pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

MEMO

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THROUGH	Mark Hammond MCH 10/14/2021 Director, Bureau of Air Quality
DATE	October 14, 2021
RE	Technical Evaluation for Case-by-Case NOx RACT Homer City Generating Station Center Township, Indiana County Source IDs 031, 032, and 033 TVOP-32-00055

MESSAGE:
This technical review memorandum outlines the technical evaluation, rationale and preliminary determination for Oxides of Nitrogen (NOx) emission limits and operational requirements for three existing coal-fired combustion units at Homer City Generating Station to include in the Pennsylvania Department of Environmental Protection (PADEP)'s State Implementation Plan (SIP) revision to address Reasonably Available Control Technology (RACT) requirements for the 2008 8-hour National Ambient Air Quality Standard (NAAQS) for ozone.

BACKGROUND:
On April 23, 2016, the Pennsylvania Department of Environmental Protection (PADEP) published 25 Pa. Code §§ 129.96 - 129.100, "Additional Requirements for Major Sources of NOx and VOCs", commonly referred to as RACT II. 20 Pa.B. 2036. Pursuant to 25 Pa. Code § 129.99, Alternative RACT proposal and petition for alternative compliance schedule, the owner or operator of the Homer City Generating Station has proposed an alternative RACT emission limitation and RACT requirements for two coal-fired electric generating units under 25 Pa. Code § 129.99(d).

FACILITY DESCRIPTION:
Homer City Generating Station operates three bituminous coal-fired combustion units (boilers with steam turbine-driven electric generators (Units 1, 2, and 3)) that provide electricity to the Pennsylvania-Jersey-Maryland (PJM) regional electric grid. Units 1 and 2 are nearly identical units and each have a nominal rating of 6,792 MMBtu/hr with gross electrical output of 690 MW for each generator at nominal maximum operating condition. Unit 3 has a nominal rating of 7,260 MMBtu/hr with gross electrical output of 710 MW. Units 1, 2, and 3 are operating as Source ID 031, 032, and 033 respectively in the TVOP-32-00055. Units 1, 2, and 3 are all equipped with Low NOx Burners (LNB) and Selective Catalytic Reduction (SCR) systems. In addition, all three units are equipped with an economizer bypass which allows for the operation of the SCR system at lower loads than would otherwise be possible.

All units are also equipped with DEP certified continuous emission monitors (CEMS) for NOx and contain exhaust gas stream flow monitors. Since Unit's 1 and 2 are nearly identical and are used for electricity generation, RACT emission limits and operational requirements determined after evaluation and analysis of either unit will apply to both units. Unit 3 will be evaluated separately both because of its slightly larger size and because of differences in its SCR system and LNB system in comparison to the other two units.

RACT:
In 40 CFR § 51.100, for the purpose of § 51.341(b) - Request for 18-month extension, RACT is defined as devices, systems, process modifications, or other apparatus or techniques that are reasonably available taking into account: (1) The necessity of imposing such controls in order to attain and maintain a national ambient air quality standard; (2) The social, environmental, and economic impact of such controls; and (3) Alternative means of providing for attainment and maintenance of such standard.

In 40 CFR Part 52, EPA has defined RACT as the lowest emission limitation that a particular source is capable of meeting by the application of control technology that is reasonably available considering technological and economic feasibility.
(https://www3.epa.gov/ttn/naaqs/aqmguide/collection/Doc_0084_VOCFR0917791.pdf)

In 25 Pa. Code §121.1, RACT is defined as the lowest emission limit for VOCs or NOx that a particular source is capable of meeting by the application of control technology that is reasonably available considering technological and economic feasibility.

Therefore, a RACT analysis should consider the technological and economic impacts of controls.

RACT ANALYSIS:
DEP used a top-down approach to determine NOx emissions limits for coal-fired boilers at Homer City Generating Station. This included searching and identifying the best methodology, technique, technology, or other means for reducing NOx while factoring environmental, energy and economic considerations into the analysis. DEP also identified controls installed on similar air contaminant sources in other states.

DEP estimated the capital, installation and annual operating costs of NOx control using the EPA's OAQPS and Control Cost Manual (Sixth edition) June 12, 2019, and vendor's quotes. DEP evaluated the cost effectiveness of technically feasible RACT control options and determined that no additional controls are cost effective.

TECHNOLOGY ANALYSIS AND NO_X EMISSION RATE DETERMINATION:
Selective Catalytic Reduction (SCR):
DEP first evaluated the most efficient NOx reduction technology SCR that is generally used to reduce NOx emissions from coal-fired boilers. All three units are already equipped with and operating SCR systems.

SCR systems typically use a titanium or vanadium catalyst and injection of ammonia or urea at optimum temperature of flue gas to convert the flue gas NOx to molecular nitrogen (N_2) and water with up to 90% NOx reduction efficiency. As per EPA's Air Pollution Control technology Fact Sheet (https://www3.epa.gov/ttncatc1/dir1/fscr.pdf), the optimum temperature of the flue gas range between 480°F and 800°F, which EPA further refined in response to comments on the Cost Manual that it "concluded that 480°F to 800°F is an ''operating'' range and that 700°F to 750°F was an optimum temperature range." (https://www.epa.gov/sites/default/files/2020-07/documents/scr_costmanual_7thed_rtc.pdf) .

Flue gas temperature varies at reduced boiler loads. Each unit at Homer City Station is required to provide the minimum electric output called for by PJM, the grid operator. Failure to provide the minimum load subjects the facility to substantial penalties, while the price paid for providing excess electricity is minimal.

SCR efficiency decreases at lower than optimum flue gas temperature. Ammonia injection at flue gas temperatures less than the optimum temperature range also become problematic because of formation of ammonium bisulfate (NH_4HSO_4) which deactivates the catalyst surface, decreases NOx reduction efficiency and boiler thermal efficiency and may lead to catalyst plugging, fouling and unplanned boiler shutdown. The original equipment manufacturer ("OEM") of the SCR system established and documented minimum operating parameters for the SCR system, including the inlet temperature to the SCR. The SCR system was designed to operate with a baseload electric generation unit (EGU); i.e. a system with a capacity load, typically operating near maximum heat input for lengthy stretches of time.

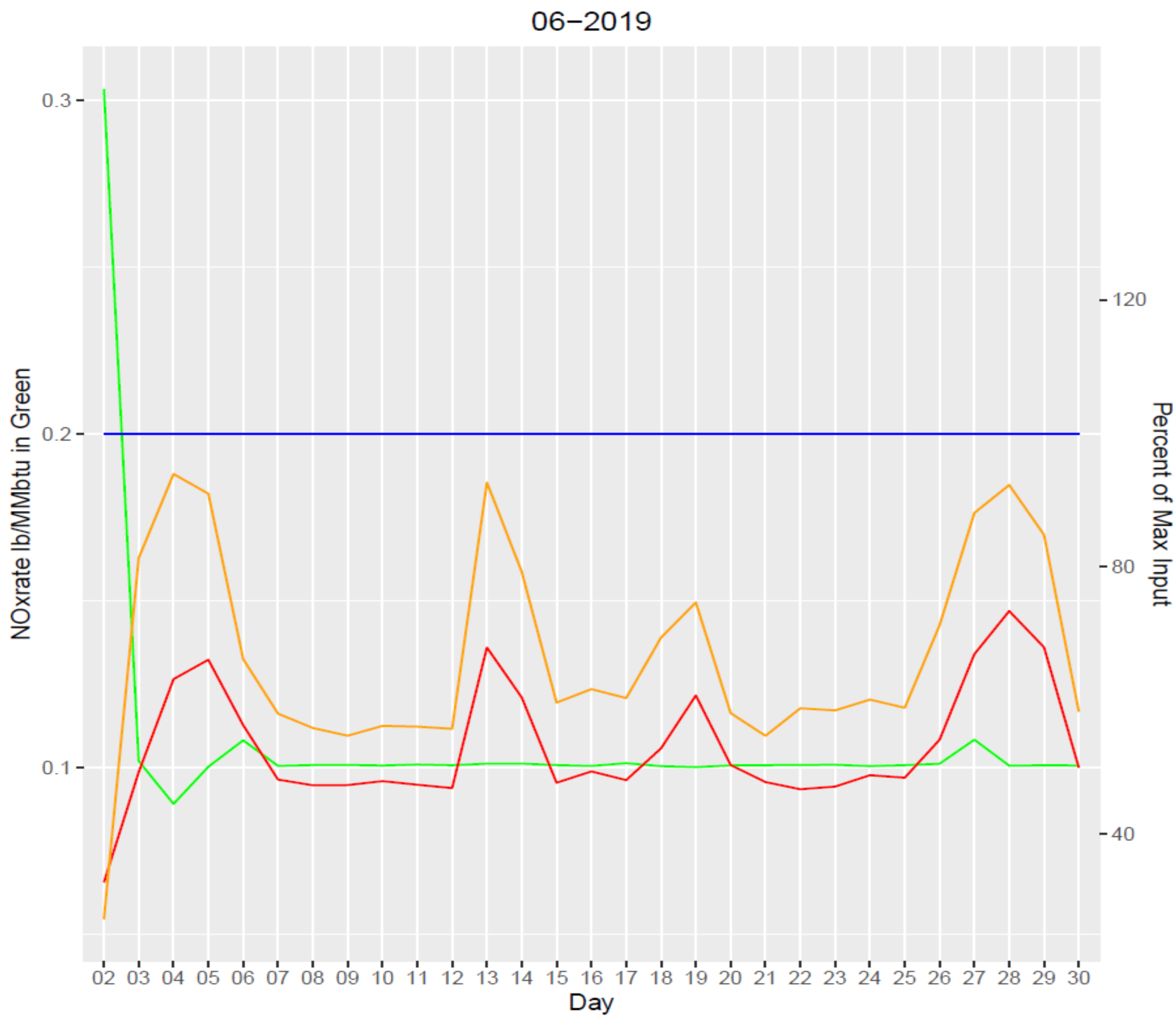
Based on a review of the ammonia feed rates, fluctuating load and NOx emission rate, any lag in the ammonia feed system is negligible. Ammonia injection rates very closely track load, and the changes in emission rate as the ammonia injection rate follows boiler load fluctuations is minor.

NOx emission limits on a daily basis:

DEP evaluated and analyzed daily NOx emissions rates from EPA's Clean Air Markets Division (CAMD) database at varying operating load conditions for Unit 1 and Unit 2 from 2017-2020. Based on this data, Homer City is targeting a NOx emission rate of about 0.10 lb NOx/MMBtu when the SCR is operating. Figure 1 below shows daily operating statistics for Homer City's Unit 1 during June of 2019. The X axis shows the day of the month while the left Y axis correlates with the green line that represents NOx emission rate in lb/MMBtu. The right Y axis is in percentage of the maximum observed heat input. The red line is the percentage of maximum heat input for the unit for the day. The orange line is the percentage of maximum ammonia input observed. The blue line is set at 100% as a reference for the maximum values for the orange and red lines.

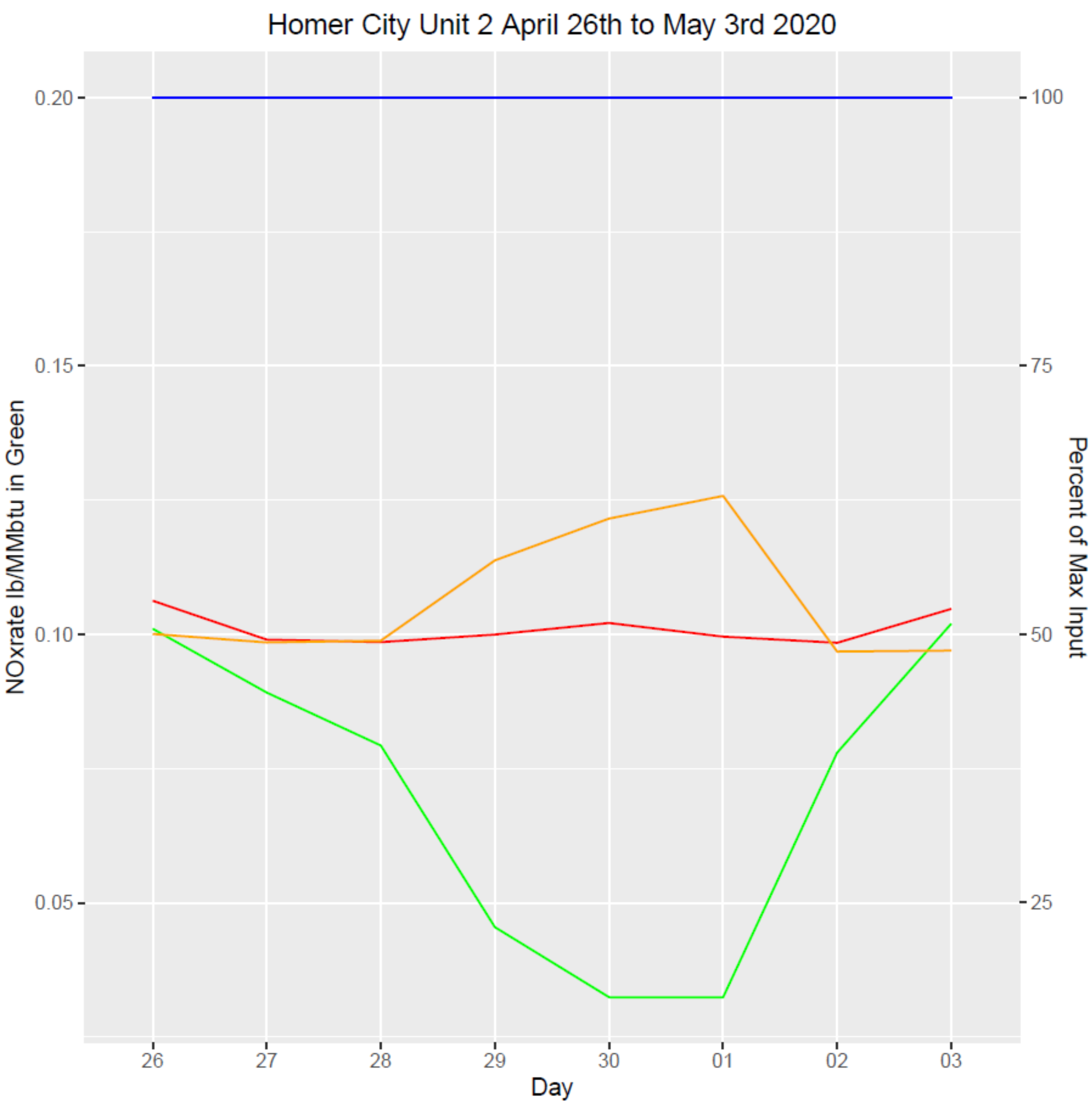
As can be seen in Figure 1, Homer City's Unit 1 was consistently targeted a NOx rate of about 0.10 lb/MMBtu.

Figure 1



While rare, there are examples of NOx rates significantly below 0.10 lb/MMBtu for Homer City's Units 1 and 2. These occurred on September 6th 2019 and May 10th of 2020 for Unit 1 and September 13th 2019, December 5th through the 7th of 2019, and April 28th through May 2nd of 2020. Figure 2 shows the period from April 26th to May 3rd 2020. During this period daily average NOx emissions drop below 0.05 lb NOx/MMBtu for a period of 3 days while ammonia injection rates increase significantly.

Figure 2



Beyond this, there are also examples of NOx emissions between the 0.05-0.10 lb/MMBtu range on an hourly basis.

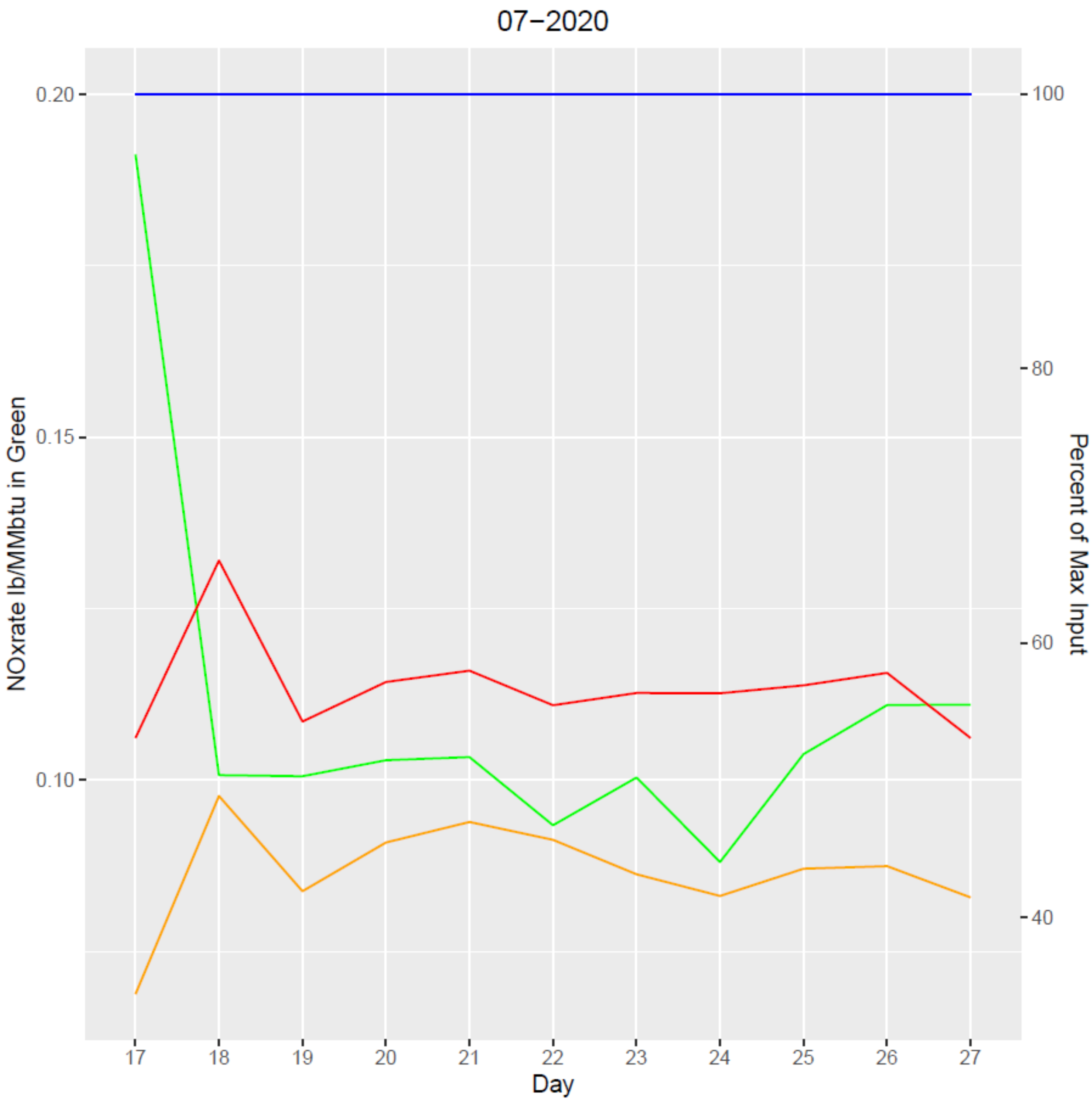
After Homer City upgraded their SCRs for Units 1 and 2 in 2018. NOx emission rates substantially improved.

During 2019 and 2020, Homer City's Unit 2 generality kept NOx emission rates at 0.10 lb NOx/MMBtu. However, Homer City was generally able to achieve this with a lower rate of ammonia injection as time went on. This is shown in Figures 3 and 4 below. Figure 3, which includes Unit 2's emission data for July of 2019, shows that Homer City was able to keep their daily NOx emission rates at 0.10 lb NOx /MMBtu with an ammonia injection rate (on average) at approximately the same percentage as the heat rate input. Figure 4 shows that one year later, Homer City was able to keep the same emission rate despite injecting significantly less ammonia and operating at a similar heat rate. A higher ammonia injection rate (orange line) relative to the percentage of maximum heat rate input (red line) indicates higher concentrations of ammonia in the exhaust. This means that Homer City's Unit 2 was able to achieve the same NOx rate despite the fact that its ammonia exhaust concentration was significantly higher during July of 2019 when compared to July of 2020. This suggests that had July of 2020's ammonia injection rates matched that of July 2019, significantly emission reductions could have been achieved during that timeframe.

Figure 3


07−2019
NOxrate lb/MMbtu in Green
0.200
0.175
0.150
0.125
0.100
0.075
Percent of Max Input
100
80
60
40
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 23 24 25 26 27 28 29 30 31
Day

Figure 4

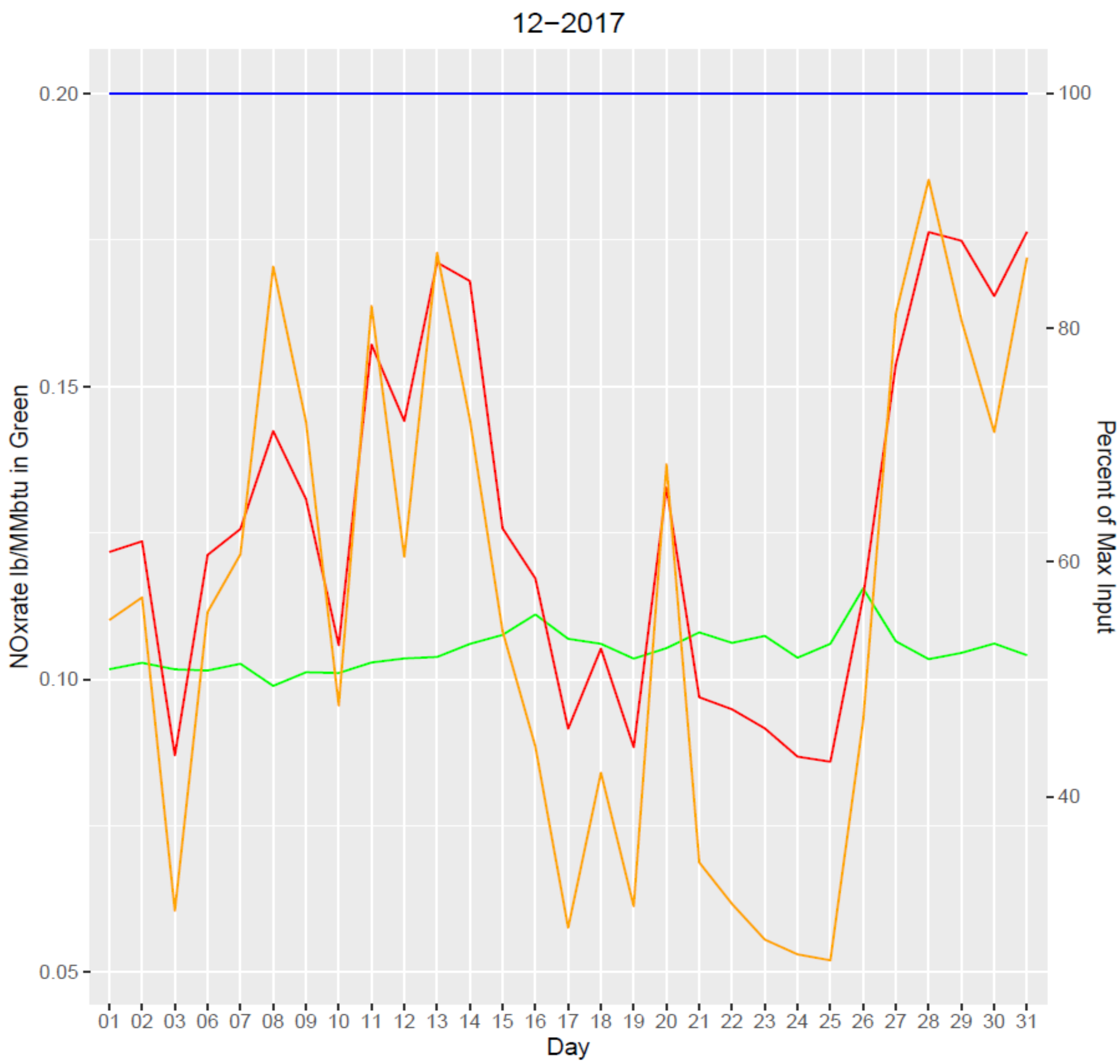


Despite the evidence presented, varying load conditions and other factors such as operating load, catalyst condition, exhaust temperature and velocity, moisture level, initial NOx levels in the exhaust, and other factors can and do affect SCR performance. Despite the fact that emissions under 0.10 lb NOx/MMBtu are possible under at least some operating conditions, accounting for other operating conditions requires a limit above the minimum achievable. Due to these factors, which include varying operating load conditions, DEP recommends a NOx emission rate permit limit of 0.080 lb/MMBtu on a daily average basis with operation of SCR also for Units 1 and 2. This limit excludes, emissions during start-up, shut-down, and malfunction; operation pursuant to emergency generation required by PJM, including any necessary testing for such emergency operations; and during periods in which compliance with this emission limit would require

operation of any equipment in a manner inconsistent with technological limitations, good engineering and maintenance practices, and/or good air pollution control practices for minimizing emissions. These exclusions are common exclusions and are included in other states presumptive RACT regulations that DEP evaluated. For example, Maryland's regulations for coal-fired electric generating units includes nearly identical provisions, with the exception that the Maryland regulations include an explicit exclusion for low-load operations. [MD COMAR Title 26, Subtitle 11, Chapter 38.04.(4)]. The daily NOx emission rate includes a factor to provide an appropriate compliance margin, fluctuations in load, any lag in the control system as well as to account for other factors in the facility's projected future operation.
Unit 3

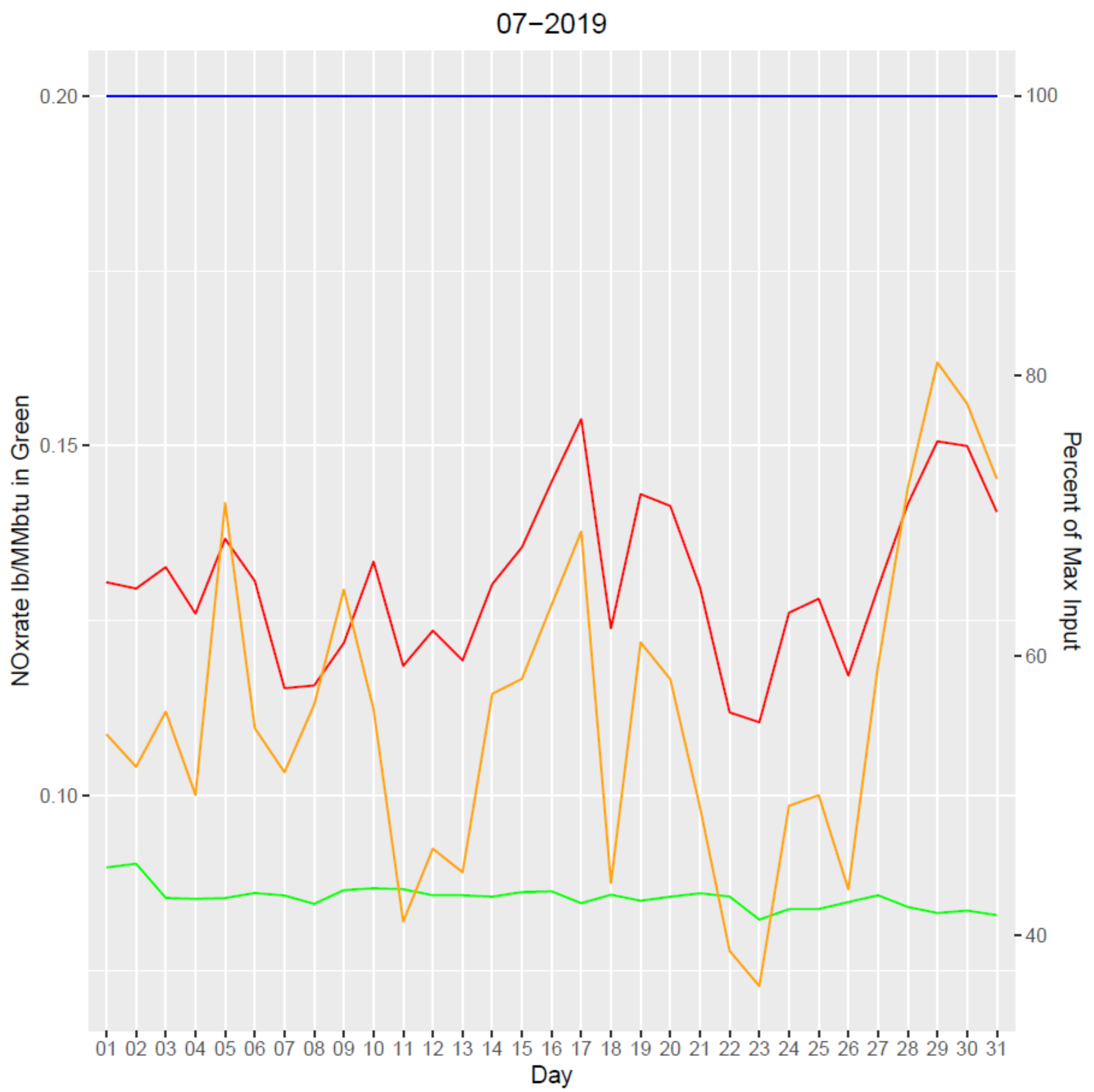
Unit 3 also appears to be targeting an emission rate of approximately 0.10 lb NOx/MMBtu. Unit 3 is able to achieve 0.10 lb NOx/MMBtu over a wide range of operating loads, possibly by utilizing its economizer bypass. This is shown in Figure 5 below.

Figure 5



After 2019, Homer City appeared to further lower the NOx emissions of Unit 3, targeting a NOx emission rate of approximately 0.09 lb/MMBtu. Figure 4 shows July of 2019, during which Unit 3 was able to consistently achieve a NOx rate between 0.09 and 0.08 lb/MMBtu. A review of the hourly data shows the NOx rate remained approximately in this range during all hours of the day despite daily load swings from as much as 45 to 90%.

Figure 6



While Unit 3 appears to be capable of achieving between 0.09 and 0.08 lb/MMBtu consistently, there is limited evidence suggesting that achieving a lower emission rate is possible, but only under certain operating conditions. Some of that evidence is presented below as Figures 7 and 8 which show emissions on September 16, 2019 and December 4, 2019 respectively.

Figure 7

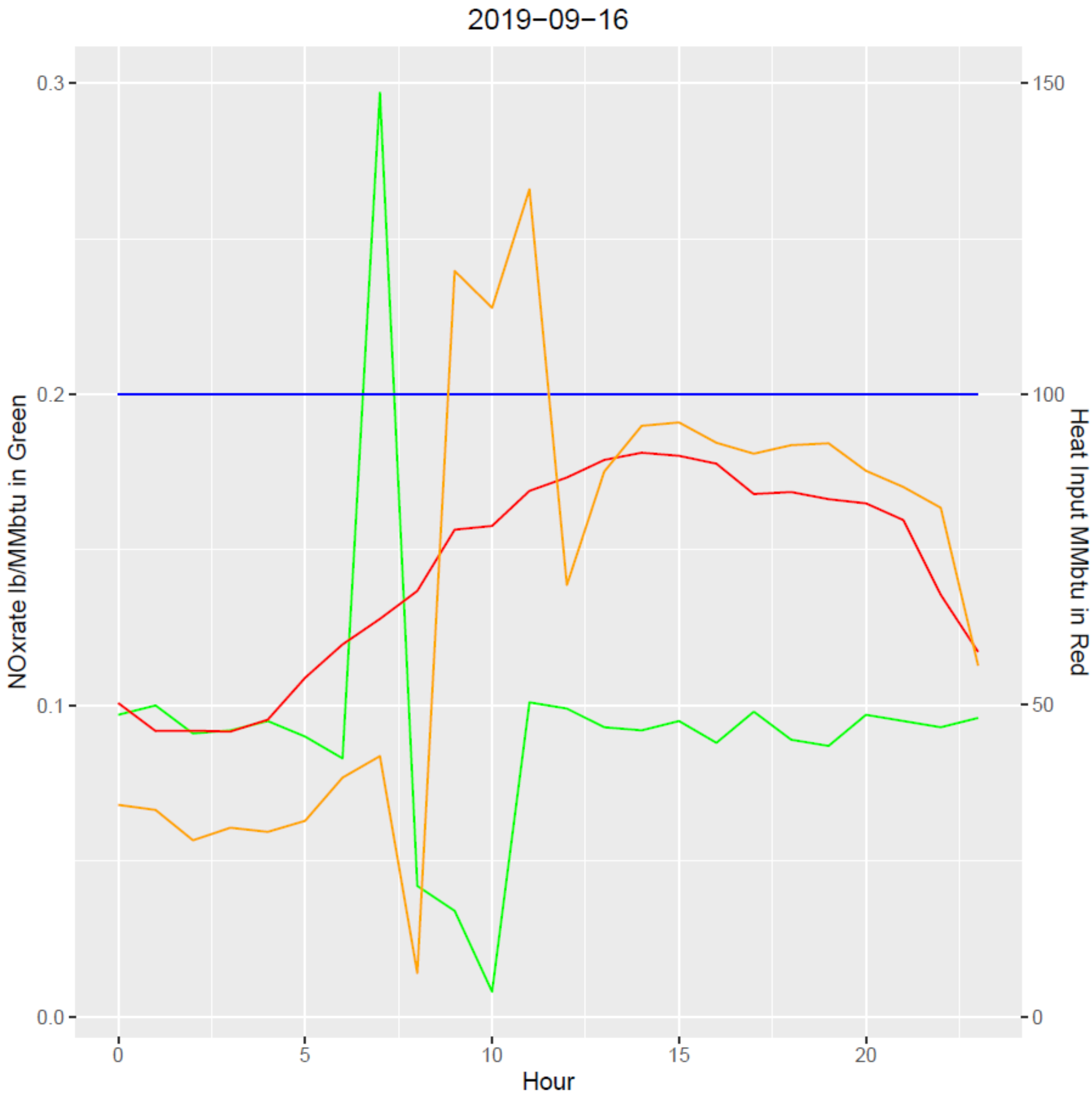
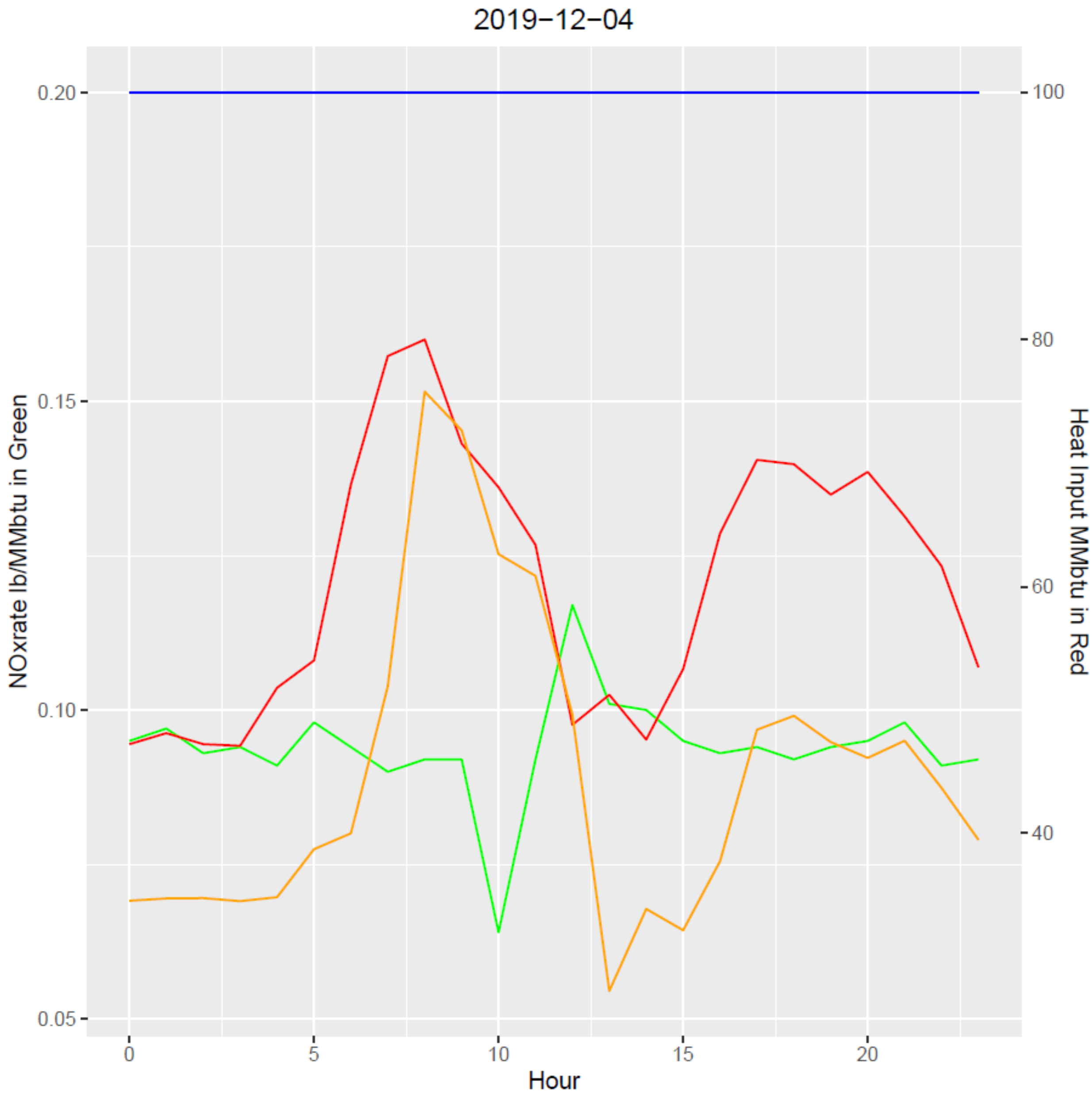

2019−09−16
NOxrate lb/MMbtu in Green
Heat Input MMbtu in Red
Hour
0.3
0.2
0.1
0.0
150
100
50
0
0
5
10
15
20

Figure 8



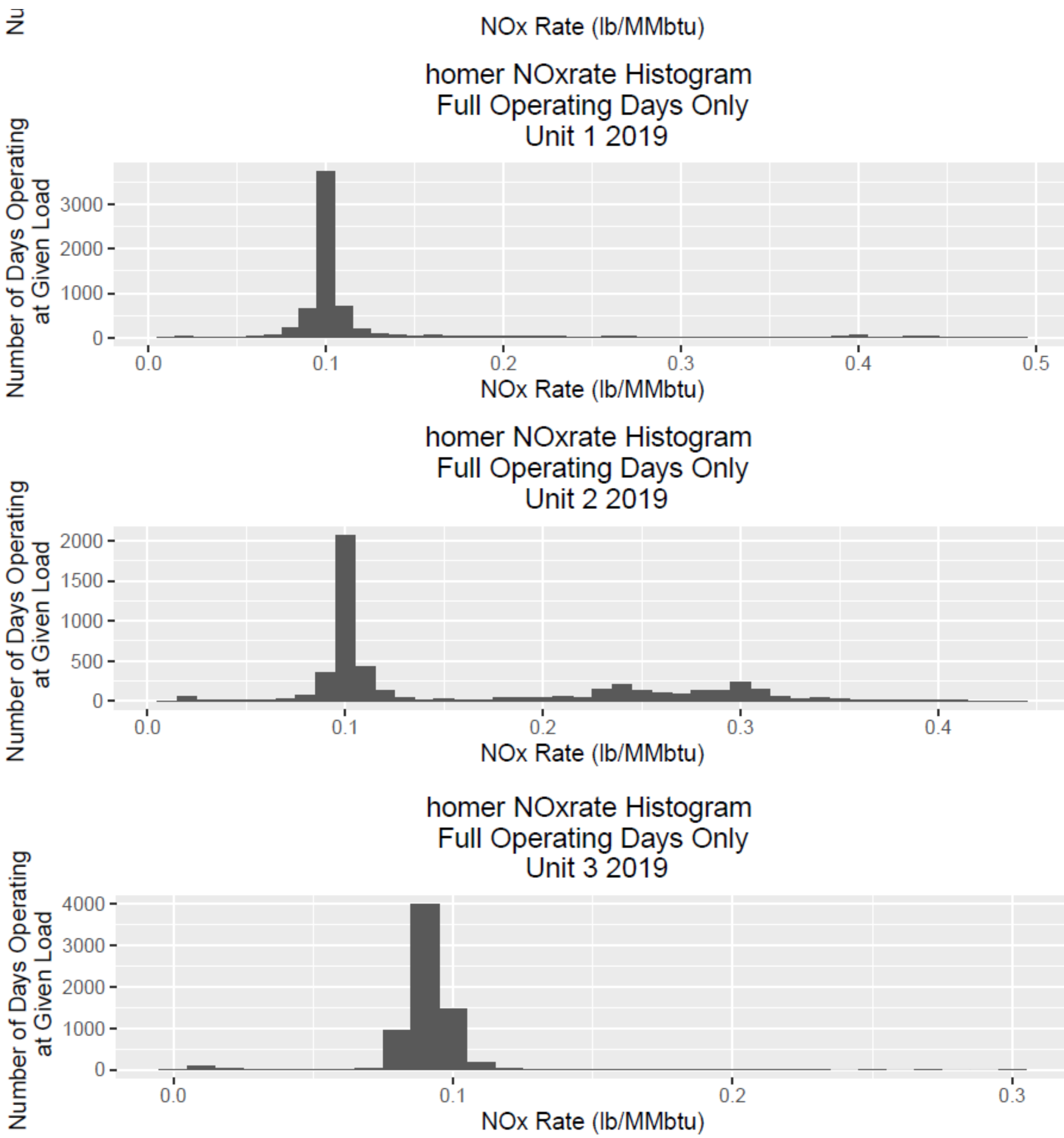
Figures 7 and 8 suggest two things. The first is that though similar occurrences are rare, Homer City's Unit 3 is capable of achieving emissions below the 0.09 lb/MMBtu it generally meets at a minimum. The second is that during instance in which the SCR either significantly overshoots or undershoots its emissions target Unit 3's operators will attempt to average out its emissions level to achieve its target, even if ammonia injection rates well above or below usually observed amounts are required. The fact that the SCR for Unit 3 is able to respond to a period of high emissions in such a way again suggests that under some operating conditions, a lower emission rate is possible.

In addition to the data presented, an engineering comparison of the design differences between Unit 1 (or 2) and Unit 3 indicate that Unit 3 is capable of lower emissions than the other two units. Homer City stated to the Department that Units 1 and 2 can currently meet an emission rate of 0.55 lb NOx/MMBtu at full load while Unit 3 can meet an emission rate of 0.38 lb NOx/MMBtu at full load. Both emission levels are before the exhaust is treated with ammonia in the SCR. The reason that Units 1 and 2 are not able to match the performance of Unit 3 is that Units 1 and 2 were designed with 24 burners and Unit 3 was designed with 48 burners. The additional burners in Unit 3 result in less fuel going through each burner which lowers the flame temperature and results in less thermal NOx formation.

However, varying load conditions and other factors such as operating load, catalyst condition, exhaust temperature and velocity, moisture level, initial NOx levels in the exhaust, and other factors can and do affect SCR performance and accounting for other operating conditions requires a limit above the minimum achievable. Due to these factors, DEP recommends a NOx emission rate permit limit of 0.07 lb/MMBtu on a daily average basis with operation of SCR also for Unit 3. This limit excludes, emissions during start-up, shut-down, and malfunction; operation pursuant to emergency generation required by PJM, including any necessary testing for such emergency operations; and during periods in which compliance with this emission limit would require operation of any equipment in a manner inconsistent with technological limitations, good engineering and maintenance practices, and/or good air pollution control practices for minimizing emissions. These exclusions are common exclusions and are included in other states presumptive RACT regulations that DEP evaluated. For example, Maryland's regulations for coal-fired electric generating units includes nearly identical provisions, with the exception that the Maryland regulations include an explicit exclusion for low-load operations. [MD COMAR Title 26, Subtitle 11, Chapter 38.04.(4)]. The daily NOx emission rate includes a factor to provide an appropriate compliance margin, fluctuations in load, any lag in the control system as well as to account for other factors in the facility's projected future operation.

DEP also evaluated and analyzed daily NOx emissions rates from EPA's Clean Air Markets Division (CAMD) database at all operating conditions for Unit 1 and Unit 2 from 2017-2020. As can be seen from the Figure 9, in 2019, NOx emission rates were as high as 0.49 lb/MMBtu for Units 1 and 2 and as high as 0.30 lb/MMBtu for Unit 3 on a daily average under all operating conditions with existing LNB and SCR system.

Figure 9



Boiler tuning:
This option involves making a number of adjustments to the boiler operating parameters that affect the generation of NOx in the boiler fire box. Changes that can be made to affect NOx generation include excess air levels, secondary air biasing, fuel/auxiliary air damper adjustments, burner tilt, fuel flow biasing, and changes to primary air flows.

Generally boiler's regular inspection, preventive maintenance, tuning, practicing during shutdown and upset conditions to prevent excess emissions, inspections and testing of Over Fire Air (OFA) components, and adjusted of burner angle to minimize NOx emissions results in lowering NOx emissions an average of 10%. The changes in set-point over time indicate that the boiler has not been tuned to minimize NOx emissions, but rather has been tuned to maximize output. A boiler cannot be simultaneously tuned to achieve both of those goals.

Therefore, DEP determined a NOx emission rate of 0.45 lb/MMBtu on a daily average basis at all operating conditions for both Units 1 and 2 and a rate of 0.27 lb/MMBtu for Unit 3 as RACT. This value includes an appropriate compliance margin and changes in the boiler utilization.

Low NOx Burner upgrade:

The Department evaluated the addition of a new LNB to replace the current LNB on all 3 units. Homer City stated in their application that the capital cost of replacing their LNB for each unit was 52, 52, and 54 million dollars for Units 1, 2, and 3 respectively. DEP then conducted an independent review of Homer City's calculations for the capital cost of the LNB replacement, which was done using factors from EPA's IPM v5.13, and determined that the actual capital costs using this methodology were 41 million 2021 dollars for each unit. Homer City stated to the Department that upgrading the LNB on Units 1 and 2 will result in a NOx emission reduction of 15% with a pre-SCR emission rate of 0.47 lb NOx/MMBtu while upgrading Unit 3's LNB will result in a 9% reduction in NOx emissions with a 0.35 lb NOx/MMBtu emission rate. The reason that Units 1 and 2 are not able to match the performance of Unit 3 is that Unit 1 and 2 were designed with 24 burners and Unit 3 was designed with 48 burners. The additional burners in Unit 3 result in less fuel going through each burner which lowers the flame temperature and results in less thermal NOx formation. Homer City stated that reconfiguring Units 1 and 2 with additional burners would likely cost more than replacing the entire boiler.

Using Homer City's PTE based on the Department's proposed 30 day rolling limit, and assuming a 15% emission reduction for Units 1 and 2, a 9% emissions reduction for Unit 3, an equipment life of 20 years, and an interest rate of 5.5% gives a cost of approximately 9,399 2021 dollars per ton for Units 1 and 2 and 15,129 2021 dollars per ton for Unit 3 making the replacement of the LNB cost prohibitive.

The cost analysis done by the Department is shown in Figure 10.

Figure 10

capital cost replacing unit 1 in 2011 dollars	$33,258,461
capital cost replacing unit 2 in 2011 dollars	$33,258,461
capital cost replacing unit 3 in 2011 dollars	$33,873,220
capital cost replacing unit 1 in 2021 dollars	$40,575,323
capital cost replacing unit 2 in 2021 dollars	$40,575,323
capital cost replacing unit 3 in 2021 dollars	$41,325,329
annualized cost 20 years 5.5%	
Unit 1	$3,396,155
Unit 2	$3,396,155
Unit 3	$3,458,930
Tons reduced assuming PTE at 30 day rolling limit	
Unit 1	361
Unit 2	361
Unit 3	229
RACT II cost 2021 dollars per ton	
Unit 1	$9,399
Unit 2	$9,399
Unit 3	$15,129

The table showing the factors used to calculate the capital cost of the LNB replacement (taken from Appendix L of the "New Hampshire Regional Haze Plan Periodic Comprehensive Revision" (DRAFT 10/31/2019)) is shown below.

Table 2.15 NO_x Combustion Control Cost Factors for Coal Fired Boilers (2011$)

Boiler Type	Technology	Capital Costs ($/kW)	Fixed O&M ($/kW-yr)	Variable O&M ($/MWh)
Dry Bottom Wall-fired	Low NO_x Burner without Overfire Air (LNB without OFA)	48	0.3	0.07
	Low NO_x Burner with Overfire Air (LNB with OFA)	65	0.5	0.09
Tangentially-fired	Low NO_x Coal-and-Air Nozzles with Close-Coupled Overfire Air (LNC1)	26	0.2	0
	Low NO_x Coal-and-Air Nozzles with Separated Overfire Air (LNC2)	35	0.2	0.03
	Low NO_x Coal-and-Air Nozzles with Close-Coupled and Separated Overfire Air (LNC3)	41	0.3	0.03
Vertically-Fired	NO_x Combustion Control	31	0.2	0.06

Scaling Factors:

- LNB without OFA and LNB with OFA = ($/kW for 300 MW Unit) x $(300/ X)^{0.359}$
- LNC1, LNC2, and LNC3 = ($/kW for 300 MW Unit) x $(300/ X)^{0.359}$
- Vertically –Fired ($/kW for 300 MW Unit) x $(300/ X)^{0.553}$

Where ($kW for 300 MW Unit) is from the above Capital Costs or Fixed O&M Costs, and X is the capacity in MW of the unit.

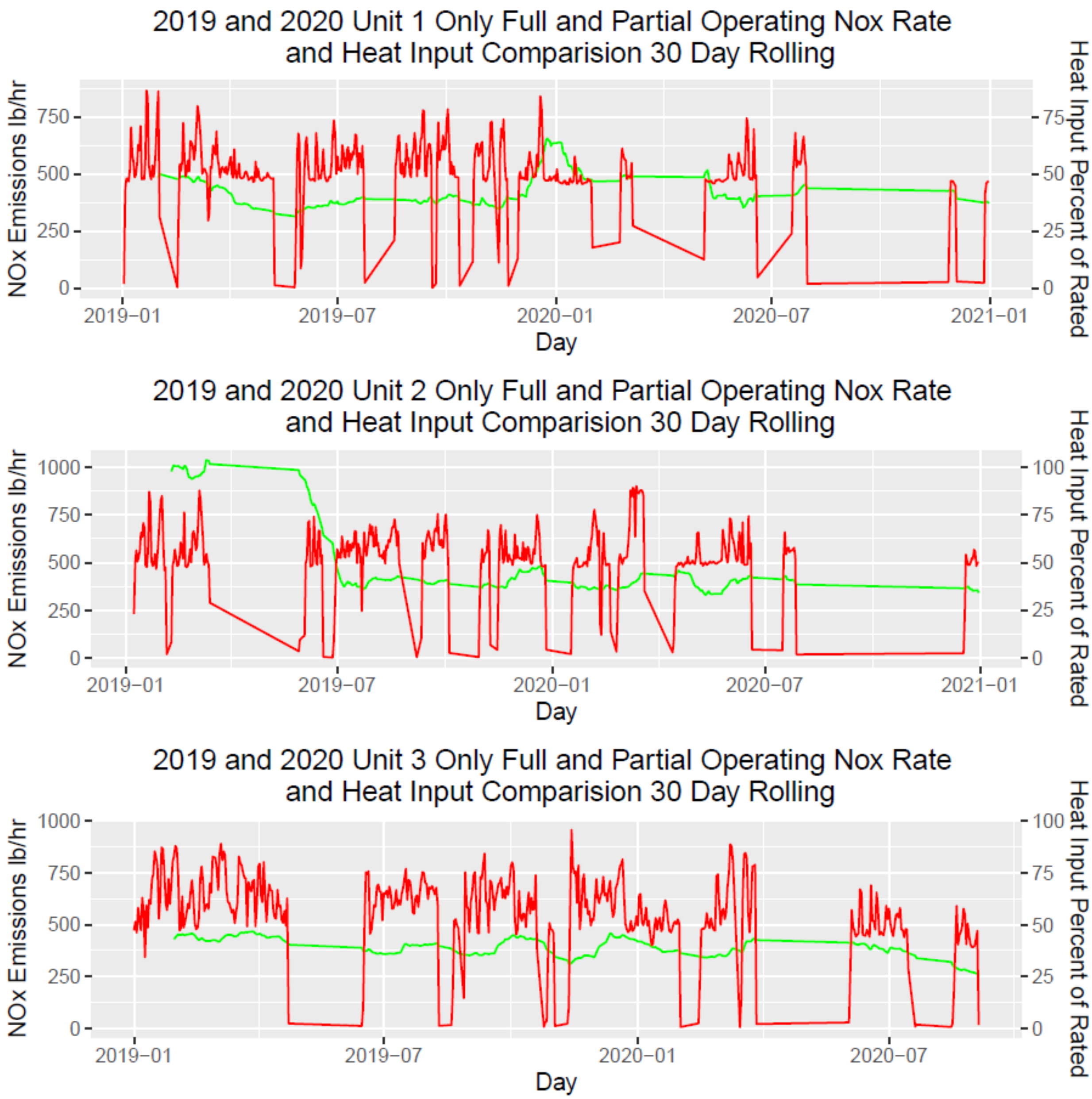
Table Reference: EPA, 2013

NOx emission limits on a 30 operating day rolling average basis:

As previously stated, the Department is proposing a daily limit of 0.08 lb/MMBtu based on the emission reduction potential of the SCR, including an appropriate margin for compliance. Homer City's Units 1 and 2 emits about 550 lb NOx per hour and Unit 3 emits about 510 lb NOx per hour assuming an emission level from Units 1 and 2 of 0.08 lb/MMBtu, and an emission level of 0.07 lb/MMBtu from Unit 3 assuming all units are operating at 100% load. . The impact to the environment should never exceed those levels on a long-term basis. The Department is proposing these emission levels as limits on a 30 operational day rolling basis which accounts for all operating scenarios including situations during which the SCR is not able to operate.

DEP also evaluated and analyzed mass-based NOx emission rate in pounds per hour on a 30-day rolling average basis from EPA's Clean Air Markets Division (CAMD) database at all operating conditions for all 3 units from 2017-2020. Mass based emission rate on a 30 operating day rolling average is dependent on the number of hours a unit is operated, on average, at high load versus low load for the past 30 operating days.

Figure 11



As per Figure 11, Units 1 and 2 were able to achieve a 30 operating day rolling average NOx rate of 500 lb/hr or lower, except for two brief spikes for Unit 1 and the first half of the year for Unit 2. In reviewing the daily and hourly data the Department observed that these spikes were related to periods during which Homer City's NOx emission rates were frequently above 0.2 lb NOx/MMBtu despite the injection of some ammonia into the SCR. Based on the data reviewed, the Department is unable to explain why these high emissions occurred and concluded that they are not indicative of Homer City's typical operations. For this reason, the Department believes the limits assigned above are achievable.

As per Figure 8, Unit 3 was able to consistently achieve 30 operating day rolling average NOx rate of 500 lb/hr or lower. However, because the unit typically operated significantly below its maximum load, a higher limit is necessary to account for this possibility.

Selective Non-Catalytic Reduction (SNCR):
SNCR system converts NOx to its elemental components by injecting either urea or ammonia under high temperature conditions. In this add on control technology, ammonia or urea is injected into the flue gas where the temperature of the flue gas is about 1800°F to 1900°F. At this temperature, NOx and the ammonia or urea react to form nitrogen gas and water. There is a great deal of temperature sensitivity in this reaction and since the urea or ammonia are often injected as aqueous solutions, there is an energy penalty on the overall boiler efficiency from vaporizing the water. Relatively small concentrations of ammonia result from the use of this NOx control. This system typically provides for 20% reduction in NOx emissions.

All three units at Homer City are equipped with LNB and SCR systems.

DEP determines SNCR technology to be technically infeasible option for all three units.

Switching to natural gas:
The Homer City Generating Station does not have access to an adequate natural gas supply. Installing a pipeline may make this option extremely expensive. Conversion of the units from coal to natural gas would result in a significant heat rate penalty, which would impact the economic viability of the units for dispatch.

DEP believes that cost-effectiveness of switching coal-fired units to natural gas-fired units and installing a new pipeline would exceed the cost-effectiveness benchmark and therefore determines conversion to natural gas option as economically infeasible option. Even if this is not the case, a change in fuel is a change in the nature of the source which is beyond the scope of a RACT analysis.

Oxygen enhanced combustion:
An oxygen enhanced combustion system uses a cryogenic process to supply pure oxygen; atmospheric-pressure combustion for fuel conversion in a conventional supercritical pulverized-coal boiler and substantial flue gas recycle making it cost-prohibitive for large coal units. This technology hasn't been demonstrated on coal-fired boilers. DEP determines oxygen enhanced combustion as technically infeasible option.

Flue gas recirculation (FGR):
Flue gas is used as a thermal diluent to reduce combustion temperatures in FGR system. Flue gas is withdrawn after the economizer or air heater and re-admitted through the burner windbox. This technology reduces thermal NOx and is not applied to coal-fired EGU boilers because NOx

emissions from coal-fired boilers are primary fuel NOx and the flue gas contains relatively high concentrations of ash. DEP determined that the FGR system is a technically infeasible option.

Rotating opposed fire air (ROFA):
A ROFA system injects air into the furnace to break up the fireball and then to create a cyclonic gas flow to improve combustion. The difference between ROFA and conventional OFA is that ROFA utilizes a booster fan to increase the velocity of air to promote better mixing and to increase the retention time in the furnace. Typically, ROFA is used in combustion units that do not have other types of OFA systems, which is not the case at Homer City.

At Homer City, installing ROFA would require removal of the existing SOFA systems and significant modification of the combustion air delivery systems, including installation of new fans, requiring extended shutdowns of the Units. There is inadequate free space around the Homer City boilers to accommodate the additional fans and ductwork and other required equipment. Furthermore, there would be little, if any, additional NO_x reduction over the existing SOFA systems. Replacement of the existing SOFA systems with ROFA is not technologically feasible for Homer City Units 1, 2, and 3.

SCR optimization:
The owner or operator of Homer City Generating Station will be required to work closely with the SCR catalyst vendor to monitor SCR performance in accordance with the catalyst management plans (CMPs) developed for the SCR systems.

V-temp system:
The V-temp system reduces heat absorption by the economizer during reduced boiler operating load conditions, thus increasing the flue gas temperature at the downstream SCR. However, it also negatively impacts boiler efficiency, specifically at varying load operations. All three units at Homer City are equipped with an economizer bypass which is at least equally effective in reducing NOx emissions as a V-temp system would be as both allow for the full heat contained in the flue gas to be used in the SCR. For this reason, the installation of a V-temp system is not an effective NOx reduction option and does not constitute RACT.

Flue gas reheat:
Flue gas reheat during low load, startup and shutdown increases the flue gas temperature making operation of SCR technically feasible at low load operations. The option involves the installation of burners, dilution air fans and ductwork near the economizer exits to reheat the flue gas. The Homer City application does not include an analysis of partial flue gas reheat, nor does it analyze other heat inputs. Clearly, any additional flue gas reheat will have a beneficial effect on NOx emission rates, and Homer City will be required to submit an engineering analysis, within 180 days of the effective date of this permit, evaluating partial flue gas reheat.

Dry sorbent injection:
SCR systems cannot be operated at select low loads due to deposition of ammonium sulfate and ammonium bisulfate formed by ammonia reacting with SO_3. Dry sorbent injection before the SCR uses sodium carbonate to reduce SO_3 concentrations and prevent the formation of ammonium sulfate and bisulfate. Based on concerns raised by other ESP equipped facilities in

PA, it is likely that the increase in particulate loading across the SCRs and downstream electrostatic precipitators (ESPs) would result in increased induced draft fan blade wear and accelerated blade replacement. The presence of SO_3 in the flue gas stream is also desirable because it results in enhanced particulate capture by the Electrostatic Precipitator (ESP). In addition, because all three of Homer City's Units are equipped with an economizer bypass system, the flue gas temperature at the inlet to the SCR is rarely low enough to cause the SCR to be unable to operate due to the formation of ammonium sulfate and bisulfate.

Compliance demonstration, Recordkeeping, Monitoring and Reporting requirements:

The facility shall demonstrate compliance with NOx emissions limits using existing Continuous Emissions Monitoring System (CEMS). The facility shall comply with recordkeeping, monitoring and reporting requirements as set forth by NWRO in the Title V Operating Permit. These requirements shall apply to emission limits, the emissions rate and other records as specified by NWRO for the facility. The records shall be reported to the program on the schedule specified by NWRO in the permit. §127.12(a)(3), §127.411(a)(4)(i), §127.12b(c), §127.441, §127.442 and §127.511.

NOx RACT emission limits for Unit 1, 2, and 3:

DEP concludes that the following NOx emissions limits are reasonable and to be incorporated in RACT permit as they reflect control levels achieved by the application of existing control technologies and after considering both the economic and technological analysis of other NOx mitigations measures.

(1) Emissions of NOx expressed as NO_2 for Units 1 and 2 are individually limited to a maximum of 0.080 lb NOx /MMBtu while Unit 3 is limited to a maximum of 0.07 lb NOx/MMBtu on a daily average basis. These limits exclude, emissions during start-up, shut-down, and malfunction; operation pursuant to emergency generation required by PJM, including any necessary testing for such emergency operations; and during periods in which compliance with this emission limit would require operation of any equipment in a manner inconsistent with technological limitations, good engineering and maintenance practices, and/or good air pollution control practices for minimizing emissions.

Startup means: The period in which operation of the EGU is initiated after a shutdown event for any purpose. Startup ends when any of the steam from the boiler is used to generate electricity for sale over the grid or for any other purpose (including on-site use). Any fraction of an hour in which startup occurs constitutes a full hour of startup.

Shutdown means: The period in which cessation of operation of an EGU is initiated for any purpose. Shutdown begins when the EGU no longer generates electricity or when no fuel is being fired in the EGU, whichever is earlier. Any fraction of an hour in which shutdown occurs constitutes a full hour of shutdown.

Daily average means: The total mass for each of the hours during the calendar day divided by the total heat input for each of the hours during the calendar day. This calculation methodology would also apply to the limit contained in (2), below.

(2) Emissions of NOx expressed as NO_2 from Units 1 and 2 are individually limited to a maximum of 0.45 lb NOx /MMBtu on a daily average basis under all operating conditions. Emissions of NOx expressed as NO_2 from Unit 3 are limited to a maximum of 0.27 lb NOx /MMBtu on a daily average basis under all operating conditions.

(3) Emissions of NOx expressed as NO_2 from Units 1 and 2 are individually limited to a maximum 550 lbs NOx/hr on a 30-operating day rolling average basis under all operating conditions. Emissions of NOx expressed as NO_2 from Unit 3 are limited to a maximum 510 lbs NOx/hr on a 30-operating day rolling average basis under all operating conditions.

(4) The owner or operator shall calibrate, operate, and maintain all elements of the SCR system and units in accordance with the manufacturer's specifications, in a manner consistent with good engineering and air pollution control practices when the SCR system is in use.

(5) The owner or operator shall operate and maintain LNB in accordance with the manufacturer's specifications and in a manner consistent with good engineering and air pollution control practices. (State only requirement)

(6) The owner or operator shall maintain NOx controls as effectively as reasonably possible during startups and shutdowns.

(7) The owner or operator shall take steps to bring NOx controls back into full service as quickly as practicable whenever the control equipment experiences a malfunction.

(8) The owner or operator shall document and report to the DEP, information regarding the cause of the malfunction and the steps for bringing the controls back.

(9) All operators of Unit 1, Unit 2, Unit 3, SCR, and LNB shall be trained in the operation and maintenance of the unit(s) they are assigned to operate by qualified personnel.

(10) The owner or operator shall develop, maintain and implement an operation and maintenance plan (O&M Plan) for Unit 1, Unit 2, Unit 3 and the SCR. The O&M Plan shall include, but not be limited to the following:

(a) Inspection, repairs, and preventive maintenance procedures to be followed to ensure proper operation of all three units and associated SCR systems and continuing compliance with the applicable emission limits specified in this Permit.

(b) A description of preventive maintenance schedules, spare parts inventories, procedures and protocols for unscheduled outages, and provisions for equipment replacement and measures to be taken to protect SCR system in the event of failure or shutdown.

(c) Inspections of duct work and boiler casing and repairs of leaks to maintain flue gas temperature.

(d) Details of the practices and procedures to be followed during periods of startup, shutdown and upset conditions in order to prevent emissions in excess of the standards specified in this permit.

(11) The owner or operator shall develop, maintain and implement an operation and maintenance plan (O&M Plan) for the Unit 1, 2, and 3 LNBs. The O&M Plan shall include, but not be limited to the following:

(a) Inspection, repairs, and preventive maintenance procedures to be followed to ensure proper operation of all three units and LNB and continuing compliance with the emission standards specified in this Permit.

(b) A description of preventive maintenance schedules, spare parts inventories, procedures and protocols for unscheduled outages, and provisions for equipment replacement and measures to be taken to protect air pollution control equipment in the event of any control equipment failure or shutdown.

(c) Details of the practices and procedures to be followed during periods of startup, shutdown and upset conditions in order to prevent emissions in excess of the standards specified in this permit.

(e) Inspections, repair and testing of Over Fire Air (OFA) components.

(f) Details of the practices and procedures to be followed to ensure that the boiler is tuned to optimize NOx reduction over combustion efficiency, including but not limited to the properly adjusted burner angle.

(12) The facility shall tune the boiler to minimize NOx emissions within 6 months of the effective date of this permit. (State only requirement)

(13) The facility shall tune the boiler to minimize NOx emissions annually after the initial boiler tuning. (State only requirement)

(14) Within 3 months of the effective date of this permit, the facility shall set the SCR for Units 1 and 2 at a target NOx emission rate set-point of 0.06 lb. NOx per MMBtu. The SCR for Unit 3 shall be set at a target NOx emission rate set-point of 0.05 lb. NOx per MMBtu (State only requirement)

(15) After operating the SCR with an outlet NOx emission rate set-point of 0.06 lb per MMBtu for Units 1 and 2 for twelve consecutive months, the facility shall submit an engineering study within 180 days that analyzes the overall environmental performance of the system at that set-point. (State only requirement)

(16) After operating the SCR with an outlet NOx emission rate set-point of 0.05 lb per MMBtu for Unit 3 for twelve consecutive months, the facility shall submit an engineering study within 180 days that analyzes the overall environmental performance of the system at that set-point. (State only requirement)

(17) During the first 60 days of each calendar year, the facility shall perform a catalyst activity test.

(18) Within 60 days of receiving the results of catalyst activity test, the facility shall consult with the SCR catalyst vendor to monitor SCR performance in accordance the catalyst management plans (CMPs) developed for the SCR systems.