ALTERNATIVE RACT AND COMPLIANCE PROPOSAL

APS No. 345963
AUTH No. 1536486
PFID No. 238534

PQ LLC – CHESTER, PA

JULY 2025

SUBMITTED BY:

PQ LLC
1201 W. Front Street
Chester, PA 19013-3436

SUBMITTED TO:

Pennsylvania Department of Environmental Protection
Bureau of Air Quality
Southeast Regional Office
2 E. Main Street
Norristown, PA 19401-4915

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1. INTRODUCTION

PQ LLC (PQ) owns and operates a sodium silicate production facility located in Chester, Delaware County, Pennsylvania (Facility). The Facility operates under Pennsylvania Department of Environmental Protection (PADEP or Department) Title V Operating Permit (TVOP) No. 23-00016. PQ is submitting this Alternative Reasonably Available Control Technology (RACT) and Compliance Proposal for the #4 Sodium Silicate Furnace, Source ID 102 (Furnace), operated at the Facility in response to PADEP's request[1] for an alternative case-by-case RACT III analysis to address emissions from the Furnace that occur on non-operating days. A non-operating day is defined as any calendar day (i.e., period that begins at midnight local time and ends 24 hours later) in which glass is not being pulled from the Furnace. Non-operating days may occur during periods of Furnace idling (e.g., hot holds), startup, and shutdown. Therefore, PQ is also by way of this submittal requesting the establishment of an Alternate Operating Scenario to cover the periods of time when the furnaces are in hot hold, startup, and shutdown modes of non-glass production.

This Alternative RACT and Compliance Proposal is prepared in accordance with 25 Pa. Code §§129.111-129.115 (commonly referred to as "RACT III"), and as a Significant Operating Permit Modification Application (Application) in accordance with 25 Pa. Code §129.114(d)(2). PQ previously submitted a notification of RACT III applicability and intention for the Furnace to comply with the presumptive RACT III requirements on operating days, in accordance with 25 Pa. Code §129.115(a), under separate cover in December 2022 to PADEP. This Application addresses RACT requirements for Furnace emissions on non-operating days only. RACT III applicability and compliance plans for non-Furnace sources at the Facility are provided in the December 2022 notification.

1.1 FACILITY DESCRIPTION

PQ operates the Furnace for the production of sodium silicate. Other sources operated at the Facility include two boilers, Cleaver-Brooks (CBLE200-350) Boiler (Source ID 037) and Donlee Tech Boiler (Source

[1] May 22, 2025 email from Mr. Joseph Schlosser (Air Quality Engineer, PADEP) to Mr. Hassan Akhtar (Plant Manager, PQ).

ID 038); a natural gas-fired spray dryer (Source ID 038); and an emergency generator (Source ID 700). A facility location map is presented as Figure 1-1.

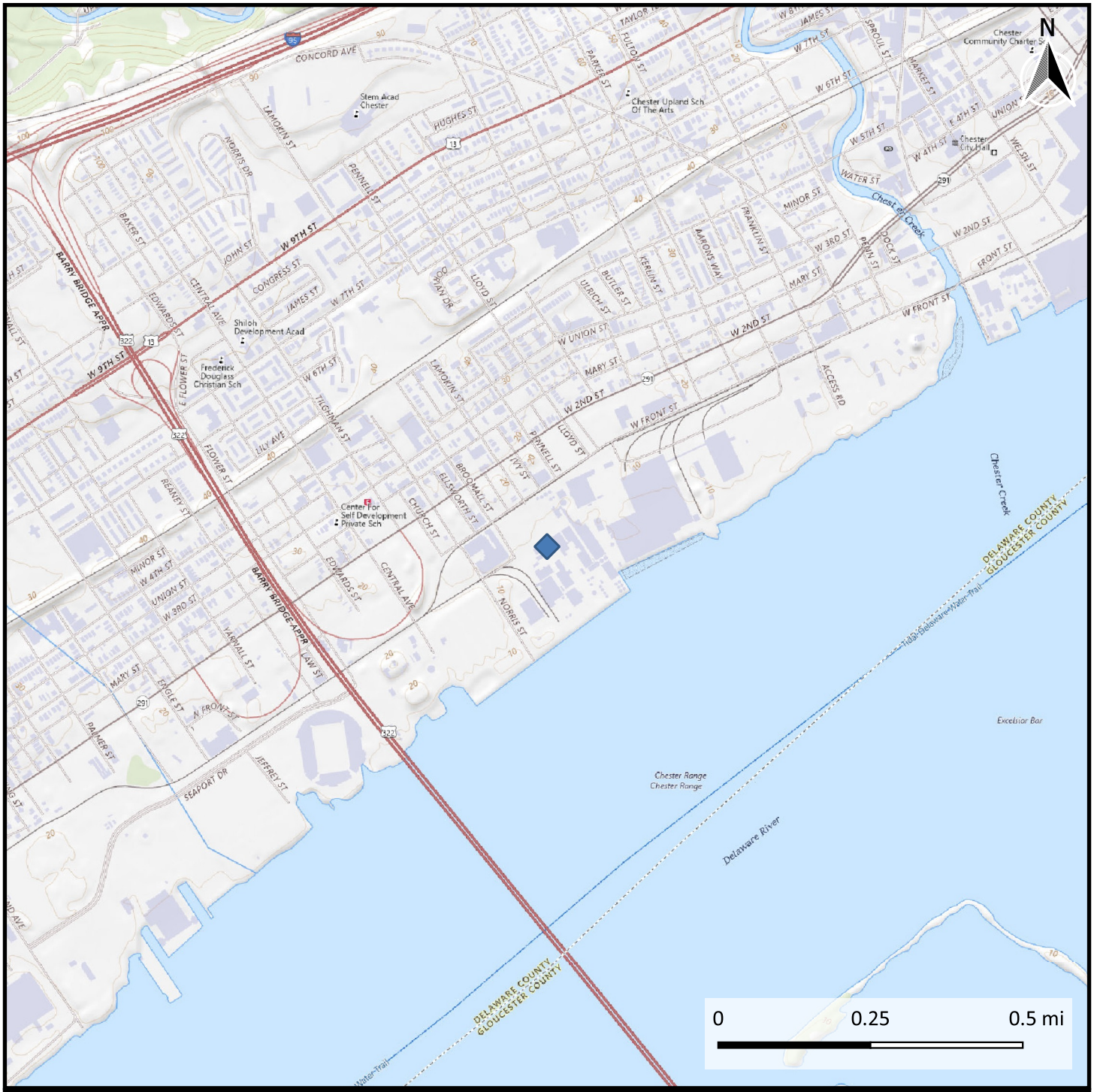
1.2 RACT III DESCRIPTION

On November 12, 2022, PADEP published 25 Pa. Code §§129.111-129.115, "Additional RACT Requirements for Major Sources of NO_X and VOCs for the 2015 Ozone NAAQS." RACT III requirements or emissions limitations supersede the requirements or emissions limitations of a RACT permit previously issued in accordance with 25 Pa. Code §§129.91-129.95 and 129.96-129.100, except in cases where an existing RACT permit specifies more stringent requirements and/or emissions limitations.

RACT III applies to major nitrogen oxides (NO_X) and/or major volatile organic compound (VOC) emitting facilities. 25 Pa. Code §121.1 defines major NO_X and VOC emitting facilities as follows:

- Major NO_X emitting facility – a facility-wide NO_X potential to emit (PTE) of greater than 100 tons per year (tpy)
- Major VOC emitting facility – a facility-wide VOC PTE of greater than 50 tpy

The Facility-wide NO_X PTE is greater than 100 tpy, and the Facility is therefore considered a major NO_X emitting facility subject to the NO_X provisions of RACT III per 25 Pa. Code §129.111(a). However, the Facility-wide VOC PTE is less than 50 tpy; therefore, the Facility is not a major VOC emitting facility and is not subject to the VOC provisions of RACT III per 25 Pa. Code §129.111(a).



Legend

PQ LLC Facility

Figure 1-1
Facility Location Map

PQ LLC
1201 W. Front Street
Chester, PA 19013-3436

PREPARED BY:	CHECKED BY:
S.H.	M.C.
DATE:	PROJ NO.:
July 2025	00634-0028

ALL4

Topographic map courtesy of the United States Geological Survey.

2. RACT III APPLICABILITY

As was detailed in PQ's December 2022 RACT III notification to PADEP, on operating days the Furnace will continue to comply with the presumptive RACT III emissions limitation of 6.0 pounds NO_X per ton of glass pulled in accordance with 25 Pa. Code §129.112(i)(5). Because the presumptive RACT III requirement for NO_X is based on tons of glass pulled by the Furnace, it has no applicability when glass is not being pulled from the Furnace. Therefore, PQ is proposing an alternative RACT emissions limit for the Furnace during non-operating days when the furnace is kept hot with no glass production, which PQ is also proposing as an Alternate Operating Scenario for the Furnace operation to be incorporated into the TVOP. The case-by-case RACT determination, prepared in accordance with 25 Pa. Code §129.114(d), for the Furnace on non-operating days is presented in Section 3.

Through this Application, PQ proposes to incorporate the applicable RACT III requirements and emissions limitations for the Furnace in Section D of TVOP No. 23-00016. The proposed additions to the TVOP do not impact manufacturing operations at the Facility, do not modify any source within the Facility, and do not involve an increase in actual emissions at the Facility. The required Application form is included in Appendix A, and the municipal notifications required per 25 Pa. Code §127.413 are included in Appendix B.

3. ALTERNATIVE CASE-BY-CASE RACT ANALYSIS

The case-by-case RACT analysis for the Furnace is based upon a "five-step, top-down" analysis, as outlined in the United States Environmental Protection Agency (U.S. EPA) Draft "New Source Review Workshop Manual,"[2] as discussed herein. Searches were performed using the U.S. EPA RACT/Best Available Control Technology (BACT)/Lowest Achievable Emissions Rate (LAER) Clearinghouse (RBLC) to identify potential NO_X air pollution control strategies. The remainder of Section 3 includes a description of the analysis conducted, the results of the RBLC search, and proposed alternative RACT limitations for the proposed Alternate Operating Scenario in accordance with 25 Pa. Code §129.114(d).

3.1 OVERVIEW OF CASE-BY-CASE RACT DETERMINATIONS

RACT determinations that are case-by-case analyses involve an assessment of control technologies capable of reducing emissions of a pollutant and are conducted using a "five-step, top-down" approach considering technical feasibility as well as economic, environmental, and energy impacts. RACT is defined in 25 Pa. Code §121.1 as follows:

> *Reasonably available control technology – the lowest emission limit for VOCs or NO_X that a particular source is capable of meeting by the application of control technology that is reasonably available considering technological and economic feasibility.*

The RACT analysis presented in this application generally follows the 25 Pa. Code §129.92 RACT proposal requirements and U.S. EPA guidance outlined in Chapter B of the U.S. EPA Draft "New Source Review Workshop Manual."

A "five-step, top-down" RACT analysis includes the following steps:

- Step 1 – Identify Available Control Technologies
- Step 2 – Eliminate Technically Infeasible Options

[2] U.S. EPA, "New Source Review Workshop Manual," Oct. 1990.

- Step 3 – Rank Remaining Control Technologies by Control Effectiveness
- Step 4 – Evaluate Economic, Environmental, and Energy Impacts of Technically Feasible Control Technologies
- Step 5 – Identify RACT

Each step of the RACT analysis process is described in more detail in the following subsections.

3.1.1 Step 1 – Identify Available Control Technologies

The first step in the "five-step, top-down" RACT analysis process is to identify available control options. Available control options are those air pollution control technologies or techniques (including lower-emitting processes and practices) that have the potential for practical application to the emissions source and pollutant under evaluation, with a focus on technologies that have been demonstrated to achieve the highest levels of control for the pollutant in question, regardless of the source type in which the demonstration has occurred.

The scope of potentially applicable control options is determined based on a review of the RBLC database for entries within the last 10 years. The determinations identified from the RBLC database are, as applicable, supplemented with determinations from other permitted facilities. Entries that are not representative of the sources evaluated are excluded from further consideration.

3.1.2 Step 2 – Eliminate Technically Infeasible Options

In the second step of the RACT analysis, an available control technique listed in Step 1 may be eliminated from further consideration if it is not technically feasible for the specific source being evaluated. A demonstration of technical infeasibility must be documented and show, based upon physical, chemical, or engineering principles, technical reasons that would preclude the successful use of the control option on the emissions source being evaluated. In general, a technology is considered to be technically feasible if it has been demonstrated and operated successfully on the same type of emissions source under review or is available and applicable to the emissions source type being evaluated. If a technology has been operated on the same type of emissions source, it is presumed to be technically feasible. However, an available technology from Step 1 cannot be eliminated as infeasible simply because it has not been used

on the same type of unit that is being evaluated. If the technology has not been operated successfully on the type of unit being evaluated, then questions regarding availability and applicability to the particular unit type being evaluated should be considered for the technology to be eliminated as technically infeasible or economically not available..

3.1.3 Step 3 – Rank Remaining Control Technologies by Control Effectiveness

In the third step of the analysis, the remaining control technologies are listed in order of their overall control effectiveness for the pollutant being assessed. The most effective control alternative (i.e., the option with the highest control efficiency that achieves the lowest emissions level) should be ranked at the top of the list. The remaining technologies should then be ranked in descending order of control effectiveness with the least effective control alternative at the bottom. The ranking of control options in Step 3 determines where to start the selection process in Step 4. In determining and ranking technologies based on control effectiveness, facilities may include information on control efficiency (e.g., percent pollutant removed, emissions per unit of product), expected emissions rate [e.g., tpy, pounds per hour (lb/hr), pounds per unit of product, pounds per unit of input, parts per million volume, dry (ppmvd)], and expected emissions reduction in tpy associated with each technology. The metrics chosen for ranking should best represent the array of control technology alternatives under consideration for the pollutant included in the evaluation. If the top ranked control is selected prior to Step 4, then Step 4 may not be necessary.

3.1.4 Step 4 - Evaluate Economic, Environmental, and Energy Impacts of Technically Feasible Control Technologies

In the fourth step of a RACT analysis, facilities can consider the economic, environmental, and energy impacts associated with each remaining option under consideration. Accordingly, after available and technically feasible control options have been ranked in terms of control effectiveness, which occurs in Step 3, facilities should consider specific economic, environmental, and energy impacts identified with those technologies to either confirm that the top control alternative is appropriate or inappropriate. The top control option should be established as RACT unless the applicant demonstrates that the economic, environmental, and energy impacts are so constraining such that the most stringent technology is not achievable in that case. If the most stringent technology is eliminated in this fashion, then the next most

stringent alternative is considered, and so on. Both direct and indirect impacts of the emissions control option or strategy being evaluated should be considered.

3.1.5 Step 5 – Identify RACT

During the fifth and final step of a five-step, top-down RACT analysis, the most effective control option not eliminated in Step 4 should be selected as RACT for the specific pollutant and emissions source under review.

3.2 NO_X RACT ANALYSIS FOR FURNACE ON NON-OPERATING DAYS

The following sections present the alternative NO_X RACT analysis for the Furnace on non-operating days. The actual and potential NO_X emissions for the Furnace are presented in Table C-1 in Appendix C.

3.2.1 Step 1 – Identify Available Control Technologies

PQ identified the following control technologies with the potential to reduce NO_X emissions from the Furnace operations in the RBLC and/or the California Air Resources Board (CARB) BACT Clearinghouse for entries within the last 10 years:

- Good Operating Practices
- Selective Catalytic Reduction
- Selective Non-Catalytic Reduction
- Replacement of Furnace System Air-Fuel Burners

A summary of RBLC search results will be provided to PADEP upon request. The identified control technologies are described further in the following subsections.

3.2.1.1 Good Operating Practices

Good operating practices are a method of minimizing NO_X emissions. Good operating practices for combustion sources include maintaining optimum combustion efficiency, implementing appropriate maintenance procedures, optimizing the air-fuel ratio, and limiting excess air during combustion. Depending upon the operation of the emissions sources, other techniques may be used.

3.2.1.2 Selective Catalytic Reduction

Selective catalytic reduction (SCR) is a control technology used to convert NO_X into diatomic nitrogen (N_2) and water (H_2O) using a catalyst. The reduction reactions used by SCR require diatomic oxygen (O_2). SCR can achieve reduction efficiencies above 70%. The optimum operating temperature can vary from 480°F to 800°F.[3] Reactive metals such as vanadium or titanium are often used for the catalyst due to their effectiveness as a control technology for NO_X and for their cost-effectiveness for use with natural gas combustion. In addition, a gaseous reductant such as anhydrous ammonia or aqueous ammonia is added to the flue gas and absorbed onto the catalyst.[4]

3.2.1.3 Selective Non-Catalytic Reduction

Selective non-catalytic reduction (SNCR) is a post-combustion control technology for NO_X emissions that uses a reduction-oxidation reaction to convert NO_X into N_2, H_2O, and carbon dioxide (CO_2). Like SCR, SNCR involves injecting ammonia (or urea) into the flue gas stream, which must be between approximately 1,600°F and 2,000°F for the chemical reaction to occur.[5]

SNCR is generally more economical because a catalyst is not required and, in theory, SNCR can control NO_X emissions with an efficiency of up to 50%.[6] However, operating constraints on temperature, reaction time, and mixing often lead to less effective results when using SNCR in practice.

3.2.1.4 Replacement of Furnace System Air-Fuel Fuel Burners

The Furnace contains 16 air-fuel burners, one lip burner, and one draw burner. NO_X emissions from natural gas combustion within the burners can be reduced by up to 20%[7] by replacing the air-fuel burners with oxy-fuel burners. This would also require the installation of a vacuum pressure swing adsorption (VPSA) system or a liquid oxygen system to accommodate the increased need for additional oxygen.

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[3] U.S. EPA Air Pollution Control Technology Fact Sheet, EPA-452/F-03-032.
[4] The U.S. Department of Energy and Southern Company Services, Inc., "Control of Nitrogen Oxide Emissions: Selective Catalytic Reduction."
[5] Final Permit Application Review Summary, Indeck Energy – Alexandria, LLC
[6] *Ibid.*
[7] U.S. EPA "Technical Bulletin: Nitrogen Oxides (NO_X), Why and How They Are Controlled," EPA 456/F-99-006R, November 1999.

3.2.2 Step 2 – Eliminate Technically Infeasible Options

The control technology options that are not technically feasible are discussed in the following subsections.

3.2.2.1 Selective Catalytic Reduction

The optimal temperature range for an effective SCR is between approximately 480°F and 800°F. Below 480˚F, injected ammonia reacts with sulfur oxides to form ammonium bisulfate, which condenses in the SCR catalyst and destroys it. PQ reviewed the previous three years of Furnace operating data recorded by the continuous monitoring systems (CMS) and observed that the Furnace exhaust gas temperature decreases from an average of 459°F during operating days, to a range of 300°F to 350°F during non-operating days. Since the Furnace exhaust gas temperature during non-operating days is significantly below the range required for SCR to effective, SCR is not a technically feasible control technology for NO_X emissions. In addition, based on a search of the RBLC database, SCR has not been demonstrated to be effective in practice on a similar glass manufacturing system when the furnace is kept hot with no glass production. Therefore, SCR is not a technically feasible technology for the removal of NO_X emissions and based on similar glass operations is not an available technology.

3.2.2.2 Selective Non-Catalytic Reduction

In this technology, ammonia or urea is added to the hot gas stream without using a catalyst bed. The temperature of the hot gas stream must be in the range of 1,600°F to 2,000°F for the reaction to take place. As was noted in Section 3.2.2.1 for SCR, the exhaust gas temperature of the Furnace during non-operating days is 300°F to 350°F. Therefore, SNCR is also not viable for the removal of NO_X emissions from the Furnace on non-operating days. In addition to SCR, based on a search of the RBLC database, SNCR has not been demonstrated in practice on a similar glass manufacturing system when the furnace is kept hot with no glass production. Therefore, SNCR is not a technically feasible technology for the control of NO_X emissions and based on similar glass operations is not an available technology.

3.2.3 Step 3 – Rank Remaining Control Technologies by Control Effectiveness

The control technology options determined to be technically feasible under Step 2 have been ranked by control effectiveness as follows in Table 3-1:

Table 3-1
Ranking of Feasible NO_X Control Technologies

Control Technology Option	Control Efficiency	Ranking
Replacement of Air-Fuel Burners	20% [(a)]	1
Good Operating Practices	Variable	2

[(a)] Control efficiency is based on U.S. EPA "Technical Bulletin: Nitrogen Oxides (NO_X), Why and How They Are Controlled," EPA 456/F-99-006R, November 1999.

3.2.4 Step 4 - Evaluate Economic, Environmental, and Energy Impacts of Technically Feasible Control Technologies

The economic, environmental, and energy impacts were evaluated for each of the technically feasible control technologies. These evaluations are described in the following subsections.

3.2.4.1 Replacement of Furnace System Air-Fuel Burners

PQ evaluated the economic impact of the replacement of the air-fuel burners with oxy-only burners and the installation of a VPSA system to provide additional oxygen based on guidance included in U.S. EPA's Office of Air Quality Planning and Standards (OAQPS) Control Cost Manual. A cost analysis for the installation and operation of the oxy-only burners and additional VPSA system is provided in Appendix D, Table D-1. The calculated cost of controlling NO_X emissions is $45,499.46 per ton of NO_X and is, therefore, economically infeasible.

3.2.4.2 Good Operating Practices

PQ currently uses good operating practices for the Furnace system during non-operating days; therefore, a control cost analysis is not conducted. Good operating practices include minimizing the excess air when the Furnace is hot but not producing glass and utilizing a Department-certified NO_X lb/hr continuous emissions monitoring system (CEMS) to demonstrate compliance with the applicable emissions limits specified by the TVOP. PQ does not anticipate any additional economic, environmental, and energy impacts associated with this control strategy.

3.2.5 Step 5 – Identify RACT for Non-Operating Days

Based on the technical and economic feasibility of those control technologies evaluated, PQ proposes the following RACT requirement for the Furnace during non-operating days. PQ proposes that NO_X emissions may not exceed 1,304.4 pounds per non-operating day. The proposed non-operating day emissions limit is calculated based on a statistical evaluation of NO_X emissions recorded by the NO_X CEMS on non-operating days since January 1, 2023 (i.e., the initial RACT III compliance date). A summary of the statistical evaluation used to determine the proposed RACT emissions limit is provided below and in Table E-1.

3.2.5.1 CEMS Data Review and Statistical Evaluation

PQ analyzed NO_X CEMS data from January 1, 2023, to June 30, 2025, to assess achievable emissions levels on non-operating days. The analysis used data from a certified CEMS, maintained in accordance with PADEP Continuous Source Monitoring Manual (CSMM) Revision No. 8. The Upper Prediction Limit (UPL) was utilized to develop the proposed non-operating day emission limit. UPL is a well-established statistical methodology used by U.S. EPA and State agencies to set emissions standards. Specifically, UPL is a value, calculated from a data set, that identifies the average emissions level that a source or group of sources is expected to meet a specified percent of the time, as described in the Use of the Upper Prediction Limit for Calculating MACT Floors[8]. This specified percent is based on the confidence level used in the UPL calculation, which is set to 99% for determining the limits for the combined operations. Essentially, the 99% UPL predicts an emissions level that a future observation is expected to stay below 99% of the time. The intent of the UPL is not to capture absolute worst-case emissions but rather to develop a reasonable estimate accounting for the inherent variability across operating scenarios.

PQ applied the UPL methodology in accordance with U.S. EPA guidelines and reviewed the data set for normality. The kurtosis and skewness results were both near zero, indicating that the data sets exhibited normal distribution. Therefore, the equation (Equation 1) for UPL applicable to normal distribution was utilized for the daily limit.

[8] Ndoh, Tina. U.S. EPA. "Use of the Upper Prediction Limit for Calculating MACT Floors." Docket ID: EPA-HQ-OAR-2012-0522. July 30, 2014.

Equation 1 – Normal Distribution UPL:

$$UPL_{100-(\alpha\times100)} = \bar{x} + t_{(n-1),(1-\alpha)}\sqrt{s^2\left(\frac{1}{n}+1\right)}$$

where:

α = level of significance expressed as a decimal (e.g., 1% significance = 0.01), note that confidence level = 100 − (α × 100)
x = average or mean of test run data
t = t score, the one-tailed t value of the t distribution for a specific degree of freedom and level of significance
n = number of data points (daily sums)
$s2$ = variance of test run data

The resulting emissions limit associated with this evaluation is summarized in Table 3-2. Summary statistics of the data set used for the evaluation are included in Appendix E.

3.2.5.2 Proposed Emissions Limit and Compliance Demonstration

Based on the CEMS Data review and statistical analysis discussed in Section 3.2.5.1, PQ is proposing a permanent NO_X emissions limit presented in Table 3-2 for compliance with RACT III on non-operating days.

Table 3-2
Proposed Non-Operating Day Furnace Emissions Limit

Proposed NO_X Limit	Averaging Period	Calculation Basis	Validation	Data Substitution
1,304.4 lb/day	Daily	Daily sum NO_X lbs	Uses all valid and data substituted values	PADEP-approved New York State Department of Environmental Conservation (NYSDEC) 90th percentile method

Compliance with the proposed emissions limit will be achieved based on the continued use of good operating practices and will be demonstrated as follows.

- Utilize the PADEP-certified NO_X CEMS data that is submitted to the Department through the Continuous Emissions Monitoring Data Processing System (CEMDPS).

- On a quarterly basis and in conjunction with the existing RACT III report PQ submits to the Southeast Regional Office for compliance with the presumptive Furnace emissions limit on operating days, PQ will submit daily NO_X lb/day emissions recorded by the CEMS on non-operating days.

4. RACT III COMPLIANCE DEMONSTRATION AND RECORDKEEPING REQUIREMENTS

PQ is submitting this Alternative RACT and Compliance Proposal and Significant Operating Permit Modification Application to demonstrate compliance with the applicable RACT III requirements. Additionally, in December 2022 PQ submitted a notification of RACT III applicability and alternative RACT compliance analysis under separate cover in accordance with 25 Pa. Code §§129.115(a) and 129.114(i).

PQ has determined through a case-by-case RACT analysis in accordance with 25 Pa. Code §129.114(d) that a NO_X emissions limit of 1,304.4 pounds per non-operating day, achieved by good operating practices, is RACT for NO_X emissions associated with the Furnace.

In accordance with 25 Pa. Code §129.115(f), PQ will keep sufficient records for demonstrating compliance with RACT III. Per 25 Pa. Code §129.115(k), all records will be maintained for at least five years and will be made available to PADEP upon receipt of a written request.

APPENDIX A -
SIGNIFICANT OPERATING PERMIT MODICATION 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: ***23-00016***

1.2 Facility Information

Firm Name: ***PQ LLC*** Federal Tax ID: ***23-0972750***

Facility Name: ***Chester Plant*** Plant Code: ***01***

NAICS Code: ***325180*** SIC Code: ***2819***

Description of NAICS Code: ***Other Basic Inorganic Chemical Manufacturing***

Description of SIC Code: ***Manufacturing - Industrial Inorganic Chemicals, Not Elsewhere Classified***

County: ***Delaware*** Municipality: ***Chester***

Latitude: ***39° 50’ 25.4390” N*** Longitude: ***-75° 22’ 20.5260” W***

Horizontal Reference Datum: ***North American 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: ***Hassan Akhtar*** Title: ***Senior HSE Specialist***

Address: ***1201 W Front St***

City: ***Chester*** State: ***PA*** ZIP: ***19013-3436***

Telephone: ***(610) 447-3906***

Email: ***Hassan.akhtar@pqcorp.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) Hassan Akhtar Date: 07/30/2025

Name (Typed): ***Hassan Akhtar*** Title: ***Plant Manager***

Telephone: ***(610) 447-3906***

Email: ***Hassan.Akhtar@pqcorp.com***

Section 2 – Inventory of Units Being Modified		
Unit ID No.	Unit Name	Unit Type
102	***#4 Sodium Silicate Furnace***	***Process***
S02	***#4 Furnace Stack***	***Point of Air Emission***

Section 3 – Facility Changes – *Not Applicable (N/A)*

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:

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 -)

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

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

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.

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: ***102*** b. Source Name: ***#4 Sodium Silicate Furnace***

c. Manufacturer: ***PQ LLC*** d. Model No.: ***N/A***

e. Source Description: ***Process; Includes 16 Combustion Tec, Model No. Britefire 0308 furnace burners rated 6.0 MMBtu/hr; one Selas Heat Technology Company, Model No. 12 ET burner rated 0.347 MMBtu/hr; and one Selas Heat Technology Company, Model 1001NM Burner Assembly draw burner rated 0.613 MMBtu/hr***

f. Rated Capacity (for engines use BHP): ***50.00 Mcf/hr natural gas; 317.00 gal/hr #2 Fuel Oil*** g. Installation Date: ***01/01/1953***

h. Rated Power/Electric Output: ***N/A***

i. Exhaust Temperature: ***459*** Units: ***deg F*** j. Exhaust % Moisture: ***6*** k. Exhaust Flow Volume: ***29,077*** SCFM

4.3 General Control Device Information – *N/A*

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:

This Application is being submitted to propose a NO_X limit for Source ID 102 during non-operating days specific to §129.114(d). Refer to Application narrative for more details.

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 -)
N/A		

c. Anticipated date on which proposed change is scheduled to occur: ***N/A***

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
25 Pa. Code §129.114(d)	***Emissions limitation***	***TVOP No. 23-00016, Section D, Source ID 102, Condition #001***	***NO_X emissions from the #4 Sodium Silicate Furnace occurring on non-operating days shall not exceed 1,304.4 lbs/day, as per 25 Pa. Code §129.114(d).***

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?	☒	☐

Pennsylvania Department of Environmental Protection

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF AIR QUALITY

AIR QUALITY FEES FOR TITLE V OPERATING PERMIT

Company Information	
Federal Tax ID: ***23-0972750***	Firm Name: ***PQ LLC***
Permit # (If any): ***23-00016***	Facility Name: ***Chester Plant***
Municipality: ***Chester***	County: ***Delaware***
Contact Person Name: Hassan Akhtar	Telephone Number: ***(610) 447-3933***
E-mail: ***hassan.akhtar@pqcorp.com***	

Title V Operating Permit

Line #	Check the appropriate box below	Type of Authorization	Fee 2021 - 2025	Total Fees
1	☐	New Application, Subchapter G	$5,000	
2	☐	Renewal	$4,000	
3	☐	Minor Modification	$1,500	
4	☒	Significant Modification	$4,000	***$4,000***
5	☐	Administrative Amendment / Change of Ownership	$1,500	
6	☐	Plantwide Applicability Limit (PAL) for NSR regulated pollutants or PAL for PSD regulated pollutants or both	$10,000	

Pay maximum amount of fee when one or more authorizations are requested. For example, when a renewal application and a change of ownership forms are submitted, please pay only the highest amount of fee ($4,000).

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 — ***08/12/2020***

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: ***Significant Modification of Operating Permit***

SECTION A. GENERAL APPLICATION INFORMATION

Name of Applicant/Permittee/("applicant")
(non-corporations-attach documentation of legal name)
PQ LLC

Address ***1201 West Front Street***
Chester, PA 19013

Telephone ***(610) 447-3900*** **Taxpayer ID#** ***23-0972750***

Permit, Plan Approval or Application ID# ***23-00016***

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.
Manufacture of Silicates

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
Corporate Offices	*300 Lindenwood Dr., Valleybrooke Corporate Center Malvern, PA 19355*	*PA*	*23-0972750*	*Corporate Headquarters*

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
Corporate Offices	*300 Lindenwood Dr., Valleybrooke Corporate Center Malvern, PA 19355*	*Chester Co. Malvern Boro.*	*(610) 651-4200*	*Corporate Headquarters*
PQ LLC	*1201 W. Front St. Chester, PA 19013*	*Delaware Co. Chester City*	*(610) 447-3900*	*Applicant*

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

Name	Business Address
Not Applicable (N/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
Hassan Akhtar - Chester Plant Manager	***1201 West Front Street, Chester, PA 19013***

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
Facility Wide	***23-00016***	***Chester, PA***	***03/11/2022***	***03/10/2027***

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
11/29/2022	*Chester, PA*	*23-00016*	*Violation of State Implementation Plan for National Primary and Secondary Ambient Air Quality Standards (CAASIP)*	*N/A*	*N/A*	*N/A*
01/28/2022	*Chester, PA*	*23-00016*	*Violation of CAASIP*	*N/A*	*N/A*	*N/A*
02/02/2021	*Chester. PA*	*23-00016*	*Violation of CAASIP*	*N/A*	*N/A*	*N/A*

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
11/29/2022	*Chester, PA*	*23-00016*	*Violation of CAASIP*	*N/A*
01/28/2022	*Chester, PA*	*23-00016*	*Violation of CAASIP*	*N/A*
02/02/2021	*Chester. PA*	*23-00016*	*Violation of CAASIP*	*N/A*

CONTINUING OBLIGATION. 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.
Hassan Akhtar — Signature; 07/30/2025 — Date
Hassan Akhtar — Name (Print or Type)
Plant Manager — Title

APPENDIX B -
MUNICIPAL NOTIFICATION LETTERS

July 18, 2025

CERTIFIED MAIL

Dr. Monica Taylor
Council Chair – Delaware County Council
Government Center Building
201 West Front Street
Media, PA 19063

Re: Notification of Significant Operating Permit Modification Application Submittal
TVOP No. 23-00016
PQ Corporation – Chester, PA

Dear Dr. Taylor:

In accordance with Title 25, Subpart C, Article III, §127.413 of the Pennsylvania Code, PQ Corporation (PQ) hereby notifies Delaware County of its submittal of a Significant Operating Permit Modification Application (Application) to the Pennsylvania Department of Environmental Protection (PADEP). PQ owns and operates a sodium silicate production facility in Chester, Delaware County, Pennsylvania. The Application proposes revisions to Title V Operating Permit No. 23-00016 to address Reasonably Available Control Technology (RACT) requirements under 25 Pa. Code §§129.111-129.115.

PADEP will accept comments on the Application during a 30-day period which begins upon your receipt of this notification. A copy of the Application is available for your review at PADEP's Southeast Regional Office. Any comments concerning the Application should be transmitted to PADEP within 30 days of your receipt of this letter at the following address:

Pennsylvania Department of Environmental Protection
Bureau of Air Quality
Southeast Regional Office
2 E. Main Street
Norristown, PA 19401-4915

If you have any questions or concerns regarding the above information, please contact me at (610) 447-3906 or hassan.akhtar@pqcorp.com.

Sincerely,
PQ Corporation

Hassan Akhtar
Plant Manager

July 18, 2025

CERTIFIED MAIL

Mr. Stefan Roots
Mayor, City of Chester
1 Fourth Street
Chester, PA 19013

Re: Notification of Significant Operating Permit Modification Application Submittal
TVOP No. 23-00016
PQ Corporation – Chester, PA

Dear Mr. Roots:

In accordance with Title 25, Subpart C, Article III, §127.413 of the Pennsylvania Code, PQ Corporation (PQ) hereby notifies the City of Chester of its submittal of a Significant Operating Permit Modification Application (Application) to the Pennsylvania Department of Environmental Protection (PADEP). PQ owns and operates a sodium silicate production facility in Chester, Delaware County, Pennsylvania. The Application proposes revisions to Title V Operating Permit No. 23-00016 to address Reasonably Available Control Technology (RACT) requirements under 25 Pa. Code §§129.111-129.115.

PADEP will accept comments on the Application during a 30-day period which begins upon your receipt of this notification. A copy of the Application is available for your review at PADEP's Southeast Regional Office. Any comments concerning the Application should be transmitted to PADEP within 30 days of your receipt of this letter at the following address:

Pennsylvania Department of Environmental Protection
Bureau of Air Quality
Southeast Regional Office
2 E. Main Street
Norristown, PA 19401-4915

If you have any questions or concerns regarding the above information, please contact me at (610) 447-3906 or hassan.akhtar@pqcorp.com.

Sincerely,
PQ Corporation

Hassan Akhtar
Plant Manager

TRACK STATUS BY TEXT MESSAGE
Send tracking number to 28777 (2USPS)
Standard message and data rates may apply

TRACK STATUS ONLINE
Visit https://www.usps.com/tracking
Text and e-mail alerts available

PURCHASE DETAILS

Product	Qty	Unit Price	Price
First-Class Mail® Letter Media, PA 19063 Weight: 0 lb 0.40 oz Estimated Delivery Date Sat 07/26/2025	1		$0.78
Certified Mail® Tracking #: 70210950000052888845			$5.30
Return Receipt Tracking #: 9590 9402 5219 9122 9396 86			$4.40
Total			$10.48
First-Class Mail® Letter Chester, PA 19013 Weight: 0 lb 0.40 oz Estimated Delivery Date Sat 07/26/2025	1		$0.78
Certified Mail® Tracking #: 70210950000052888852			$5.30
Return Receipt Tracking #: 9590 9402 5219 9122 9396 79			$4.40
Total			$10.48
Grand Total:			$20.96
[illegible] Remit			$20.96

SENDER: COMPLETE THIS SECTION

- Complete items 1, 2, and 3.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Dr. Monica Taylor
Government Center Building
201 West Front St
Media, PA 19063

9590 9402 5219 9122 9396 86

2. Article Number *(Transfer from service label)*

7021 0950 0000 5288 8845

PS Form 3811, July 2015 PSN 7530-02-000-9053

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X Victor E Foschi Jr. ☐ Agent ☐ Addressee

B. Received by *(Printed Name)* Victor Foschi Jr. C. Date of Delivery

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
☐ Adult Signature
☐ Adult Signature Restricted Delivery
☐ Certified Mail®
☐ Certified Mail Restricted Delivery
☐ Collect on Delivery
☐ Collect on Delivery Restricted Delivery
☐ Insured Mail
☐ Insured Mail Restricted Delivery (over $500)
☐ Priority Mail Express®
☐ Registered Mail™
☐ Registered Mail Restricted Delivery
☐ Return Receipt for Merchandise
☐ Signature Confirmation™
☐ Signature Confirmation Restricted Delivery

Domestic Return Receipt

SENDER: COMPLETE THIS SECTION

- Complete items 1, 2, and 3.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Mr. Stefan Roots
1 Fourth Street
Chester, PA 19013

9590 9402 5219 9122 9396 79

2. Article Number *(Transfer from service label)*

7021 0950 0000 5288 8852

PS Form 3811, July 2015 PSN 7530-02-000-9053

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X Brittney Terry ☐ Agent ☐ Addressee

B. Received by *(Printed Name)* C. Date of Delivery 7-28-25

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
☐ Adult Signature
☐ Adult Signature Restricted Delivery
☐ Certified Mail®
☐ Certified Mail Restricted Delivery
☐ Collect on Delivery
☐ Collect on Delivery Restricted Delivery
☐ Insured Mail
☐ Insured Mail Restricted Delivery (over $500)
☐ Priority Mail Express®
☐ Registered Mail™
☐ Registered Mail Restricted Delivery
☐ Return Receipt for Merchandise
☐ Signature Confirmation™
☐ Signature Confirmation Restricted Delivery

Domestic Return Receipt

APPENDIX C -
ACTUAL AND POTENTIAL NO_X EMISSIONS

Table C-1

Source ID 102 - Actual and Potential NO_X Emissions (Non-Operating Days)

PQ LLC – Chester, PA

Source ID	Source	Operating Scenario	2023-2025 Actual Emissions [(a)]		Potential Emissions [(b)]	
			Value	Unit	Value	Unit
102	#4 Sodium Silicate Furnace	Non-Operating Day	1,234.8	lbs/day	1,304.4	lbs/day

[(a)] Actual emissions on non-operating days are based on the maximum NO_X emissions recorded by the continuous emissions monitoring system (CEMS) during non-operating days from January 1, 2023 through June 30, 2025.

[(b)] Potential emissions are based on a statistical analysis of NO_X emissions recorded on non-operating days by the CEMS over the last three years.

APPENDIX D -
COST CONTROL ANALYSIS

Table D-1
Capital and Annualized Costs for Implementing Oxy-Only Burners for Source ID 102 during Idling
Source ID 102 - #4 Sodium Silicate Furnace
PQ LLC – Chester, PA

CAPITAL COSTS

COST ITEM	FACTOR	COST ($)
Direct Capital Costs[a]		
Purchased Equipment Costs		
Total Purchased Equipment Cost[b]	**B**	**$0.00**
Direct Installation Costs[a]		
Furnace Burner Replacements		
Miscellaneous Piping		
Total Direct Installation Cost		**$500,000.00**
Total Direct Capital Cost	***DC***	***$500,000.00***
Indirect Capital Cost[a]		
Indirect Installation Costs		
Initial Monthly Oxygen Facility Fee[c]		$131,313.18
Total Indirect Installation Cost	**IDC**	**$131,313.18**
Total Capital Investment (TCI)		***$631,313.18***

ANNUALIZED COSTS

COST ITEM	FACTOR	UNIT COST	ANNUAL COST ($)
Direct Annual Costs			
Operating Labor[d]			
Operating Labor	1.00 hr/mo	$150.00 per hour	$1,800.00
Supervisory Labor	15% of Operating Labor		$270.00
Maintenance Labor	1.00 hr/mo	$150.00 per hour	$1,800.00
Maintenance Materials	100% of Labor		$1,800.00
Burner Tuning		$75.00 per hour	$15.00
Utilities			
Electricity[a]	$0.06 per kWh	$36,967.000 per month	$443,604.00
Monthly Oxygen Facility Fee[e]		$132,298.23 per month	$1,455,280.51
Supplemental Liquid Oxygen[f]			$45,917.17
Total Direct Annual Costs		***DAC***	***$1,950,486.68***
Indirect Annual Costs[a]			
Overhead	60% of sum of operating, supervisor, and maintenance labor and maintenance materials		$3,411.00
Administrative charges	2% of TCI		$12,626.26
Property taxes	1% of TCI		$6,313.13
Insurance	1% of TCI		$6,313.13
Capital recovery	0.113 CRF x TCI		$71,519.73
Expected lifetime of equipment:	15 years		
at	7.5% interest		
Total Indirect Annual Costs		***IDAC***	***$100,183.25***
Total Annual Costs			***$2,050,669.94***

Cost Effectiveness ($/ton)			
Control Efficiency[g]:	20%		
Uncontrolled NO_X emissions[h]:	225.35	tons NO_X/yr	***Annual Cost/Ton NO_X Removed:*** ***$45,499.46***
Potential controlled NO_X:	45.07	tons NO_X/yr	

Notes:

(a) Based on on-site oxygen supply system installation proposal provided by Linde PLC to PQ LLC in August 2024.

(b) Purchased Equipment Costs are included in the Direct Installation Costs.

(c) Initial Monthly Oxygen Facility Fee is calculated using the following equation provided by Linde PLC.

$$I = Base\ Oxygen\ Monthly\ Facility\ Fee\ * \left(0.60 * \left(\frac{PPIc}{PPIb}\right) + 0.40\right)$$

Where:

PPIc = The greater of the Producer Price Index Series ID WPSID6331PPI -Trade services for manufacturing industries, seasonally adjusted at the time First Delivery Date occurs or PPIb.

PPIb = Q2 2024 average of the Producer Price Index Series ID WPSID6331PPI- Trade services for manufacturing industries, seasonally adjusted.

(d) Based upon the U.S. EPA Office of Air Quality Planning and Standards (OAQPS) Control Cost Manual, Seventh Edition (November 2017), Section 1, Chapter 2.

(e) Monthly Oxygen Facility Fee is calculated using the following equation provided by Linde PLC.

$$M = Inital\ Monthly\ Oxygen\ Facility\ Fee * \left(0.40 * \left(\frac{New\ ECI}{Base\ ECI}\right) + 0.60\right)$$

Where:

New ECI = The greater of (i) the average ECI for the two calendar quarters most currently available at the time of the price adjustment, or (ii) Base ECI.

Base ECI = 165.3

(f) Supplemental Liquid Oxygen is calculated using the following equation provided by Linde PLC and assumes 175 hr/yr of supplemental liquid oxygen use during plant downtime and maintenance.

$$S = Base\ Liquid\ Product\ Price * \left(0.50 * \left(\frac{New\ Power}{Base\ Power}\right) + 0.35\ * \left(\frac{New\ Diesel}{Base\ Diesel}\right) + 0.15\ * \left(\frac{New\ ECI}{Base\ ECI}\right)\right)$$

Where:

Power = The average rate during a calendar month for power, expressed in dollars per mega-watt hour and calculated under Rate Schedule "LP-5 and GSC-2" of PPI Electric Utilities Corporation, regardless of whether Buyer or Seller purchases power under such rate schedule, using a monthly demand of 10,000 kilowatts and energy determined at 90% load factor, and including without limitation all applicable costs, adjustments, trackers, and/or surcharges, customer charges, demand charges, energy charges, fuel charges, fuel adjustments, taxes, franchise fees, stranded costs, competitive transition costs, securitization charges, decommissioning fees, system benefits fund costs, environmental charges, homeland security costs, regulatory charges, resilience fees, climate change /greenhouse gases and related costs, etc.

Base Power = Average monthly rate for Q1 & Q2 calendar year 2025.

New Power = The greater of (i) the average Power most currently available for the latest Period at the time of the Price adjustment, or (ii) Base Power, provided that if subsequent to invoicing for Product a change occurs which affects the Power retroactively, Seller may adjust the Price accordingly.

Diesel = The Weekly U.S. No. 2 Diesel Retail Prices (dollars per gallon) as published by the U.S. Energy Information Administration.

Base Diesel = Average monthly $ average for Q1 & Q2 calendar year 2025.

New Diesel = The greater of (i) the average Diesel most currently available for the latest Period at the time of the Price adjustment, or (ii) Base Diesel.

(g) Control efficiency is based on U.S. EPA "Technical Bulletin: Nitrogen Oxides (NO_X), Why and How They Are Controlled," EPA 456/F-99-006R, November 1999.

(h) Uncontrolled NO_x emissions on non-operating days are based on the maximum annual NO_X emissions recorded by the continuous emissions monitoring system (CEMS) during non-operating days from January 1, 2023 through June 30, 2025.

APPENDIX E -
CEMS DATA STATITISCAL EVALUATION

Table E-1
Identification of RACT for Non-Operating Days
PQ LLC – Chester, PA

Date [a]	Operating Hours	NO_X (lb) [b]
1/4/2023	0.0	436.6
3/15/2023	0.0	542.6
3/16/2023	0.0	416.7
7/18/2023	0.0	575.0
8/3/2023	0.0	1,234.8
9/13/2023	0.0	748.7
9/16/2023	0.0	476.9
10/24/2023	0.0	824.8
12/14/2023	0.0	895.3
6/3/2024	0.0	642.7
6/25/2024	0.0	706.2
6/26/2024	0.0	428.5
6/27/2024	0.0	260.0
6/28/2024	0.0	183.0
11/24/2024	0.0	441.5
12/14/2024	0.0	1,120.1
12/15/2024	0.0	994.8
12/16/2024	0.0	728.8
12/17/2024	0.0	793.9
12/18/2024	0.0	451.8
1/19/2025	0.0	552.1
1/20/2025	0.0	466.5
1/21/2025	0.0	718.3
1/22/2025	0.0	825.2

Statistical Analysis:	
Mean	644.4
Standard Error	52.8
Median	608.9
Standard Deviation	258.7
Sample Variance	66,931.4
Kurtosis	0.0
Skewness	0.5
Range	1,051.8
Minimum	183.0
Maximum	1,234.8
Sum	15,464.8
Count	24.0
Confidence Level (95%)	109.2
z (99)	2.5
1 Standard Deviation	903.1
2 Standard Deviation	1,161.8
99% UPL [c]	**1,304.4**

[a] Data set represents all Furnace non-operating days from January 1, 2023, to June 30, 2025.

[b] NO_X emissions recorded by PADEP-certified continuous emissions monitoring system (CEMS).

[c] 99% Upper Prediction Level (UPL) calculated as follows:

$$UPL_{100-(\alpha\times100)} = \bar{x} + t_{(n-1),(1-\alpha)}\sqrt{s^2\left(\frac{1}{n}+1\right)}$$

where:

α = level of significance expressed as a decimal (e.g., 1% significance = 0.01), note that confidence level = 100 − (α × 100)

x = average or mean of test run data

t = t score, the one-tailed t value of the t distribution for a specific degree of freedom and level of significance

n = number of data points (daily sums)

s2 = variance of test run data

Pennsylvania
Department of Environmental Protection

September 25, 2025

VIA EMAIL: Hassan.Akhtar@pqcorp.com

Hassan Akhtar
Plant Manager
PQ LLC
1201 W. Front St.
Chester, PA 19013-3436

Re: Alternate RACT III Analysis
TVOP No. 23-00016
APS No. 345963, AUTH No. 1536486
Chester City
Delaware County

Dear Hassan Akhtar:

The Department of Environmental Protection (DEP) has reviewed your Significant Operating Permit Modification application that addresses the Reasonably Available Control Technology (RACT) III alternate RACT analysis of nitrogen oxide (NOx) emissions from your #4 Sodium Silicate Furnace (Source 102). This application was submitted in accordance with 25 Pa. Code §§ 129.114(b) and 129.114(d). Per 25 Pa. Code § 129.114(d), the applicant shall submit a RACT proposal in accordance with the procedures in 25 Pa. Code §§ 129.92(a)(1)-(5) and 129.92(b). DEP has identified the following deficiencies:

1. In your application, you only identify four (4) NOx reduction options: (a) Good Operating Practices; (b) Selective Catalytic Reduction (SCR); (c) Selective Non-Catalytic Reduction (SNCR); and (d) Replacement of Furnace System Air-Fuel Burners. 25 Pa. Code § 129.92(b)(1) requires that the permittee consider all possible NOx emission reduction options that are available for the source in question. DEP requests that a RACT analysis be performed for the following NOx reduction options, pursuant to 25 Pa. Code § 129.92(b):
   - Flue Gas recirculation
   - Ceramic Catalytic Filters

2. In step your Step 2 analysis, you state that SCR and SNCR cannot be used because the stack temperature during idling is between 300°F to 350°F. However, the furnace operates in excess of 2,000°F. DEP requests that you provide additional information to justify why SCR, SNCR, and similar technologies cannot be utilized prior to the exhaust gases being cooled. This is requested in accordance with 25 Pa. Code § 129.92(b)(2).

3. In the application, it states that NOx emissions from non-operating (idling) days is 225.35 tons per year. The total annual emissions from the furnace are 275 tons per year. Provide calculations and records for 2023 and 2024 to justify the NOx emission rate for non-operating days and the number of idling days.

DEP requests that the deficiencies be responded to within ten (10) business days. If PQ LLC requires more time to perform additional cost analyses, PQ LLC may request additional time. Should you have any questions regarding the identified deficiencies, please contact DEP to discuss your concerns or to schedule a meeting. The meeting must be scheduled within the 10-day period allotted for your reply, unless otherwise extended by DEP.

If you have any questions concerning this matter, please contact me at 484-250-5920.

Sincerely,

Joseph A. Schlosser
Engineering Specialist
Air Quality

Enclosure

cc: Jillian Gallagher, EPM
Janine Tulloch-Reid, P.E.
Helen Morris, EGM
OnBase Upload

October 10, 2025

Mr. Joseph Schlosser
Engineering Specialist, Air Quality Program
Pennsylvania Department of Environmental Protection
Southeast Regional Office
2 E. Main Street
Norristown, PA 19401-4915

Re: Response to September 25, 2025 Technical Deficiency Letter
PQ LLC – Chester, Pennsylvania Facility
Title V Operating Permit No. 23-00016
Significant Operating Permit Modification
APS ID No. 345963, Authorization No. 1536486

Dear Mr. Schlosser:

The purpose of this submission is to respond to the September 25, 2025 Technical Deficiency Letter issued by the Pennsylvania Department of Environmental Protection (PADEP) regarding the Significant Operating Permit Modification submitted by PQ LLC (PQ) in July 2025, which addresses Reasonably Available Control Technology (RACT) III – alternate RACT analysis for nitrogen oxide (NO_X) emissions from the #4 Sodium Silicate Furnace (Furnace, Source ID 102). Below, PQ addresses each of the deficiencies raised by PADEP, with reference to the supporting documents included in Attachment A and B, as relevant.

PADEP Technical Deficiency No. 1:

In your application, you only identify four (4) NOx reduction options: (a) Good Operating Practices; (b) Selective Catalytic Reduction (SCR); (c) Selective Non-Catalytic Reduction (SNCR); and (d) Replacement of Furnace System Air-Fuel Burners. 25 Pa. Code § 129.92(b)(1) requires that the permittee consider all possible NOx emission reduction options that are available for the source in question. DEP requests that a RACT analysis be performed for the following NOx reduction options, pursuant to 25 Pa. Code § 129.92(b):

- *Flue Gas recirculation*
- *Ceramic Catalytic Filters*

PQ Response to Technical Deficiency No. 1:

RACT Analysis - Flue Gas Recirculation:

Flue gas recirculation (FGR) is a process in which a portion of exhaust gas from a combustion source is recirculated back into the combustion chamber, thereby reducing NO_X emissions by minimizing the oxygen (O_2) content of the combustion air[1]. FGR is not a technically feasible technology for the Furnace for the following reasons:

a. The Furnace currently operates at the minimum amount of oxygen that the air-fired combustion can sustain. Reducing the O_2 in the combustion chamber beyond the level it

[1] U.S. EPA, Office of Air Quality Planning and Standards (OAQPS). Alternative Control Techniques Document— NOx Emissions from Glass Manufacturing. EPA-453/R-94-037. June 1994..

is currently configured to, will result in incomplete combustion of the fuel. poor flame quality, and elevated carbon monoxide (CO) emissions. Additionally, starving the flame of O_2 beyond the current level will create excessive soot build up and high opacity emissions from the Furnace stack.

b. A reduced-O_2 combustion environment will increase corrosion in the Furnace, accelerate the Furnace's refractory wear, and decrease the overall life-span of the Furnace. PQ's Furnace is designed to operate in an oxidized environment – operating the Furnace in a reduced environment caused by FGR would require the Furnace to be rebuilt with new materials designed for use in a reduced environment.

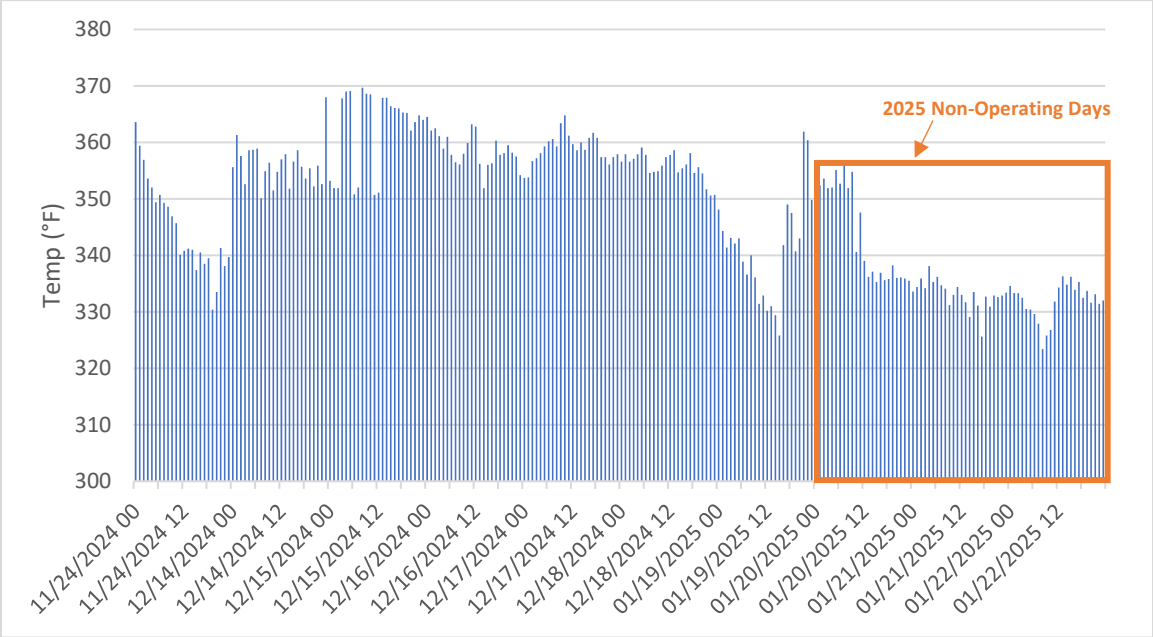
Therefore, FGR is not a technically feasible technology for control of NO_X emissions from the Furnace.

RACT Analysis – Ceramic Catalytic Filters:

Ceramic catalytic filters are made of fibrous ceramic materials and catalyst to capture particulate matter and remove NO_X. The embedded catalyst technology is similar to selective catalytic reduction (SCR), in that the catalyst functions to convert NO_X into diatomic nitrogen (N_2) and water (H_2O), and requires ammonia to be injected upstream of the filters to react with NO_X on the surface of the catalyst. The optimal temperature range for effective removal of NO_X using ceramic catalytic filters is between approximately 350°F and 950°F; however, 95% removal of NO_X does not occur until 450°F[2]. During non-operating days the Furnace stack temperature is measured continuously below 370°F and frequently below 350°F (i.e., the temperature at which "good" NO_X reduction begins). PQ has provided a plot of 1-hour average stack temperature records from Furnace non-operating days recorded from July 1, 2024 through June 30, 2025 in Figure 1 below. PQ calibrated and verified the accuracy of the Furnace stack thermocouple on July 1, 2024 during the annual relative accuracy test audit (RATA) completed on the CMS; therefore, data prior to July 1, 2024 is not included herein.

[2] Tri-Mer Corporation. UltraCat Catalytic Filter Systems. https://tri-mer.com/pdf/UltraCat-Ceramic-Brochure.pdf.

Figure 1
Furnace Stack Temperature (°F) During Non-Operating Days



Note that during the four most recent days of Furnace non-operation in calendar year 2025 (i.e., January 19-22), the stack temperature remained below 350°F for all but twelve hours in the 96-hour non-operational period. Therefore, ceramic catalytic filters are not technically feasible technologies for the control of NO_X emissions based on temperature of the flue gas during non-operating days.

PADEP Technical Deficiency No. 2:

In step your Step 2 analysis, you state that SCR and SNCR cannot be used because the stack temperature during idling is between 300°F to 350°F. However, the furnace operates in excess of 2,000°F. DEP requests that you provide additional information to justify why SCR, SNCR, and similar technologies cannot be utilized prior to the exhaust gases being cooled. This is requested in accordance with 25 Pa. Code § 129.92(b)(2).

PQ Response to Technical Deficiency No. 2:

The Furnace has many different refractory temperatures up to 2,500°F and the molten glass in the furnace may measure up to 2,200°F. However, the air temperature in the Furnace is approximately 700°F and is routed to the Furnace waste heat boiler to produce steam for the process before going to stack. The waste heat boiler consumes 300 to 400°F of temperature from the flue gas before reaching the stack.

PQ reviewed the previous three years of Furnace operating data recorded by the temperature continuous monitoring systems (CMS) installed in the stack and observed that the Furnace flue gas average temperatures is approximately of 450 - 500°F during operating days, and 300°F to 370°F during non-operating days (i.e., periods of Furnace idle). The Furnace flue gas maintains a consistent

temperature from the outlet of the furnace to the stack outlet. Additionally, there is not a physical location in the ducting of the furnace to install selective catalytic reduction (SCR), selective non-catalytic reduction (SNCR) or similar technologies at a point downstream of the furnace outlet that provides access to flue gas at temperatures above the optimal range of SCR and SNCR operation. Therefore, SCR and SNCR are not technically feasible technologies for the control of NO_X emissions based on temperature of the flue gas during non-operating days.

PADEP Technical Deficiency No. 3:

In the application, it states that NOx emissions from non-operating (idling) days is 225.35 tons per year. The total annual emissions from the furnace are 275 tons per year. Provide calculations and records for 2023 and 2024 to justify the NOx emission rate for non-operating days and the number of idling days.

PQ Response to Technical Deficiency No. 3:

PQ has defined a non-operating day as any calendar day (i.e., period that begins at midnight local time and ends 24 hours later) in which glass is not being pulled from the Furnace. Non-operating days may occur during periods of Furnace idling (e.g., hot holds), startup, and shutdown. In the application that was submitted to PADEP, PQ included a statistical evaluation of the NO_X emissions recorded during all furnace non-operating days from January 1, 2023, to June 30, 2025 within Appendix E. This statistical evaluation was performed on a dataset of 24 individual non-operating days, where it was determined that the maximum emissions rate recorded by PQ's continuous emissions monitoring system (CEMS) on a non-operating days was 1,234.8 pounds in the day. This worst-case one-day mass emissions rate was used to annualize NO_X emissions as a conservative, worst-case emissions estimate, yielding a total of 225.35 tons per year (tpy). Due to the unpredictability of future product demand, PQ cannot estimate the number of non-operating days that may occur in a calendar year. Therefore, 225.35 tpy represents the "worst-case" emissions if the Furnace were required to be in non-operation/idle for the duration of a calendar year.

This conservative emissions estimate (i.e., 225.35 tpy) was then used in the cost analysis for the replacement of the air-fuel burners with oxy-only burners and the installation of a vacuum pressure swing adsorption VPSA system. According to the methodology outlined in the cost analysis template developed and published by U.S. EPA's Office of Air Quality Planning and Standards (OAQPS) Control Cost Manual, uncontrolled emissions have an inverse relationship with a given project's annual cost / ton pollutant removed metric (i.e., as uncontrolled emissions rise, annual costs per ton of pollutant remove decrease), which is the primary metric used for determining a project's economic feasibility.

Should you have any questions related to this submittal, or require additional information, please contact me at (610) 447-3934.

Sincerely,
PQ LLC

Hassan Akhtar

Hassan Akhtar
Plant Manager

Cc: Matt Carideo (mcarideo@all4inc.com) – ALL4 LLC