COMMONWEALTH OF PENNSYLVANIA
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Southeast Regional Office
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RE Alternate RACT for TVOP No. 23-00016
PQ LLC
APS No. 345963, AUTH No. 1536486
City of Chester
Delaware County

RACT III Application

On August 1, 2025, the Department of Environmental Protection ("DEP") received a Significant Operating Permit Modification application for Reasonably Available Control Technology (RACT) Phase III to address Alternate RACT, regarding nitrogen oxide (NOx) emissions from a "glass" furnace owned and operated by PQ LLC located at 1201 West Front Street, in Chester, PA. Municipal notifications with proof of delivery were performed as required. The application was accompanied by the appropriate fee of $4,000.

The RACT III regulation applies to any owner or operator of a "major NOx emitting facility" or a "major volatile organic compound (VOC) emitting facility" that existed on or before August 3, 2018 (25 Pa. Code § 129.111(a). RACT III supersedes RACT I and RACT II. PQ LLC is a major NOx emitting facility. The primary source of emissions is a #4 Sodium Silicate Furnace (Source ID 102), that is regulated under RACT III as a type of glass furnace.

Presumptive RACT for NOx and/or VOC

Table 1a and Table 1b list the sources that are subject to presumptive RACT for NOx and/or VOC, as required under 25 Pa. Code § 129.112, unless otherwise noted. The PTE for sources listed in Table 1a and 1b is based on the rated capacity, the emission factor, and 8,760 hours of operation per year.

Table 1a – Presumptive NOx RACT

Source ID	Source Name	Rated Capacity	Emission Factor (EF)[1]	EF Source	PTE of NOx (TPY)	Presumptive RACT (NOx)
037	Cleaver-Brooks Boiler	14.21 MMBtu/hr	15.9 lb/10^3 gal FO	Manf.	7.22	129.112(c)(4)
038	Donlee Tech Boiler	10.04 MMBtu/hr	20 lbs/10^3 gal FO	AP-42	6.40	129.112(c)(4)
102	#4 Sodium Silicate Furnace	11.6 Tons/hr	6.0 lbs/ton product	Limit	275.0	129.112(i)(5)[2]
103	Spray Dryer G & GD	13.39 MMBtu/hr	0.019 lbs/gal propane	FIRE	11.23	129.112(c)(4)
700	400kW Emerg. Generator	619 bhp	5.7 g/kw-hr	Manf.	2.40	129.112(c)(1)

[1] FO - #2 Fuel Oil

[2] This presumptive RACT requirement only applies when the furnace is producing material; emissions during non-production periods is addressed under Case-by-case RACT.

Table 1b – Presumptive VOC RACT

Source ID	Source Name	Rated Capacity	Emission Factor (EF)[1]	EF Source	PTE of NOx (TPY)	Presumptive RACT (NOx)
037	Cleaver-Brooks Boiler	14.21 MMBtu/hr	5.5 lbs/10^6 cf NG[1]	AP-42	0.33	N/A[2]
038	Donlee Tech Boiler	10.04 MMBtu/hr	5.5 lbs/10^6 cf NG	AP-42	0.23	N/A
102	#4 Sodium Silicate Furnace	11.6 Tons/hr	0.1 lbs/ton product	AP-42	9.56	129.112(d)
103	Spray Dryer G & GD	13.39 MMBtu/hr	0.0008 lbs/gal propane	AP-42	0.47	N/A
700	400kW Emerg. Generator	619 bhp	0.11 g/kw-hr	Manf.	0.04	129.112(c)(2)

[1] NG – Natural Gas

[2] Not subject (N/A; Not Applicable) to RACT because emissions are less than 1.0 ton per year.

Case-by-case RACT for NOx and/or VOC

Following is an analysis for RACT III as it applies to emissions occurring from the #4 Sodium Silicate Furnace (Source ID 102), for non-operating emissions only. During RACT II, all emissions from the furnace were addressed under the Glass Melting Furnace regulations, per 25 Pa. Code § 129.301-129.310 (CONTROL OF NOx EMISSIONS FROM GLASS MELTING FURNACES), which constituted as presumptive RACT, per 25 Pa. Code § 129.96(a). Prior to RACT II, the glass furnace was subject to case-by-case RACT I. The following summarizes pre-existing RACT requirements that the furnace and the facility were subject to under RACT I:

- The No. 4 Sodium Silicate shall not emit more than 8 pounds of nitrogen oxides (NOx) per ton of glass produced from this furnace.

- The nitrogen oxides emissions from the No. 4 Sodium Silicate Furnace shall not exceed 275 tons per year on a 12-month rolling basis.

- The company shall continuously monitor flame patter, crown temperature, and monitor daily the oxygen levels of the No. 4 Sodium Silicate Furnace. These parameters shall be controlled in such a manner as to minimize nitrogen oxides generation.

- The nitrogen oxides emissions from the facility shall not exceed 368 tons per year on a 12-month rolling basis.

RACT III for the #4 Sodium Silicate Furnace –

Under the initial implementation of RACT III, PQ LLC had determined that the #4 Sodium Silicate Furnace (Source 102) would comply with a presumptive RACT III limit of 6.0 lbs/ton product. However, the furnace periodically operates in **an idle mode**, where the furnace maintains enough heat to keep material inside the furnace from solidifying, but there is no production. The Pennsylvania RACT III regulations did not address idling emissions. Therefore, the DEP Southeast Regional Office determined that RACT III didn't apply under idling conditions.

In April 2025, the DEP Southeast Regional Office was having discussions with EPA regarding PQ LLC's RACT III when EPA brought it to the Southeast Regional's attention the need to address idling emissions under Case-by-Case RACT. EPA directed the Southeast Regional Office to review a RACT III analysis done for a glass furnace in the Southcentral Office, where a case-by-case analysis was performed for idling emissions of NOx. This led the Southeast Regional Office to the RACT III Frequently Asked Questions document, dated June 1, 2023, for Pennsylvania's RACT III requirements. Question No. 17 addressed the requirement to do Case-by-Case for idling emissions, stating:

> *"An operating day is a 24-hour period beginning at 12:00 midnight which the source operates at any time and produces emissions. This time period includes emissions that were generated during startups, shutdowns, or malfunctions. For sources subject to presumptive NOX RACT III emission limits based on production output (e.g. pounds of NOx per ton of glass pulled), any day when there is no production of the applicable product is not considered to be an operating day. The owner or operator needs to address emissions which occurred during the non-operating day separately for RACT."*

Based on the above information, DEP determined that PQ LLC would need to do case-by-case RACT to address emissions from the furnace during idling days. The RACT III case-by-case application submitted by PQ LLC addresses these emissions.

Per 25 Pa. Code §§ 129.114(b) and (d), PQ LLC performed the following analysis for case-by-case RACT for NOx emissions from furnace idling:

Step 1: Identify available control technologies.
Step 2: Eliminate technically infeasible options.
Step 3: Rank remaining control technologies by cost effectiveness.
Step 4: Evaluate economic, environmental, and energy impacts of technically feasible controls.
Step 5: Identify RACT.

Step 1 – Identify Available Control Technologies:

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

Good Operating Practices – Good operating practices are a method of minimizing NOx 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.

Selective Catalytic Reduction – Selective catalytic reduction (SCR) is a control technology used to convert NOx 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. Reactive metals such as vanadium or titanium are often used for the catalyst due to their effectiveness as a control technology for NOx 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.

Selective Non-Catalytic Reduction – Selective non-catalytic reduction (SNCR) is a post-combustion control technology for NOx emissions that uses a reduction-oxidation reaction to convert NOx 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. SNCR is generally more economical because a catalyst is not required and, in theory, SNCR can control NOx emissions with an efficiency of up to 50%. However, operating constraints on temperature, reaction time, and mixing often lead to less effective results when using SNCR in practice.

Ceramic Catalytic Filters – Ceramic catalytic filters are made of fibrous ceramic materials and catalyst to capture particulate matter and remove NOx. The embedded catalyst technology is similar to selective catalytic reduction (SCR), in that the catalyst functions to convert NOx into diatomic nitrogen (N_2) and water (H_2O). This requires ammonia to be injected upstream of the filters to react with NOx on the surface of the catalyst. The optimal temperature range for effective removal of NOx using ceramic catalytic filters is between approximately 350°F and 950°F; however, 95% removal of NOx does not occur until 450°F.

Replacement of Furnace System Air-Fuel Burners – The Furnace contains 16 air-fuel burners, one lip burner, and one draw burner. NOx emissions from natural gas combustion within the burners can be reduced by up to 20% 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.

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 NOx emissions by minimizing the oxygen (O_2) content of the combustion air.

Step 2: Eliminate technically infeasible options:

PQ LLC identified the following control technologies that are not technically feasible:

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 LLC 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 nonoperating 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 NOx 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 NOx emissions and based on similar glass operations is not an available technology.

NOTE: The exhaust gas from the furnace does exit the furnace around 700°F. This is lower than the actual furnace temperature. The furnace receives combustion air from each side of the furnace, but only 20 minutes at a time, from one side of the furnace. After 20 minutes, the side that was used for exhausting the furnace air becomes the intake air chamber, which has been pre-heated from the previous 20-minute cycle. This cycle occurs every 20 minutes, where the air intake is switched to the opposite side of the furnace. The exhaust gas is further reduced as the result of the furnace exhaust being used to create steam through a waste heat boiler. This results in the exhaust air temperature being reduced to less than 400°F at the point that a control device might be used on the furnace. This condition applies to the evaluation for *Selective Non-Catalytic Reduction* and *Ceramic Catalytic Filters*.

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 with regards to SCR, the exhaust gas temperature of the Furnace during nonoperating days is 300°F to 350°F. Therefore, SNCR is also not viable for the removal of NOx 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 NOx emissions and based on similar glass operations is not an available technology.

Ceramic Catalytic Filters – The optimal temperature range for effective removal of NOx using ceramic catalytic filters is between approximately 350°F and 950°F; however, 95% removal of NOx does not occur until 450°F. 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" NOx reduction begins). Therefore, this technology has been deemed technically infeasible.

Flue Gas Recirculation – FGR is not a technically feasible technology for the Furnace for the following reasons:

- 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 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.
- A reduced O_2 combustion environment will increase corrosion in the Furnace, accelerating 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 O_2 environment.

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 2:

Table 2 – Ranking of Feasible NOx Controls

Control Technology Option	Control Efficiency	Ranking
Replacement of Air-Fuel Burners	20%	1
Good Operating Practices	Variable	2

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.

Replacement of Furnace System Air-Fuel Burners – PQ LLC 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 of the application. The calculated cost of controlling NOx emissions is ***$45,499.46 per ton of NOx*** and is, therefore, economically infeasible.

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

Step 5 – Identify RACT for Non-Operating Days:

Based on the technical and economic feasibility of those control technologies evaluated, PQ LLC does not propose any new equipment or emission controls. Currently, NOx emissions on a non-operating day are restricted to 1,670.4 lbs/day, based on a maximum NOx rate of 6.0 lbs/ton, a maximum production rate of 11.6 tons/hr, and 24 hours a day. PQ LLC reviewed the NOx emissions that were reported through their certified continuous emissions monitoring system (CEMS) during non-operating days from January 1, 2023, through June 30, 2025. The maximum daily average was reported as 1,234.8 lbs/day. To determine an achievable daily emission limit below the current permit limit, PQ implemented the use of the Upper Prediction Limit (UPL), a well-established statistical methodology used by U.S. EPA and State agencies to establish emissions standards. Specifically, the UPL is used to estimate the upper boundary of a future observation based on a dataset. Based on the data from the CEMS, PQ LLC determined the UPL to be 1,304.4 pounds per non-operating day. PQ LLC proposes that the Furnace be subject to this more stringent daily limit of 1,304.4 pounds per non-operating day as RACT.

Compliance Methods for Alternate RACT for Non-Operating (Idling) Days –

The #4 Sodium Silicate Furnace is equipped with a Continuous Emissions Monitoring System (CEMS) for NOx emissions. PQ LLC will use the CEMS to determine daily emissions on non-operating days to demonstrate compliance with the daily limit. PQ shall maintain a monthly log of non-operating days and the daily NOx emissions associated with each non-operating day.

Permit Revision

Per this Significant Modification of Title V Operating Permit No. 23-00016, the following revisions have been made:

- Section C, Condition #018, Reporting Requirements. This condition to report NOx and VOC emission annually has been removed as this is already required per Condition #025 and #031 under Section B of the operating permit, regarding when the facility submits annual AIMS report.

- Section D, #4 Sodium Silicate Furnace (Source ID 102), Conditions #001, #006, #013, #022, #026, #030, #035, and #037). Revised the NOx limit conditions to reflect the presumptive RACT III requirements and case-by-case RACT III, including the Monitoring, Recordkeeping, and Work Practice Requirements.

- Section D, #4 Sodium Silicate Furnace (Source ID 102). Referring to the currently active permit, the following conditions will have been revised or removed because of the redaction of the glass melting furnace regulations: Conditions #001, #014, #023, #028, #029, #030 (removed), #031 (removed), #033, #034, #035 (removed), #036, #044, and #045. Redaction of the glass melting furnace regulations includes removal the NOx limit exemption for startup and shutdown under 129.303, along with the reporting condition, and removal of the NOx limit exemption under 129.304 for routine maintenance on add-on controls. Most of the revisions involved simply removing references to the glass melting furnace regulations.

- Section D, 400 kW Emergency Generator (Source ID 700, Condition #006). Added an 800 hrs/year limit on the emergency generator, per eRFD 3277, as part of compliance with presumptive RACT III for NOx sources emitting less than 5 tons per year. Also, added presumptive RACT condition (Condition #013) to operate in accordance with the manufacturer's specifications and good operating practices.

Public Notices

The intent to modify PQ LLC's Title V Operating Permit to incorporate RACT III was published on October 25, 2025, in the Pa. Bulletin (Volume 55, Number 43). The newspaper notice for the RACT III review was published in the _____ on _____, _____ and _____ of 2025. The notices indicated that a public hearing would take place for PQ LLC's RACT III proposal.

Public Hearing

A public hearing for PQ LLC's RACT III review will be held on December 2, 2025 at 7:00 P.M. at Chester City Hall, One 4th Street, Chester, PA 19013, to accept oral comments on the proposed RACT III Alternate Proposal and the proposed SIP revision for PQ LLC's Title V Operating Permit.

Comment/Response

A draft of the operating permit was sent to the PQ LLC and EPA on October 28, 2025.

Recommendations

In accordance with 25 Pa. Code § 129.114(e), DEP agrees with the proposed RACT III determination from PQ LLC for their case-by-case source, that there are no new control technologies that are both technically feasible and economically feasible. The Title V Operating Permit will continue to maintain short term limits, long term limits, and throughput limits to ensure compliance with RACT III. I recommend that Title V Operating Permit No. 23-00016 be modified to incorporate RACT III for their Furnace located at 1201 West Front Street, Chester, PA in the City of Chester, in Delaware County.