Nevada Division of Environmental Protection
BART Determination Review of
NVEnergy's Fort Churchill Generating Station Units 1 and 2

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 and 2 at the Fort Churchill Generating Station (Ft. Churchill) dated October 3, 2008. Fort Churchill consists of two BART-eligible units with a generating capacity of 113 megawatts each. The fuel currently used in units 1 and 2 is pipeline quality natural gas (PNG) or blended fuel oil (No. 6 residual oil and No. 2 distillate 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, 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)
- Use of low-sulfur No. 2 fuel oil
- Spray Dryer Absorber (SDA)

Potential PM_{10} Control Options (No PM_{10} controls currently implemented)
- Use of low-sulfur No. 2 fuel oil and LNB
- Dry Electrostatic Precipitator (dry ESP)
- Wet Electrostatic Precipitator (wet ESP)
- 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 water wall changes.

SO_2

Technical feasibility for the proposed control options were based on fuel storage delivery constraints, boiler configuration and the emission reduction potential of No. 2 fuel oil. None of the control options were eliminated.

PM_{10}

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. Fabric filter is expected to function properly only with pre-coating with the increased particulate loading from the SDA operation. NVE noted that the current baseline PM_{10} emissions while burning PNG or No. 2 fuel oil already meet BACT emissions levels.

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 based on firing with No. 6 fuel oil:

1) LNB – 45.4 to 49.5 percent with an emissions level of 0.26 lb/MMBtu (PNG) and 0.22 lb/MMBtu (low-sulfur No. 2 fuel oil).
2) LNB with FGR – 53.2 to 56.7 percent with an emissions level of 0.12 lb/MMBtu (PNG) and 0.14 lb/MMBtu (low-sulfur No. 2 fuel oil).
3) LNB with SNCR – 59.1 to 62.1 percent with an emissions level of 0.20 lb/MMBtu (PNG) and 0.17 lb/MMBtu (low-sulfur No. 2 fuel oil).
4) ROFA with Rotamix – 63.0 to 65.7 percent with an emissions level of 0.15 lb/MMBtu (PNG & low-sulfur No. 2 fuel oil).
5) LNB with SCR – 86.4 to 87.4 percent with an emissions level of 0.07 lb/MMBtu (PNG & low-sulfur No.2 fuel oil).

<u>SO_2</u>
SDA is estimated to achieve 84.8 percent control efficiency and meet an emissions level of 0.10 lb/MMBtu. Conversion to low-sulfur No. 2 fuel oil is estimated to achieve 93 percent control efficiency and meet an emission level of 0.05 lb/MMBtu.

<u>PM_{10}</u>
Fabric filter is estimated to achieve 46 to 53 percent control efficiency and meet an emissions level of 0.015 lb/MMBtu with installation of SDA. The conversion to low-sulfur No. 2 fuel oil with utilization of LNB is estimated to meet an emission level of 0.03 lb/MMBtu.

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.**

<u>Costs of Compliance</u>
Control options cost comparisons are presented in Tables 3-3, 3-5 and 3- 7 of each NVE BART determination report. A complete economic analysis for NO_x, SO_2 and PM_{10} is presented in the appendix to each BART determination report.

<u>Energy Impacts</u>
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 116 to 313 kilowatts. SCR retrofit will increase pressure drop. No energy impact is 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 are included for SO_2 and PM_{10} control options in the economic analysis presented in the appendix to each NVE BART determination report.

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. No negative environmental impacts are expected from the utilization of new LNB, switching to low sulfur fuel, or utilizing a fabric filter.

Remaining Useful Life
The remaining useful life is estimated to be 23 years from the installation of BART controls for units 1 and 2.

STEP 5 – Determine visibility impacts (improvements):

- **Run the model at pre-control and post-control emission rates;**
- **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 and 2 at Fort Churchill. The NO_x emission rate (0.40 lb/MMBtu) modeled is in excess of the proposed NVE BART limit (0.28 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:

Based on the information provided in NVE's October 3, 2008 BART determination reports, NDEP concurs with each BART determination for units 1 and 2 at Fort Churchill, with the exception of the installation of only LNB for control of NO_x emissions and the associated NO_x emission limits. For both 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, 24-hr average. 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

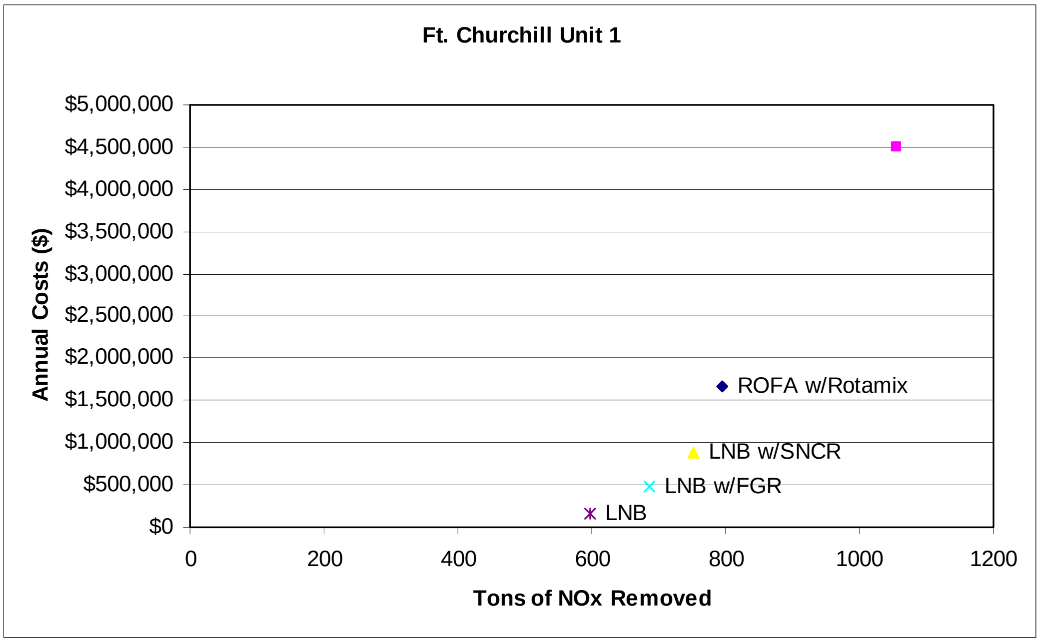
Ft. Churchill 1						
		NOx Control				
	Current Operation (Uncontrolled)	LNB w/SCR	ROFA w/Rotamix	LNB w/SNCR	LNB w/FGR	LNB
Capital Cost	$0	$35,781,250	$5,250,940	$4,416,563	$1,610,000	$1,050,000
First Year O&M Cost	$0	$705,037	$695,193	$424,800	$320,219	$45,200
First Year Debt Service	$0	$3,794,816	$974,564	$468,403	$170,750	$111,359
Total Annual Cost	$0	$4,499,853	$1,669,757	$893,203	$490,969	$156,559
Base Heat Input (MMBtu)	5,472,541					
Total Heat Input allowed (MMBtu)	11,561,448					
Base emissions (tons)	1209					
NOx Removal Rate %	0.0%	87.4%	65.7%	62.1%	56.7%	49.5%
NOx Removed (Tons)	0	1057	794	751	686	598
NOx Emission Rate (Tons)	1209	152	415	458	524	611
NOx Emission Rate (lb/MMBtu)		0.056	0.152	0.167	0.191	0.223
First Year Cost ($/ton removed)		**$4,259**	**$2,102**	**$1,190**	**$716**	**$262**
Incremental Cost ($/ton)		**$10,787**	**$17,842**	**$6,161**	**$3,842**	**$262**

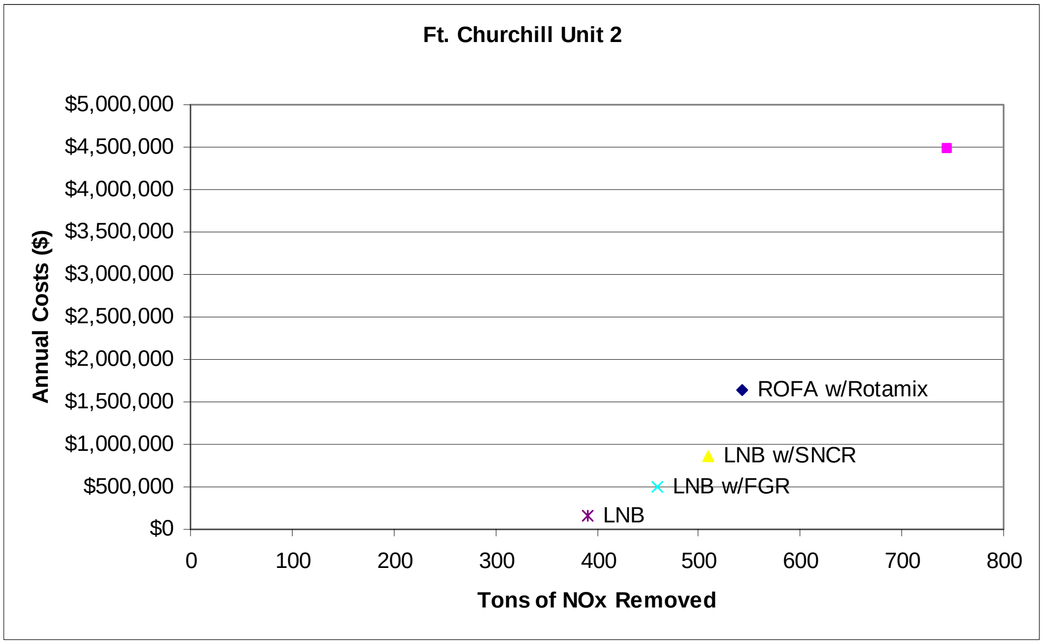
Ft. Churchill 2						
		NOx Control				
	Current Operation (Uncontrolled)	LNB w/SCR	ROFA w/Rotamix	LNB w/SNCR	LNB w/FGR	LNB
Capital Cost	$0	$35,781,250	$9,189,145	$4,416,563	$1,610,000	$1,050,000
First Year O&M Cost	$0	$685,698	$664,514	$393,739	$320,219	$45,200
First Year Debt Service	$0	$3,794,816	$974,564	$468,403	$170,750	$111,359
Total Annual Cost	$0	$4,480,514	$1,639,078	$862,142	$490,969	$156,559
Base Heat Input (MMBtu)	5,197,003					
Total Heat Input allowed (MMBtu)	11,561,448					
Base emissions (tons)	862					
NOx Removal Rate %	0.0%	86.4%	63.0%	59.1%	53.2%	45.4%
NOx Removed (Tons)	0	745	543	510	459	391
NOx Emission Rate (Tons)	862	117	319	353	404	471
NOx Emission Rate (lb/MMBtu)		0.045	0.123	0.136	0.155	0.181
First Year Cost ($/ton removed)		**$6,014**	**$3,017**	**$1,692**	**$1,070**	**$400**
Incremental Cost ($/ton)		**$14,082**	**$23,103**	**$7,296**	**$4,972**	**$400**

NDEP specifically reviewed the cost per ton of NO_x removed for each unit at Fort Churchill and determined that installation of LNB with FGR meets the BART criteria, with associated first year costs of $716 and $1,070/ton of NO_x removed for units 1 and 2, respectively. 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 SNCR, ROFA and SCR technologies with only slight improvements in visibility.

FIGURE 1

<u>LEAST COST ENVELOPE</u>





Based on this review, NDEP concludes that for NO_x the installation of LNB with FGR with an emission level at 0.20 lb/MMBtu for unit 1 and 0.16 lb/MMBtu for unit 2, 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 37 to 49 percent of the rates modeled by NVE, while the total annual BART emissions are 48 to 59 percent of the modeled rates, therefore the visibility improvement due to BART may be as much as twice that modeled.