Revised Nevada Division of Environmental Protection BART Determination Review of NV Energy's Reid Gardner Generating Station Units 1, 2 and 3

*EXPLANATION: **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 NV 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 nominal 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 51, followed by NDEP's analysis and BART determination.

NV ENERGY ANALYSIS

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

- **Pollution prevention (used 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 – (Current controls consist of 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

Potential PM_{10} Control Options – (Current controls consist of a mechanical collector. As part of the planned environmental upgrade pursuant to a 2007 consent decree, the mechanical collector is being removed and new pulse jet fabric filter is being installed for units 1 through 3.)

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

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).**

NO_x

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. Due to previous experience with ROFA, NVE does not consider ROFA as a stand-alone technology option. No control options were eliminated.

SO_2

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. No additional scrubber upgrades beyond those identified above were considered, as the upgrades accomplish many of the same purposes.

PM_{10}

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 as 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).**

NO_x

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 emission levels of 0.16 lb/MMBtu for units 1 and 2, and 0.20 lb/MMBtu for unit 3.
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.

SO_2

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.

PM

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.**

Costs of Compliance

Control cost comparisons are presented for NO_x and PM_{10} in Tables 3-2 and 3-4, respectively 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 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. Installation of ROFA with Rotamix will result in additional power requirements ranging from 343 to 746 kilowatts. SCR retrofit will increase pressure drop. 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 with ROFA. 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 or installation of fabric filter. 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 98th percent days for pre- and post-control runs.**

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). Consequently, the modeling results show a lesser improvement in visibility than would be achieved with NVE's proposed BART limit. Modeling results for other technically feasible control options were not presented

NDEP ANALYSIS

NDEP's review of NVE's October 2008 BART determination reports for Reid Gardner resulted in revisions to all of NVE's BART determinations except the control technologies proposed as

BART for SO_2 and PM_{10}. NDEP concurs that BART for SO_2 is the existing wet soda ash FGD and BART for PM_{10} is a fabric filter, for the three BART units.

Nevada utilized NVE's cost and control efficiencies, as presented for each control technology in NDEP's NO_x BART economic analysis and control technology determination. The control technologies were ordered in range of efficiency from highest to lowest control efficiency. NDEP's economic analysis summary for NO_x 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**

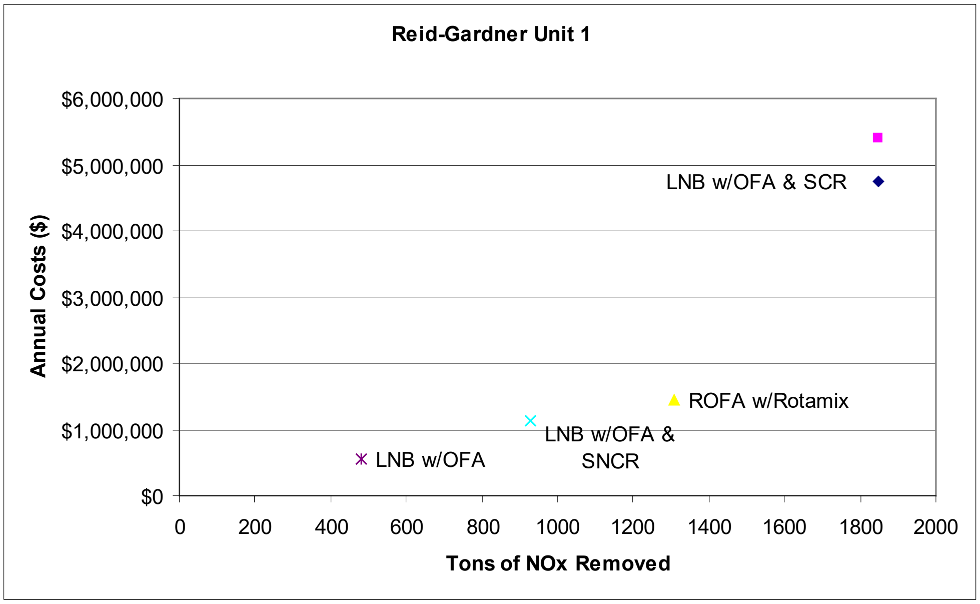
NDEP specifically reviewed the cost per ton of NO_x removed for each unit at Reid Gardner and determined that installation of ROFA with Rotamix for units 1 through 3 is BART for NO_x, with associated first year costs of $1,038 to $1,588/ton of NO_x removed, depending on the unit evaluated. These values are considered cost effective. The cost data from the tables above are presented graphically in Figure 1. NDEP also considered the Clean Air Act factors of expected emission rates, emissions performance levels, expected emissions reductions, energy impacts, non-air quality environmental impacts and modeled visibility impacts in Nevada's control technology determination. NDEP concluded, based on a review of the economic analysis, that the $/ton of NO_x removed increased significantly for the LNB with OFA and SNCR, and ROFA with SCR technologies without correspondingly significant improvements in visibility.

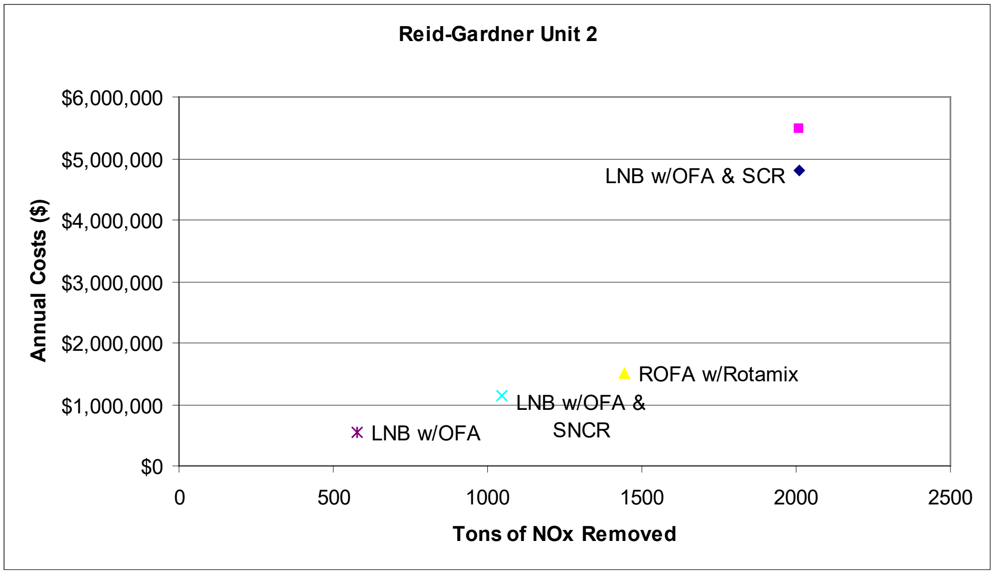
In order to determine the BART emission limits for NO_x and PM_{10}, NDEP established baseline emissions scenarios for NO_x using acid rain data and for PM_{10} using annual emissions reported to NDEP, from calendar years 2001 through 2007. NDEP used the average of the two consecutive years of the highest annual emissions to establish the baseline emissions for NO_x and PM_{10} in lb/MMBtu. The control efficiencies provided in NVE's BART analyses were then applied to the baseline NO_x emission rates to calculate the BART emission limits. The BART emission limits for PM_{10} were also calculated using the capacity factors presented in NVE's BART analyses and the NDEP baseline data.

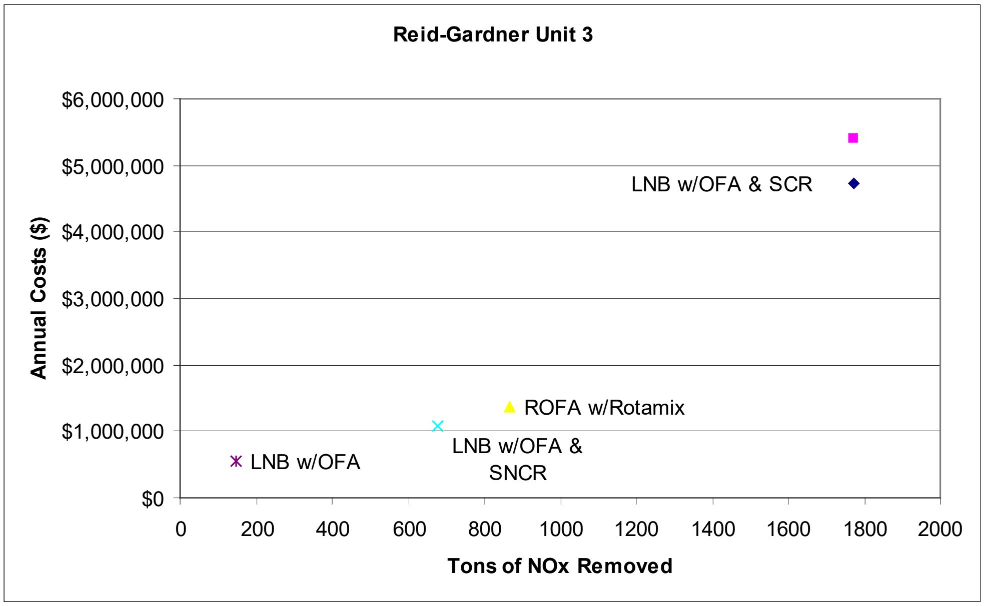
To determine the BART emission limits for SO_2, NDEP initially (for the January 2009 FLM review draft) used acid rain data from 2001 through 2007 in establishing a baseline emissions scenario for SO_2. The SO_2 acid rain data for Reid Gardner contained periods of invalid data which NDEP omitted from the calculation of baseline SO_2 emissions. In light of the long operational history of the SO_2 controls, NDEP then used the 98th percentile emissions values to establish SO_2 BART emission limits of 0.25 lb/MMBtu for Reid Gardner's units. These BART emission limits allowed for future operation within 98 percent of historical emissions (after discard of the invalid data) and provided some flexibility during transition to a different post-BART operating scenario including operation under a balanced draft versus force draft scenario due to the installation of the fabric filter and a potential change in coal type.

FIGURE 1

LEAST COST ENVELOPE







However, based on USEPA, FLM and NGO comments on the public review draft regarding the BART SO_2 emission limits for Reid Gardner, NDEP re-evaluated NV Energy's BART analyses for Reid Gardner and the use of acid rain data. In light of Nevada's further evaluation of the acid rain data, which is not a compliance dataset, Nevada decided to incorporate recent emissions data collected under the 40 CFR Part 60 requirements, which is a compliance dataset. The BART analyses submitted by NV Energy depended on emissions data representing the period prior to the installation of pulse jet fabric filter (a requirement of the consent decree described in section 6.5.2.2 of Nevada's RH SIP).

Baghouses were installed at Reid Gardner in late 2008 and early 2009 upstream of the FGD system, so there is now a limited emission dataset considering the performance of baghouses coupled with wet soda ash FGD and flue balancing. These data, particularly the Part 60 data, provided a higher level of confidence that the facility can not only comply with the 0.25 lb/MMBtu limit, but also indicated that the BART limit can be lowered to 0.15 lb/MMBtu without jeopardizing compliance with the limit.

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. NDEP concludes that BART for SO_2 is the existing wet soda ash FGD with emission limits of 0.15 lb/MMBtu, 24-hour average, for all three units and BART for PM_{10} is fabric filter with emission limits of 0.015 lb/MMBtu, 3- hour average, for all three units.

NDEP anticipates greater visibility improvement upon implementation of BART than shown in NVE's October 2008 BART report, which is based on a NO_x emission rate of 0.46 lb/MMBtu, an SO_2 rate of 0.40 lb/MMBtu, and a PM_{10} rate of 0.03 lb/MMBtu. The total annual BART emissions are 50 percent of the modeled rates, therefore the visibility improvement due to BART should improve significantly from that modeled.