Public Notice
Ohio Environmental Protection Agency
Draft State Implementation Plan
NOx Reasonably Available Control Technology (RACT)
for BASF Corporation (Facility ID 0247040195)

Lorain County

Notice is hereby given that the Director of the Ohio Environmental Protection Agency, (Ohio EPA) is submitting to the United States Environmental Protection Agency (U.S. EPA) Reasonably Available Control Technology (RACT) for BASF Corporation (Facility ID 0247040195) for approval into Ohio's state implementation plan (SIP) for the 2015 ozone National Ambient Air Quality Standard (NAAQS).

On March 17, 2025, Ohio submitted a revision to Ohio's SIP to address RACT requirements for the 2015 8-hour ozone NAAQS. As noted in this submittal, OAC rule 3745-110-03(J) requires facilities that have the potential to emit of fifty tons per year or more, but less than one hundred tons per year of nitrogen oxides (NOx) and are located in nonattainment counties that have existing source-specific RACT to submit an updated RACT study within one year of the effective date of the rule. Upon review of the RACT study, Ohio EPA will determine if the existing RACT continues to be appropriate under the 2015 ozone NAAQS, or if is necessary to establish updated RACT for the source.

This facility is located in the Cleveland 2015 serious ozone maintenance area and has existing source-specific RACT established in OAC rule 3745-110-03(R). The updated RACT Study was submitted per OAC rule 3745-110-03(J).

Ohio is now certifying the source-specific NOx RACT established in OAC rule 3745-110-03(R) for BASF Corporation (Facility ID 0247040195) constitutes RACT under the serious 2015 ozone NAAQS.

Ohio EPA is seeking public comment to satisfy U.S. EPA requirements for public involvement in SIP related activities in accordance with 40 CFR 51.102.

The public comment period will run until September 28, 2026. Written comments should be submitted at: https://ohioepa.commentinput.com - Search by entering the Facility Name (BASF Corporation) in the "Search Projects" search box.

A public hearing on this action may be requested by contacting Kathryn Jobe at 614-728-0671 or kathryn.jobe@epa.ohio.gov no later than 30 days from the draft public notice. If a public hearing is requested, a new notification will be published to identify the time and location of the public hearing. The public hearing will be held at least 30 days after the date of the new notification.

All interested persons are entitled to comment on these changes. All comments submitted to the above address by the close of business 30 days from when the draft public notice is issued will be considered by Ohio EPA prior to final action on this action. Written statements submitted after this time period may be considered as time and circumstances permit but will not be part of the official record.

Questions or comments about this document should be directed to Kathryn Jobe at 614-728-0671 or kathryn.jobe@epa.ohio.gov.

DATE

Ms. Anne Vogel
Regional Administrator
U.S. EPA, Region 5
77 West Jackson Blvd.
Chicago, Illinois 60604

Re: Revision to Ohio's Reasonably Available Control Technology (RACT) State Implementation Plan for the 2015 Ozone National Ambient Air Quality Standards – Source-Specific NOx RACT for BASF Corporation (Facility ID 0247040195)

Dear Administrator Vogel:

On March 17, 2025, Ohio submitted a revision to Ohio's State Implementation Plan (SIP) to address Reasonably Available Control Technology (RACT) requirements for the 2015 8-hour ozone National Ambient Air Quality Standards (NAAQS) for areas classified as serious. As noted in this submittal, Ohio EPA adopted requirements in OAC rule 3745-110-04 for facilities in the nonattainment areas that have existing source-specific RACT to submit an updated RACT study within one year of the effective date of the rule. Upon review of the RACT study, Ohio EPA will determine if the existing RACT continues to be appropriate under the 2015 ozone NAAQS, or if is necessary to establish updated RACT for the source to satisfy RACT requirements under the 2015 ozone NAAQS.

Ohio is now certifying source-specific NOx RACT for BASF Corporation (Facility ID 0247040195). This facility is located in the Cleveland 2015 ozone maintenance area and has existing source-specific RACT established in OAC rule 3745-110-03(R). These emissions limits were previously considered state-level RACT, as NOx RACT was not requested for approval into Ohio's SIP until the March 30, 2022, submittal. OAC rule 3745-110-03(R) was approved into Ohio's SIP effective February 19, 2026 (91 FR 2308).

The updated RACT study was submitted per OAC rule 3745-110-03(J). Ohio has determined that the updated RACT study, along with supplemental information submitted subsequently, is sufficient to justify continuing the existing NOx RACT in OAC rule 3745-110-03(R) proposed by the facility to act as RACT under the 2015 ozone NAAQS serious classification. The RACT study is provided in Appendix A.

Ohio held a public comment period on Ohio's RACT determination from August 27 to September 28, 2026. Appendix B contains the public notice. ***[Ohio's response to comments received during the public comment period is in Appendix E/No comments were received during the public comment period].***

This SIP does not include the relaxation of any existing requirements and therefore will not interfere with the attainment or maintenance of the NAAQS in accordance with section 110(l) of the CAA.

Ohio EPA is now certifying the source-specific NOx RACT established in OAC rule 3745-110-03(R) for BASF Corporation (Facility ID 0247040195) constitutes RACT under the serious 2015 ozone NAAQS.

Ohio EPA is submitting this SIP via U.S. EPA's State Planning Electronic Collaboration System (SPeCS). If you have questions, please contact Jennifer Van Vlerah in our Division of Air Pollution Control at (614) 644-3696.

Sincerely,

John Logue
Director

Cc: Bob Hodanbosi, Chief, Division of Air Pollution Control, Ohio EPA

Enclosures

NOx RACT Engineering Study

Ohio Environmental Protection Agency

March 30, 2026

Revised April 23, 2026, and June 18, 2026

Prepared for:

Public Copy – Redacted

BASF Corporation
120 Pine Street
Elyria Ohio 44035

BASF We create chemistry

Prepared by:

Mike Rectanus
Principal Consultant
michael.rectanus@bsigroup.com

Reviewed by:

Kelley Hand, P.E.
Principal Consultant
kelley.hand@bsigroup.com

bsi

Table of Contents

Tables

Attachments

1. Introduction

1.1 Background

BASF Corporation (BASF) owns and operates a base-metal catalyst manufacturing facility in Elyria, Lorain County, Ohio. BASF is authorized to operate the air contaminant sources (emissions units) at this facility under Title V permit P0137603, effective March 19, 2025. Lorain County is one of seven Ohio counties that comprise the Cleveland nonattainment area for the 2015 ozone standard. Based on certified ozone monitoring data for 2021, 2022, and 2023, this area failed to meet the ozone standard by the August 3, 2024, attainment date and was reclassified to serious nonattainment by U.S. Environmental Protection Agency (EPA) in accordance with the Clean Air Act (CAA) effective January 16, 2025. Reclassification from moderate to serious nonattainment has triggered additional CAA requirements for major stationary sources located in the serious nonattainment area including evaluation and potential implementation of Reasonably Available Control Technology (RACT).

As identified in Title V permit P0137603, six emissions units (Calciners P009, P010, P080, P092, P102, and P103) are subject to site-specific nitrogen oxides (NOx) RACT emission limitations codified in the NOx RACT rule in Ohio Administrative Code (OAC) 3745-110-03(R). As a result of the Cleveland area reclassification from marginal to moderate nonattainment, revision to the NOx RACT rule, effective March 25, 2022, required any source located in Lorain County for which the director had established a site-specific definition of RACT to submit an updated RACT study to the Ohio EPA. BASF submitted a letter to the Ohio EPA on December 8, 2023, demonstrating that the BASF Elyria facility was not subject to the RACT requirements of OAC 3745-110, other than the site-specific NOx emissions limitations in 3745-110-03(R), as the facility does not emit nor has the potential to emit more than 100 tons per year (tons/year) of NOx from all emission units at that facility combined [OAC 3745-110-02(A)(1)(a)]. Additionally, all emission units at the facility were exempt under OAC 3745-110-03(K), based on the following exemptions:

- All industrial boilers have a maximum heat input of less than or equal to 20 mmBtu/hr (B007, B008, B009, and B010).
- All stationary internal combustion engines are emergency use that operate less than 500 hours during any consecutive twelve-month period (P128, P145, and P146).
- All emission units have the potential to emit less than 25 tons/year of NOx based on either the maximum capacity of the unit or federally enforceable allowable permit limits.

Now that OAC 3745-110-02 was revised again on April 1, 2025, due to the Cleveland ozone nonattainment area redesignation to “serious” nonattainment, the NOx RACT applicability threshold in the Cleveland area decreased from 100 tons/year potential to emit NOx to 50 tons/year. Additionally, the NOx RACT study exemptions under OAC 3745-110-03(K)(16) and (17), were decreased from 25 tons/year to 10 tons/year of NOx. As a result of these regulatory changes, BASF is no longer exempt from the NOx RACT study requirements solely on the facility’s total NOx potential to emit. However, the facility can remain exempt from the NOx RACT study requirements based on the exemptions in OAC 3745-110-03(K). An evaluation of the NOx RACT study exemptions on an emission unit basis is provided in Section 2.2.

1.2 RACT Study Requirements

Under Rule 3745-110-03(J), a full RACT engineering study must include the following information:

- General information on the owner/operator, contact information, and standard industrial classification code and source classification code.
- General information for each affected source including company identification and Ohio EPA emissions unit identification number, source description, installation date, normal operating schedule, annual production rates, average and maximum daily production rates, and type of control equipment employed and the date installed.
- A plot plan which shows the general layout of the facility and the affected sources.
- Emissions data for each affected source including average daily NOx emissions, maximum daily NOx emissions , annual NOx emissions, documentation of the efficiency of the existing control equipment, and documentation of any emissions testing which has been performed.
- A detailed discussion of the technical feasibility of employing control measures for each affected source (or combination of sources) that may be applicable.
- For each type of control measure that is determined to be technically feasible, an estimate of the control efficiency that can be achieved.
- For each control option that is determined to be technically feasible, an estimate of the capital cost, annualized cost (including capital and operating costs), and the cost-effectiveness (annual dollars per ton of NOx removed annually).
- A comparison and discussion of the advantages and disadvantages of control options that are determined to be technically feasible.
- A recommended definition of RACT for the source, including one or more of the following: enforceable production limitations, emissions limitations, control efficiencies, and operating requirements.
- An expeditious schedule for implementing the recommended definition of RACT, including milestones for awarding contracts, initiating construction, completing construction, and performing emissions testing, if necessary, to demonstrate compliance with the approved definition of RACT.
- Clean and detailed documentation of all calculations of the NOx emissions, including all assumptions made.
- Capital and operating costs and cost-effectiveness estimates calculated in a manner consistent with the most recent edition of the "United States environmental protection agency air pollution control cost manual."

2. Facility Information

The BASF Elyria plant consists of the production of high-quality custom and proprietary catalysts used primarily in the petrochemical and oleochemical processing industries. The catalyst production process can be generally divided into three general products: powder, tablets, and extrudates. Production of these three product types occurs in two distinct areas of the Elyria facility. The north end of the facility primarily produces powder and tablet catalyst products from copper-based substrates. The south end of the facility primarily produces powder and extrudate products from alumina and silica-based powders.

Although each catalyst has a different preparation method, production can be generalized into two main phases. The first phase includes blending raw materials, extrusion (for extrudates only), drying, size reduction, screening, and calcining to form a substrate. The raw materials used, number of extrusion passes, and critical operating conditions of the equipment vary with the product being produced. Included in the second phase are the activities of impregnating the base substrate with metal oxides or salts, drying after each impregnation, and screening. The number of impregnations, types and concentrations of metals, and critical operating conditions vary with the catalyst being prepared.

2.1 General Facility Information

Table 1 provides the general facility information required in Rule 3745-110-3(J)(a) through (d).

Table 1: General Facility Information

Information Requirement	BASF Facility Information
Facility Name	BASF Corporation
Ohio EPA Facility Identification Number	0247040195
Facility Address	120 Pine Street Elyria, OH 44035
BASF RACT Study Contact Person	Lindsay Larson, EHS Manager 120 Pine Street, Elyria, OH 44035 440.687.5827 lindsey.larson@basf.com
Responsible Official	Chad Rosin, Site Director 120 Pine Street, Elyria, OH 44035 440.329.2510 chad.rosin@basf.com
Standard Industrial Code (SIC)	2819 – Industrial Inorganic Chemicals, Not Elsewhere Classified
North American Industry Classification System (NAICS)	325180 – Other Basic Inorganic Chemical Manufacturing

Note: Source classification code numbers are provided in Table 2 for the applicable affected source.

2.2 RACT Affected Source Determination

RACT applicability and analysis applies to air contaminant sources, as defined in OAC 3745-15-05(A)(3), that are subject to Ohio EPA air regulations. As such, BASF must complete a NOx RACT study in accordance with OAC 3745-110-03(J) that includes all air contaminant sources subject to Ohio EPA regulations that are not otherwise exempt per OAC 3745-110-03(K). Examples of these exemptions include:

- Any industrial boiler having a maximum heat input of less than or equal to 20 MMBtu/hr.
- Any standby boiler, stationary internal combustion engine, or stationary combustion turbine which operates less than 500 hours during any consecutive twelve-month period. However, the owner or operator of the standby engine, boiler, or turbine shall maintain for a period of not less than three years, in a bound logbook, or other format acceptable to the director, a list of the dates and number of hours the standby engine, boiler, or turbine operated.
- Any source located in Lorain County other than a boiler, gas turbine or internal combustion engine that has the potential to emit less than ten tons/year of NOx emissions.
- Any source located in Lorain County issued a valid permit-to-install or permit-to-install and operate by Ohio EPA that restricts such source to less than ten tons/year of NOx emissions.

Table 2 summarizes the air contaminant sources (i.e., emission units [EU]) installed at the facility and identifies their current permitting status, exemption status, if applicable, and NOx potential to emit.

Table 2: Facility-Wide Summary of Permitting Status and NOx PTE for Each Source

<table>
<tr><th>EU ID</th><th>EU Description</th><th>Permit Status</th><th>NOx PTE (tons/year)</th></tr>
<tr><td>P009</td><td>Rotary Calciner #4</td><td>Significant</td><td rowspan="6">23.04
Combined NOx limit for process gases from SCR and TriMer
(see below for NOx combustion emissions)</td></tr>
<tr><td>P010</td><td>Rotary Calciner #1</td><td>Significant</td></tr>
<tr><td>P080</td><td>Rotary Calciner #5</td><td>Significant</td></tr>
<tr><td>P092</td><td>Rotary Calciner #6</td><td>Significant</td></tr>
<tr><td>P102</td><td>Rotary Calciner #2</td><td>Significant</td></tr>
<tr><td>P103</td><td>Rotary Calciner #3</td><td>Significant</td></tr>
<tr><td>B007</td><td>Package Boiler, 8.6 MMBtu/hr</td><td>Permit Exempt</td><td>3.69</td></tr>
<tr><td>B008</td><td>Package Boiler, 8.6 MMBtu/hr</td><td>Permit Exempt</td><td>3.69</td></tr>
<tr><td>B009</td><td>Package Boiler, 8.6 MMBtu/hr</td><td>Permit Exempt</td><td>3.69</td></tr>
<tr><td>B010</td><td>Package Boiler, 8.6 MMBtu/hr</td><td>Permit Exempt</td><td>3.69</td></tr>
<tr><td>P005</td><td>Tunnel Kiln #4</td><td>de minimis</td><td>1.76</td></tr>
<tr><td>P006</td><td>Copper Calciner 1</td><td>Significant</td><td>6.06</td></tr>
<tr><td>P009</td><td>Rotary Calciner #4</td><td>Combustion Emissions</td><td>1.44</td></tr>
<tr><td>P010</td><td>Rotary Calciner #1</td><td>Combustion Emissions</td><td>1.47</td></tr>
<tr><td>P018</td><td>Copper/Alumina Dryer (Wyssmont Dryer)</td><td>Significant</td><td>0.30</td></tr>
<tr><td>P024</td><td>Gen Cat Reaction Tanks</td><td>de minimis</td><td>0</td></tr>
<tr><td>P026</td><td>Gen Cat Blender</td><td>de minimis</td><td>0</td></tr>
<tr><td>P027</td><td>Gen Cat Littleford Mixer #1</td><td>de minimis</td><td>0</td></tr>
<tr><td>P028</td><td>Gen Cat Extruder #1</td><td>de minimis</td><td>0</td></tr>
</table>

EU ID	EU Description	Permit Status	NOx PTE (tons/year)
P031	CER Color Blend, Crush, Mill	*de minimis*	0
P049	HC-11 Tanks	*de minimis*	0
P051	Misc Tablet Mixing	*de minimis*	0
P055	Zinc Tablet Mix	*de minimis*	0
P069	P-K Blender #1	*de minimis*	0
P070	CU/CR Strike	*de minimis*	0
P080	Rotary Calciner #5	Combustion Emissions	1.39
P081	Gen Cat Nitric Dilution	*de minimis*	0
P082	ZR Sinter Furnace	*de minimis*	0.37
P084	WWTP	*de minimis*	0
P086	Gen Cat P&S #1 Dryer	Significant	0.21
P092	Rotary Calciner #6	Combustion Emissions	1.36
P094	Spin Flash Dryer	Significant	0.18
P095	Copper Calciner #2	Significant	6.17
P096	Horne Tabletting Machines	*de minimis*	0
P098	Bldg. 25 East Tabletting	*de minimis*	0
P099	PK Blender #2	*de minimis*	0
P100	Tunnel Kiln #2	*de minimis*	1.34
P102	Rotary Calciner #2	Combustion Emissions	1.52
P103	Rotary Calciner #3	Combustion Emissions	1.52
P106	National Dryer in Al Gel	Significant	1.72
P110	Gen Cat Mixer #3	*de minimis*	0
P111	Gen Cat Blender B-2	*de minimis*	0
P115	Gen Cat Extruder #2	*de minimis*	0
P116	Gen Cat Extruder #3	*de minimis*	0
P118	Briquettor	*de minimis*	0
P121	Gen Cat P&S #2 Dryer	Significant	0.97
P122	Gen Cat P&S #3 Dryer	Significant	0.97
P123	Reduction Tower #6	*de minimis*	1.20
P127	Briquettor	*de minimis*	0
P128	370 HP diesel emergency generator	Permit Exempt	1.04
P130	Gen Cat P&S #6 Dryer	Significant	1.29
P131	Copper Tablet Precursor Process	Significant	0.37
P132	Powder Room-Pneumatic Conveyor Lines	Significant	0
P133	Spin Flash Dryer	*de minimis*	1.07
P134	Bldg. 26 Micro-pulverizers	*de minimis*	0
P135	Reduction Tower #3	*de minimis*	1.20

EU ID	EU Description	Permit Status	NOx PTE (tons/year)
P136	Blender and Granulator, Building 24	*de minimis*	0
P138	Copper Milling Repackaging Station	*de minimis*	0
P139	Abbe Mixer	*de minimis*	0
P140	Gen Cat Mixer #2	*de minimis*	0
P141	Two screeners	*de minimis*	0
T001	Nitric Acid Tank	*de minimis*	0
P145	536 HP, NG-fired emergency generator	Permit-By-Rule	0.30
P146	134 HP, NG-fired emergency generator	Permit-By-Rule	0.07
TMP221070	Tabletting Machines 1-6	*de minimis*	0
TMP221071	Tabletting Machines 7-12	*de minimis*	0
TMP221072	Tabletting Machines 13-18	*de minimis*	0
TMP221073	Screener 1	*de minimis*	0
TMP221074	Screener 2	*de minimis*	0
		Facility-wide total NOx emissions:	73

2.2.1 Exempt and Excluded Emissions Units

Under Rule 3745-15-05(B), air contaminant sources that have a *de minimis* level of emissions are exempt from Ohio's air regulations and therefore not subject to RACT requirements in OAC rule 3745-110-03. Additionally, current Ohio EPA guidance is that emissions units that are insignificant activities, *de minimis*, or permanently exempt can be excluded from a RACT study. Insignificant activities are defined in OAC 3745-77-1 as any of the following:

- All source categories excluded from the requirements to obtain installation permits or operating permits under section 3704.011 of the Revised Code or OAC Chapter 3745-15 or 3745-31.
- All source categories specifically exempted under 40 CFR Part 70.
- Any emissions unit with uncontrolled potential emissions of five tons or less per year of any regulated air pollutant other than a hazardous air pollutant (HAP) and not more than twenty percent of an applicable major source threshold under the Act.
- Any research and development source that is by itself not a major source.

Based on this guidance, the EUs identified in Table 2 as *de minimis* or permit exempt are not subject to RACT study requirements and are not addressed further herein. Additionally, the significant emissions units that qualify for any of the RACT exemptions in OAC rule 3745-110-03(K) are not subject to NOx RACT requirements. Table 3 summarizes the significant emissions units that quality for a NOx RACT exemption in OAC rule 3745-110-03(K).

Regarding the comment in OAC 3745-110-3(K)(16) stating *"For any affected facility that has more than one source claiming this exemption, the Ohio environmental protection agency may require an evaluation of the sources collectively as a part of a RACT study to be submitted in accordance with paragraph (J) of this rule"*, the only emission units identified in Table 3 that are located in the same area that could potentially be evaluated collectively based on their potential to emit as part of this RACT study are Copper Calciners #1 and #2 (P006 and P095) in Building 26.

Table 3: NOx RACT Exempt Sources per Rule 3745-110-3(K)

EU ID	EU Description	NOx RACT Exemption
B007	Package Boiler, 8.6 MMBtu/hr	**3745-110-03(K)(1)**: Any industrial boiler having a maximum heat input of less than or equal to 20 mmBtu/hr.
B008	Package Boiler, 8.6 MMBtu/hr	
B009	Package Boiler, 8.6 MMBtu/hr	
B010	Package Boiler, 8.6 MMBtu/hr	
P145	536 HP, NG-fired emergency generator	**3745-110-03(K)(2)**: Any stationary internal combustion engine which operates less than 500 hours during any consecutive twelve-month period.
P146	134 HP, NG-fired emergency generator	
P006	Copper Calciner 1 (6.06 ton/yr NOx)	**3745-110-03(K)(16)(b)**: Any source located in Lorain County other than a boiler, gas turbine or internal combustion engine that has the potential to emit less than ten tons per year of NOx emissions.
P018	Copper/Alumina Dryer (0.30 ton/yr NOx)	
P086	Gen Cat P&S #1 Dryer (0.21 ton/yr NOx)	
P094	Spin Flash Dryer (0.18 ton/yr NOx)	
P095	Copper Calciner #2 (6.17 ton/yr NOx)	
P106	National Dryer in Al Gel (1.72 ton/yr NOx)	
P121	Gen Cat P&S #2 Dryer (0.97 ton/yr NOx)	
P122	Gen Cat P&S #3 Dryer (0.97 ton/yr NOx)	
P130	Gen Cat P&S #6 Dryer (1.29 ton/yr NOx)	
P131	Copper Tablet Precursor Process (0.37 ton/yr NOx)	
P132	Powder Room (0 ton/yr NOx)	

Copper Calciners #1 and #2 (P006 and P095) are indirect, natural gas-fired calciners with maximum heat inputs of 2.01 and 2.25 MMBtu/hr, respectively, resulting in 0.2 lb/hr or 0.88 ton/yr of potential NOx emissions from natural gas combustion. Combustion emissions from the indirect firing of natural gas are discharged to atmosphere via natural draft through a separate stack from the process emissions. Heating of the calciner crown is performed in a manner to allow for multiple, independent heating zones, providing precise temperature control along the length of the kiln, which is required to impart the desired chemical and physical properties of the catalyst products. The calciner manufacturer has warned BASF that changing the natural draft flow regime on the combustion emissions exhaust stack could impact the ability to effectively control the heating zones to the desired temperatures. As such, installing add-on control devices that require the use of a fan or blower would not be technically feasible for the combustion exhaust of the calciners.

Copper Calciners #1 and #2 operate in a batch production mode to produce catalyst products from copper-based substrates, some of which contain small amounts of nitrates in the feed material that have the potential to generate NOx emissions. Potential NOx emissions from the calcining process were calculated for permitting purposes based on the maximum throughput rate of the calciner of 1,000 lb/hr (i.e., physical limitation of the calciner output rate), which resulted in a maximum NOx potential to emit from the calcining process of 1.19 lb/hr or 5.2 ton/yr. The maximum throughput rate was used for permitting purposes to be consistent with the methodology to calculate potential particulate matter emissions without having to identify product-specific throughput rates. However, each individual product has a target feed rate and nitrate content specification. The target feed rate for each product manufactured in Copper Calciner #1 over the past 10 years ranged from 300 to 630 lb/hr. These product-specific throughput rates and the corresponding maximum nitrate content of the feed material result in maximum hourly NOx emissions ranging from 0.12 to 0.84 lb/hr. Conservatively assuming continuous operations at the maximum hourly NOx emissions rate for the worst-case product (0.84 lb/hr) results in an annual NOx potential to emit from the calcining process of 3.69 ton/year.

For more than five years, Copper Calciner #2 has primarily calcined products that are nitrate free, resulting in no NOx emissions generated from the calcining process. The only exception was in 2022 where approximately 167,000 pounds of feed material containing an average of 1.7 percent nitrate was calcined, generating a total of 115 pounds of NOx emissions.

Table 4 presents the annual NOx emissions from the calcining process from Copper Calciners #1 and #2 over the past 5 calendar years. As identified in this table, the batch operations of these calciners in conjunction with variations in nitrate feed content, result in actual process emissions that are less than half of the potential NOx emissions for the worst-case product.

Table 4: Actual NOx Process Emissions from Copper Calciners #1 and #2

EU ID	EU Description	Emission Source	Annual NOx Emissions (tons/yr)				
			2021	2022	2023	2024	2025
P006	Copper Calciner #1	Process	1.52	1.3	0.35	0.41	0.60
P095	Copper Calciner #2	Process	0	0.06	0	0	0
		Combined Total	**1.5**	**1.4**	**0.35**	**0.41**	**0.60**

Excluding natural gas combustion emissions, combining process emissions from Copper Calciners #1 and #2, assuming the worst-case product is continuously calcined on both calciners results in a total combined NOx potential to emit of 7.36 ton/yr. In accordance with the 10 ton/yr exemption specified in OAC 3745-110-3(K)(16)(b) and the economic feasibility evaluation presented in Section 3.3 below, no further evaluation of technically feasible control options is warranted for Copper Calciners #1 and #2, as no add-on control options are available that would be cost effective in reducing less than 7.5 tons/year of NOx.

The remaining significant emissions units include the six rotary calciners (south end) that are currently subject to the source-specific NOx RACT limits in OAC rule 3745-110-03(R) including use of a wet scrubber or selective catalytic reduction (SCR) system as follows:

(R) "BASF Corporation" (0247040195) or any subsequent owner or operator of the "BASF Corporation" facility located at 120 Pine Street, Elyria, Ohio; shall comply with the NOx emission limitations as follows:

(1) [Reserved.]

(2) On and after June 18, 2020, the NOx emissions from calciners P009, P010, P080, P092, P102, and P103, shall meet the following requirements and be vented to either of the following:

(a) The TriMer caustic scrubber, the emissions from which are not to exceed a controlled NOx emissions limitation of 250.0 ppmvd, as a three-hour block average, based on the average of three, one-hour stack test runs, if stack testing is used to demonstrate compliance.

(b) A selective catalytic reduction system, the emissions from which are not to exceed a controlled NOx emissions limitation of 200.0 ppmvd, as a three-hour block average, except that if a continuous emission monitoring system, which complies with the requirements of 40 CFR Part 60, is employed by

the owner or operator to demonstrate ongoing compliance with the allowable NOx emissions limitation, the averaging time for the NOx emissions limitation is a twenty-four-hour arithmetic average for each calendar day. The arithmetic average is based upon CEMS data for only those hours during which one or more emissions units are operating and, as a result, could be based upon less than twenty-four hours. (If a CEMS is employed, pursuant to 40 CFR Part 60.13(h), at least one valid data point in each fifteen-minute quadrant of the hour in which the emissions unit operates is required to calculate the hourly average emission rate. Also, if more than one valid data point is obtained during a fifteen-minute quadrant, all of the valid data points obtained are to be used to calculate the hourly average emission rate.)

[Comment: The above-mentioned NOx emissions limitations do not include the NOx emissions from the combustion of natural gas for the indirect heating of each calciner. The NOx RACT study approved by Ohio EPA on February 11, 2010, contained calculations supporting the conclusion that NOx emissions from the combustion of natural gas for the indirect heating of each calciner to be less than ten pounds per day.]

Based on these federally enforceable limits, maximum annual emissions from the calciners, assuming they process NOx-generating materials continuously for 8,760 hours per year, would be 8.15 tons/year for those controlled by the SCR system and 14.89 tons/year for those controlled by the TriMer scrubber. Therefore, calciners controlled by the SCR system would be exempt from the NOx RACT study requirement as the potential emissions are less than 10 tons/year (i.e., no single emission unit has the potential to emit NOx greater than 10 tons/year since the combined potential to emit NOx for all emission units controlled by the SCR is 8.15 tons/year); however, the combined NOx potential to emit for calciners controlled only by the TriMer scrubber is more than 10 tons/year.

BASF currently operates the six calciners such that Rotary Calciners #1 (P010) and #5 (P080) are controlled only by the TriMer scrubber for NOx, Rotary Calciners #2, (P102), #3 (P103), and #6 (P092) are controlled only by the SCR system for NOx, and Rotary Calciner #4 (P009) can be controlled by either the TriMer scrubber or SCR system. As such, the rotary calciners that may utilize the TriMer scrubber for NOx control when processing NOx generating materials (i.e., Rotary Calciners #1, #4, or #5) do not qualify for the 10 ton/yr RACT exemption and are included in this RACT study. As requested by Ohio EPA, however, the rotary calciners controlled by the SCR system (Rotary Calciners #2, #3, and #6) are included in this RACT study to demonstrate that no further controls are technically and economically feasible.

2.2.2 RACT Affected Sources

Table 5 through Table 10 provide the general information for the six rotary calciners P009, P010, P080, P092, P102, and P103, respectively, as required by OAC 3745-110-03(J)(d) and (e). Historically, BASF produced one product in Rotary Calciner #6 (P092) that had the potential to generate NOx emissions. That product is no longer produced in Rotary Calciner #6, and BASF has no future intentions of producing this product.

Pursuant to OAC rule 3745-110-03(J)(1)(f), a plot plan showing the general layout of the facility and the location of the RACT affected sources is presented in Attachment A.

Table 5: General Information for Rotary Calciner #4 (P009)

Ohio EPA EU identification number	**P009 – Rotary Calciner #4**	
Source description	Rotary Calciner #4 in Building 16, equipped with a dust collector (P009-1), DC P009-3, TriMer wet scrubber, and SCR system.	
Source classification code numbers	3-05-150-02, Industrial Processes, Mineral Products, Calcining, General 3-05-150-04, Industrial Processes, Mineral Products, Calcining, Finishing Product Handling 3-05-150-01, Industrial Processes, Mineral Products, Calcining, Raw Material Handling 3-01-900-03, Industrial Processes, Chemical Manufacturing, Fuel Fired Equipment, Process Heater: Natural Gas	
Current Ohio EPA permit number	P0133733 – Active PTI P0137820 – Active Title V	
Current Ohio EPA application number	Last application was Title V application A0078939 for P0137820	
Month and year installed	June 1968	
Normal operating schedule	24 hours a day, 7 days per week, 52 weeks per year	
Production Rates	**All Products**	**NOx-Generating Products**
Annual production rates:		
2023	383 tons/year	340 tons/year
2024	494 tons/year	150 tons/year
2025	176 tons/year	147 tons/year
Daily maximum production rates:		
2023	11,200 pounds/day	10,800 pounds/day(1)
2024	14,850 pounds/day	9,600 pounds/day(2)
2025	13,750 pounds/day	10,800 pounds/day
Daily average production rates:		
2023	5,216 pounds/day	5,276 pounds/day
2024	6,587 pounds/day	5,444 pounds/day
2025	4,829 pounds/day	4,980 pounds/day
Type of Control Equipment	The TriMer is used to control PM and NOx emissions from the process exhaust of the calciner. The TriMer is used when producing batches that have NOx-generating materials. P009 is connected to the DC CTO/SCR collector and the CTO/SCR system for controlling PM and NOx emissions. DC P009-3 is used to control PE when producing non-NOx-generating materials. DC P009-3 is also used for product discharge and packaging. DC P009-1 is used for the feed hopper and material handling.	

1. 9,600 lb/day was the maximum daily production rate for all NOx-generating materials during 2024; however, the NOx-generating material with the greatest emission factor that results in the maximum daily emission rate had a maximum daily production rate of 8,400 lb/day.
2. 10,800 lb/day was the maximum daily production rate for all NOx-generating materials during 2025; however, the NOx-generating material with the greatest emission factor that results in the maximum daily emission rate had a maximum daily production rate of 7,232 lb/day.

Table 6: General Information for Rotary Calciner #1 (P010)

Ohio EPA EU identification number	P010 – Rotary Calciner #1	
Source description	Rotary Calciner #1 #1 in Building 31, equipped with two wet scrubbers, the TriMer and P010-1/F-1.	
Source classification code numbers	3-05-150-02, Industrial Processes, Mineral Products, Calcining, General 3-05-150-04, Industrial Processes, Mineral Products, Calcining, Finishing Product Handling 3-05-150-01, Industrial Processes, Mineral Products, Calcining, Raw Material Handling 3-01-900-03, Industrial Processes, Chemical Manufacturing, Fuel Fired Equipment, Process Heater: Natural Gas	
Current Ohio EPA permit number	P0134367 – Active PTI P0137820 – Active Title V	
Current Ohio EPA application number	Last application was Title V application A0078939 for P0137820	
Month and year installed	June 1968	
Normal operating schedule	24 hours a day, 7 days per week, 52 weeks per year	
Production Rates	**All Products**	**NOx-Generating Products**
Annual production rates:		
2023	209 tons/year	69 tons/year
2024	203 tons/year	0 tons/year
2025	20 tons/year	0 tons/year
Daily maximum production rates:		
2023	14,575 pounds/day	12,000 pounds/day
2024	14,486 pounds/day	0 pounds/day
2025	6,944 pounds/day	0 pounds/day
Daily average production rates:		
2023	5,677 pounds/day	6,006 pounds/day
2024	4,841 pounds/day	0 pounds/day
2025	3,673 pounds/day	0 pounds/day
Type of Control Equipment	The TriMer is used to control PM and NOx emissions from the process exhaust of the calciner when producing product batches containing NOx-generating materials. P010-1/F-1 is used to control PE from the process exhaust of the calciner when producing non-NOx-generating materials and is also used to control PE from the feed hopper, feed material handling, product discharge, screening and packaging.	

Table 7: General Information for Rotary Calciner #5 (P080)

Ohio EPA EU identification number	**P080 – Rotary Calciner #5**	
Source description	Rotary Calciner #5 in Building 16, equipped with a feed hopper dust collector (P080-1), dust collector (P080-2) and wet scrubber (TriMer).	
Source classification code numbers	3-05-150-02, Industrial Processes, Mineral Products, Calcining, General 3-05-150-04, Industrial Processes, Mineral Products, Calcining, Finishing Product Handling 3-05-150-01, Industrial Processes, Mineral Products, Calcining, Raw Material Handling 3-05-104-98, Industrial Processes, Mineral Products, Bulk Materials Unloading Operation, Mineral 3-05-104-99, Industrial Processes, Mineral Products, Bulk Materials Unloading Operation, Other 3-05-999-99, Industrial Processes, Mineral Products, Other Not Defined, Other 3-01-900-03, Industrial Processes, Chemical Manufacturing, Fuel Fired Equipment, Process Heater: Natural Gas	
Current Ohio EPA permit number	P0137820 – Active Title V	
Current Ohio EPA application number	Last application was Title V application A0078939 for P0137820	
Month and year installed	June 1963	
Normal operating schedule	24 hours a day, 7 days per week, 52 weeks per year	
Production Rates	**All Products**	**NOx-Generating Products**
Annual production rates:		
2023	147 tons/year	0 tons/year
2024	451 tons/year	451 tons/year
2025	698 tons/year	146 tons/year
Daily maximum production rates:		
2023	7,311 pounds/day	0 pounds/day
2024	7,000 pounds/day	7,000 pounds/day
2025	13,650 pounds/day	7,000 pounds/day
Daily average production rates:		
2023	5,441 pounds/day	0 pounds/day
2024	4,097 pounds/day	4,097 pounds/day
2025	7,463 pounds/day	5,596 pounds/day
Type of Control Equipment	TriMer wet scrubber is used to control particulate emissions and NOx emissions from the process exhaust of the calciner. TriMer wet scrubber is used when producing NOx generating materials. Dust collector (P080-2) is used to control particulate emissions from the process exhaust of the calciner when producing non-NOx generating materials. Dust collector (P080-2) is also used to control particulate emissions from product discharge and packaging. Feed hopper dust collector (P080-1) is used to control particulate emissions from the feed hopper and feed material handling.	

Table 8: General Information for Rotary Calciner #6 (P092)

Ohio EPA EU identification number	**P092 – Rotary Calciner #6**	
Source description	Mineral Catalyst Calciner #6 in Building 16, equipped with the CTO/SCR dust collector (DC), P092-DC, the Sly wet scrubber and SCR system.	
Source classification code numbers	3-05-150-02, Industrial Processes, Mineral Products, Calcining, General 3-05-150-04, Industrial Processes, Mineral Products, Calcining, Finishing Product Handling 3-01-900-03, Industrial Processes, Chemical Manufacturing, Fuel Fired Equipment, Process Heater: Natural Gas	
Current Ohio EPA permit number	P0133733 – Active PTI P0137820 – Active Title V	
Current Ohio EPA application number	Last application was Title V application A0078939 for P0137820	
Month and year installed	June 1960	
Normal operating schedule	24 hours a day, 7 days per week, 52 weeks per year	
Production Rates	**All Products**	**NOx-Generating Products**
Annual production rates:		
2023	484 tons/year	0 tons/year
2024	431 tons/year	0 tons/year
2025	509 tons/year	0 tons/year
Daily maximum production rates:		
2023	7,800 pounds/day	0 pounds/day
2024	7,350 pounds/day	0 pounds/day
2025	8,025 pounds/day	0 pounds/day
Daily average production rates:		
2023	5,409 pounds/day	0 pounds/day
2024	3,795 pounds/day	0 pounds/day
2025	4,528 pounds/day	0 pounds/day
Type of Control Equipment	The CTO/SCR collector and SCR system are in series, used to control PE and NOx emissions, respectively. The SCR system is used when producing NOx-generating materials. P092-DC is used for screening and packaging. The Sly scrubber is used for controlling PE generated from the feed hopper and product discharge. The Sly scrubber is used when producing non-NOx generating materials.	

Table 9: General Information for Rotary Calciner #2 (P102)

Ohio EPA EU identification number	P102 – Rotary Calciner #2	
Source description	Rotary Calciner #2 in Building 31, equipped with the CTO/SCR DC, SCR system, TriMer scrubber, wet scrubber P010-1/F-1, and DC #2	
Source classification code numbers	3-05-150-02, Industrial Processes, Mineral Products, Calcining, General 3-05-150-04, Industrial Processes, Mineral Products, Calcining, Finishing Product Handling 3-05-150-01, Industrial Processes, Mineral Products, Calcining, Raw Material Handling 3-05-999-99, Industrial Processes, Mineral Products, Other Not Defined, Other 3-01-900-03, Industrial Processes, Chemical Manufacturing, Fuel Fired Equipment, Process Heater: Natural Gas	
Current Ohio EPA permit number	P0133733 – Active PTI P0137820 – Active Title V	
Current Ohio EPA application number	Last application was Title V application A0078939 for P0137820	
Month and year installed	June 1968	
Normal operating schedule	24 hours a day, 7 days per week, 52 weeks per year	
Production Rates	**All Products**	**NOx-Generating Products**
Annual production rates:		
2023	733 tons/year	28.2 tons/year
2024	296 tons/year	201 tons/year
2025	361 tons/year	7.7 tons/year
Daily maximum production rates:		
2023	24,250 pounds/day	6,600 pounds/day
2024	13,200 pounds/day	13,200 pounds/day
2025	19,400 pounds/day	8,800 pounds/day
Daily average production rates:		
2023	12,211 pounds/day	4,338 pounds/day
2024	6,573 pounds/day	7,165 pounds/day
2025	9,380 pounds/day	1,931 pounds/day
Type of Control Equipment	The CTO/SCR collector and SCR system are in series, used to control PE and NOx emissions, respectively from the process exhaust of the calciner. The TriMer scrubber is used to control PE and NOx emissions from the process exhaust of the calciner. Either the SCR system or TriMer scrubber is utilized when producing NOx-generating materials. Wet scrubber P010-1/F-1 is used to control PE from the process exhaust of the calciner when producing non-NOx-generating materials.	

Table 10: General Information for Rotary Calciner #3 (P103)

Ohio EPA EU identification number	**P103 – Rotary Calciner #3**	
Source description	Rotary Calciner #3 #1 in Building 31, equipped with the CTO/SCR DC, SCR system, the TriMer wet scrubber, wet scrubber P010-1/F-1 and DC #3.	
Source classification code numbers	3-05-150-02, Industrial Processes, Mineral Products, Calcining, General 3-05-150-04, Industrial Processes, Mineral Products, Calcining, Finishing Product Handling 3-05-150-01, Industrial Processes, Mineral Products, Calcining, Raw Material Handling 3-01-900-03, Industrial Processes, Chemical Manufacturing, Fuel Fired Equipment, Process Heater: Natural Gas	
Current Ohio EPA permit number	P0133733 – Active PTI P0137820 – Active Title V	
Current Ohio EPA application number	Last application was Title V application A0078939 for P0137820	
Month and year installed	June 1968	
Normal operating schedule	24 hours a day, 7 days per week, 52 weeks per year	
Production Rates	**All Products**	**NOx-Generating Products**
Annual production rates:		
2023	714 tons/year	714 tons/year
2024	655 tons/year	655 tons/year
2025	665 tons/year	665 tons/year
Daily maximum production rates:		
2023	15,792 pounds/day	15,792 pounds/day(1)
2024	12,308 pounds/day	12,308 pounds/day(2)
2025	15,400 pounds/day	15,400 pounds/day(3)
Daily average production rates:		
2023	7,591 pounds/day	7,591 pounds/day
2024	6,096 pounds/day	6,096 pounds/day
2025	6,968 pounds/day	6,968 pounds/day
Type of Control Equipment	The CTO/SCR collector and SCR system are in series, used to control PE and NOx emissions, respectively from the process exhaust of the calciner. The TriMer scrubber is used to control PE and NOx emissions from the process exhaust of the calciner. Either the SCR system or TriMer scrubber is utilized when producing NOx-generating materials. Wet scrubber P010-1/F-1 is used to control PE from the process exhaust of the calciner when producing non-NOx-generating materials.	

1. 15,792 lb/day was the maximum daily production rate for all NOx-generating materials during 2024; however, the NOx-generating material with the greatest emission factor that results in the maximum daily emission rate had a maximum daily production rate of 13,200 lb/day.
2. 12,308 lb/day was the maximum daily production rate for all NOx-generating materials during 2024; however, the NOx-generating material with the greatest emission factor that results in the maximum daily emission rate had a maximum daily production rate of 11,580 lb/day.
3. 15,400 lb/day was the maximum daily production rate for all NOx-generating materials during 2024; however, the NOx-generating material with the greatest emission factor that results in the maximum daily emission rate had a maximum daily production rate of 8,080 lb/day.

2.3 NOx Emissions from Affected Sources

Table 11 provides the average daily, maximum daily, and annual NOx emissions for the six rotary calciners, pursuant to OAC rule 3745-110-03(J)(1)(g). The average and maximum daily NOx emissions (lb/day) are based on the highest average and maximum daily production rates for each of the three full calendar years preceding the submittal date of this study. The annual NOx emissions (tons/year) are based on the total production rates for 2023, 2024, and 2025. The NOx emission rates provided in Table 11 do not include NOx from natural gas combustion from indirect heating of the calciners. The maximum heat input capacity of the indirect-fired natural gas burners for all six rotary calciners are each less than 3.6 MMBtu/hr, with maximum potential NOx emissions less than 10 lb/day. Attachment B provides the data used to calculate the emissions in Table 11.

Table 11: NOx Emissions from Affected Sources

EU ID	EU Description	Average Daily NOx Emissions (lb/day)			Maximum Daily NOx Emissions(lb/day)			Annual NOx Emissions (tons/yr)		
		2023	2024	2025	2023	2024	2025	2023	2024	2025
P009	Rotary Calciner #4	7.7	2.3	3.2	38.1	12.3	14.3	0.57	0.17	0.12
P010	Rotary Calciner #1	1.7	0	0	9.9	0	0	0.06	0	0
P080	Rotary Calciner #5	0	2.4	0.9	0	4.2	4.2	0	0.27	0.09
P092	Rotary Calciner #6	0	0	0	0	0	0	0	0	0
P102	Rotary Calciner #2	0.7	1.0	0.1	10.5	4.4	2.9	0.04	0.04	0.003
P103	Rotary Calciner #3	1.3	0.5	1.3	4.4	2.5	11.3	0.13	0.05	0.13

Note: Rotary Calciner #6 no longer produces NOx-generating products.

2.4 Control Equipment for RACT Affected Source

As discussed above, BASF operates six rotary calciners (P009, P010, P080, P092, P102, and P103) that may calcine materials that generate NOx emissions. BASF's current Title V permit includes the following federally enforceable NOx emission limits under OAC Rule 3745-31-05(A)(3) and NOx RACT limits under Rule 3745-110-03(R)(2) for these six rotary calciners:

- The NOx emissions from calciners P009, P010, P080, P092, P102 and P103, combined, shall not exceed 1.86 lb/hr (200.0 ppmvd) as a 24-hour arithmetic average for each calendar day, when operating the SCR system.
- The NOx emissions from calciners P009, P010, P080, P102 and P103, combined, shall not exceed 3.4 lb/hr (250.0 ppmvd) as a three-hour block average, excluding NOx emissions from NG combustion, when operating the caustic/ chemical TriMer scrubber.

The SCR system, which was installed in 1996, is used when producing batches having NOx-generating materials in Rotary Calciners #2 (P102), #3 (P103), #4 (P009), and #6 (P092) to control NOx emissions from the process exhaust of the calciners. The process exhaust from these calciners is vented through the CTO/SCR DC to remove particulate matter (PM) from the process exhaust prior to the SCR system.

The TriMer scrubber, which was installed in 1983, is used when producing batches having NOx-generating materials in Rotary Calciners #1 (P010) and #5 (P080) and infrequently in Rotary Calciner #4 (P009) to control PM and NOx emissions from the process exhaust of the calciners. BASF has implemented an indepth preventative maintenance program for the TriMer scrubber that is tracked and managed through their business management system. Additionally, BASF has conducted periodic upgrades to the system, including a significant refurbishment project in 2016 costing approximately $300,000, replacing the scrubber packing in 2022, and numerous improvement measures to modernize and optimize the system. These improvement measures included upgrading such items as the control system components and logic, probes and transmitters, and caustic delivery system. The ongoing preventative maintenance and continuous improvement programs for the TriMer scrubber, with a total cost of approximately $1.5 million since 2010, have maintained the performance of the TriMer scrubber as demonstrated by continuous compliance with the biannual performance tests conducted for the NOx RACT emission limit.

When not processing NOx-generating materials, the process exhaust from the calciners can be vented to a dust collector to control PM emissions. Dust collectors also are used for controlling PM emissions from material handling operations to and from the calciners, such as material feed, product discharge, and packaging operations.

2.5 NOx Compliance Monitoring Methodologies

As an on-going Title V permit requirement, BASF must conduct NOx emissions testing every 2.5 years for the rotary calciners controlled by the TriMer scrubber to demonstrate compliance with the 3.4 lb/hr (250.0 ppmvd) combined emission limit. Table 12 provides the results of the NOx emissions tests conducted over the previous 5 years for the TriMer scrubber when processing NOx generating material under worst-case conditions.

Table 12: TriMer Scrubber Stack Test Results

Test Date	Hourly Emissions		Emission Limit	
	(lb/hr)	(ppmvd)	(lb/hr)	(ppmvd)
February 12, 2026	3.1	188.0	3.4	250
February 8, 2024	1.64	106.6		
February 22, 2022	2.1	146.0		

The SCR system employs a NOx continuous emissions monitoring system (CEMS) to continuously monitor and record NOx emissions. The continuous monitoring and recording equipment is designed and programmed to measure and record the NOx emissions during each minute of operation of the SCR system; however, compliance with the requirement to continuously monitor and record NOx emissions is maintained as long as at least one valid data point per 15-minute quadrant of operation is obtained, pursuant to 40 CFR 60.13. Operation of the CEMS is conducted in accordance with a written quality assurance/quality control plan for the system based on the requirements of 40 CFR Part 60, Appendix F, which includes the requirement to conduct quarterly cylinder gas audits and relative accuracy test audits (RATA) in accordance with and at the frequencies required per 40 CFR Part 60.

As the SCR system relies on the use of an approved CEMS to monitor emissions from the rotary calciners controlled by the SCR and operates under a quality assurance/quality control plan meeting the requirements of 40 CFR Part 60, the requirement to conduct a periodic compliance or stack test is not required. See Table 11 for a summary of the associated NOx emissions data.

3. NOx RACT Evaluation

U.S. EPA defines RACT as the lowest emission limit that a particular source is capable of meeting by the application of control technology that is reasonably available considering technological and economic feasibility[1]. U.S. EPA guidance on RACT studies indicates that the analysis may rely on past EPA guidance, such as Control Techniques Guidelines (CTG), for help and should also review other available information regarding the appropriate controls. With respect to using a Best Available Control Technology (BACT) "top-down" analysis, U.S. EPA indicates that BACT requires that new or modified sources adopt the best available controls and, as such, the BACT analysis first looks at the most stringent level of control available for a source. RACT requires that sources adopt controls that are reasonably available and thus they may not be the most stringent controls that have been adopted as BACT for other similar sources[2].

Irrespective of whether a "top-down" analysis could result in identifying technically feasible control options that may be more stringent that those considered reasonably available, this NOx RACT evaluation was generally based on a "top-down" approach that included the following steps:

1. identify possible NOx control options;
2. review the technical feasibility of the control options and identify the potential NOx control efficiency for each option;
3. rank the control options based upon emissions reduction potential and address economic factors for the top-ranked options; and
4. identify RACT as the top-ranked control option considering the economic factors.

3.1 NOx Control Options

Under CAA section 108(h), the U.S. EPA is required to make information regarding emission control technology available to states and to the general public through a central database. The RACT/BACT/LAER Clearinghouse (RBLC) database is mainly a repository for air pollution control and pollution prevention technology determinations required for major new and modified sources subject to New Source Review (BACT and Lowest Achievable Emission Rate [LAER]) permitting requirements but can also be informative in RACT due diligence reviews. An RBLC database search was performed to identify the emission control technologies and emission levels that were determined by permitting authorities within the past ten years for process code 62.999 (Chemical Manufacturing – Other Inorganic Chemical Manufacturing Sources). The RBLC identified two facilities with NOx permit limits from process operations. However, the NOx limits are based on combustion emissions from natural gas fired furnaces, heaters, or incinerators and include combustion controls with emission limits in units of lb/MMBtu. Other process types were searched, including 69.999 (Chemical Manufacturing, except 61, 62, 63, 64 & 65 - Other Chemical Manufacturing Sources) and searching for "catalysts" in the process name, but no NOx limits were identified. Attachment C provides a summary of the RBLC search results.

[1] 44 FR 53762, September 17, 1979

[2] U.S. EPA Memo from William T. Harnett, Air Quality Policy Division Director, to Regional Air Division Directors, May 18, 2006, "RACT Qs & As – Reasonably Available Control Technology (RACT): Questions and Answers", pg. 2.

In addition, Ohio EPA considers the following technologies to be generally available for controlling NOx emissions and must be evaluated, as specified in OAC 3745-110-03(J):

- Low-NOx burners
- Close coupled or separated over-fire ports
- Flue gas recirculation
- Low NOx burners with external flue gas recirculation
- Burners out of service
- Steam/water injection
- Dry low-NOx burners
- Ignition timing retard
- Separate circuit after-cooling
- Fuel emulsification
- Selective noncatalytic reduction (SNCR)
- Nonselective catalytic reduction (NSCR)
- SCR using urea, ammonia, and methane as reducing agents
- Incineration (for sources other than boilers)
- Scrubbing (for sources other than boilers)
- Process modification
- Fuel switching
- Adjustment of air/fuel ratio (for internal combustion engines only)
- Low excess air
- Mid-kiln firing
- Mid-kiln air injection
- Gaseous fuels reburn
- Any other such RACT alternatives not listed in paragraph (J)(1)(h) of this rule that may be applicable to an affected source, or as are proposed by the owner or operator

It should be noted that NOx are formed primarily through combustion processes. As such, much of the available NOx control technologies are designed for combustion processes. These NOx control technologies include two primary control principles:

1. Reducing the initial formation of thermal NOx from fuel combustion through limiting temperature, residence time, and/or combustion air-to-fuel stoichiometric ratios.
2. Removing NOx from process gases through the use of add-on control devices.

The potential NOx emissions generated from the affected sources at the BASF Elyria facility are not related to fuel combustion, rather from the calcination of nitrogen-containing raw materials under specific operating conditions using indirect-fired heating. As such, the combustion control technologies identified above are not technically feasible for the BASF affected sources and are not evaluated further herein. The add-on control devices identified above that are not specific to only fuel combustion include the following:

- SNCR
- NSCR
- SCR
- Incineration

- Scrubbing
- Process modification

The technical feasibility of these add-on control options, including potential NOx control efficiencies, are discussed below.

3.1.1 Selective Noncatalytic Reduction

SNCR is based on the chemical reduction of the NOx molecule into molecular nitrogen (N_2) and water vapor (H_2O). A nitrogen-based reducing agent (reagent), such as ammonia or urea, is injected into the post-combustion flue gas. The reagent can react with a number of waste gas components. However, the NOx reduction reaction is favored over other chemical reaction processes for a specific temperature range and in the presence of oxygen, therefore, it is considered a selective chemical process. Injection of the reagent causes mixing with the flue gas. The optimum temperature range for the reduction reaction occurs between 1,600 to 2,100°F, which is why SNCR is typically used as a post-combustion control technology, as the flue gas temperature is hot enough for the reduction reaction to occur[3].

The important design and operational factors that affect the reduction of NOx by an SNCR system include temperature, residence time, degree of mixing, type of reducing agent, reagent injection rate, and uncontrolled NOx concentration level. The reaction temperature is critical since heat is needed to drive the reaction. At lower temperatures, reaction kinetics are slow, resulting in potential ammonia slip. Although installation of urea-based systems is more common than ammonia-based deployments, higher NOx reductions occur with ammonia reagent. U.S. EPA has reported that the median (as a measure of average) reductions for urea-based SNCR systems in various industry source categories range from 25 to 60 percent, while median reductions for ammonia-based SNCR systems range from 61 to 65 percent.[4].

As previously stated, NOx emissions generated by the BASF affected sources occur because of calcining nitrogen-containing materials in indirect-fired calciners at temperatures ranging from approximately 330 to 430°F. This process is not conducive to SNCR control as there is no combustion chamber for the reagent to be injected into and the operating temperature range of the calciners is well below the optimal temperature range for the NOx reduction reaction to occur. Additionally, SNCR NOx reduction potential is less than that of the existing control devices employed on the affected sources. As such, SNCR is not technically feasible for the affected sources and is excluded from further evaluation herein.

3.1.2 Nonselective Catalytic Reduction

NSCR is used as a post-combustion control for the simultaneous reduction of carbon monoxide (CO), volatile organic compounds (VOCs), and NOx through catalytic oxidation and catalytic reduction. To control NOx, the catalytic reduction process requires CO to complete the following reduction reaction:

$$2NO + 2CO \rightarrow N_2 + 2CO_2$$

NSCR is often used for stationary sources that operate at a rich fuel-to-air ratio, such as four-stroke rich burn reciprocating internal combustion engines. NSCR is not applicable to the calciner process exhaust

[3] U.S. EPA Clean Air Technology Center, Air Pollution Control Technology Fact Sheet for SNCR.

[4] U.S. EPA Air Pollution Control Cost Manual, Seventh Edition. Section 4, Chapter 1, Selective Noncatalytic Reduction. Revised April 25, 2019.

where there is no source of CO to complete the reduction reaction, other than the CO concentration of ambient air at the facility. As a result, this control measure is not technically feasible.

3.1.3 Selective Catalytic Reduction

SCR is like SNCR in that it is based on the chemical reduction of the NOx molecule. The primary difference between SNCR and SCR is that SCR employs a metal-based catalyst with activated sites to increase the rate of the reduction reaction. The use of a catalyst results in two primary advantages of the SCR process over SNCR including higher NOx reduction efficiency and a lower and broader temperature range for the SCR reactions. In an SCR system, the optimum temperature depends on both the type of catalyst used in the process and the flue gas composition. For the majority of commercial catalysts (metal oxides), the operating temperatures for the SCR process range from 480 to 800°F, with the optimal temperature range between 700 and 750°F. SCR is capable of NOx reduction efficiencies in the range of 70% to greater than 95%. However, the greater reduction efficiencies require additional capital and operating costs, such as for installation of multi-stage catalyst beds and significant ammonia and catalyst replacement costs, which could result in the system not being cost effective.

The reducing agent employed by the majority of SCR systems is gas-phase ammonia (NH_3) because it readily penetrates the catalyst pores. The NH_3 is vaporized before injection by a vaporizer. Within the appropriate temperature range, the gas-phase NH_3 then decomposes into free radicals. After a series of reactions, the ammonia free radical comes into contact with the NOx molecule and reduces it to N_2 and H_2O. The SCR system can use either aqueous or anhydrous ammonia for the reduction reaction, and some plants use urea-to-ammonia reagent systems where aqueous ammonia is produced onsite.

SCR catalysts are composed of active metals or ceramics with a highly porous structure. Within the pores of the catalyst are activated sites. These sites have an acid functional group on the end of the compound structure where the reduction reaction occurs. After the reduction reaction occurs, the site reactivates via rehydration or oxidation. Over time, however, the catalyst activity decreases, requiring replacement, washing/cleaning, rejuvenation, or regeneration of the catalyst. Catalyst designs and formulations are proprietary. Both the catalyst material and configuration determine the properties of the catalyst.

As previously stated, NOx emissions generated by the BASF affected sources are exhausted to the down-stream control device at temperatures ranging from approximately 330 to 430°F. At this temperature, the exhaust stream would require preheating to be within the optimal temperature range for the NOx reduction reaction. Considering that the SCR system would be a retrofit installation where multiple calciner exhausts would enter the SCR system through a combined header system, a tail-end SCR unit would likely be required. For this type of system, the exhaust stream would require a particulate control device to be installed upstream of the SCR to remove most flue gas constituents detrimental to SCR catalyst before the flue gas enters the SCR reactor. Tail-end SCR systems have a higher capital cost than the other SCR systems because of the additional equipment and operational costs associated with particulate control and flue gas reheating. However, these costs are in part offset by reductions in catalyst costs. Tail-end units require less catalyst because they can use catalysts with smaller pitch and higher surface area per unit volume[5].

[5] EPA Office of Air Quality Planning and Standards, Air Pollution Control Cost Manual, Section 4 – NOx Control, Chapter 2 – Selective Catalytic Reduction. June 2019.

Without consideration of cost, an SCR system to control NOx emissions from the process exhaust of multiple rotary calciners is technically feasible and is evaluated for economic feasibility below.

3.1.4 Incineration

Incinerators are typically used to control emissions from operations that generate exhaust streams containing organic constituents with sufficient heat content to be thermally oxidized with minimal supplemental fuel firing, such as from surface coating or paint lines. This control technology is not applicable to the rotary calciner process exhaust that does not contain organic constituents.

3.1.5 Scrubbing

Scrubbing is the process of removing air pollutants by inertial or diffusional impaction, reaction with a sorbent or reagent slurry, or absorption into liquid solvent. There are two main ways that wet scrubbers remove NOx: absorption and chemical reaction. For absorption, NOx gases dissolve in the liquid solution. The solubility of NOx in water is affected by a number of factors, including the pH of the solution and the temperature of the gas stream. For chemical reaction, NOx gases can react with certain chemicals in the liquid solution to form insoluble compounds that can be removed from the gas stream. Wet scrubbers can achieve removal efficiencies ranging from 50% to more than 95% depending on the type of reagent solution used and the number of reaction stages.

There are several types of wet scrubbers often used to remove NOx from industrial emissions, each with different benefits, drawbacks, and appropriate applications. Examples of these wet scrubbers include spray tower scrubbers, packed-bed scrubbers, and venturi scrubbers. Spray tower scrubbers are low-energy scrubbers that use nozzles to spray liquid solution into the gas stream. Spray tower scrubbers are typically used for applications where the gas stream is relatively low NOx concentration and the removal efficiency requirements are not as stringent. Packed bed scrubbers are filled with a packing material, such as Raschig rings or Pall rings. The liquid solution is sprayed over the packing material, and the NOx gases dissolve in the liquid as it flows through the packing material. Packed bed scrubbers are typically used for applications where the gas stream contains other contaminants, such as particulates, and the removal efficiency requirements are high. Venturi scrubbers are high-energy scrubbers that use a high-pressure gas stream to atomize the liquid solution. This creates a fine mist of droplets that can effectively capture pollutants from the gas stream.

Based on the process exhaust from the rotary calciners, a packed-bed scrubber can be an effective NOx control option. In the NOx scrubbing process, the process exhaust enters the packed towers for contact with effective reagents that absorb nitric oxide (NO) and nitrogen dioxide (NO_2), typically through a multi-stage system. Alkaline solutions, such as sodium hydroxide (NaOH) or lime (CaO), may be used to increase the pH of the liquid solution. This can increase the solubility of NOx gases in the solution.

The BASF Elyria facility currently employs a three-stage packed-bed caustic scrubber (TriMer scrubber) to control NOx from the calciner process exhaust.

3.1.6 Process Modification

Process modification is not a feasible option for the rotary calciners at the BASF Elyria facility. The production process is a batch operation to produce customer-specific products that require specific formulations and operating conditions. Modification of the production process to minimize NOx emissions would impact the ability to manufacture the BASF's full portfolio of catalyst products.

3.1.6 RACT Alternatives

BASF did not identify any additional control options to reduce NOx emissions beyond those identified above.

3.2 Evaluation of Most Effective Control Option

The technically feasible control technologies options reviewed above are ranked by estimated control efficiency:

1. SCR (70% to greater than 95% NOx control efficiency)
2. Wet scrubber (50% to 95% NOx control efficiency)

As previously stated, BASF employs an SCR system and wet scrubber system to control NOx emissions from the process exhaust of the six rotary calciners. BASF has continuously demonstrated compliance with the NOx RACT limits for these control systems. Because an SCR system is capable of a greater NOx reduction efficiency than the TriMer scrubber, the only technical feasible option for reducing NOx emissions from the six rotary calciners is to replace the wet scrubber with an SCR system designed to control NOx by greater than 95%. Because the NOx RACT limits are emission limits and not control efficiency limits, adding a third control system would remove the inherent total NOx emissions limit for the six calciners (i.e., 1.86 lb/hr from the SCR system and 3.4 lb/hr from the wet scrubber) and allow for additional NOx emissions from the third control device.

To that end, replacing the TriMer scrubber with an SCR system is the only new control scheme that is technically feasible for reducing NOx emissions from the affected sources and is further evaluated below to determine economic feasibility.

3.3 Economic Feasibility

This economic feasibility assessment includes evaluation of retrofitting the calciners currently controlled by the TriMer scrubber with an SCR system capable of controlling NOx by at least 98%. The potential NOx removed for a new SCR system to replace the TriMer scrubber must account for the current NOx limit of the TriMer scrubber (3.4 lb/hr at 94% control). This equates to a controlled emission rate of the new SCR system of 1.13 lb/hr [(3.4 lb/hr NOx) / (1 – 94%) x (1 – 98%)]. The total reduction in NOx emissions is 2.27 lb/hr from the new SCR system (3.4 lb/hr from the TriMer minus 1.13 lb/hr from the new SCR system). Therefore, the total annual NOx reduction based on 8,760 hr/yr is 9.9 tons removed.

In accordance with OAC 3745-110-03(J)(1)(o), capital and operating costs, as well as cost-effectiveness, of the technically feasible control options should be calculated in a manner consistent with the most recent edition of the U.S. EPA's Air Pollution Control Cost Manual. Accordingly, cost calculations were performed for installing an SCR system downstream of the rotary calciners using a combination of a recent SCR vendor quotes for a similar, but not identical, calcination processes at another BASF facility and calculation methods provided in the U.S. EPA's 2019 Air Pollution Control Cost Manual, Section 4.2 – NOx Controls, NOx Post-Combustion, Chapter 2 - Selective Catalytic Reduction (2019 Cost Control Manual), unless otherwise identified.

Critical inputs to U.S. EPA's cost model include heat input rate represented by the total maximum burner heat input to the unit, observed actual exhaust gas temperature and flow rate, potential annual NOx emissions and maximum operating hours for the unit, and market cost data for ammonia, natural gas, and electricity. The combined gas volume from the existing system and natural gas reheat process is utilized for SCR design parameters such as the catalyst area.

The BASF rotary calciners generate NOx emissions from the calcination of nitrogen-containing raw materials introduced to the indirect-fired rotary calciners. As such, heat input rate is not an applicable design parameter to use in calculating capital costs. Therefore, direct capital costs were obtained from the vendor quote for an SCR system for a similar process operation. It must be noted that the vendor quote provides multiple design options. To obtain 98% NOx control for the proposed SCR system, it would require a multi-stage catalyst reactor system. The vendor quote includes a cost option for a second stage to obtain a total NOx reduction of approximately 96%. The proposed equipment and installation costs for this system were conservatively used to assume 98% NOx control for the cost-effectiveness evaluation.

The total SCR equipment cost used in this evaluation includes the SCR base cost of $948,000, costs of the circulation equipment ($197,500), and the costs of a second stage SCR needed to achieve 98% reduction ($269,800) for a total direct purchase cost of $1,415,300. The Installation costs are based on vendor quote from JDI Industrial Services of $1,963,950. No adjustments were made for retrofit factors or elevation factors.

The Total Capital Investment (TCI) calculation in the 2019 Control Cost Manual (Equations 2.40 and 2.47) includes a factor of 1.3 to estimate indirect installation costs, including engineering and construction management costs, labor adjustment for installation (e.g., per diem and premium for work shifts of 10 hr), and contractor profit and fees. Because the vendor quotes include direct equipment and installation costs, but do not include indirect installation costs, such as engineering and general facilities costs, the indirect installation costs were estimated based on the calculation method included in Section 2.4.1 of the 2002 Control Cost Manual. The 2002 manual reflects a more robust determination for indirect costs for SCR as equations incorporate several sensitivity cases, while the 2019 approach is based on the Clean Air Markets Division (CAMD) Integrated Planning Model (IPM) for utility and industrial boilers.

Finally, the cost model assumes an SCR operating life of 20 years and an 8.25% interest rate based on the current prime bank rate[6] for estimating the capital recovery cost (i.e., indirect annual cost).

Table 13 provides a summary of the estimated capital investment cost, annualized cost (including capital and operating costs), and the cost-effectiveness (annual dollars per ton of NOx removed annually), as required by OAC 3745-110-03(J)(1)(j). Appendix D provides detailed cost calculations to evaluate the economic feasibility of installing and operating a new SCR system to replace the TriMer scrubber.

Table 13: SCR System Economic Feasibility Evaluation

EU ID	EU Description	Total Capital Investment Cost	Total Annualized Cost	Cost Effectiveness
P009	Rotary Calciner #4	$4,005,100	$660,095	$66,676/ton
P010	Rotary Calciner #1			
P080	Rotary Calciner #5			

[6] https://www.federalreserve.gov/releases/h15/

Ohio EPA determined that the upper limit for a cost-effective control technology under the NOx RACT rules for moderate nonattainment areas is approximately $5,000/ton of pollutant controlled.[7] While Ohio EPA has not defined a cost-effectiveness threshold for serious nonattainment areas, it can be concluded that installation of an SCR system to provide additional NOx control over the performance of the TriMer scrubber system is not cost effective at more than $66,000/ton. Attachment D presents the detailed economic feasibility calculations.

[7] 2021 Business Impact Analysis for OAC Chapter 3745-110, Rules 01 to 05, available at: https://www.registerofohio.state.oh.us/servlet/RooBusinessPDF?ruleActionId=597890&docTypeId=14

4. Selected RACT for Affected Sources

As demonstrated herein, technically feasible alternative add-on NOx control technologies for the rotary calciners when processing NOx-generating materials include SCR and caustic wet scrubbing. BASF currently operates an SCR system and TriMer scrubber for controlling NOx emissions. The economic feasibility evaluation in Section 3.3 demonstrated that replacing the TriMer scrubber with a new SCR system is not economically feasible. As such, RACT for Rotary Calciners #1 through #6 remains the use of either the SCR system or TriMer scrubber. Based on the actual emissions identified in Table 11 and the TriMer scrubber stack test results provided in Table 12, the current RACT emission limits are better than the presumptive NOx emission limitations specified in the NOx RACT rules for the use of combustion controls, which typically represent a 50% to 75% reduction in NOx emissions.[8]

Table 14 summarizes BASF's proposed RACT limits in accordance with OAC 3745-110-03(J)(1(l).

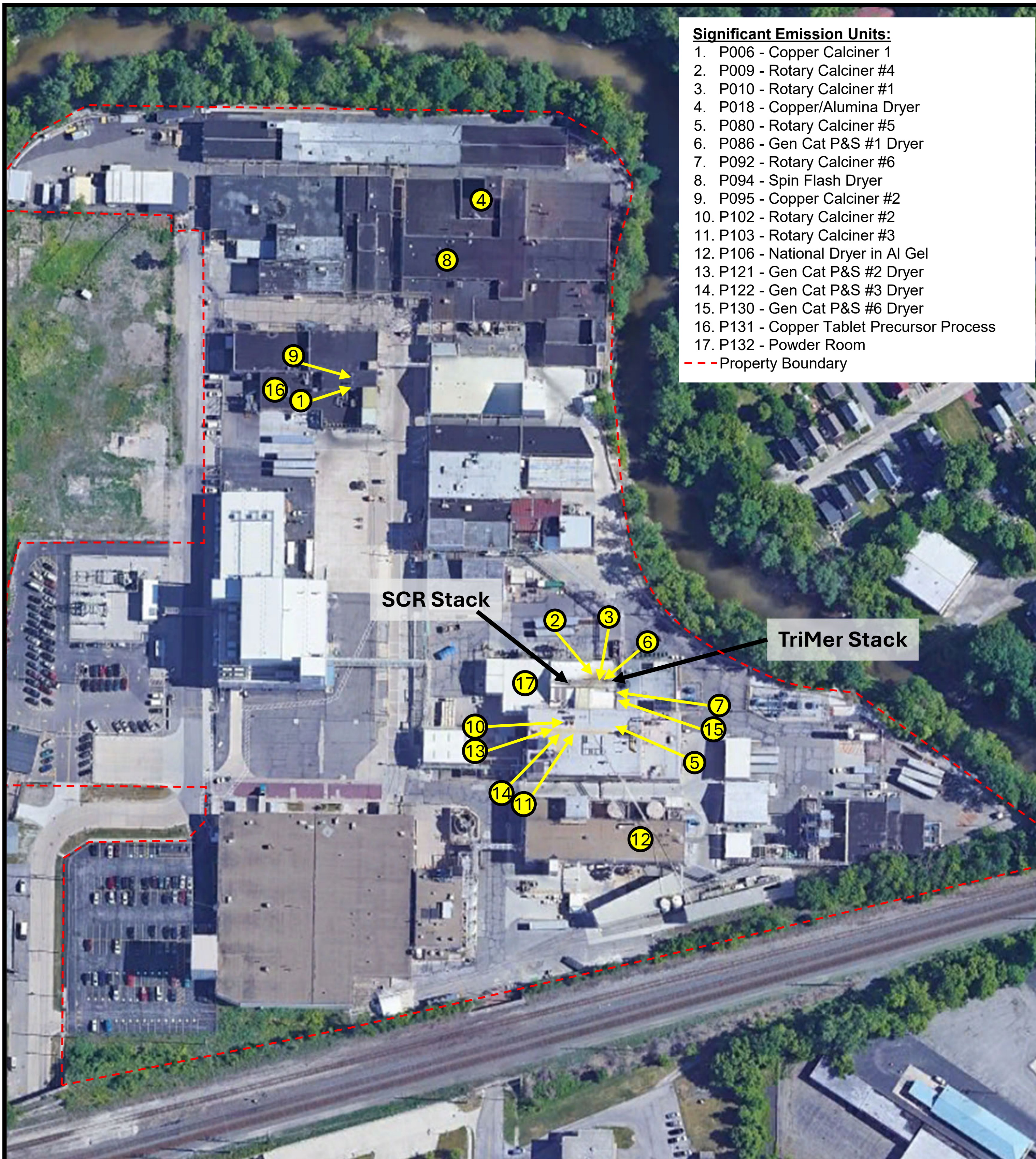
Table 14: Proposed RACT for Each Affected Source

EU ID	EU Description	RACT Limit
P009 P010 P080 P092 P102 P103	Rotary Calciner #4 Rotary Calciner #1 Rotary Calciner #5 Rotary Calciner #6 Rotary Calciner #2 Rotary Calciner #3	Calciners P009, P010, P080, P092, P102, and P103 shall not exceed the NOx emission limitation of 1.86 lbs/hr (200.0 ppmvd) as a 24-hour arithmetic average for each calendar day, excluding NOx emissions from NG combustion, when operating the SCR system.
P009 P010 P080 P102 P103	Rotary Calciner #4 Rotary Calciner #1 Rotary Calciner #5 Rotary Calciner #2 Rotary Calciner #3	Calciners P009, P010, P080, P102, and P103 shall not exceed the NOx emission limitation of 3.4 lbs/hr (250.0 ppmvd) as a three-hour block average, excluding NOx emissions from NG combustion, when operating the caustic/chemical TriMer scrubber.

BASF will implement these RACT requirements immediately [OAC 3745-110-03(J)(1)(m)] by continuing to maintain and demonstrate compliance with the RACT limits through the Additional Terms and Conditions, Operational Restrictions, Monitoring, Recordkeeping, Reporting, and Testing requirements currently specified in Title V permit P0137603.

[8] Ohio EPA, 2015 Ozone SIP - Reasonably Available Control Technology (RACT) SIP for the Cleveland, OH Serious 2015 Ozone Nonattainment Area, Appendix E - NOx RACT Analysis 2015 Ozone Standard

Attachment A: Facility Plot Plan



BASF Corporation
100 Pine Street
Elyria, OH 44035

Facility Plot Plan
Significant Emission Unit Locations
Facility ID: 0247040195

BASF We create chemistry

Date: March 2026

Attachment B: NOx Emission Calculations

Year	EU No.	EU Description	Control Device	Control Efficiency	Product ID	Annual Production (lb/year)	Maximum Daily Production (lb/day)	Days of Production All Products	Days of Production NOx Products	Average Daily Production All Products (lb/day)	Average Daily Production NOx Products (lb/day)	NOx Emission Factor (lb NOx/lb product)	Weighted-averge Emission Factor (lb NOx/lb product)	Annual Emissions (ton/yr)	Maximum Daily Emissions (lb/day)	Average Daily Emissions (lb/day)
2023	P009	Rotary Calciner #4	SCR System	98.90%	[redacted]	153,100	9,600	147	129	5,216	5,276	0.0129	0.1347	0.57	38.1	7.7
						5,800	3,400					0.0168				
						63,141	7,200					0.0404				
						6,193	5,000					0.1445				
						150,179	8,400					0.1326				
						66,200	9,800					0.1727				
						22,600	11,200					0				
						18,700	6,233					0.2293				
						36,300	9,600					0.2233				
						28,796	5,424					0.1799				
						63,616	6,880					0				
						152,132	**10,800**					0.3209				
					TOTAL/MAXIMUM	**766,758**	**11,200**									
	P010	Rotary Calciner #1	TriMer Scrubber	93.90%	[redacted]	110,123	7,740	74	23	5,647	6,006	0	0.0048	0.06	9.9	1.7
						91,200	**12,000**					0.0136				
						46,944	9,600					0.0168				
						72,050	14,575					0				
						47,000	9,000					0				
						50,592	5,952					0				
					TOTAL/MAXIMUM	**417,909**	**14,575**									
	P080	Rotary Calciner #5	TriMer Scrubber	93.90%	[redacted]	149,792	6,000	54	0	5,441	0	0	0	0	0	0
						143,996	7,311					0				
					TOTAL/MAXIMUM	**293,788**	**7,311**									
	P092	Rotary Calciner #6	SCR System	98.90%	[redacted]	7,787	3,675	179	0	5,409	0	0	0	0	0	0
						20,029	7,400					0				
						336,573	7,493					0				
						28,175	7,350					0				
						113,750	6,600					0				
						4,200	2,100					0				
						403,839	7,800					0				
						53,900	6,300					0				
					TOTAL/MAXIMUM	**968,254**	**7,800**									
	P102	Rotary Calciner #2	SCR System	98.90%	[redacted]	1,275,570	24,250	120	13	12,211	4,338	0	0.0052	0.04	10.5	0.7
						23,169	15,894					0				
						51,800	**6,600**					0.1445				
						66,800	7,460					0				
						24,600	6,300					0				
						18,750	3,750					0				
						4,600	4,600					0.0301				
					TOTAL/MAXIMUM	**1,465,290**	**24,250**									
	P103	Rotary Calciner #3	SCR System	98.90%	[redacted]	12,347	4,522	188	188	7,591	7,591	0.0199	0.0156	0.13	4.38	1.3
						338,230	13,200					0.0301				
						393,600	11,700					0.0146				
						147,555	12,632					0.0073				
						237,331	**15,792**					0.0033				
						165,466	9,045					0.0255				
						81,481	7,538					0.0039				
						51,143	8,685					0.0068				
					TOTAL/MAXIMUM	**1,427,154**	**15,792**									

Year	EU No.	EU Description	Control Device	Control Efficiency	Product ID	Annual Production (lb/year)	Maximum Daily Production (lb/day)	Days of Production All Products	Days of Production NOx Products	Average Daily Production All Products (lb/day)	Average Daily Production NOx Products (lb/day)	NOx Emission Factor (lb NOx/lb product)	Weighted-averge Emission Factor (lb NOx/lb product)	Annual Emissions (ton/yr)	Maximum Daily Emissions (lb/day)	Average Daily Emissions (lb/day)
2024	P009	Rotary Calciner #4	SCR System	98.90%	[redacted]	94,401	**9,600**	150	55	6,587	5,444	0.0404	0.0316	0.17	12.3	2.3
						22,600	6,000					0.1445				
						26,840	7,392					0				
						182,400	8,400					0.1326				
						336,745	14,850					0				
						325,048	12,000					0				
					TOTAL/MAXIMUM	**988,034**	**14,850**									
	P010	Rotary Calciner #1	TriMer Scrubber	93.90%	[redacted]	35,260	6,880	84	0	4,841	0	0	0	0	0	0
						67,555	14,486					0				
						110,000	10,000					0				
						193,797	5,952					0				
					TOTAL/MAXIMUM	**406,612**	**14,486**									
	P080	Rotary Calciner #5	TriMer Scrubber	93.90%	[redacted]	15,150	3,450	220	220	4,097	4,097	0.0028	0.0097	0.27	4.2	2.4
						602,990	**7,000**					0.0098				
						283,248	6,750					0.0098				
					TOTAL/MAXIMUM	**901,388**	**7,000**									
	P092	Rotary Calciner #6	SCR System	98.90%	[redacted]	51,800	6,650	227	0	3,795	0	0	0	0	0	0
						36,944	6,480					0				
						55,714	5,688					0				
						27,500	5,200					0				
						329,883	5,850					0				
						130,725	6,475					0				
						228,941	7,350					0				
					TOTAL/MAXIMUM	**861,507**	**7,350**									
	P102	Rotary Calciner #2	SCR System	98.90%	[redacted]	224,439	12,600	90	56	6,573	7,165	0.0129	0.0135	0.04	4.4	1.0
						19,800	7,000					0.0168				
						151,130	7,600					0				
						157,007	**13,200**					0.0301				
						39,200	6,880					0				
					TOTAL/MAXIMUM	**591,576**	**13,200**									
	P103	Rotary Calciner #3	SCR System	98.90%	[redacted]	100,582	10,108	215	215	6,096	6,096	0.0068	0.0073	0.05	2.5	0.5
						132,202	9,650					0.0068				
						25,119	7,536					0.0039				
						308,608	7,035					0.0039				
						53,956	10,528					0.0033				
						137,435	**12,308**					0.0073				
						390,180	11,584					0.0073				
						114,400	12,000					0.0146				
						48,250	11,580					0.0199				
					TOTAL/MAXIMUM	**1,310,733**	**12,308**									

Year	EU No.	EU Description	Control Device	Control Efficiency	Product ID	Annual Production (lb/year)	Maximum Daily Production (lb/day)	Days of Production All Products	Days of Production NOx Products	Average Daily Production All Products (lb/day)	Average Daily Production NOx Products (lb/day)	NOx Emission Factor (lb NOx/lb product)	Weighted-averge Emission Factor (lb NOx/lb product)	Annual Emissions (ton/yr)	Maximum Daily Emissions (lb/day)	Average Daily Emissions (lb/day)
2025	P009	Rotary Calciner #4	SCR System	98.90%	[redacted]	11,000	4,200	73	59	4,829	4,980	0.0168	0.0609	0.12	14.3	3.2
						57,044	8,900					0.0404				
						26,048	6,400					0.1445				
						67,820	8,040					0.0255				
						24,200	13,750					0				
						34,558	11,000					0				
						23,000	9,000					0.0444				
						54,569	**10,800**					0.0496				
						54,313	7,232					0.1799				
					TOTAL/MAXIMUM	**352,552**	**13,750**									
	P010	Rotary Calciner #1	TriMer Scrubber	93.90%	[redacted]	19,840	5,952	11	0	3,673	0	0	0	0	0	0
						20,562	6,944					0				
					TOTAL/MAXIMUM	**40,402**	**6,944**									
	P080	Rotary Calciner #5	TriMer Scrubber	93.90%	[redacted]	1,072,251	13,650	187	52	7,463	5,596	0	0.0020	0.09	4.2	0.9
						32,400	6,000					0				
						199,000	6,750					0.0098				
						92,000	**7,000**					0.0098				
					TOTAL/MAXIMUM	**1,395,651**	**13,650**									
	P092	Rotary Calciner #6	SCR System	98.90%	[redacted]	143,207	8,025	225	0	4,528	0	0	0	0	0	0
						158,184	7,290					0				
						4,312	3,600					0				
						23,800	6,825					0				
						232,309	6,500					0				
						52,771	4,800					0				
						48,010	5,950					0				
						202,546	7,350					0				
						153,754	7,000					0				
					TOTAL/MAXIMUM	**1,018,893**	**8,025**									
	P102	Rotary Calciner #2	SCR System	98.90%	[redacted]	15,445	**8,800**	77	8	9,380	1,931	0.0301	0.0006	0.003	2.9	0.1
						109,125	17,175					0				
						597,686	19,400					0				
					TOTAL/MAXIMUM	**722,256**	**19,400**									
	P103	Rotary Calciner #3	SCR System	98.90%	[redacted]	116,503	12,000	191	191	6,968	6,968	0.0136	0.0175	0.13	11.3	1.3
						13,227	5,511					0.0168				
						47,952	10,342					0.0404				
						9,000	5,175					0.0083				
						11,759	5,790					0.0199				
						124,284	**15,400**					0.0301				
						195,343	12,000					0.0146				
						148,425	10,860					0.0073				
						21,237	10,619					0.0073				
						153,483	10,528					0.0033				
						36,180	7,035					0.0255				
						6,216	5,250					0.0039				
						49,903	7,350					0.0039				
						338,658	10,108					0.0068				
						58,730	8,080					0.1274				
					TOTAL/MAXIMUM	**1,330,901**	**15,400**									

Attachment C: RBLC Summary Table

Table B-1: RBLC Summary Table

RBLC ID	Facility Name	Facility State	Process Name	Control Method Description	NOx Emission Limit	Case-by-Case Basis
TX-0992 (draft)	JEFFERSON RAILPORT TERMINAL I (TEXAS) LLC	TX	Natural gas and LPG-fueled furnaces	Ultra-low NOx burners	0.0300 lb/MMBtu	BACT-PSD
TX-0845	ARKEMA BEAUMONT PLANT	TX	Incinerator	Low NOx burners	0.0600 lb/MMBtu	BACT-PSD
			Natural gas-fueled heaters	Low NOx burners, clean fuel	0.0400 lb/MMBtu	BACT-PSD

Attachment D: Economic Feasibility Calculations

Parameter	Variable	Calculation	Value	Units	Reference
Input Data					
SCR Design Data					
Number of SCR Reactor Chambers	n_{SCR}		2		Vendor quote for SCR equipment purchase
Volume of Reactor	$Vol_{catalyst}$		25.4	ft3	Vendor quote for SCR equipment purchase
Catalyst Replacement Factor	R_{layer}	$R_{layer} = n_{layer} = 2$	2		2 layers of catalys per SCR vendor quote
Catalyst Replacement Cost	$Cost_{catalyst}$	$n_{SCR} \times Vol_{catalyst} (CC_{replace}/R_{layer})$	8582.4		Eq. 2.63, 2019 EPA Cost Control Manual
Future Worth Factor	FWF	$i[1/((1+i)^{Y} -1)$	0.19		Eq. 2.65, 2019 EPA Cost Control Manual
Term	Y	$h_{catalyst}/h_{year}$	5	years	Eq. 2.66, 2019 EPA Cost Control Manual
Hours per year SCR operates	h_{year}	220 days/year × 24 hr/day	5280	hours	Days per year NOx products produced on RC1 and RC5 x 24 hours/day
Operating Life of Catalyst in Hours	$h_{catalyst}$		24,000	hours	2019 EPA Cost Manual, pg. 2-73
Plant capacity factor	CF_{plant}	220 days/365 days	0.60		Ratio of daily NOx products per year (220 days to 365 potential days)
SCR system capacity factor	CF_{SCR}		1.00		SCR operated all production days with NOx products
Total system capacity factor	CF_{total}	$CF_{plant} \times CF_{SCR}$	0.60		Eq. 2.7, 2019 EPA Cost Control Manual
Operating time per year	t_{op}	$CF_{total} \times 8{,}760$	5,280	hr/yr	Eq. 2.59, 2019 EPA Cost Control Manual
Reagent solution volume flow rate	q_{sol}	0.132 gal/min × 60 min/hr	7.9	gph	SCR vendor specifications - 0.132 gal/min 40wt% urea
Required Electrical Power	P		195	kWh	SCR vendor specifications
Cost Data					
40wt% Urea Solution Cost	$Cost_{reag}$	$1,100/275 gal	$ 4.00	$/gal	$1,100 per 275-gal tote
Electrical Power Cost	$Cost_{elect}$		$ 0.071	$/kWh	BASF accounts payable records for electricity costs
Catalyst Cost	$CC_{replace}$	$\$8{,}000/m^3 / 35.315\ ft^3/m^3 \times 1.49$	$ 337.55	$\$/ft^3$	2019 EPA Cost Manual; adjsusted from 2010 using consumer price idex
Total Capital Investment Costs					
Total Direct Capital Costs	**DCC**	**PEC + DIC**	**$ 3,379,250**		**Section 2.4.1, Direct Capital Cost, 2002 EPA Cost Control Manual**
Direct Purchase Equipment Costs	PEC		$ 1,415,300	$	Vendor quote for equipment purchase costs
Direct Installation Costs	DIC		$ 1,963,950	$	Vendor quote for equipment installation costs
Indirect Installation Costs	**IIC**	**Eng + GF + Cont**	**$ 675,850**	**$**	**Section 2.4.1, Indirect Capital Cost, 2002 EPA Cost Control Manual**
Engineering Costs	Eng	0.10 × DCC	$ 337,925	$	Table 2.5, 2002 EPA Cost Manual, not included in vendor quotes
General Facilities	GF	0.05 × DCC	$ 168,963	$	Table 2.5, 2002 EPA Cost Manual, not included in vendor quotes
Process Contingencies	Cont	0.05 × DCC	$ 168,963	$	Table 2.5, 2002 EPA Cost Manual, not included in vendor quotes
Total Capital Investment	**TCI**	**DCC + IIC**	**$ 4,055,100**		**Section 2.4.1, 2019 EPA Cost Control Manual**
Total Annual Costs					
Direct Annual Costs					
Annual Maintenance Cost	AMC	0.005 × TCI	$ 20,276	$/year	Eq. 2.57, 2019 EPA Cost Control Manual
Annual Reagent Cost	ARC	$q_{sol} \times Cost_{reag} \times t_{op}$	$ 167,270	$/year	Eq. 2.58, 2019 EPA Cost Control Manual
Annual Electricity Cost	AEC	$P \times Cost_{elect} \times t_{op}$	$ 73,102	$/year	Eq. 2.62, 2019 EPA Cost Control Manual
Annual Catalyst Cost	ACC	$Cost_{catalyst} \times FWF$	$ 1,673	$/year	Eq. 2.64, 2019 EPA Cost Control Manual
Future Worth Factor	FWF	$i[1/((1+i)^{Y} -1)$	0.19		Eq. 2.65, 2019 EPA Cost Control Manual
Term	Y	$h_{catalyst}/h_{year}$	5	years	Eq. 2.66, 2019 EPA Cost Control Manual
Direct Annual Costs	**DAC**	**AMC+ARC+AEC+ACC**	**$ 262,320.94**	**$/year**	**Eq. 2.56, 2019 EPA Cost Control Manual**

Parameter	Variable	Calculation	Value	Units	Reference
Indirect Annual Costs					
Interest Rate	i		7.50%		https://www.federalreserve.gov/releases/h15/
SCR System Life	n		20	years	2019 EPA Cost Control Manual, page 2-48
Capaital Recovery Factor	CRF	$(i(1+i)^n) / ((1+i)^n - 1)$	9.81%		Eq. 2.55, 2019 EPA Cost Control Manual
Captital Recover	CR	CRFxTCI	$ 397,774	$/year	Eq. 2.70, 2019 EPA Cost Control Manual
Administrative Charges	ACC		$ -	$/year	Cost not estimated
Indirect Annual Costs	**IAC**	**CR + ACC**	**$ 397,774**	**$/year**	**Eq. 2.68, 2019 EPA Cost Control Manual**
Total Annual Cost	**TAC**	**DAC + IAC**	**$ 660,095**	**$/year**	**Eq. 2.72, 2019 EPA Cost Control Manual**
Cost Effectiveness					
NOx Removed per Year	$NOx_{removed}$		9.9	ton/yr	Replacing TriMer scurbber at 94% efficient with SCR at 98% efficient
Cost Effectiveness		**$TAC/NOx_{removed}$**	**$ 66,676**	**$/ton**	**Eq. 2.73, 2019 EPA Cost Control Manual**