Nevada Division of Environmental Protection
BART Determination Review of
NV Energy's Tracy 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 NVEnergy (NVE) for units 1, 2 and 3 at the Tracy Generating Station (Tracy) dated October 3, 2008. Tracy consists of three BART eligible units with a generating capacity of 251 megawatts (MW), of which unit 1 is a 55 MW, unit 2 is 83 MW and unit 3 is 113 MW. The Title V permit allows burning pipeline quality natural gas (PNG) or blended residual (No. 2 and No. 6 and non-PCB mineral oil) fuel oil. In completing the BART analysis, technology alternatives were investigated and potential reductions in NO_x, SO_2 and PM_{10} emissions rates were identified by NVE. NVE's BART analysis is summarized below, organized according to the five step analysis contained in Appendix Y of 40 CFR 51 Appendix Y, followed by NDEP's review and BART determination.

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 good combustion practices)

- Low NO_x Burners (LNB)
- LNB with Flue Gas Recirculation (FGR)
- LNB with Selective Non-Catalytic Reduction (SNCR) System
- Rotating Opposed Fire Air (ROFA) with Rotamix
- LNB with Selective Catalytic Reduction (SCR) System

Potential SO_2 Control Options (No SO_2 controls currently implemented)

- Unit 1 – Use of low-sulfur No. 2 fuel oil
- Unit 2 – Use of low-sulfur No. 2 fuel oil or Spray Dryer Absorber (SDA)
- Unit 3 - Use of low-sulfur No. 2 fuel oil or Spray Dryer Absorber (SDA)

Potential PM_{10} Control Options (No PM_{10} controls currently implemented)

- Unit 1 - No control proposed.
- Unit 2 – Use of low-sulfur No. 2 fuel oil and LNB, or dry Electrostatic Precipitator (dry ESP), or wet Electrostatic Precipitator (wet ESP) or Fabric Filter
- Unit 3 – Use of low-sulfur No. 2 fuel oil and LNB, or dry ESP, or wet ESP or Fabric Filter

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 were based on physical constraints, boiler configuration and emission reduction potential. However, the installation of over-fire air (OFA) was the only control option eliminated due to the potential cost of boiler wall changes.

SO_2

Technical feasibility for the proposed control option was based on fuel storage delivery constraints, boiler configuration, and on the ability of low-sulfur No. 2 fuel oil to achieve SO_2 reduction.

PM_{10}

Unit 1

NVE indicated that Tracy unit 1 is considered to meet BART PM_{10} emissions levels when burning either PNG or low-sulfur No. 2 fuel oil.

Units 2 and 3

Technical feasibility for the proposed control options was based on physical, chemical and emissions reduction potential. Dry ESP was eliminated due to the uncertainty in chemical and physical characteristics of the oil-fired particulate and the increased loading from SDA. Likewise, wet ESP was eliminated due to the potential increased particulate loading from an SDA not allowing the wet ESP to meet the required control efficiency when used in conjunction with SDA. Fabric filter is expected to function properly only with pre-coating and the increased particulate loading from the SDA operation.

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 - unit 1 at 8.4 percent, unit 2 at 38.7 percent, and unit 3 at 16.4 percent.
2) LNB with FGR - unit 1 at 41.1 percent, unit 2 at 51.4 percent, and unit 3 at 28.8 percent.
3) LNB with SNCR - unit 1 at 31.3 percent, unit 2 at 54 percent, and unit 3 at 37.3 percent.

4) ROFA with Rotamix - unit 1 at 49.1 percent, unit 2 at 52 percent, and unit 3 at 45.2 percent.
5) LNB with SCR - unit 1 at 74.5 percent, unit 2 at 85.2 percent, unit 3 at 78.3 percent.

SO_2

Unit 1

Control efficiency not estimated. NVE indicated that unit 1 is unable to burn 100 percent No. 2 fuel oil because capital improvements would be required.

Units 2 and 3

Control efficiency for SDA estimated at 84.8 percent with an emissions level of 0.10 lb/MMBtu. NVE indicated that units 2 and 3 are unable to burn 100 percent No. 2 fuel oil because capital improvements would be required.

PM_{10}

Unit 1

Control efficiency not stated. Unit is considered to meet BART PM_{10} emissions levels when burning either PNG or low-sulfur No. 2 fuel oil.

Units 2 and 3

Control efficiency for fabric filter is estimated at 76.9 percent with an emissions level of 0.015 lb/MMBtu. Conversion to No. 2 fuel oil with LNB is estimated to meet an emissions level of 0.03 lb/MMBtu (3-hr average).

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, the anticipated annual emissions will be estimated 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 options cost comparisons are presented in Tables 3-3, 3-5 and 3-7 (except the unit 1 report, which does not include Table 3-7) of each NVE BART determination report. An economic analysis of the control options is presented in the appendix to each BART determination report.

Energy Impacts

The installation of LNB is not expected to impact boiler efficiency or forced draft fan power usage substantially. Installation of ROFA with Rotamix or SNCR will result in additional power requirements ranging from 55 to 239 kilowatts. SCR retrofit will increase pressure drop. No energy impacts for SO_2 reduction are associated with switching to low-sulfur No. 2 fuel oil; however additional system pressure drop will result from installation of SDA. There is no additional energy impact from PM_{10} reduction as a result of LNB or burning low-sulfur No. 2 fuel oil. Fabric filter and ductwork will add a pressure drop to the system. No energy impact costs for are included in the economic analysis presented in the appendix to each NVE BART determination report for SO_2 and PM_{10} control options.

Environmental Impacts

SNCR, Rotamix and SCR installation could potentially create a visible stack plume, which may impact visibility improvements. Transport of ammonia to the site may be an issue in the event of an accidental release. No environmental impact is associated with switching to low-sulfur No. 2 fuel oil or installation of an SDA for SO_2 emissions reduction. No negative environmental impacts are expected from the utilization of new LNB's, switching to low-sulfur No. 2 fuel oil, or utilizing a fabric filter for PM_{10} emissions reduction.

Remaining Useful Life

The remaining useful life is estimated to be 23 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, 2 and 3 at Tracy. The NO_x emission rate (0.40 lb/MMBtu) modeled by NVE is in excess of their proposed BART limit (0.25 lb/MMBtu for unit 1, 0.29 lb/MMBtu for unit 2 and 0.27 lb/MMBtu for unit 3 all on an annual basis). Consequently, the modeling results show less 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:

Based on the information provided in NVE's October 3, 2008 BART determination report, NDEP concurs with each BART determination for units 1, 2 and 3 at Tracy, with the exception of the installation of only LNB for control of NO_x emissions at units 2 and 3, and the proposed NO_x emission limits at all three units. For all Tracy units, BART for SO_2 is use of PNG and/or low-sulfur No. 2 fuel oil with an emission limit of 0.05 lb/MMBtu, based on a 24-hr averaging period. For PM_{10}, BART is also PNG and/or low-sulfur No. 2 fuel oil but with an emission limit of 0.03 lb/MMBtu, 3-hr average.

For NO_x, NDEP established a baseline emissions scenario using Acid Rain Data from calendar years 2002 through 2007. NDEP used the average of the two consecutive years of the highest annual NOx emissions to establish the NO_x baseline 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 from highest to lowest control efficiency. NDEP's economic analysis summary is presented in Table 1.

TABLE 1

NDEP ECONOMIC ANALYSIS SUMMARY

Tracy Unit 1						
		NOx Control				
	Current Operation (Uncontrolled)	**LNB w/SCR**	**ROFA w/Rotamix**	**LNB w/FGR**	**LNB w/SNCR**	**LNB**
Capital Cost	$0	$21,175,000	$7,389,835	$1,820,000	$4,431,875	$1,232,000
First Year O&M Cost	$0	$194,090	$129,900	$83,589	$68,330	$22,000
First Year Debt Service	$0	$2,245,736	$783,736	$193,022	$470,027	$130,661
Total Annual Cost	$0	$2,439,826	$913,636	$276,611	$538,357	$152,661
Base Heat Input (MMBtu)	1,772,289					
Total Heat Input allowed (MMBtu)	6,403,560					
Base emissions (tons)	221					
NOx Removal Rate %	0.0%	74.5%	49.1%	41.1%	31.3%	8.4%
NOx Removed (Tons)	0	164	108	91	69	19
NOx Emission Rate (Tons)	221	56	112	130	152	202
NOx Emission Rate (lb/MMBtu)		0.064	0.127	0.147	0.171	0.228
First Year Cost ($/ton removed)		**$14,840**	**$8,432**	**$3,050**	**$7,794**	**$8,235**
Incremental Cost ($/ton)		**$27,227**	**$36,082**	**-$12,103**	**$7,632**	**$8,235**

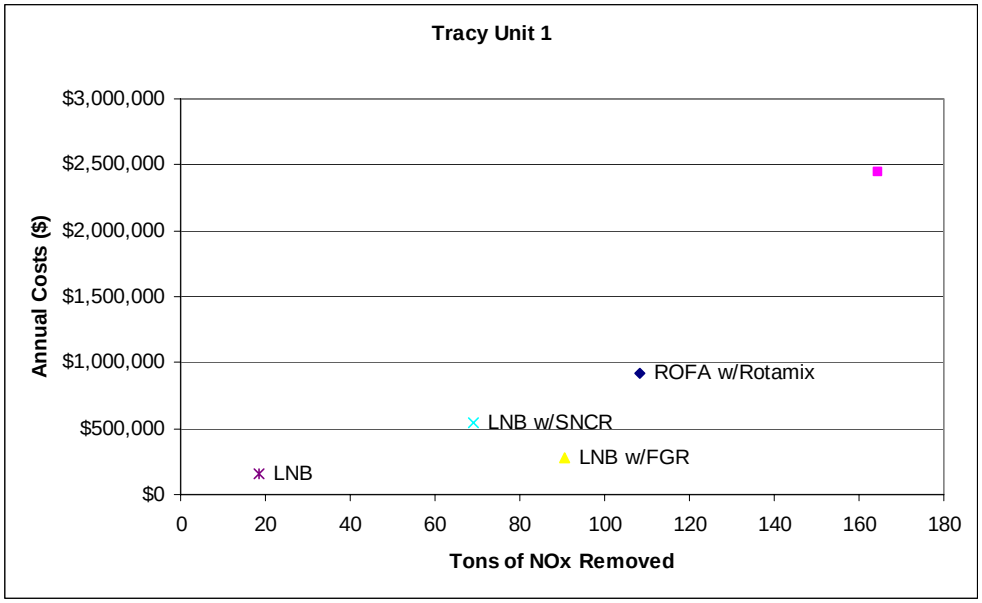
Tracy Unit 2						
		NOx Control				
	Current Operation (Uncontrolled)	**LNB w/SCR**	**LNB w/SNCR**	**ROFA w/Rotamix**	**LNB w/FGR**	**LNB**
Capital Cost	$0	$31,812,500	$4,624,375	$8,013,408	$2,156,000	$1,540,000
First Year O&M Cost	$0	$400,266	$201,968	$317,342	$169,768	$33,200
First Year Debt Service	$0	$3,373,907	$490,443	$849,870	$228,657	$163,326
Total Annual Cost	$0	$3,774,173	$692,411	$1,167,212	$398,425	$196,526
Base Heat Input (MMBtu)	2,591,991					
Total Heat Input allowed (MMBtu)	8,795,040					
Base emissions (tons)	321					
NOx Removal Rate %	0.0%	85.2%	54.0%	52.0%	51.4%	38.7%
NOx Removed (Tons)	0	273	173	167	165	124
NOx Emission Rate (Tons)	321	47	148	154	156	197
NOx Emission Rate (lb/MMBtu)		0.037	0.114	0.119	0.120	0.152
First Year Cost ($/ton removed)		**$13,803**	**$3,995**	**$6,994**	**$2,415**	**$1,582**
Incremental Cost ($/ton)		**$30,778**	**-$73,973**	**$399,253**	**$4,954**	**$1,582**

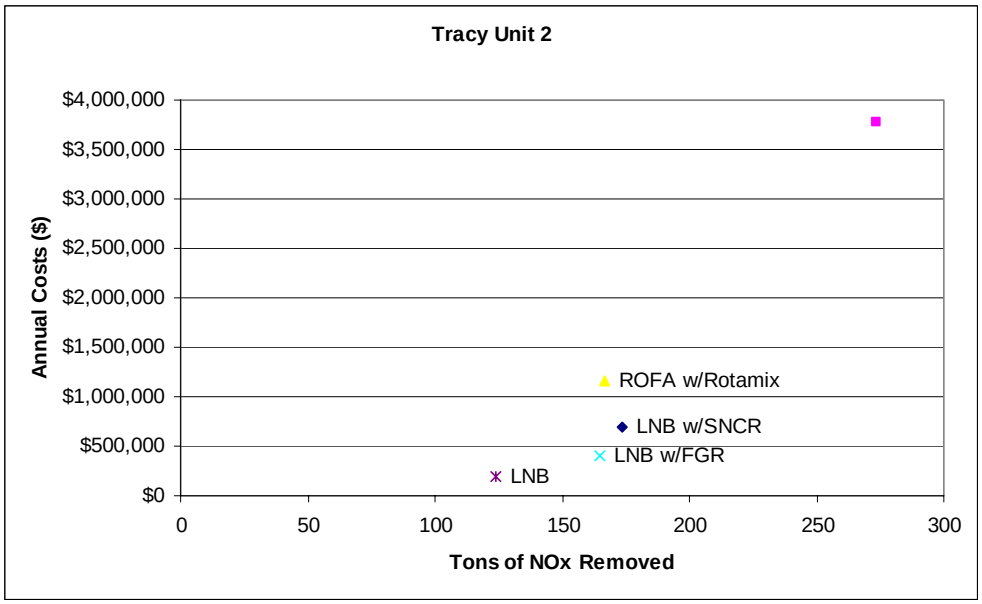
Tracy Unit 3						
		NOx Control				
	Current Operation (Uncontrolled)	LNB w/SCR	ROFA w/Rotamix	LNB w/SNCR	LNB w/FGR	LNB
Capital Cost	$0	$35,862,500	$9,189,145	$4,431,875	$2,072,000	$1,232,000
First Year O&M Cost	$0	$593,848	$548,326	$236,432	$354,865	$45,200
First Year Debt Service	$0	$3,803,433	$974,564	$470,027	$219,748	$130,661
Total Annual Cost	$0	$4,397,281	$1,522,890	$706,459	$574,613	$175,861
Base Heat Input (MMBtu)	5,485,741					
Total Heat Input allowed (MMBtu)	10,074,000					
Base emissions (tons)	795					
NOx Removal Rate %	0.0%	78.3%	45.2%	37.3%	28.8%	16.4%
NOx Removed (Tons)	0	622	359	296	229	130
NOx Emission Rate (Tons)	795	172	435	498	566	664
NOx Emission Rate (lb/MMBtu)		0.063	0.159	0.182	0.206	0.242
First Year Cost ($/ton removed)		**$7,067**	**$4,240**	**$2,383**	**$2,511**	**$1,349**
Incremental Cost ($/ton)		**$10,928**	**$13,005**	**$1,952**	**$4,047**	**$1,349**

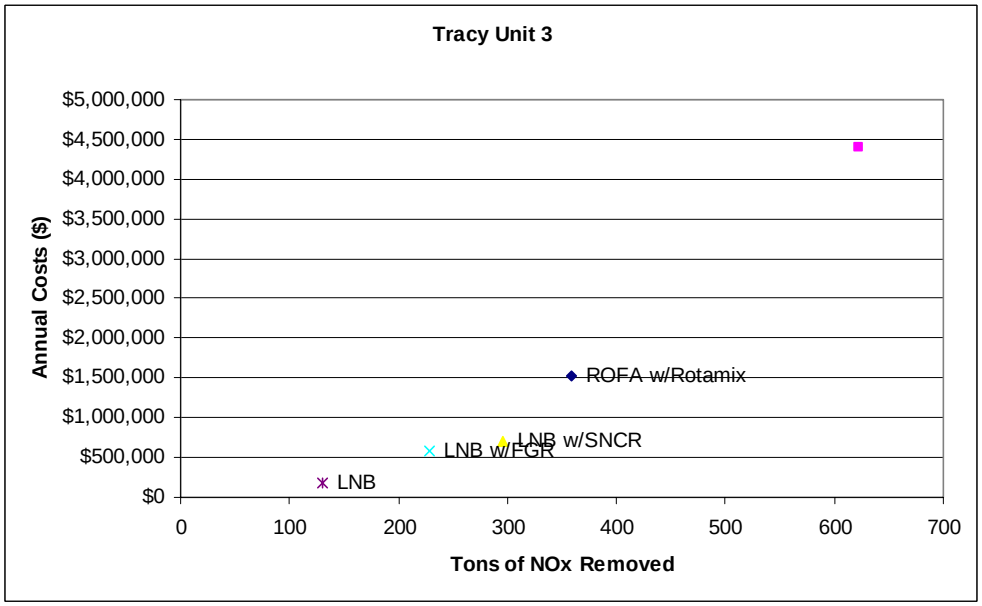
NDEP specifically reviewed the cost per ton of NO_x removed for each unit at Tracy and determined that installation of LNB with FGR for units 1 and 2, as well as LNB with SNCR for unit 3, meets the BART criteria. Associated first year costs range from $2,383 to $3,050/ton of NO_x removed. These values are considered cost effective. The cost data from the tables above are presented graphically for each unit in Figure 1. NDEP also concluded based on a review of the economic analysis that the $/ton of NO_x removed for units 1 and 2 increased significantly for LNB with SNCR, ROFA with Rotamix, and SCR with only slight improvements in visibility. Similarly, the $/ton of NO_x removed for units 3 increased significantly for ROFA with Rotamix and SCR with only slight improvements in visibility.

FIGURE 1

LEAST COST ENVELOPE







NDEP concludes that for NO_x the installation of LNB with FGR with an emission limit of 0.15 lb/MMBtu for unit 1 and 0.12 lb/MMBtu for unit 2, as well as LNB with SNCR with an emission limit of 0.19lb/MMBtu for unit 3, on a 12-month rolling average, is BART.

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 0.40 lb/MMBtu. The annual NO_x BART emissions are 27 to 48 percent of the rates modeled by NVE, while the total annual BART emissions are 39 to 57 percent of the modeled rates, therefore the visibility improvement due to BART may be as much as twice that modeled.