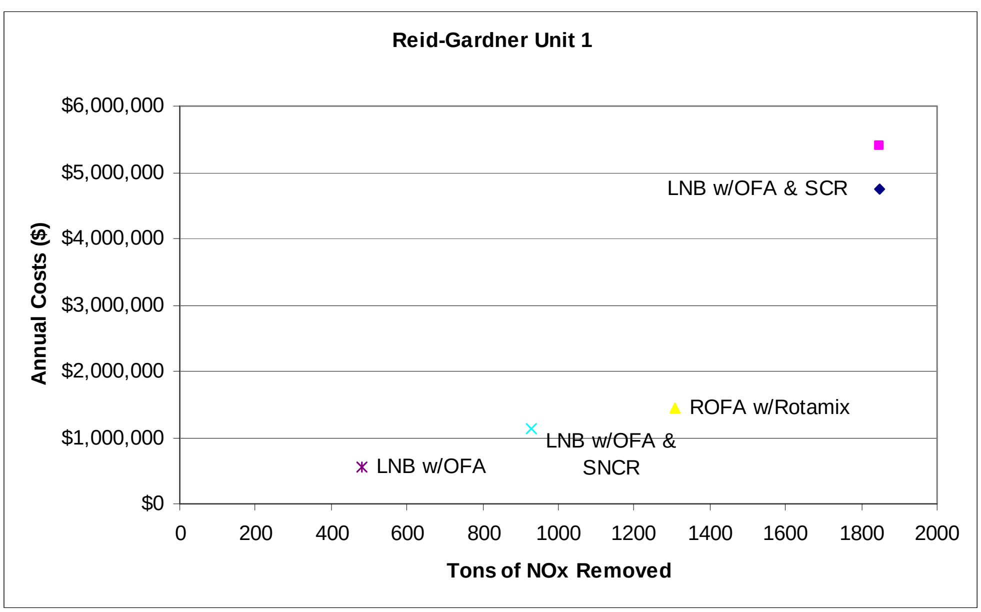
Reid-Gardner Unit 2						
		NOx Control				
	Current Operation (Uncontrolled)	ROFA w/SCR	LNB w/OFA & SCR	ROFA w/Rotamix	LNB w/OFA & SNCR	LNB w/OFA
Capital Cost	$0	$38,484,900	$35,048,000	$7,884,900	$6,945,500	$4,448,000
First Year O&M Cost	$0	$1,388,071	$1,078,551	$661,760	$418,657	$80,000
First Year Debt Service	$0	$4,081,555	$3,717,051	$836,241	$736,612	$471,737
Total Annual Cost	$0	$5,469,626	$4,795,602	$1,498,001	$1,155,269	$551,737
Base Heat Input (MMBtu)	10,501,749					
Total Heat Input allowed (MMBtu)	10,643,400					
Base emissions (tons)	2,445					
NOx Removal Rate %	0.0%	82.2%	82.2%	59.0%	42.7%	23.7%
NOx Removed (Tons)	0	2010	2010	1443	1044	580
NOx Emission Rate (Tons)	2445	435	435	1003	1401	1866
NOx Emission Rate (lb/MMBtu)		0.083	0.083	0.191	0.267	0.355
First Year Cost ($/ton removed)		**$2,721**	**$2,386**	**$1,038**	**$1,106**	**$952**
Incremental Cost ($/ton)		**$7,001**	**$5,813**	**$860**	**$1,299**	**$952**

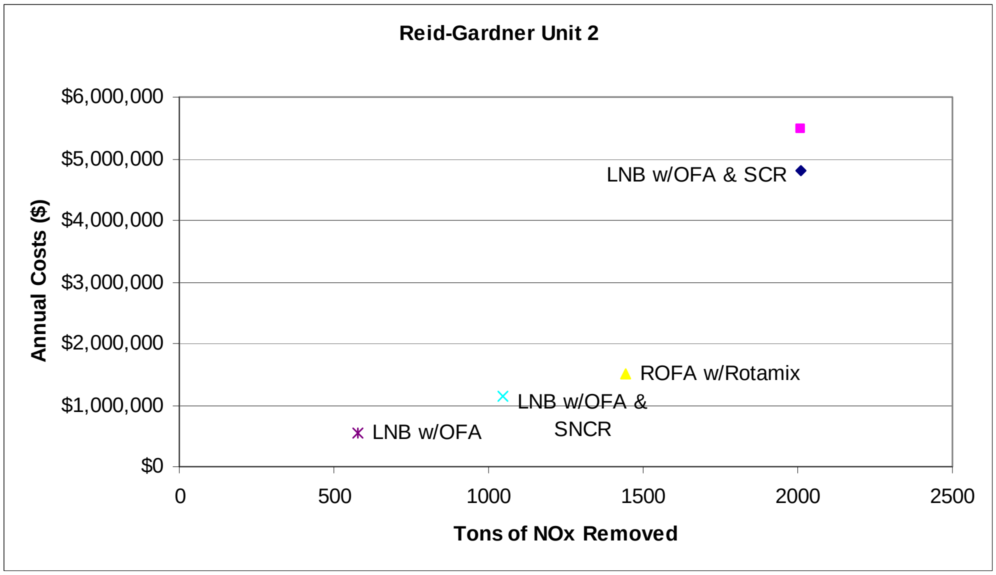
Reid-Gardner Unit 3						
		NOx Control				
	Current Operation (Uncontrolled)	ROFA w/SCR	LNB w/OFA & SCR	ROFA w/Rotamix	LNB w/OFA & SNCR	LNB w/OFA
Capital Cost	$0	$38,484,900	$35,048,000	$7,884,900	$6,945,500	$4,448,000
First Year O&M Cost	$0	$1,320,114	$1,000,893	$543,568	$345,970	$80,000
First Year Debt Service	$0	$4,081,555	$3,717,051	$836,241	$736,612	$471,737
Total Annual Cost	$0	$5,401,669	$4,717,944	$1,379,809	$1,082,582	$551,737
Base Heat Input (MMBtu)	10,063,851					
Total Heat Input allowed (MMBtu)	10,836,120					
Base emissions (tons)	2,268					
NOx Removal Rate %	0.0%	78.2%	78.2%	38.3%	29.9%	6.5%
NOx Removed (Tons)	0	1774	1774	869	678	147
NOx Emission Rate (Tons)	2268	494	494	1400	1590	2121
NOx Emission Rate (lb/MMBtu)		0.098	0.098	0.278	0.316	0.421
First Year Cost ($/ton removed)		**$3,045**	**$2,660**	**$1,588**	**$1,596**	**$3,742**
Incremental Cost ($/ton)		**$4,444**	**$3,688**	**$1,560**	**$1,000**	**$3,742**

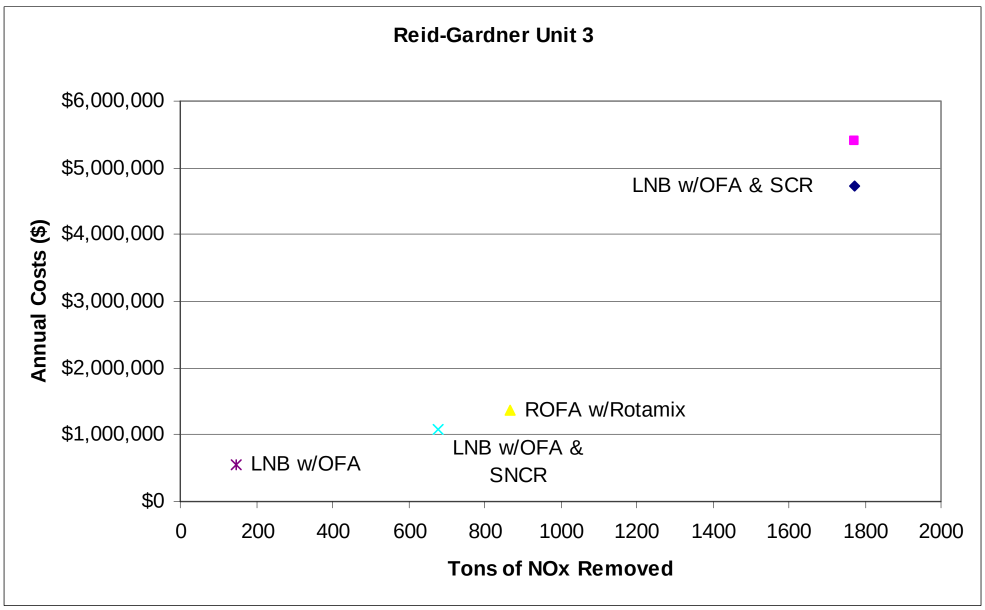
NDEP specifically reviewed the cost per ton of NO_x removed for each unit at Reid Gardner and determined that installation of ROFA with Rotamix for Units 1 through 3 meets the BART criteria, with associated costs of $1,038 to $1,588/ton of NO_x removed, depending on the unit evaluated. These values are considered cost effective. The cost data from the tables above are presented graphically in Figure 1. NDEP also concluded based on a review of the economic analysis that the $/ton of NO_x removed increased significantly for LNB with OFA and SNCR technology without any clear environmental benefit.

FIGURE 1

<u>LEAST COST ENVELOPE</u>







Visibility improvement upon installation of ROFA with Rotamix is anticipated to be greater than modeling with NVE's proposed BART limit. Modeling the visibility impact based upon the emission rates presented in Table 1 will be performed at a later date. Thereafter, data will be added to this report. Based on this review, NDEP concludes that for NO_x the installation of ROFA with Rotamix with an emission level at 0.20 lb/MMBtu for Unit 1 and Unit 2, and 0.28 lb/MMBtu for Unit 3, on a 12-month rolling average, is BART.