



Public Service
of New Hampshire

ORIGINAL

P.U.C. Case No.	DE 10-261
Exhibit No.	NHSC #3
Witness	Fangel
CONFIDENTIAL	

Ruled not Confidential as hearing

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The Northeast Utilities System

July 9, 2010

Michele Roberge
Administrator, Permitting and Environmental Health Bureau
NH Department of Environmental Services, Air Resources Division
29 Hazen Drive
PO Box 95
Concord, NH 03302-0095

*Released per
Nov 3, 2010
Letter PSNH*

*Rec'd via e-mail
on July 16, 2010*

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JUL 16 2010

~~CONFIDENTIAL BUSINESS INFORMATION~~

Public Service of New Hampshire
Best Available Retrofit Technology (BART)
Response to Request for Additional Information

AIR RESOURCES DIVISION

Dear Ms. Roberge:

As requested, PSNH provides the following information to support the Merrimack Unit #2 (MK2) NOx limits and the Newington (NT1) fuel oil sulfur content for New Hampshire's Regional Haze SIP. We are providing this information as confidential business information since it contains various operating scenarios and financial costs which are competitively sensitive in nature and could be harmful if disclosed.

Merrimack Station Unit #2: Merrimack Station was the first investor owned utility in the nation to install an SCR to achieve NOx reductions. Given the operation of the SCR, it is PSNH's position that maintaining operational flexibility is a critical priority in order to ensure continued and cost-effective compliance while simultaneously achieving significant reductions in NOx emissions. The following information summarizes the primary drivers and the associated costs that would be incurred in ensuring attainment of NOx emissions rates lower than the current NOx emission limits set in the NH Regional Haze SIP

1. Operating Temperature of SCR

As previously provided, the SCR has a temperature permissive that must be met in order for the SCR to be put in service or kept in service. During start-ups, shut-downs, and low load operation of Merrimack Unit #2, the temperature is lower than that permissive temperature and the SCR cannot be operated. For example, Merrimack Unit 2 typically has 10 to 15 outages per year and approximately 8 low load operations per year. During these events, SCR operating temperatures are less than the permissive temperature rendering the SCR inoperable. The timing of these events is not predictable; the estimate of occurrences provided reflects historical performance.

Examples of low load situations include, but are not limited to, the following:

- Forced and planned outage start ups and shutdowns;

- Loss of one of any equipment pair: Both pieces are necessary for full load operation and the loss of one results in half load operation (such as forced draft fans, condensate pumps);
- Loss of the main boiler feed pump;
- Loss of coal feeders, condenser waterbox cleaning, etc.; and
- Any condition which results in the flue gas temperatures to be below the SCR permissive temperature will result in the SCR not able to be put in service.

2. Malfunction and Fouling of the SCR and/or Associated Equipment

In addition to boiler operations and load conditions that affect SCR operation, malfunctions of the SCR system and/or associated equipment can also affect the operation of the SCR. Malfunctions of the SCR system and/or associated equipment can result in partial or complete reduction of SCR performance.

Also as part of normal service, the SCR performance degrades over time. One reason this occurs is due to blinding of the catalyst with fly ash. This condition will cause the SCR process control settings to compensate by increasing SCR loading to maintain the set point. This is necessary because the reagent distribution becomes less uniform as less surface area of the catalyst is exposed to the flue gas. To manage this condition from developing to the point that a maintenance outage is necessary, the SCR is cleaned on-line utilizing soot blowers and cleaned during outages, as needed. Increased SCR loading will lead to more frequent maintenance outages. Reagent injection grid nozzles are directly exposed to the flue gas and become fouled over time. This can affect reagent distribution, compounding the effect of a fouled catalyst. The reagent injection grid is cleaned, as needed, during outages. Also as catalyst ages, it becomes less reactive. This causes a reduction in ability for NO_x conversion to take place. This in itself does not typically result in higher NO_x emissions because the SCR has four layers of catalyst, intentionally staggered in age. However, it will compound the effect of a fouled catalyst and can result in the SCR being unable to perform continually at its maximum capability. As a result, PSNH needs flexibility to operate the SCR based on current operating conditions. Currently the SCR averages greater than 86% efficiency. The uncontrolled NO_x rate at normal full load is as high as 2.66 lb NO_x/mmBTU, with an average of 2.4 lb NO_x/mmBTU. The uncontrolled NO_x rate at reduced load and during start ups and shut-downs is typically 1.0 - 1.5 lb NO_x/mmBTU.

With these short-term challenging operational conditions, PSNH's greatest concern is ensuring consistent compliance. We have reviewed historical data and concluded that start-ups and shut downs can significantly impact both a calendar month and a rolling 30-day average emission rate by up to 0.04 lb NO_x/mmBTU. If there is more than 1 outage during the averaging period, the impact to the average emission rate could be as high as 0.08 lb NO_x/mmBTU. To allow for this potential operating occurrence, Merrimack Station would need to operate to maintain a much lower average NO_x rate. Reviewing the historical monthly averages, this leaves little margin for typical operating fluctuations in NO_x controls. For example, if a unit is off for a longer period of time, there are less valid operating days available to be included in average rate. This analysis is particularly interesting, because in this specific scenario, the total tons of emissions are less than full load operation for the same averaging period, but could have a high emission rate. An extreme example of this scenario was observed in August 2009 when the monthly average emission rate was 0.813 lb NO_x/mmBTU and yet total emissions for that month were

approximately 1 ton. This was primarily due the unit operating only a short amount of time in that month.

3. Potential Costs Associated with Proposed Reduction in NOx emission rate

Merrimack Station will need to consider a number of additional compliance efforts if not provided the necessary flexibility to deal with short-term events as described above and the operational restrictions of the SCR. Each has an additional cost as outlined below.

There will be increased maintenance costs to maintain peak NOx reduction capability. For example, air heater cleanings will be required more frequently because of increased loading of the SCR. This scenario results in additional maintenance costs and replacement power costs associated with the required outages.

Maintenance (Cleaning) Costs: \$30,000 to \$100,000 per cleaning

Replacement Power Costs: The table below uses an assumption of ~ \$30/mwhr difference between the cost of Merrimack Station and the market cost. This number can vary greatly depending on energy market prices.

Duration of Cleaning/Outage	Replacement Power Cost per Outage	Number of outages per year	Total Cost per Year
Short (3 days)	\$720,000	1	\$720,000
		2	\$1,440,000
		3	\$2,160,000
		4	\$2,880,000
Mid (4.5 days)	\$1,100,000	1	\$1,100,000
		2	\$2,200,000
		3	\$3,300,000
Long (6 days)	\$1,400,000	1	\$1,400,000
		2	\$2,800,000

If air heater washings were routinely necessary to comply with a step change in the NOx rate, the cost per ton of NOx reduction would be extremely costly, as illustrated below. This cost can increase greatly if an air heater cleaning was completed during a high priced market.

Emission Rate Lb NOx/mm BTU	NOx tons emitted per year	Incremental tons per year	Incremental tons per day
0.37	5628.34		
0.34	5171.99	456.35	1.25

Duration of Cleaning/Outage	Replacement Power Cost per Outage	Incremental tons per year	Cost per Ton
Short (3 days)	\$720,000	456.35	\$1,578
Mid (4.5 days)	\$1,100,000	456.35	\$2,410
Long (6 days)	\$1,400,000	456.35	\$3,068

Examples of other compliance measures that would be necessary include accelerating the catalyst replacement in the SCR management plan. Currently, one layer of catalyst is exchanged every 2 years. To revise this plan by exchanging one layer every year would result in a project expense of approximately \$2 million every other year. Increasing the frequency of catalyst replacement would result in approximately \$12 million over the period 2013 thru 2025. This revised replacement plan would not likely result in additional total reduced tons of NOx for the year, but rather help manage the brief periodic increased emission rates associated with the events described above.

It should be reiterated that these compliance measures are focused solely on the shorter duration events that typically occur at lower loads with less heat input and for a discreet period of time-- and thus do not result in the emission of a significant amount NOx emissions. For example, the flexibility of partial load operation during high demand periods is important to the electrical reliability of the grid and can significantly protect customers from high energy costs during these peak events. It would not be in the public interest to require the unit to come off line since such action would be extremely costly to both reliability and to customers. A half-day of no operation when energy prices are over \$100/mwh will be \$250,000, \$350,000 or greater; a cost that would yield a NOx reduction of only approximately 10 – 15 tons.

This discussion demonstrates that the implementation of a calendar month and rolling 30 day lb/mmbtu NOx emission rate can result in significant cost to our customers with little environmental benefit. To avoid permit exceedences due to a short-term NOx rate excursion, would require running the SCR harder, more frequent air heater cleaning, extended outages, and forced outages.

Replacement power cost associated with outages:

	Cost delta with the Market	Total cost of Outage for customers	Cost per Ton *
1 day	\$30	\$239,040	\$15,936
	\$40	\$318,720	\$21,248
	\$50	\$398,400	\$26,560
2 days	\$30	\$478,080	\$15,936
	\$40	\$637,440	\$21,248
	\$50	\$796,800	\$26,560

*assumes saving of 15 tons per day .

As you are aware, Merrimack Station has aggressively reduced NOx emissions for the past 15 years. The total annual emissions reflect that laudable effort. Going forward, Merrimack Station anticipates continuing that effort, while maximizing customer value and providing reliable, affordable power, but to do that successfully, we do require operational flexibility. It is critical to understand that such operational flexibility will ensure consistent compliance with the monthly average emission rate while not significantly increasing total NOx emissions.

Newington Station- additional fuel oil information

In your June 15, 2010 email, you also requested information regarding Newington Station's current oil stocks, storage capacity, fuel usage rates, and operational considerations and costs

associated with switching to lower sulfur fuels required by the NH Regional Haze SIP. That information is provided below.

Please describe the current oil stocks (type and quantity) and storage capabilities.

Newington Station has the capacity to store approximately 732,500 barrels (31 million gallons) of fuel oil in four separate above ground storage tanks (identified as NT-1, NT-2, SR-2, and SR-3). Currently, these four tanks contain approximately 485,000 barrels (20 million gallons) of No. 6 fuel oil with an average sulfur concentration of approximately 1%.

How many hours of operation would this supply at current usage rates? What are the rates that this estimate is based on?

Due to various economic conditions, including the rising cost of No. 6 fuel oil, lower natural gas prices and electric demand, Newington Station has burned only a limited volume of oil in the past couple years. Current conditions are not expected to change considerably in the short term, therefore, Newington does not anticipate consuming a significant volume of oil in the next couple of years.

It is difficult to assess how long it would take to deplete this fuel oil inventory since fuel oil usage is dependent on market conditions and the demand for electricity. Newington Station will choose the fuel or blend of fuel (oil, natural gas, or natural gas and oil) based on the desired electrical output and the cost of fuel. As you are aware, Newington Station will use the most cost effective fuel to maintain its electric costs for the customer.

In an effort to understand how this inventory relates to future operating conditions, PSNH has looked at different operating scenarios to estimate the length of time it may take to deplete this inventory. The scenarios include different operating loads, a fuel mix of 75% natural gas and 25% fuel oil, and an operating capacity factor of 5% (see table below). Although, PSNH can not reliably predict with any certainty how Newington Station will operate in the next couple years, for purposes of this evaluation, PSNH has assumed an average output level of 150 MW with a heat rate of 11,750 Btu/kWh, 75% natural gas/25% oil blend, and a capacity factor of 5%.

Based on current fuel oil inventory levels, and the scenario presented above, Newington Station would deplete its existing fuel supply in 16 years.

MW	Btu/kWh	Btu/gal Oil	Capacity Factor %	BBU/yr	75% gas/25% oil BBU/yr	Projected depletion of current inventory (yrs)
400	10,793	153,846	5	292,845	73,161	7
150	11,750	153,846	5	119,533	29,883	16
100	13,860	153,846	5	93,951	23,488	21
60	16,560	153,846	5	67,352	16,838	29

Note:
 Assuming an average output level of 150 MW with a heat rate of 11,750 Btu/kWh, a 75%/25% gas/oil blend, and a capacity factor of 5%, the current inventory would be depleted in 16 years. This scenario is Newington Station's best estimate based on current operating history.

What are the specific operational considerations in switching to 0.3% S oil that do or do not make it feasible and costly?

Ms. Michele Roberge, Administrator
July 7, 2010
Page 6 of 7

PSNH understands that the Regional Haze SIP will require Newington Station to burn 0.5% or 0.3 % sulfur oil as part of its compliance strategy as early as 2013. In order to prepare for this requirement, Newington Station would need to have the available capacity to store the lower sulfur oil. Due to a variety of factors that affect the availability and cost of natural gas, PSNH believes it would be necessary to empty one of the larger bulk fuel oil storage tanks, at a minimum, to provide the storage capacity of the lower sulfur fuel. Our largest tanks (NT1 and NT-2) currently contain approximately 160,000 barrels each of fuel oil. Based on the likely operating scenario presented above, it will take more than 5 years to empty one of the larger tanks.

In this scenario, Newington would either need to operate and utilize the on-hand fuel or sell some of its current inventory if an acceptable process could be identified. It is difficult to estimate what the cost to PSNH would be if this were required, since the value of this oil in 3 years is unknown.

PSNH currently knows of no way other than consuming oil in the unit to dispose/deplete our current inventory. Although offloading oil from the tanks to a barge or ship is being considered, Newington's oil terminal was designed to accept deliveries of oil from fuel vessels and was not designed to load vessels from the oil tanks. Newington Station also does not have the capability for loading trucks from the oil tanks. Any risk to personnel safety or the environment would need to be fully eliminated to consider a transfer of oil to a vessel or truck. Therefore, at this point, it is assumed that Newington Station would be required to burn the oil in the unit at a potential incremental cost to NH customers. Consistent with the numbers above, to burn 160,000 barrels of oil to empty one of the larger tanks, the unit would have to operate an equivalent of 24 hours/day for approximately 10 days at 400 MWh. Also, as stated above, due to economic conditions, Newington Station has been reserved to protect customers from high priced market excursions. If we assume consumption of the inventory of oil is required, then it will be necessary for Newington to operate at rates higher than market rates. In this case, based on an incremental cost of \$80 per MWh, the total cost to customers will be approximately \$8 million. This is a significant cost to customers which has no associated environmental benefit.

Blending this higher sulfur fuel with lower sulfur fuel or natural gas over time is a more cost effective option and will not result in greater emissions as compared to a targeted depletion effort described in the above scenario. Although it is possible to consider the depletion of current fuel oil inventories by blending with natural gas, natural gas is not always available and could not be relied upon as a sole compliance option.

What are the estimated costs of making the switch; both capital and operating costs?

As presented in our earlier December 4, 2009 letter, the cost to PSNH in going from a 1% sulfur oil to a 0.5% sulfur oil could be as high as \$42/bbl (based on fuel oil prices from 2005-2009). Similarly, the cost to PSNH in going from 1% sulfur oil to 0.3% sulfur oil could be as high as \$51/bbl. Using the same operating scenario presented above, this equates to an additional cost to PSNH customers of \$1.2 million/year for the use 0.5% sulfur fuel and \$1.5 million/year for the use 0.3%.

Ms. Michele Roberge, Administrator
July 7, 2010
Page 7 of 7

PSNH would be happy to meet with you and your staff to discuss the information provided above. If you have questions or require additional information, please contact me at 634-2440 or Sheila Burke at 634-2512.

Sincerely,



Elizabeth H. Tillotson
Technical Business Manager – Generation

cc:
Sheila Burke, Generation Staff
Tara Olson, Newington Station

August 16, 2010

*Released
Per Nov 3, 2010
Letter to
PSNH*

~~CONFIDENTIAL BUSINESS INFORMATION~~

Public Service of New Hampshire
Best Available Retrofit Technology (BART)
Response to Request for Additional Information

SUPPLEMENTAL INFORMATION to PSNH's July 16 Letter, Response to Request for
Additional Information-re: BART

As requested, PSNH provides the following information to support the Merrimack Unit #2 (MK2) NOx limits for New Hampshire's Regional Haze SIP. We are providing this information as confidential business information since it contains various operating scenarios and financial costs which are competitively sensitive in nature and could be harmful if disclosed.

Merrimack Station Unit #2: Merrimack Station was the first investor owned utility in the nation to install an SCR to achieve NOx reductions. Given the operation of the SCR, it is PSNH's position that maintaining operational flexibility is a critical priority in order to ensure continued and cost-effective compliance while simultaneously achieving significant reductions in NOx emissions. The following information summarizes the primary drivers behind the increased costs that would be incurred in ensuring attainment of NOx emissions rates lower than the current NOx emission limits set in the NH Regional Haze SIP.

I- Operational Impacts

Based on historical data MK2 typically has 10 to 15 outages per year and approximately 8 low load operations per year. During these events, SCR operating temperatures are reduced and in some instances below the SCR permissive temperature limit. The SCR temperature permissive must be met in order for the SCR to be put in service or kept in service. During start-ups, shut-downs, and partial load operation the temperature could be lower than the permissive temperature and the SCR cannot be operated. In most cases the timing of these events is not predictable.

Examples of low load situations include, but are not limited to, the following:

- Forced and planned outage start ups and shutdowns;
- Loss of one of any equipment pair. Both pieces are necessary for full load operation and the loss of one results in half load operation (such as forced draft fans, condensate pumps);
- Loss of the main boiler feed pump;
- Loss of coal feeders, condenser waterbox cleaning, etc.; and
- Any condition which results in the flue gas temperatures to be below the SCR permissive temperature will result in the SCR not able to be put in service.

A more stringent limit could result in the unnecessary shutdown of the unit rather than operating at partial load. An example of this scenario has occurred in the past when a critical pump failed which restricted full load operation. While the pump was repaired the unit remained operating

but at a reduced capacity, the duration of this event was approximately 240 hours. PSNH's customers received significant benefit from this partial load operation. Replacement power costs associated with this type of event are shown in the Table 1.

Replacement Power Costs: The table below uses an assumption of \$30/mwhr difference between the cost of MK2 and the market cost. This number can vary greatly depending on energy market prices.

Table 1a. Cost Associated with De-rate Flexibility at 0.37 lb/MMBtu
 Assumes 0.64 tons per hr

Duration of De-Rate	De-rate Capacity	Remaining Capacity Online	Avoided Replacement Power Cost	Cost per ton
240 hr	132 MW	200 MW	\$1,440,000	\$0
100 hr	132 MW	200 MW	\$ 600,000	\$0
50 hr	132 MW	200 MW	\$ 300,000	\$0

Table 1b. Cost Associated with limited De-rate Flexibility at 0.34 lb/MMBtu
 Assumes 0.59 ton per hr

Duration of De-Rate	De-rate Capacity	Remaining Capacity Online	Un-avoided Replacement Power Cost	Cost per ton
240 hr	132 MW	200 MW	\$1,440,000	\$10,169
100 hr	132 MW	200 MW	\$ 600,000	\$10,169
50 hr	132 MW	200 MW	\$ 300,000	\$10,169

The opportunity for partial load operation during high demand periods would be even more costly to both reliability and to customers. The example mentioned above resulted in a long duration of partial load operation but it is important to note that during periods of high energy prices a much shorter event could also have significant cost. For example, assuming a \$100 per MWh market price, operating at 200MW partial load for a period of 12-hours would avoid \$240,000 of replacement power cost. During this period a NOx reduction of approximately 7 tons would be realized which equates to \$34,000 per ton NOx. Under some of these scenarios partial load operation would be eliminated to ensure consistent compliance with the proposed NOx limit reduction.

2 - Maintenance Impacts

PSNH's highest priority is ensuring compliance with all emission limits. PSNH has reviewed historical data and concluded that start-ups, shut downs partial load operating conditions and upsets can significantly impact a calendar month average emission rate. To account for these events PSNH operates NOx control equipment to maintain a NOx emission rate of approximately 0.25 lb/MMBtu calendar month average. In order to ensure compliance with the 15.4 ton/day limit or the equivalent 0.37 lb/MMBtu emission rate, PSNH targets a 0.15 lb/MMBtu difference between the average NOx emission rate and the specific limit. Further limitations would impact operation and increase incremental maintenance and capital cost.

In addition to boiler operation and load conditions that affect SCR operation, malfunctions of the SCR system and/or associated equipment can also affect the operation of the SCR. Malfunctions

of the SCR system and/or associated equipment can result in partial or complete reduction of SCR performance.

Also, as part of normal service, the SCR performance degrades overtime. One reason this occurs is due to blinding of the catalyst with fly ash. This condition will cause the SCR process control settings to compensate by increasing SCR loading to maintain the set point. This is necessary because the reagent distribution becomes less uniform as less surface area of the catalyst is exposed to the flue gas. To manage this condition from developing to the point that a maintenance outage is necessary, the SCR is cleaned on-line utilizing soot blowers and cleaned during outages, as needed. Increased SCR loading could lead to more frequent maintenance outages. It is anticipated that a minimum of three additional SCR cleanings and air heater washes would be necessary to maintain compliance with the 0.34 lb/MMBtu proposed NOx limit. Cleanings are expected cost between \$30,000 and \$100,000 as noted below in item 3. Replacement power costs associated with the necessary maintenance outages are also described in item 3 below.

Additionally, reagent injection grid nozzles are directly exposed to the flue gas and become fouled over time. This can affect reagent distribution, compounding the effect of blinded catalyst. The reagent injection grid is cleaned, as needed, during outages. Also as catalyst ages, it becomes less reactive. This causes a reduction in ability for NOx conversion to take place. This in itself does not typically result in higher NOx emissions because the SCR has four layers of catalyst, intentionally staggered in age. However, increased loading of the SCR catalyst would be necessary to maintain compliance with the proposed reduction in NOx limit and accelerate catalyst degradation. For example, the SCR is unable to perform continually at its maximum capability. As a result, PSNH needs flexibility to operate the SCR based on current operating conditions. Currently the SCR averages greater than 86% efficiency.

Each catalyst layer has an anticipated functional life of 8 years and each layer is staggered in age to accommodate replacing one layer every 24 months. Further NOx limitation would increase loading of the SCR and could result in accelerated catalyst degradation requiring premature replacement. This would result in a loss of investment. Even if minor catalyst degradation occurred reducing the catalyst useful life from 8 years to 7.5 years the replacement schedule would need to be adjusted. The change in replacement schedule is necessary because catalyst replacement projects must coincide with MK2's overhaul schedule which is on a 12-month cycle. PSNH would incur a loss of investment of approximately \$143,000 annually due to the early replacement. It is also important to note that the revised replacement plan would result in minimal reductions to the total reduced tons of NOx for the year, but rather be put in place to avoid the periodic increased emission rates at the end of the catalyst life. As shown below in Table 2, PSNH believes minimal catalyst replacement and maintenance cost are associated with the 0.37 lb/MMBtu rates provided certain exceptions for start-up and shutdown and malfunctions.

Table 2. Incremental Maintenance and Capital Cost

Emission Limit (lb/MMBtu)	Calendar Month Control Target (lb/MMBtu)	Annual Loss of Investment of SCR Catalyst	Increase Maintenance (Cost of Air heater and SCR Maintenance)	Predicted Incremental Cost
0.37	0.22	\$0	\$0	\$0
0.34	0.19	\$143,000	\$195,000	\$338,000

3 – Replacement Power Costs associated with the Proposed Reduction in NOx Emission Rate

Merrimack Station will need to consider a number of additional compliance efforts if not provided the necessary flexibility to deal with short-term events as described above and the operational restrictions of the SCR. Each has an additional cost as outlined below.

There will be increased maintenance costs to maintain peak NOx reduction capability. For example, air heater and SCR cleanings will be required more frequently because of increased loading of the SCR. This results in additional maintenance costs and replacement power costs associated with the required outages. It is anticipated that at least one additional 4.5 day (mid) maintenance outage would be necessary to maintain compliance with the 0.34 lb/MMBtu proposed limit. In addition to the maintenance outage additional cleaning will be completed as a proactive measure during forced outages resulting in delayed start-ups. Outage duration is from time offline until the unit is phased.

If air heater washing were completed to comply with a step change in the NOx rate as shown below, the cost per ton of NOx reduction would be extremely costly. Again this number can increase greatly if an air heater cleaning was completed during a high priced market.

Table 3. Potential Emission Summary (8760 hrs)

Emission Rate Lb NOx/mm BTU	NOx tons emitted per year	Incremental reduction in <u>Potential</u> emissions tons per year
0.37	5628.34	0
0.34	5171.99	456

Maintenance (Cleaning) Costs: \$30,000 to \$100,000 per cleaning

Replacement Power Costs: The table below uses an assumption of \$30/mwhr difference between the cost of MK2 and the market cost. This number can vary greatly depending on energy market prices.

Duration of Cleaning/Outage	Replacement Power Cost per Outage
Short (3 days)	\$720,000
Mid (4.5 days)	\$1,100,000
Long (6 days)	\$1,400,000

It should be reiterated that these compliance measures are focused solely on the shorter duration events that typically occur at lower loads with less heat input and for a discreet period of time thus do not result in the emission of a significant amount of NOx emissions. To meet the proposed rates of 0.34 lb NOx/MMBtu, under the conditions referenced above, PSNH may be forced to shutdown for air heater/SCR cleaning and also may be forced to shutdown rather than operate at partial load. Each of these aforementioned scenarios has significant cost as described above.

Also, with out exceptions for short term operational conditions additional incremental costs may be incurred when considering a calendar month averaging period. PSNH may be forced to delay start-up to maintain a 0.34 lb/MMBtu calendar month average. It is important to note that start-up shutdowns, and partial load operating scenarios may bias a lb/MMBtu rate but typical result in low tonnage emission total. To manage for this situation it may be necessary for PSNH to adjust the current operating strategy by delaying start-ups or to prevent a short operating periods during the calendar month. Table 6., below illustrates the potential cost with delaying an outage start-up.

	Cost delta with the Market	Total cost of Outage for customers	Cost per Ton *
1 day	\$30	\$239,040	\$15,936
	\$40	\$318,720	\$21,248
	\$50	\$398,400	\$26,560
2 days	\$30	\$478,080	\$31,872
	\$40	\$637,440	\$42,496
	\$50	\$796,800	\$53,120

*assumes saving of 15 tons per day

4 - Summary of Analysis

Merrimack Station has had a program in place to reduce NOx emissions for the past 15 years. The reductions in total annual emissions reflect that laudable effort. Going forward, Merrimack Station anticipates continuing that effort, while maximizing customer value and providing reliable and affordable power. It is critical to understand adjusting the NOx rate will significantly increase the incremental costs of compliance without significantly decreasing total NOx emissions. This effort will have virtually no effect on MK2's actual emissions and is focused on limiting MK2's potential emission which results in eliminating operational flexibility and increasing operating costs. Table 7. below is a summary of the incremental costs that PSNH will incur when considering the 0.34 lb/MMBtu proposed NOx emission rate.

Emission Limit (lb/MMBtu)	Calendar Month Control Target (lb/MMBtu)	Loss of Investment of SCR Catalyst per year	Un-avoidable Replacement Power cost (Partial Load) @ 240 hrs	Increase Maintenance (Cost of Air heater and SCR Maintenance) 3 per year	Replacement Power Cost For Maintenance Outage at \$30 MWH	Delayed start-up to clean SCR and Air Heater 2days (One day each for two outages)	Incremental reduction in <u>Potential</u> tons per year	Predicted Incremental Cost Increase \$/yr	Cost per ton
0.37	0.22	\$0	\$0	\$0	\$0	\$0	0	\$0	\$0
0.34	0.19	\$143,000	\$1,440,000	\$195,000	\$1,100,000	\$478,080	456	\$3,356,080	\$7,359

This analysis demonstrates that the implementation of a 0.34 lb/MMBtu or more stringent rate will result in significant cost to our customers with little environmental benefit. This is true because a lb/MMBtu rate could result in running the SCR harder, more frequent air heater cleaning, extended outages, and forced outages, and limit partial load operation.

PSNH would be happy to meet with you and your staff to discuss the information provided above. If you have questions or require additional information, please contact Lynn Tillotson at 634-2440 or Sheila Burke at 634-2512.

cc:

Elizabeth H. Tillotson, TBM, Generation Staff
Sheila Burke, Generation Staff
Tara Olson, Newington Station

Hoffman, Barbara

From: Monroe, Pamela
Sent: Friday, July 16, 2010 3:21 PM
To: Hoffman, Barbara
Subject: FW: Additional Information Regarding BART

We should maybe attach this e-mail with the letter to show when it came in.

Pamela G. Monroe
Compliance Bureau Administrator
N.H. Department of Environmental Services
Air Resources Division
29 Hazen Drive
Concord, NH 03302
Phone (603) 271-0882
Fax (603) 271-7053
Pamela.Monroe@des.nh.gov

~~CONFIDENTIAL~~
*Released per
Nov 3, 2010 letter
to PSNH*

-----Original Message-----

From: Wright, Craig
Sent: Friday, July 16, 2010 3:13 PM
To: Monroe, Pamela
Subject: FW: Additional Information Regarding BART

-----Original Message-----

From: tilloeh@nu.com [mailto:tilloeh@nu.com]
Sent: Friday, July 16, 2010 2:45 PM
To: Roberge, Michele
Cc: Wright, Craig; burkesa@nu.com; landilt@nu.com; olsonte@nu.com; cribbdj@nu.com
Subject: Additional Information Regarding BART

Attached please find additional information requested specific to proposed BART compliance items.

If you have additional questions, please let us know.

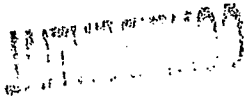
Thanks
Lynn

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The Northeast Utilities System

December 15, 2010

Robert Scott
Director
NH Department of Environmental Services, Air Resources Division
29 Hazen Drive
PO Box 95
Concord, NH 03302-0095

Public Service of New Hampshire
Best Available Retrofit Technology (BART)
Response to Request for Additional Information

Dear Mr. Scott:

As requested in your December 8, 2010 letter, PSNH provides the following additional information to support the Merrimack Unit #2 (MK2) NOx limits for New Hampshire's Regional Haze SIP.

Merrimack Station Unit #2:

Merrimack Station was the first investor owned utility in the nation to install an SCR to achieve NOx reductions. Given the operation of the SCR, it is PSNH's position that maintaining operational flexibility is a critical priority in order to ensure continued and cost-effective compliance while simultaneously achieving significant reductions in NOx emissions. The following information summarizes the primary drivers behind the increased costs that would be incurred in ensuring attainment of NOx emissions rates lower than the current NOx emission limits set in the NH Regional Haze SIP.

This submittal will analyze the 0.30 lb/MMBtu emission rate averaged on a 30-day rolling basis as well as the impact of a more stringent limit. A 30-day rolling average is defined as the arithmetic average of all hourly rates for the current boiler operating day and the previous 29 boiler operating day¹. This definition is consistent with November 22, 2010 comments provided by EPA pertaining to the draft rule.

¹ Boiler operating day for units constructed, reconstructed, or modified on or before February 28, 2005, means a 24-hour period during which fossil fuel is combusted in a steam-generating unit for the entire 24 hours. (40 CFR 60 Subpart Da)

The summary of the analysis is provided in the following table, all supporting calculations and basis for this determination are detailed in the items below.

Summary of Analysis			
Emission Limit (lb/MMBtu)	Incremental reduction in <u>Potential</u> tons per year ²	Predicted Incremental Cost Increase \$/yr	Cost per ton
0.37	0	\$0	\$0
0.30	1,065	\$880,000	\$826
0.25 - 0.30	380	\$2,888,000	\$7,600

1- Operational Impacts

Based on historical data MK2 typically has 10 to 15 outages per year and approximately 8 low load operations per year. During these events, SCR operating temperatures are reduced and in some instances below the SCR permissive temperature limit. The SCR temperature permissive must be met in order for the SCR to be put in service or kept in service. During start-ups, shut-downs, and partial load operation the temperature could be lower than the permissive temperature and the SCR cannot be operated.

Examples of low load situations include, but are not limited to, the following:

- Forced and planned outage start ups and shutdowns;
- Loss of one of any equipment pair. Both pieces are necessary for full load operation and the loss of one results in half load operation (such as forced draft fans, condensate pumps);
- Loss of the main boiler feed pump;
- Loss of coal feeders, condenser waterbox cleaning, etc.; and
- Any condition which results in the flue gas temperatures to be below the SCR permissive temperature will result in the SCR not able to be put in service.

The ability to manage these events is beneficial to our customers. Adequate flexibility allows the high cost of replacement power to be minimized. Limiting operational flexibility could result in the unnecessary shutdown of the unit rather than operating at partial load. Tables 1a. and 1b. below demonstrate the replacement power cost associated with a 0.30 lb/MMBtu, 30-day rolling average emission rate. The opportunity for partial load operation during high demand periods would be even more valuable to both reliability and to customers.

² Incremental reduction of Potential emissions is the calculated mean of the 0.25-0.30 range.

Replacement Power Costs: The table below uses an assumption of \$30/mwhr difference between the cost of MK2 and the market cost.

Table 1a. Cost Associated with De-rate Flexibility at 0.37 lb/MMBtu
 Assumes 0.64 tons per hr

Avoided Cost			
Duration of De-Rate	De-rate Capacity	Remaining Capacity Online	Avoided Replacement Power Cost
240 hr	132 MW	200 MW	\$1,440,000
100 hr	132 MW	200 MW	\$600,000
50 hr	132 MW	200 MW	\$300,000

Table 1b. Cost Associated with limited De-rate Flexibility at 0.30 lb/MMBtu
 Assumes 0.51 ton per hr

Un-Avoided Cost			
Duration of De-Rate	De-rate Capacity	Remaining Capacity Online	Un-avoided Replacement Power Cost
240 hr	132 MW	200 MW	\$1,440,000
Avoided Cost			
Duration of De-Rate	De-rate Capacity	Remaining Capacity Online	Avoided Replacement Power Cost
100 hr	132 MW	200 MW	\$600,000
50 hr	132 MW	200 MW	\$300,000

The table is based on a steady state NOx emission rate of 0.22 lb/MMBtu and a NOx emission rate of 0.8 lb/MMBtu during partial load operation. The maximum number of days MK2 can operate in a partial load is 4.2 days (100 hrs) when considering a 0.30 lb/MMBtu 30-day rolling emission limit.

It should be noted previous submittals did not consider the rolling averaging method, because the existing Data Acquisition and Handling System (DAHS) is not configured for this averaging period. Based on EPA comments of the proposed Env-A 2300 Rule, PSNH has consulted the software vendor which supplies the DAHS and is reviewing the best available option to manage this averaging period. Current method of achieving this is through a new "Smart Reporting" software trial program. PSNH is confident in working with the vendor that the rolling average period will be achievable. Preliminary information suggests that implementing the new software has an estimated cost of \$10,000 and an annual recurring cost of \$2,000.

2 - Maintenance Impacts

Calendar Month Analysis (Previously Submitted):

PSNH's highest priority is ensuring compliance with all emission limits. PSNH has reviewed historical data and concluded that start-ups, shut downs partial load operating conditions and upsets can significantly impact average emission rates. PSNH's current method of operation to account for these events is to operate NOx control equipment to maintain an emission rate of

approximately 0.25 lb/MMBtu calendar month average to ensure compliance with the 15.4 ton/day limit or the equivalent 0.37 lb/MMBtu emission rate. This method of operation results in approximately a 0.15 lb/MMBtu difference between the average NOx emission rate and the limit, this allows for operational flexibility as described above (i.e. start-up, shutdown, partial load operation etc). Further limitations based on a calendar month would impact operation and increase incremental maintenance and capital cost. For complete breakdown of the costs represented in Table 2a. and a calendar month analysis reference PSNH's August 16, 2010, submittal.

Emission Limit (lb/MMBtu)	Calendar Month Control Target (lb/MMBtu)	Annual Loss of Investment of SCR Catalyst	Increase Maintenance (Cost of Air heater and SCR Maintenance)	Predicted Incremental Cost
0.37	0.22	\$0	\$0	\$0
0.34	0.19	\$143,000	\$195,000	\$338,000

30-Day Rolling Average analysis:

In addition to the above analysis and based on EPA comments to the draft rule and DES's request for additional information, PSNH further analyzed the impact of changing its current method which is based on a calendar month average and reviewed a 30-day rolling emission limit, as well as the incremental cost associated with this limit. PSNH agrees with EPA that the 30-day rolling average method addresses flexibility for start-up, shutdown, emergency and malfunction. However, additional flexibility is necessary to maintain short term partial load capability.

PSNH has determined that a 0.30 lb/MMBtu emission rate on a 30-day rolling average will accommodate reasonably anticipated operating scenarios while achieving approximately 20% reduction in potential emissions. The maintenance costs that will be incurred by complying with this limit is estimated to be \$30,000 per year, and can be attributed to additional cleaning and inspection of the SCR and air heater. PSNH also analyzed more stringent limits and determined costs similar to those represented in Table 2a above would be incurred. The increase cost associated with a more stringent limit can be attributed to the cascading effect of increased loading of the SCR.

Increased loading of the SCR results in the following conditions each more impactful as loading increases. More detail associated with these conditions can be found in the August 16, 2010, PSNH submittal.

- 1) Blinding of Catalyst;
- 2) More Frequent Maintenance Outages;
- 3) Fouled reagent distribution nozzles;
- 4) Accelerated catalyst derogation; and
- 5) Loss of Investment of catalyst.

Emission Limit (lb/MMBtu)	Annual Loss of Investment of SCR Catalyst	Increase Maintenance (Cost of Air heater and SCR Maintenance)	Predicted Incremental Cost
0.37	\$0	\$0	\$0
0.30	\$0	\$30,000	\$30,000
0.25-0.30	\$143,000	\$195,000	\$338,000

As noted in condition 2 above there will likely be additional maintenance outages to ensure optimum SCR performance. Replacement power costs that customers would incur from an additional maintenance outage are described in Item 3.

3 – Replacement Power Costs associated with more stringent limit than 0.30 lb/MMBtu NOx Emission Rate

Merrimack Station will need to consider a number of additional compliance efforts if not provided the necessary flexibility to deal with events as described above.

Increased maintenance costs to maintain peak NOx reduction capability could be significant. For example, air heater and SCR cleanings will be required more frequently because of increased loading of the SCR. This results in additional maintenance costs and replacement power costs associated with the required outages. In addition to the maintenance outages additional cleaning will be completed as a proactive measure during forced outages resulting in delayed start-ups. Outage duration is from time offline until the unit is phased.

If air heater washing were completed to comply with a step change in the NOx rate as shown below, the cost per ton of NOx reduction would be extremely costly. Again this number can increase greatly if an air heater cleaning was completed during a high priced market.

Duration of Cleaning/Outage	Replacement Power Cost per Outage
Short (3 days)	\$720,000
Mid (4.5 days)	\$1,100,000
Long (6 days)	\$1,400,000

Replacement Power Costs: The table uses an assumption of \$30/mwhr difference between the cost of MK2 and the market cost. This number can vary greatly depending on energy market prices.

It should be reiterated to meet more stringent emission rate than 0.30 lb NOx/MMBtu, under the conditions referenced above, PSNH may be forced to shutdown for air heater/SCR cleaning and also may be forced to shutdown rather than operate at partial load. Each of these aforementioned scenarios has significant cost as described above in Table 5.

4 - Summary of Analysis

Merrimack Station has aggressively reduced NOx emissions for the past 15 years. The total annual emissions reflect that laudable effort. Going forward, Merrimack Station anticipates continuing that effort, while maximizing customer value and providing reliable and affordable power. Table 4. below is a detailed summary of the incremental costs that PSNH will incur when considering the 0.30 lb/MMBtu proposed NOx emission rate and a more stringent limit.

Table 4. Summary of Additional Predicted Annual Cost³

Emission Limit (lb/MMBtu)	Un-avoidable Replacement Power cost (Partial Load) @ 240 hrs	New DAHS Implementation	Increase Maintenance (Cost of Air heater and SCR Maintenance 3 per year	Loss of investment of the SCR Catalyst	Replacement Power Cost For Maintenance Outage at \$30 MWH	Delayed start-up to clean SCR and Air Heater (Two days)	Incremental reduction in <u>Potential</u> tons per year	Predicted Incremental Cost Increase \$/yr	Cost per ton
0.37	\$0	\$0	\$0	\$0	\$0	\$0	0	\$0	\$0
0.30	\$840,000	\$10,000	\$30,000	\$0	\$0	\$0	1,065	\$880,000	\$826
0.25-0.30	\$1,440,000	\$10,000	\$165,000	\$143,000	\$1,100,000	\$0	380	\$2,888,000	\$7,600

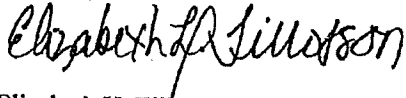
³ Values represented in Table 4 are net values.

Mr. Robert Scott, Director
December 15, 2010
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PSNH understand the cost per ton of complying with the 0.30 lb/MMBtu calculated on a 30-day rolling average is under the BART threshold and is willing to accept this limit, which results in approximately 20% reduction of MK2's potential NOx emissions. This analysis demonstrates that the implementation of a more stringent limit than 0.30 lb/MMBtu will result in significant cost to our customers with little environmental benefit. With running the SCR harder, more frequent air heater cleaning, extended outages, and forced outages, and limit partial load operation.

If you have questions or require additional information, please contact me at 634-2440 or Sheila Burke at 634-2512.

Sincerely,



Elizabeth H. Tillotson
Technical Business Manager – Generation

cc:
Sheila Burke, Generation Staff
David Cribbie, Generation Staff