Constellation

TVOP No. 46-00038

LG-25-089R1

July 31, 2025

Southeast Regional Office
Pennsylvania Department of Environmental Protection
2 East Main Street
Norristown, PA 19401

Subject: RACT III Significant Modification Application Revision
Limerick Generating Station, TVOP No. 46-00038

This letter serves to document resolution of technical deficiencies identified by PADEP in the RACT III Significant Modification Application. In a letter submitted to Constellation Energy Generation, LLC on July 14, 2025, the PADEP identified 12 deficiencies. These deficiencies have been addressed in the attached RACT III Significant Modification Application Revision as described below:

1. The catalyst filter should be ranked lower than Low NOx Burner (LNB) in Table 3-3 as per 25 Pa. Code §129.92(b)(3). Resolution: Catalyst filter eliminated from Table 3-3.

2. Contrary to 25 Pa. Code §129.92(b)(4), the catalyst filter was determined feasible but eliminated before any cost analysis. Please also see page 3-10 of the application. Resolution: Catalyst filter is no longer feasible and has been removed from the application.

3. Appendix G was not found in the application as stated. Resolution: This was a typo and Appendix G was changed to Appendix D.

4. In your consumer price index, is it 1992 or 1993 dollars, you are proposing? See page 3.6 vs Appendix D. Resolution: Consumer price index is in 1993 dollars.

5. Costs are not consistent between last paragraph of page 3.6 and Appendix D? Resolution: Costs have been updated to $666,864 on page 3.6 and in Appendix D.

6. The cost effectiveness to install LNB for the Boilers was stated to cost over $6000 per ton of nitrous oxides (NOx) removed. The cost effectiveness for nitrous oxides (NOx) is $7500 as per 25 Pa. Code §129.114(i)(1)(i). LNB may be cost effective since it may cost less than $7500 per ton of NOx removed. Resolution: Cost revised to $13,052 which is consistent with Appendix D.

7. LNB is listed as a feasible control for an engine??– please see page 3-8 of the application and Appendix D. Resolution: Removed LNB as a feasible control.

8. Please provide the content in Appendix A in a readable format. Resolution: The text has been resized to make Appendix A readable.

9. Please number the pages in Appendix D and provide labeling identifying each source (or group of sources) and each table presented. Resolution: Page numbers added to Appendix D.

10. In your consumer price index, is it 2023 or 2024 dollars in Appendix D, that you are proposing? (please see unmarked Table above Table 14 and unmarked Table above Table 15) Resolution: Price consumer index is in 2024 dollars

11. Is facility assuming 7% for 20 or 30 years in Appendix D? (see unmarked Table above Table 14 and unmarked Table above Table 15) Resolution: Note added in Appendix D that facility is assuming 7% for 15 years.

12. In general, please make sure the narrative in the step processes matches the narrative in Appendix D. (general comment that includes items #3,4,5) Resolution: Validated that narrative text agrees with Appendix D.

If you have any questions, please contact Jordan Rajan at (610) 718-3400 or jordan.rajan@constellation.com.

Respectfully,

William Levis
Plant Manager, Limerick Generating Station
Constellation Energy Generation, LLC

Enclosure:

1. RACT III Significant Modification Application Revision

bcc: D. Langseder – (MAROG Environmental files)-KSA
B. Pugh – 23rd St.
M. Gillin – GML 5-1
W. Levis – GML 5-1
L. Lynch – SSB 2-4
J. Rajan – SSB 2-4

RACT III PROPOSAL

Boilers A, B and C and Source ID 004A Generators Case-by-Case RACT

Constellation Energy Generation, LLC / Limerick Generating Station
Pottstown, PA

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July 25, 2025

Project 253902.0048

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1. INTRODUCTION

Constellation Energy Generation, LLC, (Constellation) operates the Limerick Generating Station (Limerick) nuclear power plant located in Limerick Township, Montgomery County, Pennsylvania. Limerick is currently operating in accordance with Pennsylvania Department of Environmental Protection (PADEP) Bureau of Air Quality Title V operating permit 46-00038, issued on December 16, 2021 and revised June 28, 2022. The Limerick Facility was a minor nitrogen oxide (NO_x) emitting facility due to the permit limit of 99.9 tons of NO_x emitted per year.

The Pennsylvania Department of Environmental Protection (PADEP) published 25 Pa. Code, Chapter 129: Additional Reasonably Available Control Technology (RACT) Requirements for Major Sources of NOX and VOCs for the 2015 Ozone NAAQS (the "RACT III Rule") in the Pa Bulletin on November 12, 2022 (52 Pa. Bulletin 6960). On July 30, 2024, Montgomery County, Pennsylvania, was reclassified as a serious nonattainment area for the 2015 Ozone National Ambient Air Quality Standards (NAAQS). Constellation has already submitted the proper determinations for RACT III VOC. Following the email received on November 5, 2024, Constellation is submitting this proposal to comply with the regulations under 25 Pa. Code § 129.114(b), which covers alternative Reasonably Available Technology (RACT) proposals and petition for alternative compliance schedules, for the RACT III NO_x.

The Limerick Facility is a power generation facility with a variety of combustion engines to assist in the generation and storage of power. These units are run mainly on Fuel Oil #2, with waste derived liquid fuel (WDLF) as a secondary fuel. These sources have been review for applicable RACT III requirements. This proposal contains the alternative RACT requirement, specified in 25 Pa. Code 129.114(d), and provides case-by-case NO_x RACT determinations for the facility's Boiler Units A, B, and C and the Emergency Generators in Source Group 004A.

1.1 RACT Requirements

The RACT III Rule applies to existing major facilities of NOX and/or VOC throughout Pennsylvania. Existing major facilities are those facilities which are a major source of NOX and/or VOC that exist on or before August 3, 2018 and existing minor facilities which become a major source of NOX and/or VOC after August 3, 2018. The Limerick Facility is located in Montgomery County, where the NO_x and VOC major sources thresholds are 50 and 50 tons per year (tpy), NO_x and VOC due to Montgomery County now being classified as serious for ozone. The Limerick Facility now meets the definition of an existing major source NO_x due to having a Plant Wide Applicability Limit (PAL) of 99.9 tpy per Section C, Condition #007 of the TVOP. As such, the Limerick Facility is subject to NO_x RACT requirements.

RACT is defined in 25 Pa Code 121.1 as "the lowest emission limit for VOC 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." For sources subject to RACT, under Pennsylvania's regulations, there are three options for compliance:

- Compliance Option 1: Presumptive RACT[1].
- Compliance Option 2: System-wide averaging[2]; and

[1] 25 Pa Code 129.112

[2] 25 Pa Code 129.113

- Compliance Option 3: Case-by-case RACT determination[3].

Below is a list of all sources subject to NO_x RACT requirements, as well as the compliance option applicable to each source:

- Source IDs 001 and 002A, Three (3) Fuel Oil Fired Boilers – Case-by-case RACT Proposal, included in this document
- Source ID 004A, Eight (8) Fuel Oil Fired Emergency Generators – Case-by-case RACT Proposal, included in this document
- Source ID 105, Two (2) Fuel Oil Fired Emergency Engines – Exempt per initial Section 129.115(a) submittal
- Source ID 106, Six (6) Fuel Oil Fired Emergency Engines – Exempt per initial Section 129.115(a) submittal
- Miscellaneous Combustion Sources, Temporary Boiler and Fire Pump – Exempt per initial Section 129.115(a) submittal

This RACT proposal consists of the following sections:

- Section 1: Executive Summary
- Section 2: Notification Summary
- Section 3: Case-by-Case RACT Analysis
- Section 4: RACT Proposal

The following attachments are enclosed with this application:

- Appendix A. RACT/Best Available Control Technology (BACT)/Lowest Achievable Emission Rate (LAER) Clearinghouse (RBLC) Results
- Appendix B. Title V Permit Application Forms
  - Title V Permit Application Form
  - Compliance Review Form
- Appendix C. Municipal Notifications
- Appendix D. BAT Cost Calculations

[3] 25 Pa Code 129.114

2. 129.115 NOTIFICATION SUMMARY

This section of the report serves as the written notification, specified in 25 Pa Code §129.115(a), that describes how Constellation proposes to comply with the requirements of 25 Pa Code §129.111-129.115, for Case-by-Case RACT review per Section 129.114(d) for Source IDs 001, 002A, and 004A.

2.1 Emissions Unit and RACT III Compliance Strategy

The proposed RACT III compliance strategy for each emission unit at the Limerick Facility is provided in Tables 2-1 and 2-2. These tables serve to identify the air contamination sources at this facility and identify the applicable RACT requirements or exemption status as specified in 25 Pa Code §129.115(a).

Constellation is submitting the following information as part of the RACT III initial notification requirements:

- 25 Pa Code §129.115(a)(1) – Submit the initial notification.
  - This initial notification has been submitted via PADEP OnBase on April 3rd, 2025.
- 25 Pa Code §129.115(a)(2) – Identify the air contamination sources in 25 Pa Code §129.111(a) as subject to a RACT requirement or exempt
  - See Table 2-1 below.
- 25 Pa Code §129.115(a)(3) – Identify the air contamination sources in 25 Pa Code §129.111(b) as subject to a RACT requirement or exempt
  - Not applicable, the Facility is an existing major source of NO_x.
- 25 Pa Code §129.115(a)(4) – Identify the air contamination sources in 25 Pa Code §129.111(c) which are exempt
  - See Table 2-1 below.
- 25 Pa Code §129.115(a)(5) – Provide a description of each air contamination source listed in 25 Pa Code §129.115(a)(2) including, description, make, model and location, applicable RACT requirement, how the unit will comply with RACT III, and reason for exemption (if applicable).
  - See Table 2-1 below and the source descriptions in Section 2.2.
- 25 Pa Code §129.115(a)(6) – Provide a description of each air contamination source listed in 25 Pa Code §129.115(a)(3) including, description, make, model and location, applicable RACT requirement, how the unit will comply with RACT III, and reason for exemption (if applicable).
  - Not applicable, the Facility is an existing major source of NO_x and is not subject to (a)(3).
- 25 Pa Code §129.115(a)(7) – Provide a description of each air contamination source listed in (a)(4) including, description, make, model and location and information sufficient to demonstrate that the source has a PTE less than 1 tpy of NOX or 1 tpy of VOC, as applicable.

- RACT III Exemption memo for Sources 105 and 106 as well as the miscellaneous sources was submitted via PADEP OnBase April 4, 2025.
- See the source descriptions in Section 2.2.

Table 2-1: NO_x Sources Subject to RACT III

Emissions Source ID	Source Description	NO_x RACT Compliance Strategy
001	Boiler A	Subject to RACT – cannot meet presumptive limits Case-By-Case – 25 Pa Code 129.114(d)
002A	Boilers B and C	Subject to RACT – cannot meet presumptive limits Case-By-Case – 25 Pa Code 129.114(d)
004A	Emergency Generators (8)	Subject to RACT – cannot meet presumptive limits Case-By-Case – 25 Pa Code 129.114(d)
105	Misc 2 Emergency Engines	Exempt from RACT III – 25 Pa Code 129.111(c) (Initial Notification submitted to PADEP on April 4, 2025)
106	Emergency Engines NSPS – 6 Total	Exempt from RACT III – 25 Pa Code 129.111(c) (Initial Notification submitted to PADEP on April 4, 2025)
Misc	Temp Boiler and Fire Pump	Exempt from RACT III – 25 Pa Code 129.111(c) (Initial Notification submitted to PADEP on April 4, 2025)

2.2 Source Description and Applicable Limits

The following section provides source descriptions for each unit at Constellation that is subject to RACT III requirements as well as the applicable Presumptive RACT III emission limits. The information provided in this section is required under 25 Pa Code §129.115(a)(5) and 25 Pa Code §129.115(a)(7).

2.2.1 Source IDs 001 and 002A, Boilers A, B, and C (3 Total)

Table 2-2: Boiler Specification Information

Boiler Name	Heat Input Rating (MMBTU/hr)	Manufacturer	Model/Serial Number
Boiler A	57.1	Zurn Industries	98376
Boiler B	57.1	Zurn Industries	98377
Boiler C	57.1	Zurn Industries	98378

As per 25 Pa. Code § 129.111(c), 25 Pa. Code sections §§ 129.112-129.114 apply to the owner or operator of an air contamination source that has the potential to emit greater than 1 tpy of NOX. Therefore, the three (3) boilers operated by Constellation are subject to RACT III requirements, specifically presumptive RACT III limits listed in 129.112(g)(1)(ii) for distillate oil. The presumptive RACT III NOX limit for these units will be 0.12 lb NOX/MMBtu. The above information is provided as required per Section 129.115(a)(7).

2.2.2 Source IDs 004A – Emergency Generators (8 Total)

Table 2-3: Source ID 004A Specification information

Unit Name	Total Heat Input Rating (MMBTU/hr)	Manufacturer	Model Number
Emergency Generators (8x) (Source 004A)	3963	Fairbanks Morse	38TD8-18

Constellation operates eight (8) emergency generators (Source ID 004A). The presumptive NOx RACT emissions limits specified in section §129.112 that are applicable to these generators are listed in 129.112(g)(3)(iii) for stationary internal combustion sources greater than 500 bhp. Under TVOP 46-00038, Constellation has accepted a plant applicability limit (PAL) of 99.9 tpy NO_x on a 12-month rolling total basis (12MRT). This PAL will be used as a potential to emit value for each of the emergency generators. Therefore, this source will be subject to Case-by-Case RACT review for which a proposal per Section 114(d) will be submitted by April 11, 2025.

2.2.3 Source IDs 105 and 106 – Emergency Engines (8 Total)

Table 2-4: Source ID 001 and 002 Specification information

Unit Name	Total Heat Input Rating (MMBTU/hr)	Manufacturer	Model Number
Misc Emergency Engine 1 (Source 105)	310	Cummins	NT-855-F1
Misc Emergency Engine 2 (Source 105)	170	Detroit Diesel	PTA-1SD-50
Emergency Engines NSPS 1 (3x) (Source 106)	300	Godwin	HL130M
Emergency Engines NSPS 2 (3x) (Source 106)	755	Cummings	QSX15-G0

As per 25 Pa. Code § 129.111(c), 25 Pa. Code sections §§ 129.112-129.114 do not apply to the owner or operator of an air contamination source that has the potential to emit less than 1 TPY of NO_x. Potential to emit calculations for Source IDs 105 and 106 were submitted with the initial notification letter in April of 2025. The PTE calculations show each of the eight (8) engines listed in Table 2-4 has the potential to emit less than 1 tpy of NO_x. Therefore, the eight (8) emergency engines operated at the Limerick Facility are not subject to RACT III requirements.

3. CASE-BY-CASE RACT ANALYSIS

As a major source of NO_x, the Limerick Facility is now subject to Pennsylvania's RACT regulations. As discussed above, the boilers and emergency generators in Source ID 004A do have applicable RACT III presumptive limits. However, they cannot meet these limits due to the specifications of the units. Therefore, Constellation is proposing case-by-case RACT determinations per Section 129.114(b).

3.1 Case-by-Case RACT Determination

For sources which are unable to meet presumptive RACT limits and don't participate in system-wide averaging, the third option for RACT compliance applies. Under this third option, facilities must propose an alternative RACT emission limitation (i.e., a "case-by-case RACT limit") and apply for a case-by-case RACT limit or requirement via a Plan Approval (if RACT compliance requires the installation of controls) or operating permit modification from PADEP. Constellation is proposing to use case-by-case NO_x RACT determinations for the boilers and emergency generators in order to help meet RACT III requirements. Pursuant to 25 Pa Code 129.114(b) and 25 Pa. Code 129.114(d), the case-by-case RACT limit proposal must include each of the elements required under 25 Pa Code 129.92(a)(1)-(5), (7)-(10). Table 3-1 includes a cross reference for the location of these requirements in this RACT proposal.

Table 3-1

Regulatory Requirement		Location in Proposal
25 Pa Code 129.92 (a)(1)	A list of each source subject to the RACT requirements	Section 1.1
25 Pa Code 129.92 (a)(2)	The size or capacity of each affected source and types of fuel combusted or the types and quantities of materials processed or produced in each source.	Submitted in March 2025 initial notification, Table 2-2 and 2-3
25 Pa Code 129.92 (a)(3)	A physical description of each source and its operating characteristics.	Section 1
25 Pa Code 129.92 (a)(4)	Estimates of the potential and actual NOX and VOC emissions from each source and associated supporting documentation.	Facility Wide PAL 99.9 tpy NO_x
25 Pa Code 129.92 (a)(5)	A RACT analysis which meets the requirements of subsection (b), including technical and economic support documentation for each affected source.	Section 3
25 Pa Code 129.114(d)(6)	The testing, monitoring, recordkeeping and reporting procedures proposed to demonstrate compliance with RACT.	Section 4
25 Pa Code 129.114(d)(2)	An application for an operating permit amendment or application to incorporate the provisions of the RACT proposal.	Appendix B

3.2 Top-Down Methodology

Case-by-case RACT determinations are traditionally based on a top-down methodology. PADEP has outlined the required elements of a RACT analysis and determination in 25 Pa Code 129.92(b). Presented below are the five basic steps of the top-down RACT review as identified by PADEP.

3.2.1 Step 1: Identify All Control Technologies

Under Step 1, all available control technologies are identified for each emission unit in question. The following methods may be used to identify potential technologies:

- Researching the RACT/BACT/LAER Clearinghouse (RBLC) database;
- Surveying regulatory agencies;
- Drawing from previous engineering experience;
- Surveying air pollution control equipment vendors; and
- Surveying available literature.

Once identified, the control technologies are ranked in descending order of expected control effectiveness.

3.2.2 Step 2: Eliminate Technically Infeasible Options

After control technologies are identified under Step 1, an analysis is conducted to eliminate technically infeasible options. A control option is eliminated from consideration if there are process-specific conditions that prohibit the implementation of the control technology or if the highest control efficiency of the option would result in an emission level that is higher than any applicable regulatory limits, such as a New Source Performance Standard (NSPS) or National Emission Standard for Hazardous Air Pollutants (NESHAP).

3.2.3 Step 3: Rank Remaining Control Technologies by Control Effectiveness

In Step 3, remaining control technology options are ranked based on their control effectiveness, from highest to lowest control efficiency. This list must identify, at a minimum, the baseline emissions of VOCs and NOx before implementation of each control option, the estimated reduction potential or control efficiency of each control option, the estimated emissions after the application of each control option and the economic impacts.

3.2.4 Step 4: Evaluate Most Effective Controls and Document Results

Beginning with the highest-ranked control technology option from Step 3, detailed economic, energy, and environmental impact evaluations are performed in Step 4. If a control option is determined to be economically feasible without adverse energy or environmental impacts, it is not necessary to evaluate the remaining options with lower control efficiencies.

The economic evaluation centers on the cost effectives of the control option. Costs of installing and operation control technologies are estimated and annualized following the methodologies outlined in the U.S. EPA's Office of Air Quality Planning and Standards (OAQPS) Control Cost Manual (CCM) and other industry resources.[4]

3.2.5 3.2.5 Step 5: Select RACT

Using the result of the prior steps to determine the appropriate control technology, the final step is to determine the emission limit that represents the RACT limit.

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[4] OAQPS, U.S. EPA Air Pollution Control Cost Manual , Sixth Edition, EPA 452-02-001 (https://www3.epa.gov/ttn/ecas/cost_manual.html), Daniel C. Mussatti & William M. Vatavuk, January 2002. Note that Section 4 of the CCM was updated (Seventh Edition) in May 2016. However, the remainder of the CCM has not yet been updated and the Sixth Edition is still the most recent.

3.3 NO_x RACT Assessment for Boilers

This section addresses NO_x RACT requirements for Source IDs 001 and 002A. Fuel Oil combustion in these sources produce NO_x emissions. The NO_x emissions from these chemical mechanisms are referred to as: 1) thermal NO_x, 2) fuel NO_x, and 3) prompt NO_x. The emissions from the boiler units analyzed in the section will be the fuel NO_x created from combustion.

The RACT evaluation review of NO_x from the combustion sources at the Limerick Facility focuses on verifying that the technologies for NO_x control on them meet RACT and not on attempting to compare emission rates themselves.

3.3.1 Step 1 – Identify All Control Technologies for NO_x

Step 1 in a top-down analysis is to identify all available control technologies. The evaluation of potential controls for NO_x emissions from the boiler units involves an investigation of end-of-pipe (post-combustion) and combustion modifications/optimization that reduce the formation of fuel NO_x.

The RBLC database was reviewed to identify potential add-on control technologies for processes similar to the power generation. Results of the RBLC search for #2 Fuel oil -fired commercial-sized boilers with a heat input less than 100 MMBtu/hr (Process Type 13.220) are provided in Appendix A. It should be noted that the RBLC search results presented include RACT determinations as well as any BACT and LAER determinations, which may be more stringent than RACT. Table 3-2 contains a list of the various technologies that have been identified for control of NO_x emissions for boiler units from either the RBLC search or known as standard NO_x controls for combustion units.

Table 3-2 Potentially Available NO_x Control Technologies for Incinerators

Potentially Applicable NO_x Control Technologies
Selective Catalytic Reduction (SCR)
Selective Non-Catalytic Reduction (SNCR)
Low NO_x Burners (LNBs)
Catalyst Filters
Good Combustion Practices

Other general NO_x control technologies exist in addition to those listed in Table 3-2 that are widely used for NO_x control on traditional large combustion sources. However, several of these have been identified as not applicable for use on small units such as the ones at this facility; and therefore have not been considered for this top down RACT assessment for NO_x. These technologies include, but are not limited to:

- Flares
- Refrigerated condensers

Based on our research, none of the technologies listed above apply to small boiler units (<100 MMBtu/hr) or have been commercially demonstrated on small boiler units and therefore are deemed technically infeasible in our case and have been eliminated as potential RACT technologies.

3.3.2 Review of Potentially Applicable NO_x Control Technologies

The following section provides a discussion of each potentially applicable technology identified above as it might be applied to the boilers at the Limerick Facility.

3.3.2.1 Selective Catalytic Reduction (SCR)

SCR is a post-combustion gas treatment process in which NH_3 is injected into the exhaust gas upstream of a catalyst bed. On the catalyst surface, ammonia and NO_x react to form elemental nitrogen and water. The primary chemical reactions can be expressed as follows:

$$4\,NH_3 + 4NO + O_2 \rightarrow 4N_2 + 6H_2O$$
$$4\,NH_3 + 4NO_2 + 2O_2 \rightarrow 3N_2 + 6H_2O$$

When operated within the optimum temperature range of 480 to 800°F, the reaction can result in removal efficiencies between 70 and 90 percent.[5] Operation outside the optimum temperature range can result in increased ammonia slips or increased NO_x emissions.

SCR units have the ability to function effectively under fluctuating temperature conditions (usually ±50°F), although fluctuation in exhaust gas temperature reduces removal efficiency slightly by disturbing the kinetics (speed) of the NO_x removal reaction.

3.3.2.2 Selective Non-Catalytic Reduction (SNCR)

SNCR is a post-combustion NO_x control technology based on the reaction of urea or ammonia with NO_x. In the SNCR chemical reaction, urea [$CO(NH_2)_2$] or ammonia (NH_3) is injected into the combustion gas path to reduce the NO_x to nitrogen and water. The overall reaction schemes for both urea and ammonia systems can be expressed as follows:

$$CO(NH_2)_2 + 2NO + \frac{1}{2}O_2 \rightarrow 2N_2 + CO_2 + 2H_2O$$
$$4\,NH_3 + 6NO_2 \rightarrow 5N_2 + 6H_2O$$

Typical removal efficiencies for SNCR range from 25 to 65 percent. An important consideration for implementing SNCR is the operating temperature range. The optimum temperature range is approximately 1,550 to 1,950°F.[6] Operation at temperatures below this range results in ammonia slip. Operation above this range results in oxidation of ammonia, forming additional NO_x.

3.3.2.3 Low NO_x Burners (LNBs)

The principle of all LNBs is the same: stepwise or staged combustion and localized exhaust gas recirculation at the flame. LNBs are designed to control fuel and air mixing to create larger and more branched flames. Peak flame temperatures are reduced, resulting in less NO_x formation. LNBs eliminate the need for steam or water injection, which was formerly the traditional method of NO_x control. In addition to traditional LNB regenerative burners are low NO_x design but also utilize a pair of burners which cycle to alternately heat the combustion air or recover and store the heat from the furnace exhaust gases to improve burner efficiency.

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[5] U.S. EPA, Office of Air Quality Planning and Standards. *OAQPS Control Cost Manual Section 4 Chapter 2, 7th edition*. Research Triangle Park, NC. May 2016.

[6] U.S. EPA, Office of Air Quality Planning and Standards. *OAQPS Control Cost Manual Section 4 Chapter 1*, 7th edition. Research Triangle Park, NC. May 2016.

3.3.2.4 Catalyst Filters

This technology involves the control of multiple pollutants using a single system. These systems consist of a filtration element for the control of particulate matter which is embedded with an SCR catalyst. NH_3 or urea is injected upstream of the filters. As the exhaust gases pass through the filters, NO_x in the stream is reduced in the same manner as a standard SCR.

3.3.2.5 Good Combustion Practices / Proper Incinerator Operation

The formation of NO_x is minimized by proper furnace design and operation. Generally, emissions are minimized when the furnace temperature is kept at the lower end of the desired range and when the distribution of air at the air and fuel injection zones is controlled. Ideally, maintaining a low-oxygen condition near fuel injection points approaches an off-stoichiometric staged combustion process.

A certain amount of air is required to provide sufficient oxygen to burn all of the fuel. However, any excess air contributes to increased NO_x emissions in two ways: 1) Excess air effectively increases the amount of air that must be heated, resulting in decreased fuel efficiency and higher NO_x emissions, and 2) Excess air provides greater amounts of oxygen in the combustion zone that will lead to greater amounts of thermal NO_x formation. By minimizing the amount of air used in the combustion process while maintaining proper furnace operation, the formation of NO_x can be reduced.

3.3.3 Step 2 – Eliminate Technically Infeasible Options for NO_x Control

Step 2 in a RACT top-down analysis is to eliminate the control options identified in Step 1 which are technically infeasible. The remaining technologies are then carried into Step 3.

3.3.3.1 Selective Catalytic Reduction (SCR)

The SCR process is temperature sensitive. Any exhaust gas temperature fluctuations reduce removal efficiency and upsets the NH_3/NO_x molar ratio. SCR also requires an optimum temperature range of 575°F to 750°F and fairly constant temperatures, or NO_x removal efficiency will decrease. Below this temperature range, the reaction rate drops sharply, and effective reduction of NOx is no longer feasible. Above this temperature, conventional reduction catalysts break down and are unable to perform their desired functions. Additionally, streams with high volumes of particulate matter (PM) can require additional control measures to reduce PM deposition into the catalyst.[7] Due to the operating temperature of the boilers which is 609°F, SCR is technically feasible for these units.

3.3.3.2 Selective Non-Catalytic Reduction (SNCR)

SNCR requires a high but very specific temperature range (generally between 1,550 °F and 1,950 °F) and sufficient residence time at this temperature to be effective. The average operating temperature for the three boiler units at the Limerick Facility is 609°F. This value is below the 1,550°F SCNR threshold operating temperature. Therefore, SNCR is deemed infeasible for these boiler units and will not be discussed further in this section.

3.3.3.3 Catalyst Filters

As discussed above, this technology involves the control of multiple pollutants using a single system. These systems consist of a filtration element for the control of particulate matter which is embedded with an SCR

[7] U.S. EPA, Technology Transfer Network, Clean Air Technology Center. "Air Pollution Control Technology Fact Sheet – Selective Catalytic Reduction." File number EPA-452/F-03-032. July 2003. http://www.epa.gov/ttn/catc/dir1/fscr.pdf (26 Nov. 2014).

catalyst. NH3 or urea is injected upstream of the filters. As the exhaust gases pass through the filters, NOx in the stream is reduced in the same manner as standard SCR. While the theory behind Catalyst filters could provide NO_x emission controls, this control technology has not been provided in the RBLC search or EPA guidance as a standard control device for boilers. As such, it has been deemed technically infeasible for this project.

3.3.3.4 Low NO_x Burners (LNBs)

The principle of all LNBs is the same: stepwise or staged combustion and localized exhaust gas recirculation at the flame. LNBs are designed to control fuel and air mixing to create larger and more branched flames. Peak flame temperatures are reduced, resulting in less NOx formation. Retrofitting a boiler with LNBs can be costly. While this option is technically feasible, a cost calculation will be provided in the next section.

3.3.3.5 Good combustion Practices

Good Operational Practices include minimizing losses to the atmosphere. The practices include operating the boiler and water heater at proper conditions and following work practices standards.

3.3.4 Step 3 – Rank Remaining Control Technologies by Control Effectiveness

In step 3, the remaining control technology options are ranked based on their control effectiveness, from highest to lowest control efficiency. There are three (3) control technologies that are considered technically feasible: SCR, LNBs, and Good combustion practices.

Table 3-3. Ranked NO_x Controls for Boilers

Option No.	Control Technology	Control Efficiency (%)
1	Selective Catalytic Reduction	70-90%
2	Low NO_x Burners	40-85%
3	Good combustion Practices	-

3.3.5 Step 4 – Evaluate Most Cost Effective Controls and Document Results

The most efficient, control technologies which are technically feasible for this facility are SCR, low NOx burners and good combustion practices. A cost calculation was completed on SCR to determine if it is economically feasible. These calculations can be seen in Appendix D. Based on EPA's Air Pollution Control Technology Fact Sheet for SCR, the cost effectiveness for small units such as these has a range from around $1000 to $10,000 maximum per ton of pollutant removed. The cost calculation estimate set the cost effectiveness for this project at $11,428 per ton of NO_x removed. Therefore, SCR is not considered economically feasible as RACT. Low NO_x burners were also considered technically feasible for this facility. A cost calculation was completed on retrofitting LNBs to the boilers. Based on an EPA document on NO_x emissions controls, the cost effectiveness range of retrofitting an LNB on an oil-fired boiler is between $460 and $1,900 in 1992 dollars (or $1053 and $4351 in 2024 dollars) per ton NO_x removed.[8] As a note, these 1992 values came from an EPA cost document cited below. This is different than the 1993 values that are referenced in the cost calculations in Appendix D. Additionally for RACT III determination, cost effectiveness has a threshold of $7500 per tons NOx removed per 25 Pa. Code 129.114(i)(1)(i). Our calculation set the average cost per ton removed as $13,052 in 2024 dollars using an interest rate of 7% based on The Office

[8] Alternative Control Techniques Document – NO_x Emissions from Industrial/Commercial/Institutional (ICI) Boilers (EPA-453/R-94-022). https://www3.epa.gov/airquality/ctg_act/199403_nox_epa453_r-94-022_ici_boilers.pdf

of Management and Budget's recommendation and equipment life span of 15 years.[9,10] Therefore, LNBs are also economically infeasible for these boiler units according to both cost thresholds.

3.3.6 Step 5 – Select RACT

For Step 5, Constellation will be determining which of the RACT analyzed in the previous sections are both technically and economically feasible for this facility. From the analysis, the remaining control technology for these units will be good combustion practices, which are already utilized at the Limerick Facility. Constellations will continue to adhere to these operational standards.

3.4 NO_x RACT Assessment for Stationary Internal Combustion Engines

This section addresses NO_x RACT requirements for Source ID 004A. Fuel Oil combustion in these sources produce NO_x emissions similarly to the boiler units described in Section 3.3.

The RACT evaluation review of NO_x from the combustion sources at the Limerick Facility focuses on verifying that the technologies for NO_x control on them meet RACT and not on attempting to compare emission rates themselves.

3.4.1 Step 1 – Identify All Control Technologies for NO_x

Step 1 in a top-down analysis is to identify all available control technologies. The evaluation of potential controls for NO_x emissions from the involves an investigation of end-of-pipe (post-combustion) and combustion modifications/optimization that reduce the formation of fuel NO_x.

The RBLC database was reviewed to identify potential add-on control technologies for processes similar to the power generation process. Results of the RBLC search for #2 Fuel oil -fired internal combustion engines (Process Type 17.110) are provided in Appendix A. It should be noted that the RBLC search results presented include RACT determinations as well as any BACT and LAER determinations, which may be more stringent than RACT. Table 3-4 contains a list of the various technologies that have been identified for control of NO_x emissions for these units from either the RBLC search or known as standard NO_x controls for combustion units.

Table 3-4 Potentially Available NO_x Control Technologies for Generators

Potentially Applicable NO_x Control Technologies
Selective Catalytic Reduction (SCR)
Selective Non-Catalytic Reduction (SNCR)
Catalyst Filters
Good Combustion Practices

Other general NO_x control technologies exist in addition to those listed in Table 3-4 that are widely used for NO_x control on traditional large combustion sources. However, several of these have been identified as not

[9] Control Strategy Tool Cost Equations Documentation. EPA's Office of Air Quality Planning and Standards. https://www.epa.gov/sites/default/files/2018-09/documents/cost_equations_documentation_0.pdf.

[10] EPA AIR POLLUTION CONTROL COST MANUAL 6th Edition. EPA. https://www.epa.gov/sites/default/files/2020-07/documents/c_allchs.pdf.

applicable for use on units such as the ones at this facility; and therefore have not been considered for this top down RACT assessment for NO_x. These technologies include, but are not limited to:

- Flares
- Refrigerated condensers

Based on our research, none of the technologies listed above apply to large internal combustion units (>500 HP) or have been commercially demonstrated on large internal combustion units and therefore are deemed technically infeasible in our case and have been eliminated as potential RACT technologies.

3.4.2 Review of Potentially Applicable NO_x Control Technologies

The following section provides a discussion of each potentially applicable technology identified above as it might be applied to the boilers at the Limerick Facility.

3.4.2.1 Selective Catalytic Reduction (SCR)

SCR is a post-combustion gas treatment process in which NH_3 is injected into the exhaust gas upstream of a catalyst bed. On the catalyst surface, ammonia and NO_x react to form elemental nitrogen and water. The primary chemical reactions can be expressed as follows:

$$4\,NH_3 + 4NO + O_2 \rightarrow 4N_2 + 6H_2O$$
$$4\,NH_3 + 4NO_2 + 2O_2 \rightarrow 3N_2 + 6H_2O$$

When operated within the optimum temperature range of 480 to 800°F, the reaction can result in removal efficiencies between 70 and 90 percent.[11] Operation outside the optimum temperature range can result in increased ammonia slips or increased NO_x emissions.

SCR units have the ability to function effectively under fluctuating temperature conditions (usually ±50°F), although fluctuation in exhaust gas temperature reduces removal efficiency slightly by disturbing the kinetics (speed) of the NO_x removal reaction.

3.4.2.2 Selective Non-Catalytic Reduction (SNCR)

SNCR is a post-combustion NO_x control technology based on the reaction of urea or ammonia with NO_x. In the SNCR chemical reaction, urea [$CO(NH_2)_2$] or ammonia (NH_3) is injected into the combustion gas path to reduce the NO_x to nitrogen and water. The overall reaction schemes for both urea and ammonia systems can be expressed as follows:

$$CO(NH_2)_2 + 2NO + \frac{1}{2}O_2 \rightarrow 2N_2 + CO_2 + 2H_2O$$
$$4\,NH_3 + 6NO_2 \rightarrow 5N_2 + 6H_2O$$

Typical removal efficiencies for SNCR range from 25 to 65 percent. An important consideration for implementing SNCR is the operating temperature range. The optimum temperature range is

[11] U.S. EPA, Office of Air Quality Planning and Standards. *OAQPS Control Cost Manual Section 4 Chapter 2, 7th edition.* Research Triangle Park, NC. May 2016.

approximately 1,550 to 1,950°F.[12] Operation at temperatures below this range results in ammonia slip. Operation above this range results in oxidation of ammonia, forming additional NO_X.

3.4.2.3 Catalyst Filters

This technology involves the control of multiple pollutants using a single system. These systems consist of a filtration element for the control of particulate matter which is embedded with an SCR catalyst. NH_3 or urea is injected upstream of the filters. As the exhaust gases pass through the filters, NO_X in the stream is reduced in the same manner as a standard SCR.

3.4.2.4 Good Combustion Practices / Proper Incinerator Operation

The formation of NO_X is minimized by proper furnace design and operation. Generally, emissions are minimized when the furnace temperature is kept at the lower end of the desired range and when the distribution of air at the air and fuel injection zones is controlled. Ideally, maintaining a low-oxygen condition near fuel injection points approaches an off-stoichiometric staged combustion process.

A certain amount of air is required to provide sufficient oxygen to burn all of the fuel. However, any excess air contributes to increased NO_X emissions in two ways: 1) Excess air effectively increases the amount of air that must be heated, resulting in decreased fuel efficiency and higher NO_X emissions, and 2) Excess air provides greater amounts of oxygen in the combustion zone that will lead to greater amounts of thermal NO_X formation. By minimizing the amount of air used in the combustion process while maintaining proper furnace operation, the formation of NO_X can be reduced.

3.4.3 Step 2 – Eliminate Technically Infeasible Options for NO_X Control

Step 2 in a RACT top-down analysis is to eliminate the control options identified in Step 1 which are technically infeasible. The remaining technologies are then carried into Step 3.

3.4.3.1 Selective Catalytic Reduction (SCR)

The SCR process is temperature sensitive. Any exhaust gas temperature fluctuations reduce removal efficiency and upsets the NH_3/NO_X molar ratio. SCR also requires an optimum temperature range of 575°F to 750°F and fairly constant temperatures, or NO_X removal efficiency will decrease. Below this temperature range, the reaction rate drops sharply, and effective reduction of NO_X is no longer feasible. Above this temperature, conventional reduction catalysts break down and are unable to perform their desired functions. Additionally, streams with high volumes of particulate matter (PM) can require additional control measures to reduce PM deposition into the catalyst.[13] Due to the operating temperature of the generators which is 690°F, SCR is technically feasible for these units.

3.4.3.2 Selective Non-Catalytic Reduction (SNCR)

SNCR requires a high but very specific temperature range (generally between 1,550 °F and 1,950 °F) and sufficient residence time at this temperature to be effective. The average operating temperature for the engines in Source ID 004A units at the Limerick Facility is 690°F. This value is below the 1,550°F SCNR

[12] U.S. EPA, Office of Air Quality Planning and Standards. *OAQPS Control Cost Manual Section 4 Chapter 1*, 7th edition. Research Triangle Park, NC. May 2016.

[13] U.S. EPA, Technology Transfer Network, Clean Air Technology Center. "Air Pollution Control Technology Fact Sheet – Selective Catalytic Reduction." File number EPA-452/F-03-032. July 2003. http://www.epa.gov/ttn/catc/dir1/fscr.pdf (26 Nov. 2014).

threshold operating temperature. Therefore, SNCR is deemed infeasible for these combustion units and will not be discussed further in this section.

3.4.3.3 Catalyst Filters

As discussed above, this technology involves the control of multiple pollutants using a single system. These systems consist of a filtration element for the control of particulate matter which is embedded with an SCR catalyst. NH_3 or urea is injected upstream of the filters. As the exhaust gases pass through the filters, NO_X in the stream is reduced in the same manner as standard SCR. While the theory behind Catalyst filters could provide NO_x emission controls, this control technology has not been provided in the RBLC search or EPA guidance as a standard control device for generators. As such, it has been deemed technically infeasible for this project.

3.4.3.4 Good combustion Practices

Good Operational Practices include minimizing losses to the atmosphere. The practices include operating the generators at proper conditions and following work practices standards.

3.4.4 Step 3 – Rank Remaining Control Technologies by Control Effectiveness

In step 3, the remaining control technology options are ranked based on their control effectiveness, from highest to lowest control efficiency. There are two (2) control technologies that are considered technically feasible: SCR and Good combustion practices.

Table 3-5. Ranked NO_X Controls for Generators

Option No.	Control Technology	Control Efficiency (%)
1	Selective Catalytic Reduction	70-90%
2	Good combustion Practices	-

3.4.5 Step 4 – Evaluate Most Cost Effective Controls and Document Results

The most efficient, control technologies which are technically feasible for this facility are SCR and good combustion practices. A cost calculation was completed on SCR to determine if it is economically feasible. These calculations can be seen in Appendix D. Based on EPA's Air Pollution Control Technology Fact Sheet for SCR, the cost effectiveness for small units such as these has a range from around $1000 to $10,000 maximum per ton of pollutant removed. The cost calculation estimate set the cost effectiveness for this project around $666,864 per ton of NO_X removed. Therefore, SCR is not considered economically feasible.

3.4.6 Step 5 – Select RACT

For Step 5, Constellation will be determining which of the RACTs analyzed in the previous sections are both technically and economically feasible for this facility. From the analysis, the remaining control technology for these units will be good combustion practices, which are already utilized at the Limerick Facility. Constellations will continue to adhere to these operational standards.

4. RACT PROPOSAL

4.1 Case-by-Case RACT Proposal - Boilers

As detailed in Section 3, there are no technically feasible NO_x control technologies for the boilers in Source IDs 001 and 002A which are not already utilized. As such, the Limerick Facility is proposing to utilize good combustion on the boilers. The proposed RACT requirements for each boiler is provided in the table below.

Table 4-1 Proposed RACT for Source IDs 001 and 002A

Emissions Source ID(s):	- Boiler A: 0AS2502, Title V Source ID 001 - Two Boilers (Boiler B & Boiler C), Title V Source ID 002A
Source Description(s):	Three (3) boiler units rated at 57.1 MMBtu/hr which emit NO_x, CO, VOC and HAPs. Boiler emissions are controlled by best combustion practices and limit operation requirements.
Description of RACT:	Case-by-case
	Good combustion practices and Limited use

Proposed Emissions Restriction:

- 30.00 TPY NO_x (per boiler)
- 8.5 lb/hour NO_x (per boiler)
- 99.9 TPY NO_x, facility wide

Proposed Work Practices: Constellation proposes to implement an operational limit to the boilers in order to ensure that emissions are kept below the 30 tpy threshold in Source Group 02, Condition #002 with the following change:

- NO_x emissions from each boiler unit shall be limited to 30.00 TPY

Proposed Monitoring: Per Section E, Source Group 02, Condition #008:

- Type and amount of fuel burned on a daily basis per boiler

Proposed Testing:

Proposed Recordkeeping: Per Section E, Source Group 02, Condition #008 and 009, Constellation will maintain the following records for a minimum of five (5) years:

- Type and amount of fuel burned on a daily basis per boiler
- Monthly fuel usage in gallons for each boiler, 12MRT
- Recorded calculations of air emissions
- Tune up records for each boiler including:
  - The date of the tuning procedure.
  - The name of the service company and technicians.
  - The final operating rate or load.
  - The final CO and NOx emission rates.
  - The final excess oxygen rate.

Proposed Reporting: Compliance with work practices reported annually via Title V Compliance Certification

4.2 Case-by-Case RACT Proposal - Generators

As detailed in Section 3, there are no technically feasible NO_x control technologies for the emergency generators in Source ID 004A which are not already utilized. As such, the Limerick Facility is proposing to utilize good combustion on the generators. The proposed RACT requirements for each generator is provided in the table below.

Table 4-2 Proposed RACT for Source ID 004A

<table>
<tr><td>Emissions Source ID(s):</td><td>- Emergency Generators (8), Title V Source ID 004A</td></tr>
<tr><td>Source Description(s):</td><td>Eight emergency engines, each rated at 3963 hp, which emit NOx, CO, VOC and HAPs. generator emissions are controlled by good combustion practices and limited hours of operations.</td></tr>
<tr><td rowspan="2">Description of RACT:</td><td>Case-by-case</td></tr>
<tr><td>Good combustion practices and Limited use</td></tr>
<tr><td colspan="2">Proposed Emissions Restriction:
• 6.00 TPY NOx (per generator)
• 99.9 TPY NOx, facility wide
Proposed Work Practices:
• 100 hours per year (per generator) – This includes maintenance.
Proposed Monitoring: Per Section E, Source ID 004A, Condition #005:
• Monthly and annual units (MW-hr) generated by each unit
• Fuel combusted on a daily and monthly basis, 12MRT
• Total operating hours for each unit on a monthly basis, 12MRT
Proposed Testing:
Proposed Recordkeeping: Per Section E, Source ID 004A, Condition #00, Constellation will maintain the following records for a minimum of five (5) years:
• Monthly and annual units (MW-hr) generated by each unit
• Fuel combusted on a daily and monthly basis, 12MRT
• Total operating hours for each unit on a monthly basis, 12MRT
Proposed Reporting: Compliance with work practices reported annually via Title V Compliance Certification</td></tr>
</table>

APPENDIX A. RBLC DATABASE SEARCH

Appendix A: RBLC Search Results for Generators

FACILITY_NAME	CORPORATE_OR_COMPANY_NAME	FACILITY_DESCRIPTION	PROCESS_NAME	PRIMARY_FUEL	THROUGHPUT	THROUGHPUT_UNIT	PROCESS_NOTES	POLLUTANT	POLLUTANT_GROUP(S)	CONTROL_METHOD_DESCRIPTION	EMISSION_LIMIT_1	EMISSION_LIMIT_1_UNIT
CRONUS CHEMICALS	CRONUS CHEMICALS, LLC	Chemical plant producing ammonia using natural gas as both a feedstock and a fuel. The nominal production capacity of the plant would be 3,031 tons/day of ammonia.	Emergency Generator Engine	Diesel Fuel	3985	hp		Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))		6.4	G/KW-HR
CRONUS CHEMICALS	CRONUS CHEMICALS, LLC	Chemical plant producing ammonia using natural gas as both a feedstock and a fuel. The nominal production capacity of the plant would be 3,031 tons/day of ammonia.	Firewater Pump Engine	Diesel Fuel	369	hp		Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))		4	G/KW-HR
MIDWEST FERTILIZER COMPANY LLC	MIDWEST FERTILIZER COMPANY LLC	STATIONARY NITROGEN FERTILIZER MANUFACTURING FACILITY	EMERGENCY GENERATORS (EU014A AND EU-014B)	DISTILLATE OIL	3600	HP EACH		Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	GOOD COMBUSTION PRACTICES	4.42	G/HP-H EACH
MIDWEST FERTILIZER COMPANY LLC	MIDWEST FERTILIZER COMPANY LLC	nitrogen fertilizer manufacturing facility	emergency generator EU 014a	distillate oil	3600	HP		Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))		4.42	G/HP-HR
MONSANTO LULING PLANT	MONSANTO COMPANY	Chemical Manufacture	Fire Water Diesel Pump No. 3 Engine	Diesel Fuel	600	hp	Emergency engine with a limit of 100 hours/yr on operating hours for ready testing.	Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	Proper operation and limits on hours operation for emergency engines and compliance with 40 CFR 60 Subpart IIII	0	
MONSANTO LULING PLANT	MONSANTO COMPANY	Chemical Manufacture	Fire Water Diesel Pump No. 4 Engine	Diesel Fuel	600	hp	Emergency Engine limited to 100 hours/yr for ready tests	Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	Proper operation and limits on hours of operation for emergency engines and compliance with 40 CFR 60 Subpart IIII	0	
MONSANTO LULING PLANT	MONSANTO COMPANY	Chemical Manufacture	Standby Generator No. 9 Engine	Diesel Fuel	400	hp	Operating hours limited to 100 hours/yr for ready testing.	Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	Proper operation and limits on hours of operation for emergency engines and compliance with 40 CFR 60 Subpart IIII	0	
CALCASIEU PASS LNG PROJECT	VENTURE GLOBAL CALCASIEU PASS, LLC	New Liquefied Natural Gas (LNG) production, storage, and export terminal.	Firewater Pumps	Diesel Fuel	634	kW		Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	Good Combustion and Operating Practices.	3.1	G/HP-H
CALCASIEU PASS LNG PROJECT	VENTURE GLOBAL CALCASIEU PASS, LLC	New Liquefied Natural Gas (LNG) production, storage, and export terminal.	Large Emergency Engines (>50kW)	Diesel Fuel	5364	HP	Three emergency black-start engines and two emergency generators	Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	Good Combustion and Operating Practices	5.6	G/KW-H
FG LA COMPLEX	FG LA LLC	The FG LA complex will produce ethylene, propylene, ethylene glycol, high density polyethylene, low density polyethylene, linear low-density polyethylene and polypropylene. To support the operation of these production plants, the complex will also include electric power and steam generating units (Utility), wastewater treatment (Central Wastewater Treatment Plant), storage and loading operations (Logistics), and associated flare systems.	Emergency Generator Diesel Engines	Diesel Fuel	550	hp		Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	Compliance with the limitations imposed by 40 CFR 63 Subpart IIII and operating the engine in accordance with the engine manufacturer's instructions and/or written procedures designed to maximize combustion efficiency and minimize fuel usage.	0	

FG LA COMPLEX	FG LA LLC	The FG LA complex will produce ethylene, propylene, ethylene glycol, high density polyethylene, low density polyethylene, linear low-density polyethylene and polypropylene. To support the operation of these production plants, the complex will also include electric power and steam generating units (Utility), wastewater treatment (Central Wastewater Treatment Plant), storage and loading operations (Logistics), and associated flare systems.	Emergency Fire Water Pumps	Diesel Fuel	550	hp		Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	Compliance with the limitations imposed by 40 CFR 63 Subpart IIII and operating the engine in accordance with the engine manufacturer's instructions and/or written procedures designed to maximize combustion efficiency and minimize fuel usage.	0	
INDECK NILES, LLC	INDECK NILES, LLC	Natural gas combined cycle power plant.	EUEMENGINE (Diesel fuel emergency engine)	Diesel Fuel	22.68	MMBTU/H	a 2,922 horsepower (HP) (2,179 kilowatts (kW)) diesel fueled emergency engine manufactured in 2011 or later and a displacement of <10 liters/cylinder. Restricted to 4 hours/day, except during emergency conditions and stack testing, and 500 hours/year on a 12-month rolling time period basis.	Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	Good combustion practices and meeting NSPS IIII requirements.	6.4	G/KW-H
INDECK NILES, LLC	INDECK NILES, LLC	Natural gas combined cycle power plant	EUFPENGINE (Emergency engine-diesel fire pump	diesel fuel	1.66	MMBTU/H	A 260 brake horsepower (bhp) diesel-fueled emergency engine manufactured in 2011 or later and a displacement of <10 Liters/cylinder. Powers a fire pump used for back up during an emergency (EUFPENGINE). Restricted to 1 hours/day, except during emergency conditions and stack testing, and 100 hours/year on a 12-month rolling time period basis.	Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	Good Combustion Practices and meeting NSPS Subpart IIII requirements	3	G/BHP-H
INDECK NILES, LLC	INDECK NILES, LLC	Natural gas combined cycle power plant	EUEMENGINE (diesel fuel emergency engine)	diesel fuel	22.68	MMBTU/H	A 2,922 horsepower (HP) (2,179 kilowatts (kW)) natural gas-fueled emergency engine (EUEMENGINE) manufactured in 2011 or later and a displacement of <10 Liters/cylinder. Restricted to 4 hours/day, except during emergency conditions and stack testing, and 500 hours/year on a 12-month rolling time period basis	Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	Good Combustion Practices and meeting NSPS Subpart IIII requirements	6.4	G/KW-H
CLEAN ENERGY FUTURE - LORDSTOWN, LLC	CLEAN ENERGY FUTURE - LORDSTOWN, LLC	962 MW (gross winter output) combined cycle gas turbine (CCGT) facility	Emergency fire pump engine (P004)	Diesel fuel	140	HP	140 hp (104.5 kW) emergency diesel-fired fire pump engine	Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	State-of-the-art combustion design	0.81	LB/H
CLEAN ENERGY FUTURE - LORDSTOWN, LLC	CLEAN ENERGY FUTURE - LORDSTOWN, LLC	962 MW (gross winter output) combined cycle gas turbine (CCGT) facility	Emergency generator (P003)	Diesel fuel	2346	HP	1,750 kW (2,346 hp) emergency generator	Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	State-of-the-art combustion design	21.6	LB/H
SOUTH FIELD ENERGY LLC	SOUTH FIELD ENERGY LLC	1150 MW combined-cycle gas turbine (CCGT) facility	Emergency fire pump engine (P004)	Diesel fuel	311	HP	311 hp (232.1 kW mechanical) emergency fire pump	Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	State-of-the-art combustion design	1.79	LB/H

SOUTH FIELD ENERGY LLC	SOUTH FIELD ENERGY LLC	1150 MW combined-cycle gas turbine (CCGT) facility	Emergency generator (P003)	Diesel fuel	2947	HP	2,000 kW electric, 2,198 kW mechanical (2,947 hp) emergency diesel generator	Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	State-of-the-art combustion design	27.18	LB/H
PALLAS NITROGEN LLC	PALLAS NITROGEN LLC	Natural gas-based facility for the manufacture of nitrogenous products.	Emergency Fire Pump Diesel Engine (P008)	Diesel fuel	460	HP	460 HP - 343 kW Emergency Fire Pump Diesel Engine	Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	good combustion control and operating practices and engines designed to meet the stands of 40 CFR Part 60, Subpart IIII	0.3	LB/H
PALLAS NITROGEN LLC	PALLAS NITROGEN LLC	Natural gas-based facility for the manufacture of nitrogenous products.	Emergency Generator (P009)	Diesel fuel	5000	HP	5,000 HP â€" 3,729 kW Emergency Generator Diesel Engine	Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	good combustion control and operating practices and engines designed to meet the stands of 40 CFR Part 60, Subpart IIII	5.5	LB/H
TRUMBULL ENERGY CENTER	TRUMBULL ENERGY CENTER	940 MW combined cycle gas turbine (CCGT) facility	Emergency generator (P003)	Diesel fuel	1529	HP	Emergency Generator 1000 kW (electrical), 1,140 kW (mechanical), 1,529 hp	Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	State-of-the-art combustion design	16.07	LB/H
TRUMBULL ENERGY CENTER	TRUMBULL ENERGY CENTER	940 MW combined cycle gas turbine (CCGT) facility	Emergency fire pump engine (P004)	Diesel fuel	300	HP	Emergency Fire Pump 300 hp (224 kW mechanical)	Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	State-of-the-art combustion design	1.97	LB/H
OREGON ENERGY CENTER	OREGON ENERGY CENTER	Combined cycle gas turbine (CCGT) facility	Emergency generator (P003)	Diesel fuel	1529	HP	1,000 kWe (1,140 kW mechanical) emergency diesel-fired generator	Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	State-of-the-art combustion design	16.1	LB/H
OREGON ENERGY CENTER	OREGON ENERGY CENTER	Combined cycle gas turbine (CCGT) facility	Emergency fire pump engine (P004)	Diesel fuel	300	HP	300 hp emergency diesel-fired fire pump	Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	State-of-the-art combustion design	1.97	LB/H
GUERNSEY POWER STATION LLC	GUERNSEY POWER STATION LLC	1,650 MW combined cycle combustion turbine electrical generating facility	Emergency Generators (2 identical, P004 and P005)	Diesel fuel	2206	HP	Two identical Emergency Generators; 1,645 kW (2,206 HP) emergency diesel-fired generator to provide on-site emergency power capabilities independent of the utility grid. Throughputs and limits are for a single generator except as noted.	Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	Certified to the meet the emissions standards in 40 CFR 89.112 and 89.113 pursuant to 40 CFR 60.4205(b) and 60.4202(a)(2). Good combustion practices per the manufacturerâ€™s operating manual.	23.21	LB/H
GUERNSEY POWER STATION LLC	GUERNSEY POWER STATION LLC	1,650 MW combined cycle combustion turbine electrical generating facility	Emergency Fire Pump (P006)	Diesel fuel	410	HP	410 HP emergency diesel-fired fire pump to provide on-site firefighting capabilities independent of the utility grid	Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	Certified to the meet the emissions standards in Table 4 of 40 CFR Part 60, Subpart IIII. Good combustion practices per the manufacturerâ€™s operating manual	2.7	LB/H
LONG RIDGE ENERGY GENERATION LLC - HANNIBAL POWER	LONG RIDGE ENERGY GENERATION LLC - HANNIBAL POWER	Combined cycle combustion turbine power generation facility	Emergency Diesel Generator Engine (P001)	Diesel fuel	2206	HP	1,645 kW (2,206 HP) emergency diesel-fired generator to provide on-site emergency power capabilities independent of the utility grid.	Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	Good combustion design	24.71	LB/H

LONG RIDGE ENERGY GENERATION LLC - HANNIBAL POWER	LONG RIDGE ENERGY GENERATION LLC - HANNIBAL POWER	Combined cycle combustion turbine power generation facility	Emergency Diesel Fire Pump Engine (P002)	Diesel fuel	700	HP	700 hp emergency diesel-fired fire pump to provide on-site firefighting capabilities independent of the utility grid	Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	Good combustion design	4.97	LB/H
IRONUNITS LLC - TOLEDO HBI	IRONUNITS LLC - TOLEDO HBI	Hot briquetted iron production	Emergency diesel-fueled fire pump (P006)	Diesel fuel	250	HP	250 hp emergency diesel-fueled fire pump	Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	Comply with NSPS 40 CFR 60 Subpart IIII	1.6	LB/H
IRONUNITS LLC - TOLEDO HBI	IRONUNITS LLC - TOLEDO HBI	Hot briquetted iron production	Emergency diesel-fired generator (P007)	Diesel fuel	2682	HP	2,000 kW (2,682 hp) emergency diesel-fired generator	Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	Comply with NSPS 40 CFR 60 Subpart IIII	28.2	LB/H
HARRISON POWER	HARRISON POWER	1000 MW natural gas-fired combined cycle combustion turbine plant	Emergency Diesel Generator (P003)	Diesel fuel	1860	HP	1,387 KW (1,860 HP) emergency diesel-fired generator	Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	Good combustion practices (ULSD) and compliance with 40 CFR Part 60, Subpart IIII	19.68	LB/H
HARRISON POWER	HARRISON POWER	1000 MW natural gas-fired combined cycle combustion turbine plant	Emergency Fire Pump (P004)	Diesel fuel	320	HP	238.6 KW (320 HP) emergency diesel-fired firewater pump	Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	Good combustion practices (ULSD) and compliance with 40 CFR Part 60, Subpart IIII	2.12	LB/H
PTTGCA PETROCHEMICAL COMPLEX	PTTGCA PETROCHEMICAL COMPLEX	Petrochemical Complex	Firewater Pumps (P005 and P006)	Diesel fuel	402	HP	Two identical Firewater Pumps 1 and 2; 300 kW (402 HP) emergency diesel-fired firewater pump engine. Limits are for single pump except as noted.	Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	Certified to the meet the emissions standards in Table 4 of 40 CFR Part 60, Subpart IIII and employ good combustion practices per the manufacturerâ€™s operating manual	2.64	LB/H
PTTGCA PETROCHEMICAL COMPLEX	PTTGCA PETROCHEMICAL COMPLEX	Petrochemical Complex	Emergency Diesel-fired Generator Engine (P007)	Diesel fuel	3353	HP	2,500 kW (3,353 HP) emergency diesel-fired generator engine	Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	certified to the meet the emissions standards in Table 4 of 40 CFR Part 60, Subpart IIII, shall employ good combustion practices per the manufacturerâ€™s operating manual	37.41	LB/H
PTTGCA PETROCHEMICAL COMPLEX	PTTGCA PETROCHEMICAL COMPLEX	Petrochemical Complex	1,000 kW Emergency Generators (P008 - P010)	Diesel fuel	1341	HP	Three identical ECU Generators 1 to 3; 1,000 kW (1,341 HP) emergency diesel-fired generator engine. Limits are for single generator except as noted.	Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	certified to the meet the emissions standards in Table 4 of 40 CFR Part 60, Subpart IIII, shall employ good combustion practices per the manufacturerâ€™s operating manual	14.96	LB/H
PETMIN USA INCORPORATED	PETMIN USA INCORPORATED	Merchant Pig Iron Production	Black Start Generator (P007)	Diesel fuel	158	HP	Black start generator, 158 HP diesel engine.	Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	Tier IV engine Tier IV NSPS standards certified by engine manufacturer.	0.104	LB/H
PETMIN USA INCORPORATED	PETMIN USA INCORPORATED	Merchant Pig Iron Production	Emergency Generators (P005 and P006)	Diesel fuel	3131	HP	Two identical Emergency generators, 3131 HP diesel engines. Throughputs and limits are for one generator, except as noted.	Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	Tier IV engine Tier IV NSPS standards certified by engine manufacturer.	3.45	LB/H

PETMIN USA INCORPORATED	PETMIN USA INCORPORATED	Merchant Pig Iron Production	Diesel-fired emergency fire pumps (2) (P009 and P010)	Diesel fuel	3131	HP	Two identical fire pump 3131 HP diesel engines. Throughputs and limits are for one engine, except as noted.	Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	Tier IV NSPS standards certified by engine manufacturer.	0	
INTEL OHIO SITE	INTEL OHIO SITE	Semiconductor manufacturing facility	5,051 bhp (3,768 kWm) Diesel-Fired Emergency Generators: P001 through P046	Diesel fuel	5051	HP	Forty-six 5,051 bhp (3,768 kWm) Diesel-Fired Emergency Generators: P001 through P046	Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	Certified to meet Tier 2 standards and good combustion practices	6.4	G/KW-H
INTEL OHIO SITE	INTEL OHIO SITE	Semiconductor manufacturing facility	275 hp (205 kW) Diesel-Fired Emergency Fire Pump Engine	Diesel fuel	275	HP		Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	Certified to meet the standards in Table 4 of 40 CFR Part 60, Subpart IIII and good combustion practices	4	G/KW-H
GREENSVILLE POWER STATION	VIRGINIA ELECTRIC AND POWER COMPANY	The proposed project will be a new, nominal 1,600 MW combined-cycle electrical power generating facility utilizing three combustion turbines each with a duct-fired heat recovery steam generator (HRSG) with a common reheat condensing steam turbine generator (3 on 1 configuration). The proposed fuel for the turbines and duct burners is pipeline-quality natural gas.	DIESEL-FIRED EMERGENCY GENERATOR 3000 kW (1)	DIESEL FUEL	0			Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	Good Combustion Practices/Maintenance	6.4	G/KW
GREENSVILLE POWER STATION	VIRGINIA ELECTRIC AND POWER COMPANY	The proposed project will be a new, nominal 1,600 MW combined-cycle electrical power generating facility utilizing three combustion turbines each with a duct-fired heat recovery steam generator (HRSG) with a common reheat condensing steam turbine generator (3 on 1 configuration). The proposed fuel for the turbines and duct burners is pipeline-quality natural gas.	DIESEL-FIRED WATER PUMP 376 bph (1)	DIESEL FUEL	0		FWP-1: 104.0 tons/year (12-month rolling total)	Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	Good Combustion Practices/Maintenance	0	
SIO INTERNATIONAL WISCONSIN, INC. -ENERGY PLANT		Energy facility providing comfort heating, production-related steam, and emergency backup power to the Fabrication 818 plant.	Diesel-Fired Emergency Generators	Diesel Fuel	0		Ten, 2,180kW Diesel-Fired Emergency Generators.	Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	The Use of Ultra Low Sulfur Fuel and Good Combustion Practices	5.36	G/KWH
SIO INTERNATIONAL WISCONSIN, INC. -ENERGY PLANT	SIO INTERNATIONAL	Nitrogen Plant	P42 -Diesel Fired Emergency Generator	Diesel Fuel	0		Maximum Continuous Rating: 1,750 kW or 2,346 bhp	Nitrogen Oxides (NOx)	(InOrganic Compounds, Oxides of Nitrogen (NOx),Particulate Matter (PM))	Good Combustion Practices, The Use of an Engine Turbocharger and Aftercooler.	5.36	G/KWH

Appendix A: RBLC Search Results for Boilers

RBLCID	FACILITY_NAME	CORPORATE_OR_COMPANY_NAME	PROCESS_NAME	PRIMARY_FUEL	THROUGHPUT	THROUGHPUT_UNIT	PROCESS_NOTES	POLLUTANT	CONTROL_METHOD_DESCRIPTION	EMISSION_LIMIT_1	EMISSION_LIMIT_1_UNIT
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Waste Incinerator	Gas, ULSD, or Trash	4.9	MMBTU/H	4.9 MMBtu Gas-, ULSD-, or Trash-fired new, small, remote Waste Incinerator capable of firing 220 lbs/hr	Carbon Dioxide Equivalent (CO2e)		981	TONS/YEAR
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Waste Incinerator	Gas, ULSD, or Trash	4.9	MMBTU/H	4.9 MMBtu Gas-, ULSD-, or Trash-fired new, small, remote Waste Incinerator capable of firing 220 lbs/hr	Volatile Organic Compounds (VOC)		3	LB/TON
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Waste Incinerator	Gas, ULSD, or Trash	4.9	MMBTU/H	4.9 MMBtu Gas-, ULSD-, or Trash-fired new, small, remote Waste Incinerator capable of firing 220 lbs/hr	Carbon Monoxide		13	PPMV
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Waste Incinerator	Gas, ULSD, or Trash	4.9	MMBTU/H	4.9 MMBtu Gas-, ULSD-, or Trash-fired new, small, remote Waste Incinerator capable of firing 220 lbs/hr	Nitrogen Oxides (NOx)		170	PPMV
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Waste Incinerator	Gas, ULSD, or Trash	4.9	MMBTU/H	4.9 MMBtu Gas-, ULSD-, or Trash-fired new, small, remote Waste Incinerator capable of firing 220 lbs/hr	Particulate matter, filterable < 10 Åµ (FPM10)		270	MG/DSCM
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Waste Incinerator	Gas, ULSD, or Trash	4.9	MMBTU/H	4.9 MMBtu Gas-, ULSD-, or Trash-fired new, small, remote Waste Incinerator capable of firing 220 lbs/hr	Particulate matter, filterable < 2.5 Åµ (FPM2.5)		270	MG/DSCM
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Remote Incinerator Generator Engine	Ultra Low Sulfur Diesel	102	hp	102 hp ULSD-fired existing, small, remote Waste Incinerator	Carbon Dioxide Equivalent (CO2e)		892	TONS/YEAR
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Remote Incinerator Generator Engine	Ultra Low Sulfur Diesel	102	hp	102 hp ULSD-fired existing, small, remote Waste Incinerator	Volatile Organic Compounds (VOC)		3	LB/TON
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Remote Incinerator Generator Engine	Ultra Low Sulfur Diesel	102	hp	102 hp ULSD-fired existing, small, remote Waste Incinerator	Carbon Monoxide		10	LB/TON
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Remote Incinerator Generator Engine	Ultra Low Sulfur Diesel	102	hp	102 hp ULSD-fired existing, small, remote Waste Incinerator	Nitrogen Oxides (NOx)		3	LB/TON
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Remote Incinerator Generator Engine	Ultra Low Sulfur Diesel	102	hp	102 hp ULSD-fired existing, small, remote Waste Incinerator	Particulate matter, filterable < 10 Åµ (FPM10)		7	LB/TON
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Remote Incinerator Generator Engine	Ultra Low Sulfur Diesel	102	hp	102 hp ULSD-fired existing, small, remote Waste Incinerator	Particulate matter, filterable < 2.5 Åµ (FPM2.5)		7	LB/TON
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Drilling, HP, and LP Flares	Gas	50	MMscf/yr	50 MMscf/yr Drilling Flare, 35 MMscf/yr HP Flare-Pilot/Purge, 20 MMscf/yr LP Flare-Pilot/Purge	Volatile Organic Compounds (VOC)		0.14	LB/MMBTU
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Drilling, HP, and LP Flares	Gas	50	MMscf/yr	50 MMscf/yr Drilling Flare, 35 MMscf/yr HP Flare-Pilot/Purge, 20 MMscf/yr LP Flare-Pilot/Purge	Carbon Monoxide		0.37	LB/MMBTU
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Drilling, HP, and LP Flares	Gas	50	MMscf/yr	50 MMscf/yr Drilling Flare, 35 MMscf/yr HP Flare-Pilot/Purge, 20 MMscf/yr LP Flare-Pilot/Purge	Carbon Dioxide		5317	TONS/YEAR
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Drilling, HP, and LP Flares	Gas	50	MMscf/yr	50 MMscf/yr Drilling Flare, 35 MMscf/yr HP Flare-Pilot/Purge, 20 MMscf/yr LP Flare-Pilot/Purge	Nitrogen Oxides (NOx)		0.068	LB/MMBTU
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Drilling, HP, and LP Flares	Gas	50	MMscf/yr	50 MMscf/yr Drilling Flare, 35 MMscf/yr HP Flare-Pilot/Purge, 20 MMscf/yr LP Flare-Pilot/Purge	Particulate matter, filterable < 10 Åµ (FPM10)		0.0264	LB/MMBTU
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Drilling, HP, and LP Flares	Gas	50	MMscf/yr	50 MMscf/yr Drilling Flare, 35 MMscf/yr HP Flare-Pilot/Purge, 20 MMscf/yr LP Flare-Pilot/Purge	Particulate matter, filterable < 2.5 Åµ (FPM2.5)		0.0264	LB/MMBTU
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Emergency Camp Generators	Ultra Low Sulfur Diesel	2695	hp	Three 2,696 hp ULSD-fired Standby Camp Generator Engines.	Carbon Dioxide Equivalent (CO2e)		2332	TONS/YEAR
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Emergency Camp Generators	Ultra Low Sulfur Diesel	2695	hp	Three 2,696 hp ULSD-fired Standby Camp Generator Engines.	Volatile Organic Compounds (VOC)		0.0007	LB/HP-H
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Emergency Camp Generators	Ultra Low Sulfur Diesel	2695	hp	Three 2,696 hp ULSD-fired Standby Camp Generator Engines.	Carbon Monoxide		2.6	GRAMS/HP-H
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Emergency Camp Generators	Ultra Low Sulfur Diesel	2695	hp	Three 2,696 hp ULSD-fired Standby Camp Generator Engines.	Nitrogen Oxides (NOx)		4.8	GRAMS/HP-H
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Emergency Camp Generators	Ultra Low Sulfur Diesel	2695	hp	Three 2,696 hp ULSD-fired Standby Camp Generator Engines.	Particulate matter, filterable < 10 Åµ (FPM10)		0.15	GRAMS/HP-H
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Emergency Camp Generators	Ultra Low Sulfur Diesel	2695	hp	Three 2,696 hp ULSD-fired Standby Camp Generator Engines.	Particulate matter, filterable < 2.5 Åµ (FPM2.5)		0.15	GRAMS/HP-H
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Turbines	Fuel Gas	7520	kW	Four 7.52 MW Solar Turbines with SoLoNOx Technology burning natural gas on the North Slope of Alaska, north of the Artic Circle. Two of the turbines are dual fired units that can combust ULSD as well as Fuel Gas	Carbon Dioxide Equivalent (CO2e)		89336	TONS/YEAR
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Turbines	Fuel Gas	7520	kW	Four 7.52 MW Solar Turbines with SoLoNOx Technology burning natural gas on the North Slope of Alaska, north of the Artic Circle. Two of the turbines are dual fired units that can combust ULSD as well as Fuel Gas	Volatile Organic Compounds (VOC)		2.5	PPMV
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Turbines	Fuel Gas	7520	kW	Four 7.52 MW Solar Turbines with SoLoNOx Technology burning natural gas on the North Slope of Alaska, north of the Artic Circle. Two of the turbines are dual fired units that can combust ULSD as well as Fuel Gas	Carbon Monoxide	SCR (Selective Catalytic Reduction) is a post-combustion gas treatment technique for reduction of nitric oxide (NO) and nitrogen dioxide (NO2) in the turbine exhaust stream to molecular nitrogen, water, and oxygen. This process is accomplished by using ammonia (NH3) as a reducing agent, and is injected into the flue gas upstream of the catalyst bed. By lowering the activation energy of the NOX decomposition removal efficiency of 80 to 90 percent are achievable.	2.5	PPMV

AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Turbines	Fuel Gas	7520	kW	Four 7.52 MW Solar Turbines with SoLoNOx Technology burning natural gas on the North Slope of Alaska, north of the Artic Circle. Two of the turbines are dual fired units that can combust ULSD as well as Fuel Gas	Nitrogen Oxides (NOx)	Dry Low NOx and SoLoNOx. DLN combustors utilize multistage premix combustors where the air and fuel is mixed at a lean fuel to air ratio. The excess air in the lean mixture acts as a heat sink, which lowers peak combustion temperatures and also ensures a more homogeneous mixture, both resulting in greatly reduced NOX formation rates. SoLoNOx is a lean premixed process which improves combustion efficiency and reduce NOx and particulate emissions	15	PPMV
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Turbines	Fuel Gas	7520	kW	Four 7.52 MW Solar Turbines with SoLoNOx Technology burning natural gas on the North Slope of Alaska, north of the Artic Circle. Two of the turbines are dual fired units that can combust ULSD as well as Fuel Gas	Particulate matter, filterable < 10 Âµ (FPM10)		0.0066	LB/MMBTU
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Turbines	Fuel Gas	7520	kW	Four 7.52 MW Solar Turbines with SoLoNOx Technology burning natural gas on the North Slope of Alaska, north of the Artic Circle. Two of the turbines are dual fired units that can combust ULSD as well as Fuel Gas	Particulate matter, filterable < 2.5 Âµ (FPM2.5)		0.066	LB/MMBTU
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Airstrip Generator Engine	Ultra Low Sulfur Diesel	490	hp	One 490 hp Airstrip Generator Engine	Carbon Dioxide Equivalent (CO2e)		163	TONS/YEAR
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Airstrip Generator Engine	Ultra Low Sulfur Diesel	490	hp	One 490 hp Airstrip Generator Engine	Volatile Organic Compounds (VOC)		0.0025	LB/HP-H
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Airstrip Generator Engine	Ultra Low Sulfur Diesel	490	hp	One 490 hp Airstrip Generator Engine	Carbon Monoxide		2.6	GRAMS/HP-H
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Airstrip Generator Engine	Ultra Low Sulfur Diesel	490	hp	One 490 hp Airstrip Generator Engine	Nitrogen Oxides (NOx)		4.8	GRAMS/HP-H
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Airstrip Generator Engine	Ultra Low Sulfur Diesel	490	hp	One 490 hp Airstrip Generator Engine	Particulate matter, filterable < 10 Âµ (FPM10)		0.15	GRAMS/HP-H
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Airstrip Generator Engine	Ultra Low Sulfur Diesel	490	hp	One 490 hp Airstrip Generator Engine	Particulate matter, filterable < 2.5 Âµ (FPM2.5)		0.15	GRAMS/HP-H
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Agitator Generator Engine	Ultra Low Sulfur Diesel	98	hp	ULSD-fired 98 hp Agitator Generator Engine	Carbon Dioxide Equivalent (CO2e)		356	TONS/YEAR
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Agitator Generator Engine	Ultra Low Sulfur Diesel	98	hp	ULSD-fired 98 hp Agitator Generator Engine	Volatile Organic Compounds (VOC)		0.0025	LB/HP-H
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Agitator Generator Engine	Ultra Low Sulfur Diesel	98	hp	ULSD-fired 98 hp Agitator Generator Engine	Carbon Monoxide		3.7	GRAMS/HP-H
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Agitator Generator Engine	Ultra Low Sulfur Diesel	98	hp	ULSD-fired 98 hp Agitator Generator Engine	Nitrogen Oxides (NOx)		5.6	GRAMS/HP-H
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Agitator Generator Engine	Ultra Low Sulfur Diesel	98	hp	ULSD-fired 98 hp Agitator Generator Engine	Particulate matter, filterable < 10 Âµ (FPM10)		0.3	GRAMS/HP-H
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Agitator Generator Engine	Ultra Low Sulfur Diesel	98	hp	ULSD-fired 98 hp Agitator Generator Engine	Particulate matter, filterable < 2.5 Âµ (FPM2.5)		0.3	GRAMS/HP-H
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Incinerator Generator Engine	Ultra Low Sulfur Diesel	102	hp	ULSD-fired 102 hp Incinerator Generator Engine	Carbon Dioxide Equivalent (CO2e)		516	TONS/YEAR
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Incinerator Generator Engine	Ultra Low Sulfur Diesel	102	hp	ULSD-fired 102 hp Incinerator Generator Engine	Volatile Organic Compounds (VOC)		0.0025	LB/HP-H
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Incinerator Generator Engine	Ultra Low Sulfur Diesel	102	hp	ULSD-fired 102 hp Incinerator Generator Engine	Carbon Monoxide		3.7	GRAMS/HP-H
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Incinerator Generator Engine	Ultra Low Sulfur Diesel	102	hp	ULSD-fired 102 hp Incinerator Generator Engine	Nitrogen Dioxide (NO2)		4.9	GRAMS/HP-H
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Incinerator Generator Engine	Ultra Low Sulfur Diesel	102	hp	ULSD-fired 102 hp Incinerator Generator Engine	Particulate matter, filterable < 10 Âµ (FPM10)		0.22	GRAMS/HP-H
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Incinerator Generator Engine	Ultra Low Sulfur Diesel	102	hp	ULSD-fired 102 hp Incinerator Generator Engine	Particulate matter, filterable < 2.5 Âµ (FPM2.5)		0.22	GRAMS/HP-H
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Boilers and Heaters	Ultra Low Sulfur Diesel	7	MMBTU/H	33 ULSD-fired Boilers and Heaters ranging from 1 to 7 MMBtu/hr	Carbon Dioxide Equivalent (CO2e)		45537	TONS/YEAR
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Boilers and Heaters	Ultra Low Sulfur Diesel	7	MMBTU/H	33 ULSD-fired Boilers and Heaters ranging from 1 to 7 MMBtu/hr	Volatile Organic Compounds (VOC)		0.252	LB/1,000 GAL
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Boilers and Heaters	Ultra Low Sulfur Diesel	7	MMBTU/H	33 ULSD-fired Boilers and Heaters ranging from 1 to 7 MMBtu/hr	Carbon Monoxide		5	LB/1,000 GAL
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Boilers and Heaters	Ultra Low Sulfur Diesel	7	MMBTU/H	33 ULSD-fired Boilers and Heaters ranging from 1 to 7 MMBtu/hr	Nitrogen Oxides (NOx)		20	LB/1,000 GAL
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Boilers and Heaters	Ultra Low Sulfur Diesel	7	MMBTU/H	33 ULSD-fired Boilers and Heaters ranging from 1 to 7 MMBtu/hr	Particulate matter, filterable < 10 Âµ (FPM10)		2.3	LB/1,000 GAL
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Boilers and Heaters	Ultra Low Sulfur Diesel	7	MMBTU/H	33 ULSD-fired Boilers and Heaters ranging from 1 to 7 MMBtu/hr	Particulate matter, filterable < 2.5 Âµ (FPM2.5)		1.55	LB/1,000 GAL
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Fire Water Pumps	Ultra Low Sulfur Diesel	610	hp	Two ULSD-fired 610 hp Fire Water Pumps	Carbon Dioxide Equivalent (CO2e)		565	TONS/YEAR

AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Fine Water Pumps	Ultra Low Sulfur Diesel	610	hp	Two ULSD-fired 610 hp Fine Water Pumps	Volatile Organic Compounds (VOC)		0.0007	LB/HP-H
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Fine Water Pumps	Ultra Low Sulfur Diesel	610	hp	Two ULSD-fired 610 hp Fine Water Pumps	Carbon Monoxide		2.6	GRAMS/HP-H
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Fine Water Pumps	Ultra Low Sulfur Diesel	610	hp	Two ULSD-fired 610 hp Fine Water Pumps	Nitrogen Oxides (NOx)		3	GRAMS/HP-H
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Fine Water Pumps	Ultra Low Sulfur Diesel	610	hp	Two ULSD-fired 610 hp Fine Water Pumps	Particulate matter, filterable < 10 Âµ (FPM10)		0.15	GRAMS/HP-H
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Fine Water Pumps	Ultra Low Sulfur Diesel	610	hp	Two ULSD-fired 610 hp Fine Water Pumps	Particulate matter, filterable < 2.5 Âµ (FPM2.5)		0.15	GRAMS/HP-H
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Bulk Tank Generator Engines	Ultra Low Sulfur Diesel	891	hp	Two ULSD-fired 891 hp Bulk Tank Storage Area Generator Engines	Carbon Dioxide Equivalent (CO2e)		7194	TONS/YEAR
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Bulk Tank Generator Engines	Ultra Low Sulfur Diesel	891	hp	Two ULSD-fired 891 hp Bulk Tank Storage Area Generator Engines	Volatile Organic Compounds (VOC)		0.0007	LB/HP-H
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Bulk Tank Generator Engines	Ultra Low Sulfur Diesel	891	hp	Two ULSD-fired 891 hp Bulk Tank Storage Area Generator Engines	Carbon Monoxide		2.6	GRAMS/HP-H
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Bulk Tank Generator Engines	Ultra Low Sulfur Diesel	891	hp	Two ULSD-fired 891 hp Bulk Tank Storage Area Generator Engines	Nitrogen Oxides (NOx)		4.8	GRAMS/HP-H
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Bulk Tank Generator Engines	Ultra Low Sulfur Diesel	891	hp	Two ULSD-fired 891 hp Bulk Tank Storage Area Generator Engines	Particulate matter, filterable < 10 Âµ (FPM10)		0.15	GRAMS/HP-H
AK-0082	POINT THOMSON PRODUCTION FACILITY	EXXON MOBIL CORPORATION	Bulk Tank Generator Engines	Ultra Low Sulfur Diesel	891	hp	Two ULSD-fired 891 hp Bulk Tank Storage Area Generator Engines	Particulate matter, filterable < 2.5 Âµ (FPM2.5)		0.15	GRAMS/HP-H
WI-0270	DAIRYLAND POWER COOP ALMA STATION	DAIRYLAND POWER COOP	B27 - Auxilary Steam Boiler	Distillate fuel oil	83.8	mmBTU/hr	Oil-fired Auxiliary Steam Boiler. Boiler is used for main boiler startup.	Particulate matter, total (TPM)	Switch to ultra-low sulfur fuel oil (sulfur content no greater than 15 ppm, by weight)	0.015	LB/MMBTU
WI-0270	DAIRYLAND POWER COOP ALMA STATION	DAIRYLAND POWER COOP	B27 - Auxilary Steam Boiler	Distillate fuel oil	83.8	mmBTU/hr	Oil-fired Auxiliary Steam Boiler. Boiler is used for main boiler startup.	Particulate matter, total < 10 Âµ (TPM10)	Switch to ultra-low sulfur fuel oil (sulfur content no greater than 15 ppm, by weight)	0.011	LB/MMBTU
WI-0270	DAIRYLAND POWER COOP ALMA STATION	DAIRYLAND POWER COOP	B27 - Auxilary Steam Boiler	Distillate fuel oil	83.8	mmBTU/hr	Oil-fired Auxiliary Steam Boiler. Boiler is used for main boiler startup.	Particulate matter, total < 2.5 Âµ (TPM2.5)	Switch to ultra-low sulfur fuel oil (sulfur content no greater than 15 ppm, by weight)	0.01	LB/MMBTU
WI-0270	DAIRYLAND POWER COOP ALMA STATION	DAIRYLAND POWER COOP	B27 - Auxilary Steam Boiler	Distillate fuel oil	83.8	mmBTU/hr	Oil-fired Auxiliary Steam Boiler. Boiler is used for main boiler startup.	Carbon Dioxide Equivalent (CO2e)	Limit GHG emissions to 203.8 pounds of carbon dioxide equivalents (CO2-e) per 1000 pounds of steam produced, averaged over any 12 consecutive month period (computed monthly).	0	
WI-0270	DAIRYLAND POWER COOP ALMA STATION	DAIRYLAND POWER COOP	B27 - Auxilary Steam Boiler	Distillate fuel oil	83.8	mmBTU/hr	Oil-fired Auxiliary Steam Boiler. Boiler is used for main boiler startup.	Visible Emissions (VE)	The available options described for controlling visible emissions are generally the controls for controlling particulate matter, sulfur dioxide, sulfur dioxide, and nitrogen oxides emissions.	10	%
WI-0270	DAIRYLAND POWER COOP ALMA STATION	DAIRYLAND POWER COOP	B27 - Auxilary Steam Boiler	Distillate fuel oil	83.8	mmBTU/hr	Oil-fired Auxiliary Steam Boiler. Boiler is used for main boiler startup.	Nitrogen Oxides (NOx)	Limit nitrogen oxides emissions to 0.21 pounds per MMBTU	0.21	LB/MMBTU
WI-0270	DAIRYLAND POWER COOP ALMA STATION	DAIRYLAND POWER COOP	B27 - Auxilary Steam Boiler	Distillate fuel oil	83.8	mmBTU/hr	Oil-fired Auxiliary Steam Boiler. Boiler is used for main boiler startup.	Sulfur Dioxide (SO2)	Switch to ultra-low sulfur fuel oil (sulfur content no greater than 15 ppm, by weight)	0	

APPENDIX B. TITLE V APPLICATION FORMS

2700-PM-BAQ0027 1/2021
Application

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF AIR QUALITY

FOR OFFICIAL USE ONLY
OP #: ______________
Date: ______________

OPERATING PERMIT MODIFICATION APPLICATION

Section 1 – General Information

1.1 Application Type

Type of permit for which application is made:

☐ Minor Modification ☐ State-Only Operating Permit

☒ Significant Modification ☐ Title V Operating Permit

Existing Operating Permit No: 46-00038

1.2 Facility Information

Firm Name:	Constellation Energy Generation, LLC	Federal Tax ID:	23-3064219-21
Facility Name:	Limerick Generating Station	Plant Code:	Constellation Limerick Generating Station
NAICS Code:	221113	SIC Code:	4911
Description of NAICS Code:	Nuclear Electric Power Generation		
Description of SIC Code:	Trans. & Utilities - Electric Services		
County:	Montgomery	Municipality:	Limerick Township
Latitude:	40° 13 38.6429	Longitude:	-75° 35 02.1560
Horizontal Reference Datum:	NA Datum of 1983	Horizontal Collection Method:	Geographic coordinate determination method based on GPS code measurements (pseudo range) differential (DGPS)
		Reference Point:	Plant Entrance (general)

1.3 Permit Contact Information

Name:	Jordan Rajan	Title:	Regulatory Assurance Manager
Address:	3146 Sanatoga Road		
City:	Pottstown	State:	PA ZIP: 19464-3418
Telephone:	(610) 718-3400		
Email:	Jordan.rajan@constellation.com		

1.4 Small Business Question

Are you a small business as defined by the Pennsylvania Air Pollution Control Act? ☐ Yes ☒ No

Are you a small business as defined by the U.S. Small Business Administration? ☐ Yes ☒ No

1.5 Request for Confidentiality

Do you request any information on this application to be treated as "Confidential"? ☐ Yes ☒ No

Place confidential information on separate page(s) marked "Confidential".

In order to request confidential treatment for information in any document, you must submit a redacted version of the relevant document with the confidential information blacked out (and thus suitable for public disclosure), along with a letter of request containing a table identifying the page and line number of each redaction, along with a justification for each redacted item as to why it should be deemed confidential under the specific criteria allowed under 25 Pa. Code §127.12(d) and Section 13.2 of the APCA.

1.6 Certification of Truth, Accuracy and Completeness by a Responsible Official

I certify that, subject to the penalties of Title 18 Pa. C.S.A. Section 4904 and 35 P.S. Section 4009(b)(2), I am the responsible official having primary responsibility for the design and operation of the facilities to which this application applies and that the information provided in this application is true, accurate, and complete to the best of my knowledge, information, and belief formed after reasonable inquiry.

(Signed) William L[signature] Date: 7/31/25

Name (Typed): William Levis Title: Plant Manager

Telephone: (610) 718-2001

Email: william.levis@constellation.com

Section 2 – Inventory of Units Being Modified

Unit ID No.	Unit Name	Unit Type
001	Boiler A: 0AS502	Combustion
022A	Two Boilers (Boiler B & Boiler C)	Combustion
004A	Emergency Generators (8)	Combustion

Section 3 – Facility Changes

Complete this section ONLY if the changes are for the entire facility. If changes are for a source or sources, skip this Section and complete Section 4 for each Source in which a change is proposed.

3.1 Describe all proposed changes to this facility: Ract III Case-by-Case limits. See attached Narrative.

3.2 If the proposed facility changes involve any changes in actual emissions, please complete the following table. Attach another table if needed.

Pollutant Name	CAS Number	Change in Actual Emissions (+ or -)
NOx	N/A	N/A

3.3 Anticipated date on which proposed change is scheduled to occur: ____________________________

3.4 List the proposed revision language for the operating permit conditions. This includes all changes to the emissions, monitoring, testing, record-keeping, reporting requirements and work practice standard requirements. Write in the type of applicable requirements in the column provided. Attach another table if needed.

Citation Number	Type of Applicable Requirement	Existing Operating Permit Condition or Condition Number	Proposed Language for Permit Condition
129.114(a)	Alternative RACT III Case-by-Case	N/A	The owner or operator of an air contamination source subject to § 129.112 (relating to presumptive RACT requirements, RACT emission limitations and petition for alternative compliance schedule) located at a major NOx emitting facility or major VOC emitti
N/A	Proposed Emission Restrictions	New Source Group #1, Condition #001	The Nitrogen Oxides (NOx) emissions from each boiler listed under this source shall not exceed the following amounts: (a). 30 tons per year NOx (per boiler unit). (b). 8.5 lb/hr NOx (per boiler unit). (c). 99.9 tons per year NOx (facility wide)
N/A	Proposed Work Practices	New Source Group #1, Condition #002	These units will be limited to the following emission threshold on a 12-month rolling basis: (a). 30 tons per year NOx
N/A	Proposed Monitoring	New Source Group #1, Condition #003	The owner or operator of these units will monitor the following on a daily basis: (a) Type of fuel burned per boiler (b) Amount of fuel burned per boiler
N/A	Proposed Recordkeeping	New Source Group #1, Condition #004	The owner or operator of these sources will maintain the following records for a minimum of five (5) years: (a) Type and amount of fuel burned per day per boiler (b) Monthly fuel usage for each boiler in gallon

			(c) Calculations of Air Emissions (d) Tune up records for each boiler including: (i) Date of tune up (ii) Name of service company that performs the tune ups (iii) Final operating rate or load (iv) Final CO and NOx emission rates (v) Final excess oxygen rate
N/A	Proposed Reporting	New Source Group #1, Condition #005	The owner or operator of these sources will report compliance with work practices annually via Title V Compliance Certification.
N/A	Proposed Emission Restrictions	New Source Group #2, Condition #001	The Nitrogen Oxides (NOx) emissions from each generator listed under this source shall not exceed the following amounts: (a). 6.00 tons per year NOx (per generator). (b). 99.9 tons per year NOx (facility wide)
N/A	Proposed Work Practices	New Source Group #2, Condition #002	These generator units shall not operate for more than 100 hours per year on a 12-month rolling basis, which includes maintenance purposes.
N/A	Proposed Monitoring	New Source Group #2, Condition #003	The owner or operator of these units will monitor the following: (a) Monthly and annual units (MW-hr) generated by each unit (b) Amount of fuel burned per unit on a daily and

			monthly basis, including as a 12-Month Rolling total (c) Total operating hours on a monthly basis, including as a 12-Month Rolling total
N/A	Proposed Recordkeeping	New Source Group #2, Condition #004	The owner or operator of these sources will maintain the following records for a minimum of five (5) years: (a) Monthly and annual units (MW-hr) generated by each unit (b) Amount of fuel burned per unit on a daily and monthly basis, including as a 12-Month Rolling total (c) Total operating hours on a monthly basis, including as a 12-Month Rolling total
N/A	Proposed Reporting	New Source Group #2, Condition #005	The owner or operator of these sources will report compliance with work practices annually via Title V Compliance Certification.

3.5 Provide a listing of all changes in chronological order (additions and subtractions) made at a facility since the last submittal and attach it to this application. For example:

- March 2016 - Added shot blast booth 5, exempted by the attached Request for Determination.
- Dec 2017 - Installed new paint line in accordance with Plan Approval XX-XXXXX

N/a

3.6 For renewals, please review the current operating permit. If you are proposing any changes to the conditions of the permit, please provide the condition number, the requested change, and justification for the requested change.

N/a

Section 4 – Unit Information (duplicate this section for each unit as needed)

4.1 Unit Type: ☐ Combustion ☐ Incinerator ☐ Process ☐ Control Device

4.2 General Source Information (Combustion/Incinerator/Process)

a. Source ID: 001 b. Source Name: Boiler A

c. Manufacturer: Erie City Iron Works d. Model No.: Keystone 11M

e. Source Description: Combustion Unit

f. Rated Capacity (for engines use BHP): 57.1 MMBtu/hr g. Installation Date: 01/01/1976

h. Rated Power/Electric Output: ______

i. Exhaust Temperature: 609 Units: Deg F j. Exhaust % Moisture: 12 k. Exhaust Flow Volume: ______ SCFM

4.2 General Source Information (Combustion/Incinerator/Process)

a. Source ID: 002A b. Source Name: Two Boilers (Boiler B & Boiler C)

c. Manufacturer: Erie City Iron Works d. Model No.: Keystone 11M

e. Source Description: Combustion Units

f. Rated Capacity (for engines use BHP): 57.1 MMBtu/hr g. Installation Date: 01/01/1976

h. Rated Power/Electric Output: ______

i. Exhaust Temperature: 609 Units: Deg F j. Exhaust % Moisture: 12 k. Exhaust Flow Volume: 10,284 SCFM

4.2 General Source Information (Combustion/Incinerator/Process)

a. Source ID: 004A b. Source Name: Emergency Generators (8)

c. Manufacturer: Fairbanks-Morse d. Model No.: 38TD8-18

e. Source Description: Combustion unit

f. Rated Capacity (for engines use BHP): 3693 g. Installation Date: 03/01/1970

h. Rated Power/Electric Output: ______

i. Exhaust Temperature: 690 Units: Deg F j. Exhaust % Moisture: 6 k. Exhaust Flow Volume: 12,260 SCFM

4.3 General Control Device Information

a. Unit ID: ______ b. Unit Name: ______

c Used by Sources: ______

d. Type: ______

e. Pressure Drop (in. H_2O): ______________ f. Capture Efficiency: ______________

g. Flow Rate (specify unit): ______________________________

h. Manufacturer: ______________ i. Model No.: ______________

j. Installation Date: ______________________________

4.4 Proposed Changes to Unit

a. Describe all proposed changes to this unit:

b. If the proposed unit changes involve any changes in actual emissions, please complete the following table. Attach another table if needed.

Pollutant Name	CAS Number	Change in Actual Emissions (+ or -)

c. Anticipated date on which proposed change is scheduled to occur: ____________________

d. List the proposed revision language for the operating permit condition. This includes all changes to the emission, monitoring, testing, record-keeping, reporting requirements and work practice standard requirement. Write in the type of applicable requirements in the column provided. Attach another table if needed.

Citation Number	Type of Applicable Requirement	Existing Operating Permit Condition or Condition Number	Proposed Language for Permit Condition

Section 5 – Compliance Plan for the Facility			
		Yes	No
5.1	Will your facility be in compliance with all applicable requirements at the time of permit issuance and continue to comply with these requirements during the permit duration?	☒	☐
5.2	Will your facility be in compliance with all applicable requirements presently scheduled to take effect during the term of the permit?	☒	☐

2700-PM-AQ0004 Rev. 6/2006

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF AIR QUALITY

AIR POLLUTION CONTROL ACT COMPLIANCE REVIEW FORM

Fully and accurately provide the following information, as specified. Attach additional sheets as necessary.

Type of Compliance Review Form Submittal (check all that apply)

☐ Original Filing — Date of Last Compliance Review Form Filing:
☒ Amended Filing — 10/13/2020

Type of Submittal

☐ New Plan Approval	☐ New Operating Permit	☐ Renewal of Operating Permit
☐ Extension of Plan Approval	☐ Change of Ownership	☐ Periodic Submission (@ 6 mos)
☒ Other: RACT III Determination		

SECTION A. GENERAL APPLICATION INFORMATION

Name of Applicant/Permittee/("applicant")
(non-corporations-attach documentation of legal name)
Constellation Energy Generation, LLC

Address 3146 Sanatoga Rd.
Pottstown, PA 19464-3418

Telephone (610) 718-2000 **Taxpayer ID#** 23-3064219-21

Permit, Plan Approval or Application ID# 46-00038

Identify the form of management under which the applicant conducts its business (check appropriate box)

☐ Individual	☐ Syndicate	☐ Government Agency
☐ Municipality	☐ Municipal Authority	☐ Joint Venture
☐ Proprietorship	☐ Fictitious Name	☐ Association
☐ Public Corporation	☐ Partnership	☒ Other Type of Business, specify below:
☐ Private Corporation	☐ Limited Partnership	

Describe below the type(s) of business activities performed.
Constellation Energy Generation is an electric generation company that owns and operates electric generating facilities, is a wholesale marketer of energy and provides retail electric and gas service as an unregulated retail energy supplier.

SECTION B. GENERAL INFORMATION REGARDING "APPLICANT"

If applicant is a corporation or a division or other unit of a corporation, provide the names, principal places of business, state of incorporation, and taxpayer ID numbers of all domestic and foreign parent corporations (including the ultimate parent corporation), and all domestic and foreign subsidiary corporations of the ultimate parent corporation with operations in Pennsylvania. Please include all corporate divisions or units, (whether incorporated or unincorporated) and privately held corporations. (A diagram of corporate relationships may be provided to illustrate corporate relationships.) Attach additional sheets as necessary.

Unit Name	Principal Places of Business	State of Incorporation	Taxpayer ID	Relationship to Applicant
See Attachment A				

SECTION C. SPECIFIC INFORMATION REGARDING APPLICANT AND ITS "RELATED PARTIES"

Pennsylvania Facilities. List the name and location (mailing address, municipality, county), telephone number, and relationship to applicant (parent, subsidiary or general partner) of applicant and all Related Parties' places of business, and facilities in Pennsylvania. Attach additional sheets as necessary.

Unit Name	Street Address	County and Municipality	Telephone No.	Relationship to Applicant
See Attachments A and B				

Provide the names and business addresses of all general partners of the applicant and parent and subsidiary corporations, if any.

Name	Business Address
See Attachment A	

List the names and business address of persons with overall management responsibility for the process being permitted (i.e. plant manager).

Name	Business Address
Jordan Rajan (Site Regulatory Assurance Manager)	3146 Sanatoga Road, Pottstown, PA 19464
William Levis (Plant Manager)	3146 Sanatoga Road, Pottstown, PA 19464

Plan Approvals or Operating Permits. List all plan approvals or operating permits issued by the Department or an approved local air pollution control agency under the APCA to the applicant or related parties that are currently in effect or have been in effect at any time 5 years prior to the date on which this form is notarized. This list shall include the plan approval and operating permit numbers, locations, issuance and expiration dates. Attach additional sheets as necessary.

Air Contamination Source	Plan Approval/ Operating Permit#	Location	Issuance Date	Expiration Date
Constellation Energy Generation, LCC	46-00038	3146 Sanatoga Road, Pottstown, PA 19464-3418	12/16/2021	12/15/2026
See Attachment B				

Compliance Background. (Note: Copies of specific documents, if applicable, must be made available to the Department upon its request.) List all documented conduct of violations or enforcement actions identified by the Department pursuant to the APCA, regulations, terms and conditions of an operating permit or plan approval or order by applicant or any related party, using the following format grouped by source and location in reverse chronological order. Attach additional sheets as necessary. See the definition of "documented conduct" for further clarification. Unless specifically directed by the Department, deviations which have been previously reported to the Department in writing, relating to monitoring and reporting, need not be reported.

Date	Location	Plan Approval/ Operating Permit#	Nature of Documented Conduct	Type of Department Action	Status: Litigation Existing/ Continuing or Corrected/Date	Dollar Amount Penalty
See Attachment C						

List all incidents of deviations of the APCA, regulations, terms and conditions of an operating permit or plan approval or order by applicant or any related party, using the following format grouped by source and location in reverse chronological order. This list must include items both currently known and unknown to the Department. Attach additional sheets as necessary. See the definition of "deviations" for further clarification.

Date	Location	Plan Approval/ Operating Permit#	Nature of Deviation	Incident Status: Litigation Existing/Continuing Or Corrected/Date
See Attachment D				

<u>CONTINUING OBLIGATION</u>. Applicant is under a continuing obligation to update this form using the Compliance Review Supplemental Form if any additional deviations occur between the date of submission and Department action on the application.

VERIFICATION STATEMENT	
Subject to the penalties of Title 18 Pa.C.S. Section 4904 and 35 P.S. Section 4009(b)(2), I verify under penalty of law that I am authorized to make this verification on behalf of the Applicant/Permittee. I further verify that the information contained in this Compliance Review Form is true and complete to the best of my belief formed after reasonable inquiry. I further verify that reasonable procedures are in place to ensure that "documented conduct" and "deviations" as defined in 25 Pa Code Section 121.1 are identified and included in the information set forth in this Compliance Review Form.	
[signature]	7/31/25
Signature	Date
William Levis	
Name (Print or Type)	
Plant Manager	
Title	

APPENDIX C. MUNICIPAL NOTIFICATIONS

Constellation

TVOP 46-00038

LG-25-089

May 16, 2025

Montgomery County Board of Commissioners
Commissioners Office Building
P.O. Box 311
Norristown, PA 19404-0311

Constellation Energy Generation, LLC - Limerick Generating Station
TVOP No. 46-00038

Subject: RACT III Determination Notification

Dear Commissioners,

Pursuant to *25 Pa. Code* § 127.413 of the Pennsylvania Code, Constellation Energy Generation, LLC (Constellation) hereby notifies Montgomery County of the submittal of a case-by-case RACT determination per 25 Pa Code 129.114(b) for their three (3) boiler units and eight (8) generators in their existing Title V Operating Permit (No. 46-00038) to the Pennsylvania Department of Environmental Protection (PADEP) concerning its nuclear power plant located in Limerick Township, Montgomery County, Pennsylvania.

Pennsylvania Code Title 25 (Environmental Protection – Air Resources) Section 127.413 requires municipal notification including a 30-day comment period regarding the permit application, which begins upon receipt of this formal notification. During this comment period, PADEP will accept such comments. Comments are to be sent to:

Air Quality – Environmental Program Manager
Pennsylvania Department of Environmental Protection
Southeast Regional Office
2 E. Main Street, Norristown, PA 19401
Phone: (484) 250-5900

Written comments should include the name, address and telephone number of the person(s) submitting the comments along with the reference number of the proposed permit.

If you have any questions regarding this application or require any additional information, please feel free to contact Jordan Rajan at (610) 718-3400 or via e-mail at jordan.rajan@constellation.com.

Respectfully,

William Levis
Plant Manager, Limerick Generating Station
Constellation Energy Generation, LLC

cc: Jordan Rajan - Constellation
Matt Page – Trinity Consultants
Kieran Dempsey – Trinity Consultants

9589 0710 5270 1139 1594 75

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Norristown, PA 19404

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☐ Return Receipt (electronic) $ $0.00	
☐ Certified Mail Restricted Delivery $ $0.00	
☐ Adult Signature Required $ $0.00	
☐ Adult Signature Restricted Delivery $ $0.00	
Postage $ $0.73	
Total Postage and Fees $5.58	05/27/2025

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Street and Apt. No., or PO Box No.

City, State, ZIP+4®

PS Form 3800, January 2023 PSN 7530-02-000-9047 **See Reverse for Instructions**

Constellation

TVOP 46-00038

LG-25-089

May 16, 2025

Limerick Township Board of Supervisors
Limerick Township Building
646 W Ridge Pike
Limerick, PA 19468

Constellation Energy Generation, LLC - Limerick Generating Station
TVOP No. 46-00038

Subject: RACT III Determination Notification

Dear Supervisors,

Pursuant to *25 Pa. Code §* 127.413 of the Pennsylvania Code, Constellation Energy Generation, LLC (Constellation) hereby notifies Montgomery County of the submittal of a case-by-case RACT determination per 25 Pa Code 129.114(b) for their three (3) boiler units and eight (8) generators in their existing Title V Operating Permit (No. 46-00038) to the Pennsylvania Department of Environmental Protection (PADEP) concerning its nuclear power plant located in Limerick Township, Montgomery County, Pennsylvania.

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Air Quality – Environmental Program Manager
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Southeast Regional Office
2 E. Main Street, Norristown, PA 19401
Phone: (484) 250-5900

Written comments should include the name, address and telephone number of the person(s) submitting the comments along with the reference number of the proposed permit.

If you have any questions regarding this application or require any additional information, please feel free to contact Jordan Rajan at (610) 718-3400 or via e-mail at jordan.rajan@constellation.com.

Respectfully,

William Levis
Plant Manager, Limerick Generating Station
Constellation Energy Generation, LLC

cc: Jordan Rajan - Constellation
Matt Page – Trinity Consultants
Kieran Dempsey – Trinity Consultants

589 0710 5270 1139 1594 82

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☐ Return Receipt (electronic) $ $0.00	
☐ Certified Mail Restricted Delivery $ $0.00	
☐ Adult Signature Required $ $0.00	
☐ Adult Signature Restricted Delivery $ $0.00	
Postage $ $0.73	
Total Postage and Fees $ $5.58	05/27/2025

ROYERSFORD PA 19468 ... 27 2025

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Street and Apt. No., or PO Box No.

City, State, ZIP+4®

PS Form 3800, January 2023 PSN 7530-02-000-9047 See Reverse for Instructions

APPENDIX D. BAT COST CALCULATIONS

Cost Calculations 1 - Low NOx Burner

Boiler

Heat Capacity	57.1	MMBtu/hr		
Capital Cost - High	473930	1993 $		
Capital Cost - Low	37115	1993 $		
Annualized Capital Cost - High	52034.97	1993 $	Assuming 7% for 15 years, CRF =	0.109795
Annualized Capital Cost - Low	4075.027	1993 $		
Operational Cost - High	85650	1993 $		
Operational Cost - Low	19414	1993 $		
Annual Cost - High	137685	1993 $		
Annual Cost - Low	23489.03	1993 $	CEPCI	
Annual Cost - High	281070.2	2024 $	1993	391.3
Annual Cost - Low	47950.51	2024 $	July 2024	798.8
Annual Cost - Average	164510.3	2024 $		
Uncontrolled Emissions	31.51	tpy		
Removed Emissions	12.604	tpy		
Cost Effectiveness - High	22300.08	$/tpy		
Cost Effectiveness - Low	3804.388	$/tpy		
Cost Effectiveness - Average	13052.23	$/tpy		

Table 14. 1993 Costs of NOx Controls

	Cost of NOx Controls in 1993 Dollars					
Control Device	Low -Cap. $/MMBTU	High -Cap. $/MMBTU	Low - Oper. $/MMBTU	High -Oper. $/MMBTU	Low $/ton	High $/ton
LN[illegible]	[illegible]	[illegible]	[illegible]	1,500	240	1,300
LNB + FGR					650	7,630
SNCR	1,600	3,300	680	1,200	N/A	N/A
(1994 ESTIMATE)					700	1,300
SCR	2,400	20,000	1,500	5,800	1,810	10,900
(1994 ESTIMATE)					500	2,800

Technical Bulletin. Nitrogen Oxides (NOx), Why and How They are Controlled. EPA. https://www3.epa.gov/ttncatc1/dir1/fnoxdoc.pdf

Cost Calculations 2 - SCR
Boiler

Data Inputs

Enter the following data for your combustion unit:

Is the combustion unit a utility or industrial boiler? Industrial

Is the SCR for a new boiler or retrofit of an existing boiler? Retrofit

What type of fuel does the unit burn? Fuel Oil

Please enter a retrofit factor between 0.8 and 1.5 based on the level of difficulty. Enter 1 for projects of average retrofit difficulty. 1

Complete all of the highlighted data fields:

What is the maximum heat input rate (QB)? 57.1 MMBtu/hour

What is the higher heating value (HHV) of the fuel? 139,440 Btu/gallon

What is the estimated actual annual fuel consumption? 3,670,440 gallons/Year

Enter the net plant heat input rate (NPHR) 11 MMBtu/MW

If the NPHR is not known, use the default NPHR value:

Fuel Type	Default NPHR
Coal	10 MMBtu/MW
Fuel Oil	11 MMBtu/MW
Natural Gas	8.2 MMBtu/MW

Plant Elevation 250 Feet above sea level

Not applicable to units burning fuel oil or natural gas

Type of coal burned: Not Applicable

Enter the sulfur content (%S) = percent by weight

Not applicable to units buring fuel oil or natural gas

Note: The table below is pre-populated with default values for HHV and %S. Please enter the actual values for these parameters in the table below. If the actual value for any parameter is not known, you may use the default values provided.

Coal Type	Fraction in Coal Blend	%S	HHV (Btu/lb)
Bituminous	0	1.84	11,841
Sub-Bituminous	0	0.41	8,826
Lignite	0	0.82	6,685

Please click the calculate button to calculate weighted average values based on the data in the table above.

For coal-fired boilers, you may use either Method 1 or Method 2 to calculate the catalyst replacement cost. The equations for both methods are shown on rows 85 and 86 on the *Cost Estimate* tab. Please select your preferred method:

- ○ Method 1
- ○ Method 2
- ● Not applicable

Enter the following design parameters for the proposed SCR:

Number of days the SCR operates (t_{SCR}) 7 days

Number of days the boiler operates (t_{plant}) 7 days

Number of SCR reactor chambers (n_{scr}) 1

Number of catalyst layers (R_{layer}) 3

Cost Calculations 2 - SCR
Boiler

Inlet NO_x Emissions (NOx_{in}) to SCR	0.126 lb/MMBtu
Outlet NO_x Emissions (NOx_{out}) from SCR	0.0378 lb/MMBtu
Stoichiometric Ratio Factor (SRF)	1.050

*The SRF value of 1.05 is a default value. User should enter actual value, if known.

Number of empty catalyst layers (R_{empty})	1
Ammonia Slip (Slip) provided by vendor	2 ppm
Volume of the catalyst layers ($Vol_{catalyst}$) (Enter "UNK" if value is not known)	UNK Cubic feet
Flue gas flow rate ($Q_{fluegas}$) (Enter "UNK" if value is not known)	UNK acfm

Estimated operating life of the catalyst ($H_{catalyst}$)	24,000 hours
Estimated SCR equipment life	20 Years*

* For industrial boilers, the typical equipment life is between 20 and 25 years.

Gas temperature at the SCR inlet (T)	650 °F
Base case fuel gas volumetric flow rate factor (Q_{fuel})	ft^3/min-MMBtu/hour

Concentration of reagent as stored (C_{stored})	29 percent*
Density of reagent as stored (ρ_{stored})	56 lb/cubic feet*
Number of days reagent is stored ($t_{storage}$)	14 days

*The reagent concentration of 29% and density of 56 lbs/cft are default values for ammonia reagent. User should enter actual values for reagent, if different from the default values provided.

Densities of typical SCR reagents:	
50% urea solution	71 lbs/ft^3
29.4% aqueous NH_3	56 lbs/ft^3

Select the reagent used: Ammonia

Enter the cost data for the proposed SCR:

Desired dollar-year	2024	
CEPCI for 2024	798.8 Enter the CEPCI value for 2024 — 541.7 2016 CEPCI	CEPCI = Chemical Engineering Plant Cost Index
Annual Interest Rate (i)	7.5 Percent	
Reagent ($Cost_{reag}$)	0.293 $/gallon for 29% ammonia*	* $0.293/gallon is a default value for 29% ammonia. User should enter actual value, if known.
Electricity ($Cost_{elect}$)	0.0361 $/kWh	* $0.0361/kWh is a default value for electicity cost. User should enter actual value, if known.
Catalyst cost ($CC_{replace}$)	227.00 $/cubic foot (includes removal and disposal/regeneration of existing catalyst and installation of new catalyst	* $227/cf is a default value for the catalyst cost based on 2016 prices. User should enter actual value, if known.
Operator Labor Rate	60.00 $/hour (including benefits)*	* $60/hour is a default value for the operator labor rate. User should enter actual value, if known.
Operator Hours/Day	4.00 hours/day*	* 4 hours/day is a default value for the operator labor. User should enter actual value, if known.

Note: The use of CEPCI in this spreadsheet is not an endorsement of the index, but is there merely to allow for availability of a well-known cost index to spreadsheet users. Use of other well-known cost indexes (e.g., M&S) is acceptable.

Maintenance and Administrative Charges Cost Factors:

Maintenance Cost Factor (MCF) =	0.005
Administrative Charges Factor (ACF) =	0.03

Cost Calculations 2 - SCR
Boiler

SCR Design Parameters

The following design parameters for the SCR were calculated based on the values entered on the *Data Inputs* tab. These values were used to prepare the costs shown on the *Cost Estimate* tab.

Parameter	Equation	Calculated Value	Units	
Maximum Annual Heat Input Rate (Q_B) =	HHV x Max. Fuel Rate =	57	MMBtu/hour	
Maximum Annual fuel consumption (mfuel) =	(QB x 1.0E6 x 8760)/HHV =	3,587,177	gallons/Year	
Actual Annual fuel consumption (Mactual) =		3,670,440	gallons/Year	
Heat Rate Factor (HRF) =	NPHR/10 =	1.10		
Total System Capacity Factor (CF_{total}) =	(Mactual/Mfuel) x (tscr/tplant) =	1.023	fraction	
Total operating time for the SCR (t_{op}) =	CF_{total} x 8760 =	8963	hours	
NOx Removal Efficiency (EF) =	(NOx_{in} - NOx_{out})/NOx_{in} =	70.0	percent	
NOx removed per hour =	NOx_{in} x EF x Q_B =	5.04	lb/hour	
Total NO_x removed per year =	(NOx_{in} x EF x Q_B x t_{op})/2000 =	22.57	tons/year	
NO_x removal factor (NRF) =	EF/80 =	0.88		
Volumetric flue gas flow rate ($q_{flue\ gas}$) =	Q_{fuel} x QB x (460 + T)/(460 + 700)n_{scr} =	0	acfm	
Space velocity (V_{space}) =	$q_{flue\ gas}$/$Vol_{catalyst}$ =	0.00	/hour	
Residence Time	1/V_{space}	#DIV/0!	hour	
Coal Factor (CoalF) =	1 for oil and natural gas; 1 for bituminous; 1.05 for sub-bituminous; 1.07 for lignite (weighted average is used for coal blends)	1.00		
SO_2 Emission rate =	(%S/100)x(64/32)*1x10^6)/HHV =			Not applicable; factor applies only to coal-fired boilers
Elevation Factor (ELEVF) =	14.7 psia/P =			Not applicable; elevation factor does not apply to plants located at elevations below 500 feet.
Atmospheric pressure at sea level (P) =	2116 x [(59-(0.00356xh)+459.7)/518.6]$^{5.256}$ x (1/144)* =	14.6	psia	
Retrofit Factor (RF)	Retrofit to existing boiler	1.00		

* Equation is from the National Aeronautics and Space Administration (NASA), Earth Atmosphere Model. Available at https://spaceflightsystems.grc.nasa.gov/education/rocket/atmos.html.

Catalyst Data:

Parameter	Equation	Calculated Value	Units
Future worth factor (FWF) =	(interest rate)(1/((1+ interest rate)^Y -1), where Y = $H_{catalyst}$/(t_{SCR} x 24 hours) rounded to the nearest integer	0.0000	Fraction
Catalyst volume ($Vol_{catalyst}$) =	2.81 x Q_B x EF_{adj} x Slipadj x NOx_{adj} x S_{adj} x (T_{adj}/N_{scr})	190.19	Cubic feet
Cross sectional area of the catalyst ($A_{catalyst}$) =	$q_{flue\ gas}$ /(16ft/sec x 60 sec/min)	0	ft^2
Height of each catalyst layer (H_{layer}) =	($Vol_{catalyst}$/(R_{layer} x $A_{catalyst}$)) + 1 (rounded to next highest integer)	#DIV/0!	feet

SCR Reactor Data:

Parameter	Equation	Calculated Value	Units
Cross sectional area of the reactor (A_{SCR}) =	1.15 x $A_{catalyst}$	0	ft^2
Reactor length and width dimensions for a square reactor =	$(A_{SCR})^{0.5}$	0.0	feet
Reactor height =	(R_{layer} + R_{empty}) x (7ft + h_{layer}) + 9ft	#DIV/0!	feet

Reagent Data:

Type of reagent used: Ammonia

Molecular Weight of Reagent (MW) = 17.03 g/mole

Density = 56 lb/ft^3

Parameter	Equation	Calculated Value	Units
Reagent consumption rate ($m_{reagent}$) =	(NOx_{in} x Q_B x EF x SRF x MW_R)/MW_{NOx} =	2	lb/hour
Reagent Usage Rate (m_{sol}) =	$m_{reagent}$/Csol =	7	lb/hour
	(m_{sol} x 7.4805)/Reagent Density	1	gal/hour
Estimated tank volume for reagent storage =	(m_{sol} x 7.4805 x $t_{storage}$ x 24)/Reagent Density =	400	gallons (storage needed to store a 14 day reagent supply rounded to th

Capital Recovery Factor:

Parameter	Equation	Calculated Value
Capital Recovery Factor (CRF) =	i (1+ i)^n/(1+ i)^n - 1 = Where n = Equipment Life and i= Interest Rate	0.0981

Other parameters	Equation	Calculated Value	Units
Electricity Usage:			
Electricity Consumption (P) =	A x 1,000 x 0.0056 x (CoalF x HRF)$^{0.43}$ = where A = (0.1 x QB) for industrial boilers.	33.31	kW

Cost Calculations 2 - SCR
Boiler

Cost Estimate

Total Capital Investment (TCI)

TCI for Oil and Natural Gas Boilers

For Oil and Natural Gas-Fired Utility Boilers between 25MW and 500 MW:

$$TCI = 86,380 \times (200/B_{MW})^{0.35} \times B_{MW} \times ELEVF \times RF$$

For Oil and Natural Gas-Fired Utility Boilers >500 MW:

$$TCI = 62,680 \times B_{MW} \times ELEVF \times RF$$

For Oil-Fired Industrial Boilers between 275 and 5,500 MMBTU/hour :

$$TCI = 7,850 \times (2,200/Q_B)^{0.35} \times Q_B \times ELEVF \times RF$$

For Natural Gas-Fired Industrial Boilers between 205 and 4,100 MMBTU/hour :

$$TCI = 10,530 \times (1,640/Q_B)^{0.35} \times Q_B \times ELEVF \times RF$$

For Oil-Fired Industrial Boilers >5,500 MMBtu/hour:

$$TCI = 5,700 \times Q_B \times ELEVF \times RF$$

For Natural Gas-Fired Industrial Boilers >4,100 MMBtu/hour:

$$TCI = 7,640 \times Q_B \times ELEVF \times RF$$

Total Capital Investment (TCI) =	$2,372,522	in 2024 dollars

Annual Costs

Total Annual Cost (TAC)

TAC = Direct Annual Costs + Indirect Annual Costs

Direct Annual Costs (DAC) =	$25,010 in 2024 dollars
Indirect Annual Costs (IDAC) =	$232,937 in 2024 dollars
Total annual costs (TAC) = DAC + IDAC	$257,947 in 2024 dollars

Direct Annual Costs (DAC)

DAC = (Annual Maintenance Cost) + (Annual Reagent Cost) + (Annual Electricity Cost) + (Annual Catalyst Cost)

Annual Maintenance Cost =	0.005 x TCI =	$11,863 in 2024 dollars
Annual Reagent Cost =	$m_{sol} \times Cost_{reag} \times t_{op}$ =	$2,368 in 2024 dollars
Annual Electricity Cost =	$P \times Cost_{elect} \times t_{op}$ =	$10,780 in 2024 dollars
Annual Catalyst Replacement Cost =	$n_{scr} \times Vol_{cat} \times (CC_{replace}/R_{layer}) \times FWF$	$0 in 2024 dollars
Direct Annual Cost =		$25,010 in 2024 dollars

Indirect Annual Cost (IDAC)

IDAC = Administrative Charges + Capital Recovery Costs

Administrative Charges (AC) =	0.03 x (Operator Cost + 0.4 x Annual Maintenance Cost) =	$193 in 2024 dollars
Capital Recovery Costs (CR)=	CRF x TCI =	$232,744 in 2024 dollars
Indirect Annual Cost (IDAC) =	AC + CR =	$232,937 in 2024 dollars

Cost Effectiveness

Cost Effectiveness = Total Annual Cost/ NOx Removed/year

Total Annual Cost (TAC) =	$257,947 per year in 2024 dollars
NOx Removed =	23 tons/year
Cost Effectiveness =	$11,428 per ton of NOx removed in 2024 dollars

Cost Calculations 3 - SCR
Generator

Data Inputs

Enter the following data for your combustion unit:

Is the combustion unit a utility or industrial boiler? Industrial

Is the SCR for a new boiler or retrofit of an existing boiler? Retrofit

What type of fuel does the unit burn? Fuel Oil

Please enter a retrofit factor between 0.8 and 1.5 based on the level of difficulty. Enter 1 for projects of average retrofit difficulty. 1

Complete all of the highlighted data fields:

What is the maximum heat input rate (QB)? 132.83 MMBtu/hour

What is the higher heating value (HHV) of the fuel? 139,440 Btu/gallon

What is the estimated actual annual fuel consumption? 22,000 gallons/Year

Enter the net plant heat input rate (NPHR) 11 MMBtu/MW

If the NPHR is not known, use the default NPHR value:

Fuel Type	Default NPHR
Coal	10 MMBtu/MW
Fuel Oil	11 MMBtu/MW
Natural Gas	8.2 MMBtu/MW

Plant Elevation 250 Feet above sea level

Not applicable to units burning fuel oil or natural gas

Type of coal burned: Not Applicable

Enter the sulfur content (%S) = percent by weight

Not applicable to units buring fuel oil or natural gas

Note: The table below is pre-populated with default values for HHV and %S. Please enter the actual values for these parameters in the table below. If the actual value for any parameter is not known, you may use the default values provided.

Coal Type	Fraction in Coal Blend	%S	HHV (Btu/lb)
Bituminous	0	1.84	11,841
Sub-Bituminous	0	0.41	8,826
Lignite	0	0.82	6,685

Please click the calculate button to calculate weighted average values based on the data in the table above.

For coal-fired boilers, you may use either Method 1 or Method 2 to calculate the catalyst replacement cost. The equations for both methods are shown on rows 85 and 86 on the *Cost Estimate* tab. Please select your preferred method:

- ○ Method 1
- ○ Method 2
- ● Not applicable

Enter the following design parameters for the proposed SCR:

Number of days the SCR operates (t_{SCR}) 7 days

Number of days the boiler operates (t_{plant}) 7 days

Number of SCR reactor chambers (n_{scr}) 1

Number of catalyst layers (R_{layer}) 3

Cost Calculations 3 - SCR

Generator

Inlet NO_x Emissions (NOx_{in}) to SCR	0.592	lb/MMBtu
Outlet NO_x Emissions (NOx_{out}) from SCR	0.1776	lb/MMBtu
Stoichiometric Ratio Factor (SRF)	1.050	

*The SRF value of 1.05 is a default value. User should enter actual value, if known.

Number of empty catalyst layers (R_{empty})	1	
Ammonia Slip (Slip) provided by vendor	2	ppm
Volume of the catalyst layers ($Vol_{catalyst}$) (Enter "UNK" if value is not known)	UNK	Cubic feet
Flue gas flow rate ($Q_{fluegas}$) (Enter "UNK" if value is not known)	UNK	acfm

Estimated operating life of the catalyst ($H_{catalyst}$)	24,000	hours
Estimated SCR equipment life	20	Years*

* For industrial boilers, the typical equipment life is between 20 and 25 years

Gas temperature at the SCR inlet (T)	650	°F
Base case fuel gas volumetric flow rate factor (Q_{fuel})		ft^3/min-MMBtu/hour

Concentration of reagent as stored (C_{stored})	29	percent*
Density of reagent as stored (ρ_{stored})	56	lb/cubic feet*
Number of days reagent is stored ($t_{storage}$)	14	days

*The reagent concentration of 29% and density of 56 lbs/cft are default values for ammonia reagent. User should enter actual values for reagent, if different from the default values provided.

Densities of typical SCR reagents:	
50% urea solution	71 lbs/ft^3
29.4% aqueous NH_3	56 lbs/ft^3

Select the reagent used: Ammonia

Enter the cost data for the proposed SCR:

Desired dollar-year	2024		
CEPCI for 2024	798.8	Enter the CEPCI value for 2024 — 541.7 2016 CEPCI	CEPCI = Chemical Engineering Plant Cost Index
Annual Interest Rate (i)	7.5	Percent	
Reagent ($Cost_{reag}$)	0.293	$/gallon for 29% ammonia*	* $0.293/gallon is a default value for 29% ammonia. User should enter actual value, if known.
Electricity ($Cost_{elect}$)	0.0361	$/kWh	* $0.0361/kWh is a default value for electicity cost. User should enter actual value, if known.
Catalyst cost ($CC_{replace}$)	227.00	$/cubic foot (includes removal and disposal/regeneration of existing catalyst and installation of new catalyst	* $227/cf is a default value for the catalyst cost based on 2016 prices. User should enter actual value, if known.
Operator Labor Rate	60.00	$/hour (including benefits)*	* $60/hour is a default value for the operator labor rate. User should enter actual value, if known.
Operator Hours/Day	4.00	hours/day*	* 4 hours/day is a default value for the operator labor. User should enter actual value, if known.

Note: The use of CEPCI in this spreadsheet is not an endorsement of the index, but is there merely to allow for availability of a well-known cost index to spreadsheet users. Use of other well-known cost indexes (e.g., M&S) is acceptable.

Maintenance and Administrative Charges Cost Factors:

Maintenance Cost Factor (MCF) =	0.005
Administrative Charges Factor (ACF) =	0.03

Cost Calculations 3 - SCR
Generator

SCR Design Parameters

The following design parameters for the SCR were calculated based on the values entered on the *Data Inputs* tab. These values were used to prepare the costs shown on the *Cost Estimate* tab.

Parameter	Equation	Calculated Value	Units	
Maximum Annual Heat Input Rate (Q_B) =	HHV x Max. Fuel Rate =	133	MMBtu/hour	
Maximum Annual fuel consumption (mfuel) =	(QB x 1.0E6 x 8760)/HHV =	8,344,742	gallons/Year	
Actual Annual fuel consumption (Mactual) =		22,000	gallons/Year	
Heat Rate Factor (HRF) =	NPHR/10 =	1.10		
Total System Capacity Factor (CF_{total}) =	(Mactual/Mfuel) x (tscr/tplant) =	0.003	fraction	
Total operating time for the SCR (t_{op}) =	CF_{total} x 8760 =	23	hours	
NOx Removal Efficiency (EF) =	(NOx_{in} - NOx_{out})/NOx_{in} =	70.0	percent	
NOx removed per hour =	NOx_{in} x EF x Q_B =	55.04	lb/hour	
Total NO_x removed per year =	(NOx_{in} x EF x Q_B x t_{op})/2000 =	0.64	tons/year	
NO_x removal factor (NRF) =	EF/80 =	0.88		
Volumetric flue gas flow rate ($q_{flue\ gas}$) =	Q_{fuel} x QB x (460 + T)/(460 + 700)n_{scr} =	0	acfm	
Space velocity (V_{space}) =	$q_{flue\ gas}$/$Vol_{catalyst}$ =	0.00	/hour	
Coal Factor (CoalF) =	1 for oil and natural gas; 1 for bituminous; 1.05 for sub-bituminous; 1.07 for lignite (weighted average is used for coal blends)	1.00		
SO_2 Emission rate =	(%S/100)x(64/32)*1x10^6)/HHV =			Not applicable; factor applies only to coal-fired boilers
Elevation Factor (ELEVF) =	14.7 psia/P =			Not applicable; elevation factor does not apply to plants located at elevations below 500 feet.
Atmospheric pressure at sea level (P) =	2116 x [(59-(0.00356xh)+459.7)/518.6]$^{5.256}$ x (1/144)* =	14.6	psia	
Retrofit Factor (RF)	Retrofit to existing boiler	1.00		

* Equation is from the National Aeronautics and Space Administration (NASA), Earth Atmosphere Model. Available at https://spaceflightsystems.grc.nasa.gov/education/rocket/atmos.html.

Catalyst Data:

Parameter	Equation	Calculated Value	Units
Future worth factor (FWF) =	(interest rate)(1/((1+ interest rate)^Y -1) , where Y = $H_{catalyst}$/(t_{SCR} x 24 hours) rounded to the nearest integer	0.0000	Fraction
Catalyst volume ($Vol_{catalyst}$) =	2.81 x Q_B x EF_{adj} x Slipadj x NOx_{adj} x S_{adj} x (T_{adj}/N_{scr})	516.52	Cubic feet
Cross sectional area of the catalyst ($A_{catalyst}$) =	$q_{flue\ gas}$ /(16ft/sec x 60 sec/min)	0	ft^2

SCR Reactor Data:

Parameter	Equation	Calculated Value	Units
Cross sectional area of the reactor (A_{SCR}) =	1.15 x $A_{catalyst}$	0	ft^2
Reactor length and width dimensions for a square reactor =	$(A_{SCR})^{0.5}$	0.0	feet

Reagent Data:

Type of reagent used: Ammonia

Molecular Weight of Reagent (MW) = 17.03 g/mole
Density = 56 lb/ft^3

Parameter	Equation	Calculated Value	Units
Reagent consumption rate ($m_{reagent}$) =	(NOx_{in} x Q_B x EF x SRF x MW_R)/MW_{NOx} =	21	lb/hour
Reagent Usage Rate (m_{sol}) =	$m_{reagent}$/Csol =	74	lb/hour
	(m_{sol} x 7.4805)/Reagent Density	10	gal/hour
Estimated tank volume for reagent storage =	(m_{sol} x 7.4805 x $t_{storage}$ x 24)/Reagent Density =	3,400	gallons (storage needed to store a 14 day reagent supply rounded to

Capital Recovery Factor:

Parameter	Equation	Calculated Value
Capital Recovery Factor (CRF) =	i $(1+i)^n/(1+i)^n - 1$ = Where n = Equipment Life and i= Interest Rate	0.0981

Other parameters	Equation	Calculated Value	Units
Electricity Usage: Electricity Consumption (P) =	A x 1,000 x 0.0056 x (CoalF x HRF)$^{0.43}$ = where A = (0.1 x QB) for industrial boilers.	77.50	kW

Cost Calculations 3 - SCR

Generator

Cost Estimate

Total Capital Investment (TCI)

TCI for Oil and Natural Gas Boilers

For Oil and Natural Gas-Fired Utility Boilers between 25MW and 500 MW:

$$TCI = 86,380 \times (200/B_{MW})^{0.35} \times B_{MW} \times ELEVF \times RF$$

For Oil and Natural Gas-Fired Utility Boilers >500 MW:

$$TCI = 62,680 \times B_{MW} \times ELEVF \times RF$$

For Oil-Fired Industrial Boilers between 275 and 5,500 MMBTU/hour :

$$TCI = 7,850 \times (2,200/Q_B)^{0.35} \times Q_B \times ELEVF \times RF$$

For Natural Gas-Fired Industrial Boilers between 205 and 4,100 MMBTU/hour :

$$TCI = 10,530 \times (1,640/Q_B)^{0.35} \times Q_B \times ELEVF \times RF$$

For Oil-Fired Industrial Boilers >5,500 MMBtu/hour:

$$TCI = 5,700 \times Q_B \times ELEVF \times RF$$

For Natural Gas-Fired Industrial Boilers >4,100 MMBtu/hour:

$$TCI = 7,640 \times Q_B \times ELEVF \times RF$$

Total Capital Investment (TCI) =	$4,107,138	in 2024 dollars

Annual Costs

Total Annual Cost (TAC)

TAC = Direct Annual Costs + Indirect Annual Costs

Direct Annual Costs (DAC) =	$20,667	in 2024 dollars
Indirect Annual Costs (IDAC) =	$403,207	in 2024 dollars
Total annual costs (TAC) = DAC + IDAC	$423,874	in 2024 dollars

Direct Annual Costs (DAC)

DAC = (Annual Maintenance Cost) + (Annual Reagent Cost) + (Annual Electricity Cost) + (Annual Catalyst Cost)

Annual Maintenance Cost =	0.005 x TCI =	$20,536	in 2024 dollars
Annual Reagent Cost =	$m_{sol} \times Cost_{reag} \times t_{op}$ =	$67	in 2024 dollars
Annual Electricity Cost =	$P \times Cost_{elect} \times t_{op}$ =	$65	in 2024 dollars
Annual Catalyst Replacement Cost =	$n_{scr} \times Vol_{cat} \times (CC_{replace}/R_{layer}) \times FWF$	$0	in 2024 dollars
Direct Annual Cost =		$20,667	in 2024 dollars

Indirect Annual Cost (IDAC)

IDAC = Administrative Charges + Capital Recovery Costs

Administrative Charges (AC) =	0.03 x (Operator Cost + 0.4 x Annual Maintenance Cost) =	$297	in 2024 dollars
Capital Recovery Costs (CR)=	CRF x TCI =	$402,910	in 2024 dollars
Indirect Annual Cost (IDAC) =	AC + CR =	$403,207	in 2024 dollars

Cost Effectiveness

Cost Effectiveness = Total Annual Cost/ NOx Removed/year

Total Annual Cost (TAC) =	$423,874	per year in 2024 dollars
NOx Removed =	1	tons/year
Cost Effectiveness =	$666,864	per ton of NOx removed in 2024 dollars