pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

MEMO

FROM William Weaver WW 11/6/23 and Thomas J. Hanlon ***TJH 11/1/23***
Air Quality Program Manager East Permit Section Chief

DATE December 20, 2022

RE RACT 3 Review Memo
Energy Center Harrisburg, LLC
Title V Operating Permit No. 22-05005
Harrisburg City, Berks County

Introduction/Facility Description

On December 16, 2022, Energy Center Harrisburg (ECH) submitted a RACT 3 proposal regarding sources at their Harrisburg facility. The facility has a 50 tpy VOC cap, and therefore is not subject to RACT 3 for VOC. The facility is a major source of NOx that has been in operation prior to August 3, 2018, and therefore, in in accordance with 25 Pa. Code Section 129.111, is subject to the Department's RACT 3 requirements cited in 25 Pa. Code Sections 129.111 thru 129.115.

The affected NOx sources at the facility include Boilers No. 13 thru 15, and Electric Generators No. 1 & No. 2. These sources are subject to RACT 3 limits because their NOx potential-to-emit is as follows:

032	BOILER 13, COMBUSTION ENGINEERING	46 tpy (per RACT 2 case-by-case)
033	BOILER 14, COMBUSTION ENGINEERING	46 tpy (per RACT 2 case-by-case)
034	BOILER 15, COMBUSTION ENGINEERING	197 tpy (per T5 D 034(e)(1))*
102	COOPER INDUSTRIES ENGINE 1	527 tpy (per T5 D 102 5K hr limit & RACT2 11 g/hp-hr oil limit)*
103	COOPER INDUSTRIES ENGINE 2	527 tpy (per T5 D 103 5K hr limit & RACT2 11 g/hp-hr oil limit)*

*These estimates do not take into account the 5% capacity factor restriction described below.

RACT 3:

Exempt or Presumptive RACT 3 Sources

In addition to the sources noted above, the Title V permit for this facility lists Source 101 PARTS WASHERS which are exempt from RACT 2 for NOx because they do not have NOx emissions. The facility's RACT 3 application lists the following as presumptive RACT 3 sources, per 25 Pa. Code Section 129.112(c)(4), as boilers or other combustion sources with an individual rated gross heat input less than 20 million Btu/hour.

The following three sources are subject to the presumptive RACT requirements of good operating practices, pursuant to 25 Pa. Code Section 129.112(c)(9) because the facility has agreed to limit these units to an annual capacity factor of less than 5%. The facility took the same approach for RACT 2 for these units:

034	BOILER 15, COMBUSTION ENGINEERING
102	COOPER INDUSTRIES ENGINE 1
103	COOPER INDUSTRIES ENGINE 2

Case-by-Case RACT 3 Evaluation

The case-by-case RACT 3 sources at this facility include Boilers 13 and 14.

Per 25 Pa. Code Section 129.114, Alternative RACT proposal and petition for alternative compliance schedule, in Section (i), "*An owner or operator subject to subsection (a), (b) or (c) and § 129.99 that has not modified or changed a source that commenced operation on or before October 24, 2016, and has not installed and commenced operation of a new source after October 24, 2016, may, in place of the alternative RACT requirement or RACT emission limitation required under subsection (d), submit an analysis, certified by the responsible official, in writing or electronically to the Department or appropriate approved local air pollution control agency on or before December 31, 2022, that demonstrates that compliance with the alternative RACT requirement or RACT emission limitation approved by the Department or appropriate approved local air pollution Control agency under § 129.99(e) (relating to alternative RACT proposal and petition for alternative compliance schedule) assures compliance with the provisions in subsections (a)—(c) and (e)—(h), except for sources subject to § 129.112(c)(11) or (i)—(k).*"

Per the facility's RACT 2 proposal, *"NOx emissions from these boilers are determined by performance of a periodic compliance emissions test program. The most recent compliance test program was conducted in February 2014. The results from the test program, which were forwarded to the Department in March 2014, showed the following:*

Boiler No.	NOx Emission Rates (lb/MMBtu)					
	Natural Gas Firing			No. 6 Fuel Oil Firing		
	Measured #	Title V Permit Limit	RACT II Rule Limit *	Measured #	Title V Permit Limit	RACT II Rule Limit *
13	0.14	0.23	0.10	0.37	0.44	0.20
14	0.16	0.23	0.10	0.40	0.44	0.20

#: Average of three consecutive test runs *: For boilers rated ≥ 50 MMBtu/hr

Because these test results demonstrate that Boilers 13 and 14 can not meet the applicable presumptive RACT emission limitation, NRG Paxton has elected to propose an alternate NOx RACT requirement per subsection (d) below."

DEP concurred in its RACT 2 determination for this facility, that the affected units were unable to meet the RACT 2 presumptive limits found at 25 Pa. Code Section 129.97(g)(1). The RACT 3 limits for these units, found at 25 Pa. Code Section 129.112(g)(1) are identical to the limits found in RACT 2. Being as the units have not been modified, DEP concurs that they also cannot meet the applicable RACT 3 presumptive limits, and therefore qualify for a RACT 3 case-by-case approach.

The facility's RACT 3 proposal states that "*Boilers 13 and 14 have not been modified since the approved case-by-case RACT II proposal; therefore, ECH is submitting the following limited case-by-case RACT analysis per §129.114(i) to demonstrate compliance with RACT III for Boilers 13 and 14. . . A review of the literature on NOx control and consultation with boiler equipment vendors has identified several possible control technologies that were evaluated in the RACT II analysis. No new control technologies have been developed since the RACT II analysis was completed.*"

ECH therefore asserts that it qualifies under 129.114(i)(1)(i), which provides that "*The owner or operator of a subject source or facility that evaluates and determines that there is no new pollutant specific air cleaning device, air pollution control technology or technique available at the time of submittal of the analysis and that each technically feasible air cleaning device, air pollution control technology or technique evaluated for the alternative RACT requirement or RACT emission limitation approved by the Department or appropriate approved local air pollution control agency under § 129.99(e) had a cost effectiveness: (i) equal to or greater than $7,500 per ton of NOx emissions reduced or $12,000 per ton of VOC emissions reduced shall include the following information in the analysis:"* [required information is listed as (A)-(E)]

DEP concurs that this option applies, per the following table snipped from DEP's 11/7/17 RACT 2 review memo for the facility, which shows that add-on control cost effectiveness #s for the affected boilers were both >$7,500 per ton.

Source Description	Fuel Type	FGR	FGR/FD Fan	FGR/FD Fan & Low NOx Burner
Boiler No. 13 & No. 14	Natural Gas	$11,850	$8,036	$9,679
Boiler No. 13 & No. 14	#6 Fuel Oil	$39,500	$17,857	$14,713

DEP's 11/7/17 RACT 2 review memo assessed the technical feasibility of the available control options for Boilers 13 and 14 as follows:

[begin quote from RACT 2 memo]

SCR (90% NOx reduction) *- Not technically feasible due to flue gas temperatures well below the effective range of control.*
Water/Steam Injection (80% NOx reduction) *- Not technically feasible due to potential adverse effects on boiler performance.*
FGR/FD Fan/Low NOx Burner (30%-75% NOx reduction) *at 15% recirculation - Technically feasible.*
FGR/Forced Draft Fan (22%-55% NOx reduction) *at 15% recirculation - Technically feasible. SNCR (50% NOx reduction) - Not technically feasible due to varying modulation in temperatures for these type boilers. Urea needs a steady state temperature range of 1400 to 1600 degrees to be effective.*
Flue Gas Recirculation (10%-25% NOx reduction) *at 4.5% recirculation - Technically feasible.*
Low Excess Air *- The subject boilers are currently using an oxygen trim system within the performance specification for a low excess air firing system. Although this option is technically feasible no additional NOx emission reductions can be expected with a new low excess air firing system.*

[end quote from RACT 2 memo]

RACT 3 129.114(i)(1)(i) ANALYSIS:

With the preceding RACT 2 case-by-case analyses as background, we now turn to the re-evaluation required under 129.114(i)(1)(i)(A)-(E). This requires the applicant to include the following information in the abbreviated RACT 3 case-by-case analysis: [requirements in **bold**; discussion following each requirement in regular font]

(A) a statement that explains how the owner or operator determined that there is no new pollutant specific air cleaning device, air pollution control technology or technique available.

ECH provided the following statement with their RACT 3 submittal: "*Boilers 13 and 14 are conventional package, dual-fuel boilers equipped to burn either natural gas or #6 fuel oil with a rated capacity of 214 MMBtu/hour per boiler. Available boiler control technologies are common and widely known. Boiler NOx control technologies are generally divided into combustion or post-combustion controls. Commonly applied combustion controls for industrial boilers are most effective at preventing the formation of thermal NOx by limiting peak flame temperatures; these technologies are not effective at preventing fuel NOx. Post-combustion controls can effectively reduce both thermal and fuel NOx because these controls are designed to remove NOx which is already present in the flue gases exiting the boiler. A review of the literature on NOx control and consultation with boiler equipment vendors has identified several possible control technologies that were evaluated in the RACT II analysis. No new control technologies have been developed since the RACT II analysis was completed..*"

(B) a list of the technically feasible air cleaning devices, air pollution control technologies or techniques previously identified and evaluated under § 129.92(b)(1)—(3) included in the written RACT proposal submitted under § 129.99(d) and approved by the Department or appropriate approved local air pollution control agency under § 129.99(e).

ECH's RACT 3 submittal included a list of the air cleaning devices, air pollution control technologies or techniques previously identified and evaluated under RACT 2.

(C) a summary of the economic feasibility analysis performed for each technically feasible air cleaning device, air pollution control technology or technique listed in clause (b) and the cost effectiveness of each technically feasible air cleaning device, air pollution control technology or technique as submitted previously under § 129.99(d) or as calculated consistent with the "EPA Air Pollution Control Cost Manual" (sixth edition), EPA/452/b-02-001, January 2002, as amended.

ECH's RACT 3 submittal included the statement that "*The RACT II analysis concluded that the only technologies technically feasible for Boilers 13 and 14 are FGR and LNB. ECH performed an economic analysis for these control options. The analysis is included in Attachment B. As shown in Table 3 of the analysis, the cost effectiveness of these technologies was calculated to be greater than $8,000 per ton NOx removed; therefore, these technologies are cost prohibitive*."

(D) a statement that an evaluation of each economic feasibility analysis summarized in clause (c) demonstrates that the cost effectiveness remains equal to or greater than $7,500 per ton of NOx emissions reduced or $12,000 per ton of VOC emissions reduced.

ECH's RACT 3 submittal included the statement that "*ECH performed an evaluation of cost effectiveness of each technically feasible control option consistent with the "OAQPS Control Cost Manual" (Sixth Edition), EPA 450/3-90-006 and material and labor costs provided by boiler vendors. The OAQPS Control Cost Manual has not been updated since the RACT II analysis was completed. In addition, based on discussions with vendors and inflation, the costs of materials and labor are expected to have increased since the RACT II analysis. Based on the expected increase in material and labor costs, the cost effectiveness of the control technologies evaluated remains greater than $7,500 per ton of NOx emissions reduced.*."

(E) additional information requested by the Department or appropriate approved local air pollution control agency that may be necessary for the evaluation of the analysis.

DEP did not require any additional information regarding the case-by-case aspect of the ECH's RACT 3 analysis.

DEP ASSESSMENT:

DEP concurs that the technically feasible add-on-controls for Boilers 13 and 14 remain cost-ineffective for RACT 3. It should be noted that the RACT 2 cost figures for these sources were made in 2016. The Chemical Engineering Plant Cost Index (CEPCI) from 2016 – 2021 (most current year available) is 1.3199. Applying this factor to these figures to convert them to current dollars would only increase the cost-ineffectiveness of the controls as follows:

Source Description	Fuel Type	FGR	FGR/FD Fan	FGR/FD Fan & Low Nox Burner
Boilers 13 and 14	Natural Gas	$ 15,640.82	$ 10,606.72	$ 12,775.31
Boilers 13 and 14	#1 Fuel Oil	$ 52,136.05	$ 23,569.45	$ 19,419.69

Per the DEP's RACT 2 11/7/17 RACT 2 review memo, [begin quote from RACT 2 memo]:

The [RACT 2] cost estimates were based on the following limits that include fuel usage limitations and short- term NOx limits that were developed as part of the facility's initial NOx RACT 2 analysis. However, as clarified in an email from NRG dated 10/13/17 (attached), the facility does not believe that the below stated short-term NOx limits are appropriate to apply on a short-term basis, but rather only as a basis for the annual limits.

RACT2 NOx Emission Limits

Source ID No.	***Description***	***Fuel***	***Short-term Nox Limit***	***Fuel Usage Limitation***	***12-month Consecutive Limit***
032	*Boiler No. 13*	*Natural Gas*	*0.15 lb/mmbtu*	*584,000,000 cf/yr*	*46.0 tons*
032	*Boiler No. 13*	*No. 6 Fuel Oil*	*0.4 lb/mmbtu*	*1,533,330 gal/yr*	
033	*Boiler No. 14*	*Natural Gas*	*0.15 lb/mmbtu*	*584,000,000 cf/yr*	*46.0 tons*
033	*Boiler No. 14*	*No. 6Fuel Oil*	*0.4 lb/mmbtu*	*1,533,330 gal/yr*	

NRG further clarified in a supplemental RACT submission dated 10/30/17 (attached), that it believes the short-term RACT 1 NOx limits developed for Boilers 13 and 14 should be retained for RACT 2 purposes. This is because "Initial operations for Boilers 13 and 14 commenced in October 1972 and October 1987, respectively. As required the initial RACT Plan Approval issued in April 1995 by the Department, NRG Paxton installed a new "low-NOx" burner in Boiler 13. The manufacturer of the new burner provided an expected NOx emissions profile of 0.12 lb I MMBtu for natural gas firing operations and 0.35 lb/MMBtu for No. 6 fuel oil-firing operations. These expected NOx emission rates (which were not achieved) were somewhat lower than the emission rates expected at Boiler 14 (burner installed in 1987), but were consistent with emission rates from boilers installed with and without low-NOx burners during that time (low-NOx burner technology was not well-developed in the early to mid-1990s as compared with contemporary technology)."

The 10/30/17 submission goes on to state that "Recognizing the state of low-NOx burner technology available in the 1980s and early to mid-1990s, it is not unexpected that the NOx emissions profile from such burners would not meet the presumptive NOx emission limits under the Department's NOx RACT II Rule (promulgated in April 2016) for boilers firing either natural gas or No. 6 fuel oil."

With regard to #6 oil-firing, the 10/30/17 submission notes that actual measured NOx emission rates have been as high or slightly above as the current 0.44 lb/MMBtu limit. The highest NOx emissions occurred during a 2002 test effort, where the fuel-bound-nitrogen (FBN) content was 0.55%, while the available data showed FBN contents between 0.33 and 0.46% during the other test efforts. NRG also asserts that there is no statistical difference between the NOx emissions profile for Boilers 13 and 14. Therefore NRG asserts that "the current 0.44 lb I MMBtu NOx emission limit is still the correct short-term emission limit, and a provision for a somewhat higher emission limit should be allowed if the FBN content is > 0.49%. The AP-42 formula included in the current operating permit condition is acceptable to NRG Paxton."

With regard to natural gas-firing, the 10/30/17 submission notes that actual measured NOx emission rates have been as high as 0.18 lb/MMBtu, which is close to the 0.23 lb I MMBtu limit. NRG also asserts that there is no statistical difference between the NOx emissions profile for Boilers 13 and 14. Therefore NRG asserts that "the current 0.23 lb I MMBtu NOx emission limit is still the correct short-term emission limit. "

DEP concurs that this re-evaluation supports retaining the existing short-term NOx limits as fulfilling RACT2.
[end quote from RACT 2 memo]

The Department has reviewed the source information, control technologies or measures, and cost analysis performed by the company. The Department also performed an independent assessment which included, the Department's continuous review of permit applications since the applicability date of RACT II, BACT/RACT/LAER Clearinghouse search, and knowledge gained from the Department permitting staff participating in technical presentations by several vendors and manufacturers of pollution control technology. Based on review of these materials, along with training and the expertise of the reviewing staff, the Department concludes that there are no new or updated air pollution control technologies available for the sources found at this facility and determines that the provisions imposed as case-by-case RACT 2 for Boilers 13 and 14, as found in Group 003 of the facility's current Title V permit, assure compliance with requirements of RACT 3 in § 129.111 - § 129.115, for the affected sources, as follows:

T5 E SG003 – RACT 2 case-by-case

Boiler No. 13 (Source ID# 032) - 214 mmbtu/hr, #6 Oil and Natural Gas Fired
Boiler No. 14 (Source ID# 033) - 214 mmbtu/hr, #6 Oil and Natural Gas Fired

RESTRICTIONS

(a) Each of the above boilers shall not exceed the following short-term limits:

(1) 0.44 lb NOx/mmbtu when combusting No. 6 Fuel oil, except as provided in (3)
(2) 0.23 lb NOx/mmbtu when combusting natural gas.
(3) When fuel borne nitrogen (FBN) in #6 Oil is greater than 0.49 percent, the lb NOx/mmbtu limits for Boilers 13 and 14 shall be calculated per the following formula, which is taken from AP-42 Table 1.3-1 Footnote (d):

NOx in lb NO2/10^3 gal. = 20.54 + 104.39(N)
Where 'N' is weight percentage of nitrogen in #6 Oil

(b) Each of the above boilers shall not exceed the following fuel usage restrictions:

(1) No. 6 fuel oil shall be limited to 1,533,300 gallons per year based on a consecutive 12-month rolling period.
(2) Natural Gas shall be limited to 584,000,000 cubic feet per year based on a consecutive 12-month rolling period.

(c) Each of the above boilers shall not exceed a NOx emission rate of 46.0 tpy based on a consecutive 12-month rolling period.

TESTING REQUIREMENTS

(d) Each of Boilers #13 and #14 shall be tested once every five years for NOx as NO2. Testing shall be performed separately with No. 6 Fuel Oil and Natural Gas on each boiler. Testing may be done using either traditional stack test methods, or using a portable analyzer.

MONITORING AND RECORDKEEPING REQUIREMENTS

(e) The permittee shall monthly monitor and record the nitrogen of the No. 6 fuel oil, from the fuel supplier's certificate.

(f) The permittee shall retain the all fuel supplier's certificate(s) including nitrogen content of the #6 Oil for the most recent five-year period, and shall make them available to the Department upon request.

(g) The permittee shall keep records to demonstrate compliance with (a) – (d) above as follows:

(1) The records must include sufficient data and calculations to demonstrate that the requirements of (a) – (d) above are met.

(2) Data or information required to determine compliance shall be recorded and maintained in a time frame consistent with the averaging period of the requirement.

WORK PRACTICE REQUIREMENTS

(g) The permittee shall maintain and operate each of the Boilers #13 and #14 in accordance with the manufacturer's specifications and with good operating practices.

RACT 1:

As noted in DEP's 11/7/17 RACT 2 review materials, the facility's RACT 1 requirements were imposed in Operating Permit 22-02005 issued 3/23/99 (boilers), and in Operating Permit 22-02015 issued 6/30/99 (engines). DEP's RACT 2 determination included provisions at least as stringent as RACT 1 for Boilers 13 and 14. The RACT 1 provisions for Boiler 15 and the two Engines are found in Source Group SG001 in Section E of the facility's current Title V permit.

Recommendations:

If a source was previously subject to RACT 2 case-by-case determinations, and that source has not been modified or changed, the owner or operator may, in lieu of doing another full case-by-case proposal for RACT 3 submit a limited analysis, as specified in 25 Pa. Code Section 129.114(i). Unless otherwise required, this submission does not need to be part of a plan approval or operating permit modification and no fee would be charged.

No changes are needed to the facility's Title V permit, as the case-by-case determination for RACT 3 for this facility is the same as for RACT 2.

cc: OnBase

RACT 3 Initial Notification Review (Page 1)	
Company Name:	Energy Center Harrisburg, LLC
Site Name:	-
Municipality:	Harrisburg City
County:	Dauphin
Date RACT 3 Initial Notification Received:	12/16/2022
RACt 3 Initial Notification Reviewed By:	W. Weaver
Permit Chief:	-
Date Reviewed:	12/16/2022
Major VOC facility ? (if not, explain)	N: T5 has VOC cap
Major NOx facility ? (if not, explain)	Y
Any <1 tpy sources or Ch 129 exempt sources? (Y/N)	Y
Any presumptive sources (O&M or otherwise)? (Y/N)	Y
Any case-by-case sources? (Y/N)	Y
Immediate Followup Needed?	No

§ 129.115(a) Initial Notification Requirement	Notification is adequate? Y/N/NA/Comment	Comments
(2) - (3) This notification shall identify the air contamination sources in § 129.111(a) [or (b)] as one of the following:		
(i) Subject to a RACT requirement or RACT emission limitation in §§ 129.112—129.114.	Y	
(ii) Exempted from §§ 129.112—129.114.	Y	notice addresses all numbered T5 sources with Nox emissions
(4) [The notification shall identify] The air contamination sources identified in § 129.111(c) that have a potential to emit less than 1 TPY of NOx located at a major NOx emitting facility subject to § 129.111(a) or (b) or a VOC air contamination source that has the potential to emit less than 1 TPY of VOC located at a major VOC emitting facility subject to § 129.111(a) or (b).	Y	see above
(5) - (6) [The notification shall identify] The following information for each air contamination source listed in paragraph (2) [or (3)]:		
(i) A description, including make, model and location, of each source.	Y	
(ii) The applicable RACT requirement or RACT emission limitation, or both, in §§ 129.112—129.114 for each source listed in accordance with paragraph (2)(i) [or (3)(i)].	Y	
(iii) How the owner or operator shall comply with subparagraph (ii) for each source listed in subparagraph (i).	Y	
(iv) The reason why the source is exempt from the RACT requirements and RACT emission limitations in §§ 129.112—129.114 for each source listed in accordance with paragraph (2)(ii) [or (3)(ii)].	Y	see above
(7) The following information for each air contamination source listed in paragraph (4):		
(i) A description, including make, model and location, of each source.	Y	see above
(ii) Information sufficient to demonstrate that the source has a potential to emit less than 1 TPY of NOx or 1 TPY of VOC, as applicable.	Y	see above

RACT 3 Initial Notification Review (Page 1): Energy Center Harrisburg, LLC - Page 2										
Source #	Name	Source is no longer operational	Exempt due to operation commencing after 8/3/18	Exempt for VOC due to other Ch 129 reg (say which)?	< 1 tpy VOC	1<x<2.7 tpy VOC (presumptive O&M)	<1 tpy NOx	1<x<5 tpy NOx (presumptive O&M)	RACT 3 Presumptive: >5 tpy NOx or >2.7 tpy VOC?	RACT 3 case-by-case
032	BOILER 13, COMBUSTION ENGINEERING	N	N	NA	NA	NA	N	N	N	Y
033	BOILER 14, COMBUSTION ENGINEERING	N	N	NA	NA	NA	N	N	N	Y
034	BOILER 15, COMBUSTION ENGINEERING	N	N	NA	NA	NA	N	N	Y	N
102	COOPER INDUSTRIES ENGINE 1	N	N	NA	NA	NA	N	N	Y	N
103	COOPER INDUSTRIES ENGINE 2	N	N	NA	NA	NA	N	N	Y	N
101	PARTS WASHERS	N	N	NA	NA	NA	Y	N	N	N

Weaver, William (DEP)

From: Black, Amanda <ablack@cecinc.com>
Sent: Friday, December 16, 2022 3:43 PM
To: Weaver, William (DEP)
Cc: Chris Freeman; Bard Rupp; David S. Fiebig; Isaac, Amber
Subject: [External] RACT III Proposal Energy Center Harrisburg, Title V Permit #22-05005
Attachments: 326-479-Harrisburg RACT III Updated CasebyCase-12.16.22.pdf

Hello Mr. Weaver,

Attached please find Energy Center Harrisburg, LLC's proposal to demonstrate compliance with the RACT III requirements per 25 Pa. Code §129.111 - §129.115.

Please let us know if you have any questions.

Amanda Black | *Principal* | *Corporate Power Market Group Lead*
Civil & Environmental Consultants, Inc.
4350 Northern Pike · Suite 141 · Monroeville, PA 15146
Toll-Free: (800) 899-3610 · Direct: (724) 387-6350 · Fax: (724) 327-5280
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From: Black, Amanda
Sent: Friday, December 9, 2022 2:38 PM
To: wiweaver@pa.gov
Cc: Chris Freeman <Chris.Freeman@cordiaenergy.com>; Bard Rupp <Bard.Rupp@cordiaenergy.com>; David S. Fiebig <DavidS.Fiebig@cordiaenergy.com>; Isaac, Amber <aisaac@cecinc.com>
Subject: RACT III Notification, Energy Center Harrisburg, Title V Permit #22-05005

Mr. Weaver,

Attached please find the RACT III notification as required by 25 Pa. Code 129.115(a) for Energy Center Harrisburg, LLC. We will also mail a hard copy of this notification.

Please let us know if you have any questions.

Thank you,

Amanda Black | *Principal* | *Corporate Power Market Group Lead*
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December 16, 2022

Mr. William R. Weaver
Air Program Manager
Pennsylvania Department of Environmental Protection
Southcentral Regional Office
909 Elmerton Ave.
Harrisburg, PA 17110

Dear Mr. Weaver:

Subject: RACT III Case-By-Case Analysis Update
Energy Center Harrisburg, LLC
Title V Operating Permit No. 22-05005
CEC Project 326-479

Civil & Environmental Consultants, Inc. (CEC) on behalf of Energy Center Harrisburg, LLC (ECH) is submitting this proposal to demonstrate compliance with the Reasonably Available Control Technology (RACT) requirements of 25 Pa. Code Sections §129.111 through §129.115 for their facility located in Harrisburg, Pennsylvania. The following proposal includes background information, a facility description, a summary of RACT affected sources and an updated limited case-by-case analysis per the requirements of §129.114(i) for sources that do not meet the presumptive RACT requirements of §129.112.

1.0 BACKGROUND AND FACILITY DESCRIPTION

On November 12, 2022, the Pennsylvania Department of Environmental Protection (PADEP) finalized amendments to 25 Pa. Code Chapters 121 (§121.1 relating to definitions) and 129 (§129.111 - §129.115), Additional RACT Requirements for Major Sources of NOx and VOCs for the 2015 Ozone NAAQS (known as RACT III). The requirements of 25 Pa. Code §129.111 - §129.115 apply to owners and operators of all facilities in Pennsylvania that emit or have the potential to emit greater than 100 tons per year (tpy) of NOx and/or 50 tpy of VOCs.

An owner or operator subject to RACT III has three compliance options as follows:

1. Compliance with presumptive RACT requirements and/emissions limits of §129.112;
2. Facility-wide or system-wide averaging for compliance with presumptive NOx emissions limits per §129.113; or

3. Case-by-case RACT determinations for sources that either do not have an applicable presumptive requirements or emissions limitation or cannot comply with the applicable presumptive RACT requirement per §129.114. If a source was previously subject to a RACT II case-by-case determination, and that source has not been modified or changed, the facility may, in lieu of doing another full case-by-case proposal for RACT III, submit a limited analysis as specified in §129.114(i).

ECH is a district energy system and internal combustion engine electric generating plant located in Harrisburg, Dauphin County, Pennsylvania. ECH is operated in accordance with Title V Operating Permit No. 22-05005 issued by the PADEP on November 18, 2020. Combustion emission units located at the facility include two dual-fuel boilers equipped to burn either natural gas or #6 fuel oil (Boilers 13 and 14), one boiler operated on #6 fuel oil (Boiler 15) and two dual-fuel reciprocating internal combustion engines operated on #2 fuel oil for compression ignition and natural gas as the primary fuel (Engines 1 and 2). The facility is considered a major source of NOx emissions; therefore, these combustion units must demonstrate compliance with RACT III requirements for sources of NOx emissions.

2.0 RACT AFFECTED SOURCES

Per 25 Pa. Code §129.111 and 129.115(a), an owner and operator of an air contamination source subject to the RACT III regulations must submit a notification describing how the facility intends to comply with the RACT III requirements, and other information identified in 25 Pa. Code §129.115(a).

On December 9, 2022, CEC on behalf of ECH submitted the required written notification of ECH's plan to demonstrate compliance with the RACT III requirements. A copy of the written notification is included as Attachment A.

The following table (Table 1-1) illustrates the sources at ECH subject to RACT III and the method used for demonstrating compliance with the RACT III requirements.

Table 1-1: Description of RACT Affected Units

Source ID	Source Description	Capacity	Fuel	RACT III Compliance Method
032	Boiler 13, Combustion Engineering	214 MMBtu/hr	Natural gas; No. 6 fuel oil	Case-by-case RACT – does not meet presumptive RACT emission limit of 0.10 lb NOx/MMBtu for natural gas-fired combustion unit with a rated heat input ≥ 50 MMBtu/hr
033	Boiler 14, Combustion Engineering	214 MMBtu/hr	Natural gas; No. 6 fuel oil	Case-by-case RACT – does not meet presumptive RACT emission limit of 0.10 lb NOx/MMBtu for natural gas-fired combustion unit with a rated heat input ≥ 50 MMBtu/hr
034	Boiler 15, Combustion Engineering	214 MMBtu/hr	No. 6 fuel oil	Presumptive RACT requirement per §129.112(c)(9) for fuel-burning unit with an annual capacity factor of < 5% – installation, maintenance and operation in accordance with manufacturer's specifications and good operating practices
102	Cooper Industries Engine 1	58 MMBtu/hr	Natural gas; No. 2 fuel oil	Presumptive RACT requirement per §129.112(c)(9) for fuel-burning unit with an annual capacity factor of < 5% – installation, maintenance and operation in accordance with manufacturer's specifications and good operating practices
103	Cooper Industries Engine 2	58 MMBtu/hr	Natural gas; No. 2 fuel oil	Presumptive RACT requirement per §129.112(c)(9) for fuel-burning unit with an annual capacity factor of < 5% – installation, maintenance and operation in accordance with manufacturer's specifications and good operating practices

ECH previously demonstrated compliance with the requirements of 25 Pa. Code Chapter 129 (§129.96 - §129.100) "Additional RACT Requirements for Major Sources of NOx and VOCs" (known as RACT II) for the combustion sources located at the facility. Boiler 15 and Engines 1 and 2 met the presumptive RACT requirements of §129.97 based on their annual capacity factor of less than 5%. For Boilers 13 and 14, PADEP approved an alternative RACT II proposal. The RACT II requirements have been incorporated into the facility's Title V Operating Permit and are, therefore, federally enforceable.

Boilers 13 and 14 have not been modified since the approved case-by-case RACT II proposal; therefore, ECH is submitting the following limited case-by-case RACT analysis per §129.114(i) to demonstrate compliance with RACT III for Boilers 13 and 14.

3.0 LIMITED CASE-BY-CASE RACT ANALYSIS FOR BOILERS 13 AND 14

According to §129.114(i), if a source was previously subject to a RACT II case-by-case determination, and that source has not been modified or changed, the facility may, in lieu of doing another full case-by-case proposal for RACT III, submit to the Department a limited analysis certified by the responsible official.

ECH previously demonstrated compliance with RACT II for Boilers 13 and 14 with a case-by-case analysis approved by PADEP. The RACT II requirements have been incorporated into the facility's Title V Operating Permit. Boilers 13 and 14 have not been modified since the RACT II analysis was completed and approved by the Department.

A copy of the case-by-case analysis completed to demonstrate compliance with RACT II for Boilers 13 and 14 is included in Attachment B. The analysis considered the technical and economic feasibility of the following control technologies:

- Selective Catalytic Reduction (SCR)
- Selective Non-Catalytic Reduction (SNCR)
- Flue Gas Recirculation (FGR)
- Burner Modification - Low NOx burners (LNB)
- Low-Excess Air Firing
- Water/Steam Injection

The analysis concluded that the only technologies technically feasible for the boilers are FGR and LNB. ECH performed an economic analysis for these control options. As shown in Table 3 of the analysis, the cost effectiveness of these technologies was calculated to be greater than $8,000 per ton NOx removed; therefore, these technologies are cost prohibitive.

The requirements of §129.114(i)(1)(i) apply to Boilers 13 and 14 based on the following:

- Per §129.114(i)(1), there is no new pollutant specific air cleaning device, air pollution control technology or technique available since the time of the approved RACT II analysis.

- Per §129.114(i)(1)(i), the approved RACT II analysis showed a cost effectiveness greater than $7,500 per ton of NOx emissions removed.

To demonstrate compliance with RACT III for Boilers 13 and 14, ECH is submitting this limited case-by-case RACT analysis. The following lists the information required by §129.114(i)(1)(i) as applicable to Boilers 13 and 14:

- *§129.114(i)(1)(i)(A): A statement that explains how the owner or operator determined that there is no new pollutant specific air cleaning device, air pollution control technology or technique available.*

  ECH Response: Boilers 13 and 14 are conventional package, dual-fuel boilers equipped to burn either natural gas or #6 fuel oil with a rated capacity of 214 MMBtu/hour per boiler. Available boiler control technologies are common and widely known. Boiler NOx control technologies are generally divided into combustion or post-combustion controls. Commonly applied combustion controls for industrial boilers are most effective at preventing the formation of thermal NOx by limiting peak flame temperatures; these technologies are not effective at preventing fuel NOx. Post-combustion controls can effectively reduce both thermal and fuel NOx because these controls are designed to remove NOx which is already present in the flue gases exiting the boiler.

  A review of the literature on NOx control and consultation with boiler equipment vendors has identified several possible control technologies that were evaluated in the RACT II analysis. No new control technologies have been developed since the RACT II analysis was completed.

- *§129.114(i)(1)(i)(B): A list of the technically feasible air cleaning devices, air pollution control technologies or techniques previously identified and evaluated under §129.92(b)(1)—(3) included in the written RACT proposal submitted under §129.99(d) and approved by the Department or appropriate approved local air pollution control agency under §129.99(e).*

  ECH Response: The RACT II analysis concluded that the only control technologies technically feasible for Boilers 13 and 14 are FGR and LNB.

- *§129.114(i)(1)(i)(C): A summary of the economic feasibility analysis performed for each technically feasible air cleaning device, air pollution control technology or technique listed in clause (B) and the cost effectiveness of each technically feasible air cleaning device, air pollution control technology or technique as submitted previously under §129.99(d) or as*

calculated consistent with the ''EPA Air Pollution Control Cost Manual'' (6th Edition), EPA/452/B- 02-001, January 2002, as amended.

ECH Response: The RACT II analysis concluded that the only technologies technically feasible for Boilers 13 and 14 are FGR and LNB. ECH performed an economic analysis for these control options. The analysis is included in Attachment B. As shown in Table 3 of the analysis, the cost effectiveness of these technologies was calculated to be greater than $8,000 per ton NOx removed; therefore, these technologies are cost prohibitive.

- *§129.114(i)(1)(i)(D): A statement that an evaluation of each economic feasibility analysis summarized in clause (C) demonstrates that the cost effectiveness remains equal to or greater than $7,500 per ton of NOx emissions reduced.*

  ECH Response: ECH performed an evaluation of cost effectiveness of each technically feasible control option consistent with the "OAQPS Control Cost Manual" (Sixth Edition), EPA 450/3-90-006 and material and labor costs provided by boiler vendors. The OAQPS Control Cost Manual has not been updated since the RACT II analysis was completed. In addition, based on discussions with vendors and inflation, the costs of materials and labor are expected to have increased since the RACT II analysis. Based on the expected increase in material and labor costs, the cost effectiveness of the control technologies evaluated remains greater than $7,500 per ton of NOx emissions reduced.

4.0 RACT PROPOSAL AND CONCLUSION

Based on the completed analysis, ECH is submitting the following proposal to demonstrate compliance with RACT III:

- Boiler 15 – The boiler meets the presumptive RACT requirement per §129.112(c)(9) for fuel-burning unit with an annual capacity factor of < 5%. Boiler 15 is installed, maintained and operated in accordance with manufacturer's specifications and good operating practices. Boiler 15 will continue to be subject to the capacity factor and fuel restrictions in the facility's Title V Operating Permit.
- Engines 1 and 2 – The engines meet the presumptive RACT requirement per §129.112(c)(9) for fuel-burning units with an annual capacity factor of < 5%. Engines 1 and 2 are installed, maintained and operated in accordance with manufacturer's

specifications and good operating practices. Engines 1 and 2 will continue to be subject to the capacity factor and fuel restrictions in the facility's Title V Operating Permit.

- Boilers 13 and 14 – RACT is proposed to be the current NOx permit limits of 0.23 lb/MMBtu and 0.44 lb/MMBtu when burning natural gas and No. 6 fuel oil, respectively. Both boilers will also continue to have fuel restrictions of 1,533,300 gallons per 12-month rolling period of No. 6 fuel oil and 584,000,000 cubic feet per 12-month rolling period of natural gas per boiler. These emission limits and fuel restrictions have been incorporated into the facility's Title V Operating Permit.

As required by §129.114(i), a certification of the RACT III analysis by the responsible official is included in Attachment C.

Please contact David S. Fiebig, Plant Manager, at 717-231-3884, or Amanda Black at 412-780-8698 or ablack@cecinc.com if you have any questions or require additional information.

Very truly yours,

CIVIL & ENVIRONMENTAL CONSULTANTS, INC.

Amber M. Isaac

Amber M. Isaac, P.E.
Project Manager

Amanda Black

Amanda Black
Principal

Enclosures

326-479-Harrisburg RACT III Updated CasebyCase-12.16.22

ATTACHMENT A

WRITTEN NOTIFICATION FORM

December 9, 2022

Mr. William R. Weaver
Air Program Manager
Pennsylvania Department of Environmental Protection
Southcentral Regional Office
909 Elmerton Ave.
Harrisburg, PA 17110

Dear Mr. Weaver:

Subject: RACT III Notification
Energy Center Harrisburg, LLC
Title V Operating Permit No. 22-05005
CEC Project 326-479

Civil & Environmental Consultants, Inc. (CEC) on behalf of Energy Center Harrisburg, LLC (ECH) is submitting this written notification of their plan to demonstrate compliance with the Reasonably Available Control Technology (RACT) requirements of 25 Pa. Code Sections §129.111 through §129.115 for their facility located in Harrisburg, Pennsylvania.

On November 12, 2022, the Pennsylvania Department of Environmental Protection (PADEP) finalized amendments to 25 Pa. Code Chapters 121 (§121.1 relating to definitions) and 129 (§129.111 - §129.115), Additional RACT Requirements for Major Sources of NOx and VOCs for the 2015 Ozone NAAQS (known as RACT III). The requirements of 25 Pa. Code §129.111 - §129.115 apply to owners and operators of all facilities in Pennsylvania that emit or have the potential to emit greater than 100 tons per year (tpy) of NOx and/or 50 tpy of VOCs. Per 25 Pa. Code §129.111 and 129.115(a), an owner and operator of an air contamination source subject to the final-form RACT III regulations must submit a notification describing how the facility intends to comply with the final-form RACT III requirements, and other information identified in 25 Pa. Code §129.115(a).

ECH is a district energy system and internal combustion engine electric generating plant located in Harrisburg, Dauphin County, Pennsylvania. ECH is operated in accordance with Title V Operating Permit No. 22-05005 issued by the PADEP on November 18, 2020. Combustion emission units located at the facility include two dual-fuel boilers equipped to burn either natural gas or #6 fuel oil (Boilers 13 and 14), one boiler operated on #6 fuel oil (Boiler 15) and two dual-fuel reciprocating internal combustion engines operated on #2 fuel oil for compression ignition and natural gas as the primary fuel (Engines 1 and 2). The facility is considered a major source of NOx emissions; therefore, these combustion units must demonstrate compliance with RACT III requirements. As such, ECH is submitting this RACT III notification.

The attached RACT III written notification template as provided by the PADEP details how ECH intends to comply with RACT III. The attached form provides the information required by §129.115(a). In summary, Boiler 15 and Engines 1 and 2 meet the presumptive RACT requirements of §129.112(c)(9) based on their annual capacity factor of less than 5%. For Boilers 13 and 14, a case-by-case RACT analysis will be submitted.

Please contact Amanda Black at 412-780-8698 or ablack@cecinc.com if you have any questions or require additional information.

Very truly yours,

CIVIL & ENVIRONMENTAL CONSULTANTS, INC.

Amber M. Isaac

Amber M. Isaac, P.E.
Project Manager

Amanda Black

Amanda Black
Principal

326-479-Harrisburg RACT III Notification Letter-12.9.22

ATTACHMENT A

WRITTEN NOTIFICATION FORM

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

CHAPTER 129. STANDARDS FOR SOURCES ADDITIONAL RACT REQUIREMENTS FOR MAJOR SOURCES OF NOx AND VOCs FOR THE 2015 OZONE NAAQS

Written notification, 25 Pa. Code §§129.111 and 129.115(a)

25 Pa. Code Sections 129.111 and129.115(a) require that the owner and operator of an air contamination source subject to the final-form RACT III regulations submit a notification describing how you intend to comply with the final-form RACT III requirements, and other information spelled out in subsection 129.115(a). The owner or operator may use this template to notify DEP. Notification must be submitted in writing or electronically to the appropriate Regional Manager located at the appropriate DEP regional office. In addition to the notification required by §§ 129.111 and 129.115(a), you also need to submit an applicable analysis or RACT determination as per § 129.114(a) or (i).

Is the facility major for NOx?	**Yes ☒ No ☐**
Is the facility major for VOC?	**Yes ☐ No ☒**

FACILITY INFORMATION						
Facility Name	Energy Center Harrisburg LLC					
Permit Number	22-05005 **PF ID if known**					
Address Line1	900 Walnut Street					
Address Line2						
City	Harrisburg	**State**	PA	**Zip**	17101	
Municipality	Harrisburg City		**County**	Dauphin		
OWNER INFORMATION						
Owner	Energy Center Harrisburg LLC/Energy Center Paxton LLC					
Address Line1	900 Walnut Street					
Address Line2						
City	Harrisburg	**State**	PA	**Zip**	17101	
Email	DavidS.Fiebig@cordiaenergy.com		Phone	717-231-3884		
CONTACT INFORMATION						
Permit Contact Name	David S. Fiebig					
Permit Contact Title	Plant Manager					
Address Line	900 Walnut Street					
City	Harrisburg	**State**	PA	**Zip**	17101	
Email	DavidS.Fiebig@cordiaenergy.com		Phone	717-231-3884		

Complete Table 1, including all air contamination sources that commenced operation on or before August 3rd, 2018. Air contamination sources determined to be exempt from permitting requirements also must be included. You may find this information in section A and H of your operating permit.

Table 1 - Source Information

Source ID	Source Name	Make	Model	Physical location of a source (i.e, building#, plant#, etc.)	Was this source subject to RACT II?
032	Boiler 13	Combustion Engineering	NA	Main Plant	Yes
033	Boiler 14	Combustion Engineering	NA	Main Plant	Yes
034	Boiler 15	Combustion Engineering	NA	Main Plant	Yes
102	Engine 1	Cooper Bessemer	LSVB -20- GDT	Main Plant	Yes
103	Engine 2	Cooper Bessemer	LSVB -20- GDT	Main Plant	Yes
101	Parts Washer	NA	NA	Main Plant	No
Exempt	No. 6 Fuel Oil Storage Tanks No. T001 and T002, capacity 980,000 gallons per tank	NA	NA	Main Plant	No
Exempt	No. 2 Fuel Oil/Diesel Storage Tanks No. T003 and T004, capacity 400 gallons per tank	NA	NA	Main Plant	No
Exempt	No. 2 Fuel Oil/Diesel Storage Tank No. T007, capacity 10,000 gallons	NA	NA	Main Plant	No
Exempt	Diesel Lube Oil Storage Tank	NA	NA	Main Plant	No

	No. T005, capacity 2,000 gallons				
Exempt	Diesel Plant Waste Oil Storage Tank No. T006, capacity 2,000 gallons	NA	NA	Main Plant	No

Complete Table 2 or 3 if the facility is a major NOx or VOC emitting facility. For the column with the title "How do you intend to comply", compliance options are:

- Presumptive RACT requirement under §129.112 (**PRES**),
- Facility-wide averaging (**FAC**) §129.113,
- System-wide averaging (**SYS**) §129.113, or
- Case by case determination §129.114 (**CbC**).

Please provide the applicable subsection if source will comply with the presumptive requirement under §129.112.

Table 2 – Method of RACT III Compliance, NOx

Source ID	Source Name	NOx PTE TPY	Exempt from RACT III (yes or no)	How do you intend to comply? (PRES, CbC, FAC or SYS)	Specific citation of rule if presumptive option is chosen
032	Boiler 13, Combustion Engineering	46.0	No	CbC	NA
033	Boiler 14, Combustion Engineering	46.0	No	CbC	NA
034	Boiler 15, Combustion Engineering	197.0	No	PRES	§129.112(c)(9)
102	Cooper Industries Engine 1	526.97	No	PRES	§129.112(c)(9)
103	Cooper Industries Engine 2	526.97	No	PRES	§129.112(c)(9)

Please complete Table 3 if the facility is a major VOC emitting facility. Please provide the applicable section if a source is complying with any RACT regulation listed in 25 Pa Code §§

129.51, 129.52(a)—(k) and Table I categories 1—11, 129.52a—129.52e, 129.54—129.63a, 129.64—129.69, 129.71—129.73, 129.75 129.71—129.75, 129.77 and 129.101—129.107.

Table 3 – Method of RACT III Compliance, VOC

Source ID	Source Name	VOC PTE TPY	Exempt from RACT III (yes or no)	How do you intend to comply?	Specify citation of rule or subject to 25 Pa Code RACT regulation, (list the applicable sections)
NA					

ATTACHMENT B

APPROVED RACT II ANALYSIS

NRG Energy Center Paxton LLC
100 N. 10th Street
Harrisburg, PA 17101
Telephone: (717) 234-4600
www.nrg.com

The power to change life.
The energy to make it happen.®

NRG Energy Center Paxton LLC
Application for Significant Permit Modification
PA DEP RACT II Rule – Applicable Requirements for All Affected Emission Sources and Case-by-Case RACT Analysis for Boilers 13 and 14 (Source IDs 032 and 033)

NRG Energy Center Paxton LLC

Harrisburg, PA

Title V Operating Permit No. 22-05005

October 2016

Section 3

Case-by-Case NOx RACT Analysis for Boilers 13 & 14

Revision No. 1

NRG Energy Center Paxton LLC ("NRG Paxton")
PA DEP RACT II Rule ("RACT II Rule")
Case-by-Case NOx RACT Analysis – Revision No. 1
For Boilers 13 and 14 (Source IDs 032 and 033, respectively)

Requirements Pursuant to 25 Pa. Code §129.99 – Alternative RACT Proposal and Petition for Alternative Compliance Schedule

(a) The owner or operator of an air contamination source subject to § 129.97 (relating to presumptive RACT requirements, RACT emission limitations and petition for alternative compliance schedule) located at a major NOx emitting facility or major VOC emitting facility subject to § 129.96 (relating to applicability) that cannot meet the applicable presumptive RACT requirement or RACT emission limitation of § 129.97 may propose an alternative RACT requirement or RACT emission limitation in accordance with subsection (d).

NRG Paxton Response

Boilers 13 and 14 each have a nominal rating of 214 MMBtu/hr and are capable of being fired with either natural gas or No. 6 fuel oil. NOx emissions from these boilers are determined by performance of a periodic compliance emissions test program. The most recent compliance test program was conducted in February 2014. The results from the test program, which were forwarded to the Department in March 2014, showed the following:

Boiler No.	NOx Emission Rates (lb/MMBtu)					
	Natural Gas Firing			No. 6 Fuel Oil Firing		
	Measured #	Title V Permit Limit	RACT II Rule Limit *	Measured #	Title V Permit Limit	RACT II Rule Limit *
13	0.14	0.23	0.10	0.37	0.44	0.20
14	0.16	0.23	0.10	0.40	0.44	0.20

#: Average of three consecutive test runs *: For boilers rated ≥ 50 MMBtu/hr

Because these test results demonstrate that Boilers 13 and 14 can not meet the applicable presumptive RACT emission limitation, NRG Paxton has elected to propose an alternate NOx RACT requirement per subsection (d) below.

.....

(d) The owner or operator proposing an alternative RACT requirement or RACT emission limitation under subsection (a), (b) or (c) shall:

(1) Submit a written RACT proposal in accordance with the procedures in § 129.92(a)(1)-(5), (7)-(10) and (b) (relating to RACT proposal requirements) to the Department or appropriate approved local air pollution control agency as soon as possible but not later than:
(i) October 24, 2016, for a source subject to § 129.96(a).
(ii) Not applicable to NRG Paxton

NRG Paxton Response

NRG Paxton submitted its proposal to the Department on August 18, 2016. This revised proposal has been prepared in response to comments from the Department as discussed during a conference call between the Department and NRG Paxton on October 18, 2016.

.....

(2) Be in receipt of an approval issued by the Department or appropriate approved local air pollution control agency in writing through a plan approval or operating permit modification for a RACT proposal submitted under paragraph (1)(ii) prior to the installation, modification or change in the operation of the existing air contamination source that will result in the source or facility meeting the definition of a major NOx emitting facility or major VOC emitting facility.

NRG Paxton Response

NRG Paxton has assumed that the Department will prepare and issue a revised Title V operating permit (i) upon approval of the NRG Paxton's proposal and (ii) in accordance with the application for significant permit modification that was included as part of the NRG Paxton's August 2016 submittal.

.....

(3) Include in the RACT proposal the proposed alternative NOx RACT requirement or RACT emission limitation or VOC RACT requirement or RACT emission limitation developed in accordance with the procedures in § 129.92(a)(1)-(5) and (b).

NRG Paxton Response

Please see below for NRG Paxton's response to the requirements under § 129.92(a)(1)-(5) and (b).

.....

(4) Include in the RACT proposal a schedule for completing implementation of the RACT requirement or RACT emission limitation as soon as possible but not later than:

(i) January 1, 2017, for a source subject to § 129.96(a).
(ii) Not applicable to NRG

NRG Paxton Response

NRG Paxton plans to demonstrate compliance with the alternate NOx RACT requirement no later than January 1, 2017.

.....

(5) Include interim dates in the schedule required under paragraph (4) for the:

(i) Not applicable to NRG Paxton
(ii) Not applicable to NRG Paxton
(iii)Completion of compliance testing.

NRG Paxton Response

NRG Paxton understands that pursuant to § 129.100(b)(1), a current compliance emissions test program must be completed no later than January 1, 2017 for sources subject to a RACT requirement or RACT emission limitation. NRG Paxton is planning to complete a current compliance emissions test program in December 2016 designed to demonstrate compliance with the alternate RACT emission limitation included in this proposal.

.....

(6) Include in the RACT proposal methods for demonstrating compliance and recordkeeping and reporting requirements in accordance with § 129.100 (relating to compliance demonstration and recordkeeping requirements) for each air contamination source included in the RACT proposal.

NRG Paxton Response

(i) Methods for Demonstrating Compliance

NRG Paxton understands that pursuant to § 129.100(a)(4), following completion of the planned December 2016 test program, subsequent compliance test programs will be repeated at least once in each 5-year calendar period.

(ii) Recordkeeping and Reporting Requirements

NRG Paxton submits that the recordkeeping and reporting requirements included in the current Title V operating permit (copied below) are sufficient to demonstrate compliance with the alternate RACT requirements.

Section E, Group 001 – Combustion Boilers

#009 – Monitoring and related recordkeeping and reporting requirements

(a) Monthly and annual natural gas usage for each of the Boilers #13 and #14.
(b) Monthly and annual No. 6 Fuel Oil usage for each of the Boilers #13 and #14.
(c) Record of the fuel borne nitrogen (FBN) in the No. 6 Fuel Oil.
(d) Record of Sulfur content in the No. 6 Fuel Oil.
(e) Annual records of the facility's NOx and VOC emissions

.....

(7) Demonstrate to the satisfaction of the Department or the appropriate approved local air pollution control agency that the proposed requirement or RACT emission limitation is RACT for the air contamination source.

NRG Paxton Response

Please see below for NRG Paxton's response to the requirements under § 129.92(a)(1)—(5) and (b).

Requirements Pursuant to 25 Pa. Code § 129.92 - RACT proposal requirements.

(a) Each RACT proposal shall, at a minimum, include the following information:

(1) A list of each source subject to the RACT requirements.

NRG Paxton Response

Boilers 13 and 14 (Source IDs 032 and 033)

.....

(2) The size or capacity of each affected source and the types of fuel combusted or the types and quantities of materials processed or produced in each source.

NRG Paxton Response

Boilers 13 and 14 each have a nominal rating of 214 MMBtu/hr and are capable of being fired with either natural gas or No. 6 fuel oil.

.....

(3) A physical description of each source and its operating characteristics.

NRG Paxton Response

Boilers 13 and 14 are each conventional package boilers that provide steam for a district energy system. Customers connected to the system use the steam for space heating, and as such, the boilers loads and utilization are highest during the heating season.

.....

(4) Estimates of the potential and actual NO_x emissions from each affected source and associated supporting documentation.

NRG Paxton Response

(i) Actual NOx emissions for calendar year 2015 as reported to the Department

Boiler 13: 26.8 tons NOx (22.7 tons attributable to natural gas firing operations, 4.1 tons attributable to No. 6 fuel oil firing)

Boiler 14: 20.7 tons NOx (22.7 tons attributable to natural gas firing operations, 4.1 tons attributable to No. 6 fuel oil firing)

(ii) Potential NOx emissions, based on conditions included in the current Title V permit

Boiler 13: NOx emission rate ≤ 0.23 lb/MMBtu while firing natural gas
NOx emission rate ≤ 0.44 lb/MMBtu while firing No. 6 fuel oil
Potential NOx emissions = 412.4 ton NOx / yr
(0.44 lb/MMBtu * 214 MMBtu/hr * 8760 hr/yr * 1 ton / 2000 lb)

Boiler 14: NOx emission rate ≤ 0.23 lb/MMBtu while firing natural gas
NOx emission rate ≤ 0.44 lb/MMBtu while firing No. 6 fuel oil
Natural gas usage ≤ 787 MMscf / consecutive 12- month period
Potential NOx emissions = 95.0 ton NOx / yr
(787 MMscf/yr * 1050 MMBtu/MMscf * 0.23 lb/MMBtu * 1 ton / 2000 lb)

(iii) For this alternate NOx RACT proposal, NRG Paxton will limit NOx emissions as follows (proposed conditions are each applicable to Boilers 13 and 14, a "year" means any consecutive 12-month period):

NOx emissions ≤ 46.0 ton / yr

Natural gas usage ≤ 584 MMscf / yr
(based on a current NOx emission rate = 0.15 lb/MMBtu, 1050 Btu/scf GCV)

No. 6 fuel oil usage ≤ 1533.3 Mgal / yr
(based on a current NOx emission rate = 0.40 lb/MMBtu, 150,000 Btu/gal GCV)

The lb/MMBtu emission rates listed above are unchanged.

.....

(5) A RACT analysis which meets the requirements of subsection (b), including technical and economic support documentation for each affected source.

NRG Paxton Response

Please see below for NRG Paxton's response to the requirements under § 129.92(b).

.....

(b) The RACT analysis required under subsection (a)(5) shall include:

(1) A ranking of the available control options for the affected source in descending order of control effectiveness. Available control options are air pollution control technologies or techniques with a reasonable potential for application to the source. Air pollution control technologies and techniques include the application of production process or methods, control systems for VOCs and NO_x and fuel combustion techniques for the control of NO_x. The control technologies and techniques shall include existing controls for the source category and technology transfer controls applied to similar source categories.

(2) An evaluation of the technical feasibility of the available control options identified in subsection (b)(1). The evaluation of technical feasibility shall be based on physical, chemical and engineering principles. A determination of technical infeasibility shall identify technical difficulties which would preclude the successful use of the control option on the affected source.

(3) A ranking of the technically feasible control options in order of overall control effectiveness for NO_x or VOC emissions. The list shall present the array of control options and shall include, at a minimum, the following information:

(i) The baseline emissions of VOCs and NO_x before implementation of each control option.

(ii) The estimated emission reduction potential or the estimated control efficiency of each control option.

(iii) The estimated emissions after the application of each control option.

(iv) The economic impacts of each control option, including both overall cost effectiveness and incremental cost effectiveness.

(4) An evaluation of cost effectiveness of each control option consistent with the ''OAQPS Control Cost Manual'' (Fourth Edition), EPA 450/3-90-006 January 1990 and subsequent revisions. The evaluation shall be conducted in accordance with the following requirements:

(i) The cost effectiveness shall be evaluated in terms of dollars per ton of NO_x or VOC emissions reduction.

(ii) The cost effectiveness shall be calculated on average and incremental bases for each option. Average cost effectiveness is calculated as the annualized cost of the control option divided by the baseline emissions rate minus the control option emission rate, as shown by the following formula:

Average cost effectiveness ($/ton removed) =
Control option total annualized cost ($/yr) /
[Baseline emission rate - Control option rate (tons/yr)]

(iii) For purposes of this paragraph, baseline emission rate represents the maximum emissions before the implementation of the control option. The baseline emissions rate shall be established using either test results or approved emission factors and historic operating data.

(iv) For purposes of this paragraph, the incremental cost effectiveness calculation compares the costs and emission level of a control option to those of the next most stringent option, as shown by the following formula:

Incremental Cost (dollars) per incremental ton removed) =
[Control option total annualized cost ($/yr) – Total annualized cost of next most stringent control option] /
[Next most stringent control option emission rate - control option emission rate]

NRG Paxton Response

NOx formation in combustion processes is generally believed to be the result of three different mechanisms producing "prompt NOx," "thermal NOx," and "fuel NOx." Prompt NOx is the result of intermediate combustion reactions involving nitrogen (N_2), oxygen (O_2) and hydrocarbons (C_xH_y). Thermal NOx is the result of N_2 and O_2 reactions occurring at high temperatures during the combustion process. Fuel NOx results from the oxidation of nitrogen compounds in the fuel itself.

Prompt NOx and thermal NOx reactions are temperature driven, with prompt NOx being the dominant mechanism at low temperatures and thermal NOx formation dominating at higher temperatures. Industrial combustion processes occur at relatively high temperatures thus making thermal NOx the more significant contributor under typical boiler operating conditions. U.S. EPA notes the "principal mechanism of NOx formation in natural gas combustion is thermal NOx" (see AP-42, §1.4.3). For purposes of this analysis, when natural gas is burned, it will be assumed that 100% of the NOx is the result of thermal NOx formation.

Fuel NOx is nominally a function of fuel-bound nitrogen concentration, thus making it a less important reaction when low nitrogen fuels such as natural gas are used. Residual fuel oil generally contains higher levels of fuel bound nitrogen resulting in fuel NOx being the dominant source of NOx when burning this fuel. U.S. EPA has observed that in "boilers fired on crude oil or residual oil, … fuel NOx typically accounts for 60 to 80 percent of the total NOx formed" (see AP-42, §1.3.4.3). For purposes of this analysis, when residual oil is burned, it will be conservatively assumed that 60% of the NOx formed is fuel NOx with the remainder being thermal NOx.

Boiler NOx control technologies are generally divided into combustion or post-combustion controls. Commonly applied combustion controls for industrial boilers are most effective at preventing the formation of thermal NOx by limiting peak flame temperatures; these technologies are not effective at preventing fuel NOx. Post-combustion controls can effectively reduce both thermal and fuel NOx because these controls are designed to remove NOx which is already present in the flue gases exiting the furnace.

A review of the literature on NOx control and consultation with boiler equipment vendors has identified several possible control technologies that could be applied to boilers similar to those installed at NRG Paxton. Many excellent narrative descriptions already exist for these control technologies so NRG Paxton will not attempt to provide any original work here. The descriptions in the following sections of this analysis have been taken from the "Boiler Emission Guide" published by Cleaver Brooks.

Combustion Control Techniques

"Combustion control techniques reduce the amount of NOx emission by limiting the amount of NOx formation during the combustion process. This is typically accomplished by lowering flame temperatures. Combustion control techniques are more economical than post-combustion methods and are frequently utilized on industrial boilers requiring NOx controls."

"**Low excess air firing**: As a safety factor to assure complete combustion, boilers are fired with excess air. One of the factors influencing NOx formation in a boiler is the excess air levels. High excess air levels (greater than 45 percent) may result in increased NOx formation because the excess nitrogen and oxygen in the combustion air entering the flame will combine to form thermal NOx. Low excess air firing involves limiting the amount of excess air that is entering the combustion process in order to limit the amount of extra nitrogen and oxygen that enters the flame. Limiting the amount of excess air entering a flame is usually accomplished through burner design and can be optimized through the use of oxygen trim controls."

"**Burner modifications**: Burner modifications for NOx control involve changing the design of a standard burner in order to create a larger flame. Enlarging the flame results in lower flame temperatures and lower thermal NOx formation which, in turn, results in lower overall NOx emissions. The technology can be applied to most boiler types and sizes. It is most effective when firing natural gas and distillate fuel oil and has little effect on boilers firing heavy oil. To comply with the more stringent regulations, burner modifications must be used in conjunction with other NOx reduction methods, such as flue gas recirculation. If burner

modifications are utilized exclusively to achieve low NOx levels (30 ppm), adverse effects on boiler operating parameters such as turndown, capacity, CO levels, and efficiency may result."

"**Water/Steam Injection**: Water or steam injection can be utilized to reduce NOx levels. By introducing water or steam into the flame, flame temperatures are reduced, thereby lowering thermal NOx formation and overall NOx levels. Water or steam injection can reduce NOx up to 80 percent (when firing natural gas) and can result in lower reductions when firing oils. There is a practical limit to the amount of water or steam that can be injected into the flame before condensation problems are experienced. Additionally, under normal operating conditions, water/steam injection can result in a 3 to 10 percent efficiency loss. Many times water or steam injection is used in conjunction with other NOx control methods such as burner modifications or flue gas recirculation."

"**Flue Gas Recirculation**: Flue gas recirculation, or FGR, is the most effective method of reducing NOx emissions from industrial boilers with inputs below 100 MMBtu/hr. FGR entails recirculating a portion of relatively cool exhaust gases back into the combustion zone in order to lower the flame temperature and reduce NOx formation. It is currently the most effective and popular low NOx technology for firetube and watertube boilers. And, in many applications, it does not require any additional reduction equipment to comply with the most stringent regulations in the United States.

Flue gas recirculation technology can be classified into two types; external or induced.

External flue gas recirculation utilizes an external fan to recirculate the flue gases back into the combustion zone. External piping routes the exhaust gases from the stack to the burner. A valve controls the recirculation rate, based on boiler input.

Induced flue gas recirculation utilizes the combustion air fan to recirculate the flue gases back into the combustion zone. A portion of the flue gases are routed by duct work or internally to the combustion air fan, where they are premixed with the combustion air and introduced into the flame through the burner. New designs of induced FGR that utilize an integral FGR design are becoming popular among boiler owners and operators because of their uncomplicated design and reliability.

Theoretically, there is no limit to the amount of NOx reduction with FGR; practically, there is a physical, feasible limit. The limit of NOx reduction varies for different fuels – 90 percent for natural gas and 25 to 30 percent for standard fuel oils.

The current trends with low NOx technologies are to design the boiler and low NOx equipment as a package. Designing as a true package allows the NOx control technology to be specifically tailored to match the boiler's furnace design features, such as shape, volume, and heat release. By designing the low NOx technology as a package with the boiler, the effects of the low NOx technology on boiler operating parameters (turndown, capacity, efficiency, and CO levels) can be addressed and minimized."

Post Combustion Control Methods

"**Selective Non-Catalytic Reduction**: Selective non-catalytic reduction involves the injection of a NOx reducing agent, such as ammonia or urea, in the boiler exhaust gases at a temperature of approximately 1,400 to 1,600 degrees Fahrenheit. The ammonia or urea breaks down the NOx in the exhaust gases into water and atmospheric nitrogen. Selective non-catalytic reduction reduces NOx up to 50 percent. However, the technology is extremely difficult to apply to industrial boilers that modulate frequently. This is because the ammonia (or urea) must be injected in the flue gases at a specific flue gas temperature. And in industrial boilers that modulate frequently, the location of the exhaust gases at the specified temperature is constantly changing. Thus, it is not feasible to apply selective non-catalytic reduction to industrial boilers that have high turndown capabilities and modulate frequently."

"**Selective Catalytic Reduction**: Selective catalytic reduction involves the injection of ammonia in the boiler exhaust gases in the presence of a catalyst. The catalyst allows the ammonia to reduce NOx levels at lower exhaust temperatures than selective non-catalytic reduction. Unlike selective non-catalytic reduction, where the exhaust gases must be approximately 1,400 to 1,600 degrees Fahrenheit, selective catalytic reduction can be utilized where exhaust gases are between 500 and 1,200 degrees Fahrenheit, depending on the catalyst used [NRG Paxton note: per the EPA Air Pollution Control Cost Manual, Section 4-NOx Control, Chapter 2-Selective Catalytic Reduction (May 2016), the optimum operating range is between 480 and 800 degrees Fahrenheit]. Selective catalytic reduction can result in NOx reductions up to 90 percent [NRG Paxton note: Boiler 13 and 14 are fitted with economizers which further reduce flue gas temperatures to well below 500 degrees Fahrenheit; operation outside of the generally recommended temperature zone dramatically reduces the effectiveness of this type of control]. However, it is costly to use and rarely can be cost justified on boilers with inputs less than 100 MBtuh."

§129.92(b)(1) - A ranking of the available control options in descending order of control effectiveness is presented below.

- Selective Catalytic Reduction (SCR) – reductions as high as 90 percent may be realized under optimal boiler operating conditions (Cost Control Manual, Chapter 2, Section 4, May 2016)
- Flue Gas Recirculation (FGR) – reductions are a function of recirculation percentages; recirculation rates of 20 percent may realize NOx reductions as high as 50 percent (AP-42, §1.3.4.3)
- Selective Non-Catalytic Reduction (SNCR) – NOx reductions of 30 to 75 percent can be realized under optimal boiler operating conditions (Cost Control Manual, Chapter 1, Section 4, May 2016)
- Burner Modifications – reductions between 40 and 85 percent are possible (AP-42, §§ 1.3.4.3 and 1.4.4)
- Low Excess Air Firing (LEA) – modest reductions of 10 to 20 percent are expected (AP-42, §1.3.4.3)
- Water/Steam Injection – control can be extremely effective but high rates of injection adversely impact boiler efficiency thus limiting the practical use of this technology to achieve high levels of control

§129.92(b)(2) - An evaluation of the technical feasibility of the available control options identified in subsection (b)(1) is presented below.

- Selective Catalytic Reduction – Although the technology can achieve very high levels of NOx control, the expected flue gas temperatures for Boilers 13 and 14 are well below the effective range typically required for the application of SCR controls. This control is being eliminated from further consideration on the basis that it is not technically feasible.

- Flue Gas Recirculation – FGR is a commonly-applied technology which has been widely applied to industrial boilers, although the operating costs increase with recirculation rates as the increased flows require more energy to operate recirculation fans. This technology will be included for further analysis as it is widely applied on similar emission units and therefore considered feasible. The technology is an effective thermal NOx control but is expected to have little effect on reducing fuel NOx formation.

- Selective Non-Catalytic Reduction – The narrative description presented above identifies problems with applying this technology to industrial boilers. Boilers that cycle and modulate, such as those used in heating applications, make it difficult to locate the necessary temperature zone for ammonia injection. This technology is being eliminated from further analysis for reasons stated previously in this narrative.

- Burner Modifications – Low NOx burners (LNB) have been widely used in gas-fired boiler applications. The most effective control results when combining LNB technology with other techniques such as FGR. The technology has been demonstrated to significantly reduce thermal NOx formation but is not expected to have a significant impact on fuel NOx formation.

- Low Excess Air Firing – The modest levels of reduction coupled with the already relatively low NOx levels permitted at NRG Paxton make it unlikely that this technology would yield cost-effective benefits. An oxygen trim system that is designed to maintain an optimum air-to-fuel ratio is currently installed and operated on Boilers 13 and 14. This technology will not be subject to additional review due to the very modest levels of control achievable; control of fuel NOx would be negligible

- Water/Steam Injection – NOx control can be extremely effective but high rates of injection adversely impact boiler efficiency thus limiting the practical use of this technology to achieve high levels of control. Because of the potential adverse impacts on boiler performance, and the availability of other technologies capable of similar or better levels of control, this technology will not be included for further analysis.

Based on the evaluations presented above and boiler vendor recommendations, NRG Paxton has selected flue gas recirculation (FGR) and burner modification (LNB) for further evaluation. FGR at two levels, 4.5 percent and 15 percent, and 15 percent FGR with an LNB will be analyzed for cost effectiveness.

§129.92(b)(3) - A ranking of the technically feasible control options in order of overall control effectiveness for NO_x emissions is presented below. The following three NOx emissions control options were considered (listed in increasing order of control effectiveness):

- Control Option No. 1 – FGR @ 4.5% recirculation rate
- Control Option No. 2 - FGR @ 15% recirculation rate with a new forced draft (FD) fan
- Control Option No. 3 - FGR @ 15% recirculation rate with a new FD fan and LNB

NOx control effectiveness and associated cost information was obtained from a recently-generated vendor quote for the NRG Pittsburgh Energy Center, please see below.

Babcock & Wilcox

NRG Pittsburgh Steam Plant									October 26, 2016
Submitted by Joe Bisesi							Pricing is estimated +/- 15%		
FM-1158 (2 Units)	NOx	Units	NOx	Units	% FGR	Equipment Required	Material	Labor	Total
Natural Gas - Case 1	0.100	LB/MMBTU	82	PPM*	0	New Burner	$165,000	$100,000	$265,000
Natural Gas - Case 2	0.100	LB/MMBTU	82	PPM*	4.5	FGR Duct	$108,000	$145,000	$253,000
Natural Gas - Case 3	0.050	LB/MMBTU	41	PPM*	15	FD Fan/FGR Duct	$175,000	$210,000	$385,000
Natural Gas - Case 4	0.036	LB/MMBTU	30	PPM*	15	Burner/FD Fan/FGR Duct	$340,000	$357,000	$697,000
Oil - Case 1	0.12**	LB/MMBTU	~100	PPM*	**Oil Guarantees will be based on B&W Standard #2 Oil Analysis				
* Corrected to 3% O2 Dry (ALL EMISSIONS NUMBERS ARE REPRESENTATIVE OF GUARANTEE LEVELS)									
CO guarantee of 100 PPM will be targeted, but B&W needs to perform baseline testing at full load							Pricing is estimated +/- 15%		
FM-2199	NOx	Units	NOx	Units	% FGR	Equipment Required	Material	Labor	Total
Natural Gas - Case 1	0.100	LB/MMBTU	82	PPM*	0	New Burner	$175,000	$100,000	$275,000
Natural Gas - Case 2	0.100	LB/MMBTU	82	PPM*	4.5	FGR Duct	$108,000	$145,000	$253,000
Natural Gas - Case 3	0.050	LB/MMBTU	41	PPM*	15	FD Fan/FGR Duct	$190,000	$228,000	$418,000
Natural Gas - Case 4	0.036	LB/MMBTU	30	PPM*	15	Burner/FD Fan/FGR Duct	$365,000	$385,000	$750,000
Oil - Case 1	0.12**	LB/MMBTU	~100	PPM*	**Oil Guarantees will be based on B&W Standard #2 Oil Analysis				
* Corrected to 3% O2 Dry (ALL EMISSIONS NUMBERS ARE REPRESENTATIVE OF GUARANTEE LEVELS)									
CO guarantee of 100 PPM will be targeted, but B&W needs to perform baseline testing at full load							Pricing is estimated +/- 15%		
All Three Units						Equipment Required	Material	Labor	Total
Natural Gas - Case 1						New Burner	$505,000	$300,000	$805,000
Natural Gas - Case 2						FGR Duct	$324,000	$435,000	$759,000
Natural Gas - Case 3						FD Fan/FGR Duct	$540,000	$648,000	$1,188,000
Natural Gas - Case 4						Burner/FD Fan/FGR Duct	$1,045,000	$1,099,000	$2,144,000
Oil - Case 1						New Burner	$505,000	$300,000	$805,000

B&W Standard Oil Analysis:

Ultimate Analysis		Units	
Carbon	87	% weight	HHV
H_2	12.5	% weight	19,300
Sulfur	0.3	% weight	BTU/LB
Nitrogen	0.02	% weight	
Oxygen	0.18	% weight	
H_2O	0	% weight	
Total	100	% weight	

The NRG Pittsburgh Energy Center operates three conventional package boilers that provide steam for a district energy system. All three boilers are capable of being fired with either natural gas (primary fuel) or No. 2 fuel oil (used only when natural gas is unavailable from the supplier), and like the NRG Paxton boilers, are installed and operated with an oxygen trim system. Two boilers (identified as FM-1158 in the quote above) at the NRG Pittsburgh Energy Center are rated at 92 MMBtu/hr while the other boiler (FM-2199) is rated at 131.1 MMBtu/hr. The vendor quote provides the NOx emission rate guarantee (lb/MMBtu) for natural gas-firing operations for each of the control options listed above. Because the vendor quote does not include NOx emission rate guarantees for No. 6 fuel oil firing operations, NRG Paxton estimated the NOx control effectiveness from the baseline NOx emission rate (0.40 lb/MMBtu) based on AP-42, Table 1.3-14. The NOx control effectiveness values are estimated to be 10 percent (0.36 lb/MMBtu), 30 percent (0.28 lb/MMBtu) and 50 percent (0.20 lb/MMBtu) for Control Option Nos. 1, 2 and 3, respectively.

§129.92(b)(4) - An evaluation of cost effectiveness of each control option consistent with the ''OAQPS Control Cost Manual'' (Fourth Edition), EPA 450/3-90-006 January 1990 and subsequent revisions and a related guidance document (attached herein) is presented in the following tables:

Table 1 – Capital Cost Estimates
Table 2 – Annualized Cost Estimates
Table 3 – Cost-Effectiveness Estimates

As previously noted in this document, for this alternate NOx RACT proposal, NRG Paxton will limit NOx emissions as follows (proposed conditions are each applicable to Boilers 13 and 14, a "year" means any consecutive 12-month period):

NOx emissions ≤ 46.0 ton / yr, which is the baseline emission rate used in the calculations

Natural gas usage ≤ 584 MMscf / yr
(based on a current NOx emission rate = 0.15 lb/MMBtu, 1050 Btu/scf GCV)

No. 6 fuel oil usage ≤ 1533.3 Mgal / yr
(based on a current NOx emission rate = 0.40 lb/MMBtu, 150,000 Btu/gal GCV)

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Conclusion per §129.99(d)(7)

Per Table 3, because all of the average cost effectiveness values are in excess of $8000 / ton NOx removed, NRG Paxton submits that the three evaluated control options are cost prohibitive. NRG Paxton requests the Department's approval of the alternative NOx RACT emission requirements and limits listed above. The lb/MMBtu NOx emission limits included in the current Title V operating permit (0.23 lb/MMBtu for natural gas-firing operations. 0.44 lb/MMBtu for No. 6 oil-firing operations) are unchanged.

NRG Energy Center Paxton LLC
PA DEP RACT II Rule - Case-by-Case NOx RACT Proposal for Boilers 13 and 14
Table 1 - Capital Cost Estimates *

Cost Item	Computation Method	Factor	Costs for Each NOx Control Option			Notes
			Option 1	Option 2	Option 3	
Direct Costs						
Purchased Equipment (PE)	Vendor Quote x factor	1.34	$144,914	$254,941	$489,756	Vendor quote for boiler rated at 131.1 MMBtu/hr at NRG Pittsburgh Energy Center (see Appendix); factor = $(214/131.1)^{0.6}$, based on "sixth-tenths factor" rule per Section 3.2 of Engineering Guide #46
Taxes	PE x factor	0.06	$8,695	$15,296	$29,385	6% PA sales tax
Freight	PE x factor	0.05	$7,246	$12,747	$24,488	
Total Purchased Equipment Costs (PEC)	Sum		$160,855	$282,985	$543,629	
Installation Costs	Vendor Quote	1	$145,000	$228,000	$385,000	
Total Direct Costs (TDC)	Sum PEC + Installation Costs	1	$305,855	$510,985	$928,629	
Installation Costs, Indirect						
Engineering / supervision	TDC x factor	0.10	$30,585	$51,098	$92,863	Per Table 4.3 of Engineering Guide #46
Construction / field expenses	TDC x factor	0.10	$30,585	$51,098	$92,863	Per Table 4.3 of Engineering Guide #46
Construction fee	TDC x factor	0.10	$30,585	$51,098	$92,863	Per Table 4.3 of Engineering Guide #46
Start-up	TDC x factor	0.01	$3,059	$5,110	$9,286	Per Table 4.3 of Engineering Guide #46
Performance test	TDC x factor	0.01	$3,059	$5,110	$9,286	Per Table 4.3 of Engineering Guide #46
Model Study	TDC x factor	0	$0	$0	$0	Per Table 4.3 of Engineering Guide #46
Contingencies	TDC x factor	0.15	$45,878	$76,648	$139,294	Vendor Quote
Total Indirect Costs (TIC)	Sum	0.47	$143,752	$240,163	$436,456	
Total Capital Investment (TCI)	Sum TDC + TIC	1	$449,606	$751,148	$1,365,084	

*: Prepared per Ohio EPA Engineering Guide #46 - Determination of Cost-Effectiveness for BAT and RACM Evaluations, Table C-1

NOx Control Option 1: FGR (4.5% recirculation rate) (the costs are the same for each boiler)
NOx Control Option 2: FGR (15% recirculation rate) + FD fan
NOx Control Option 3: FGR (15% recirculation rate) + FD fan + low-NOx burners

NRG Energy Center Paxton LLC
PA DEP RACT II Rule - Case-by-Case NOx RACT Proposal for Boilers 13 and 14
Table 2 - Annualized Cost Estimates **

Cost Item	Computation Method	Factor	Costs for Each NOx Control Option			Notes
			Option 1	Option 2	Option 3	
Direct Operating Costs						
Operating Labor - Operator (OL)	(0.5 man-hours / shift) x (equivalent shifts / yr) x factor	60.00	$22,500	$22,500	$22,500	Per Table 5-2 of Engineering Guide #46; factor = typical loaded labor rate ($/hr)
Operating Labor - Supervision	OL x factor	0.15	$3,375	$3,375	$3,375	
Maintenance Labor (ML)	(0.5 man-hours / shift) x (equivalent shifts / yr) x factor	60.00	$22,500	$22,500	$22,500	Per Table 5-2 of Engineering Guide #46; factor = typical loaded labor rate ($/hr)
Maintenance Materials	100% of ML	1	$22,500	$22,500	$22,500	
Utilities - Electricity						
Additional Fan Power KWh	Calculation - see below KWh x factor	1 0.10	$7,478	$27,037	$27,037	Per Section 5.3.1 of Engineering Guide #46 Factor = typical electricity cost ($/KWh)
Total Direct Operating Costs (DOC)	Sum		$78,353	$97,912	$97,912	
Indirect Operating Costs						
Overhead	(OL + ML) x factor	0.80	$36,000	$36,000	$36,000	
Property Tax	TCI x factor	0.01	$4,496	$7,511	$13,651	
Insurance	TCI x factor	0.01	$4,496	$7,511	$13,651	
Administration	TCI x factor	0.02	$8,992	$15,023	$27,302	
Capital Recovery	TCI x factor	0.10979	$49,362	$82,469	$149,873	Factor per Table B-1 Engineering Guide #46
Total Indirect Operating Costs (IOC)	Sum		$103,347	$148,514	$240,476	
Total Annualized Cost (TAC)	Sum DOC+ IOC	1	$181,700	$246,426	$338,388	

**: Prepared per Ohio EPA Engineering Guide #46 - Determination of Cost-Effectiveness for BAT and RACM Evaluations, Table C-2

NOx Control Option 1: FGR (4.5% recirculation rate) (the costs are the same for each boiler)
NOx Control Option 2: FGR (15% recirculation rate) + FD fan
NOx Control Option 3: FGR (15% recirculation rate) + FD fan + low-NOx burners

Assumptions for Calculations	Operating hours per year	6000	operating hours / yr	
	Equivalent shifts per year	750		
	Typical flue gas %O2, dry	4.5	%, dry	per 2014 compliance stack test
	Typical Max Heat Input	163.2	MMBtu/hr	per 2014 compliance stack test
	Calculated flue gas flow rate	30,192	dscfm	using EPA RM 19 F-factor for natural gas (8710 dscf/MMBtu)
	Calculated flue gas flow rate	53,096	acfm	assumes 350 deg. F, 29.0 in. Hg stack pressure, 10% H2O content
	4.5% FGR			
	Increase in ΔP	1.3	in. H2O	Engineering estimate
	Additional Fan Power	74,782	KWh	0.746 x acfm x ΔP x operating hours / (6356 x 0.65)
	15% FGR (w and wo LNB)			
	Increase in ΔP	4.7	in. H2O	Engineering estimate
	Additional Fan Power	270,366	KWh	0.746 x acfm x ΔP x operating hours / (6356 x 0.65)
	Capital Recovery Factor	0.10979		Per Table B-1 to Engineering Guide #46
	Equipment Life	15	years	Per Table B-1 to Engineering Guide #46
	Annual Compounded Interest	7	%	Per Table B-1 to Engineering Guide #46

NRG Energy Center Paxton LLC
PA DEP RACT II Rule - Case-by-Case NOx RACT Proposal for Boilers 13 and 14
Table 3 - Cost-Effectiveness Estimates

For each control option, the cost-effectiveness values represent the extremes (either all natural gas firing or all No. 6 oil firing)

Control Option No.	Description	Fuel	NOx Before (tons/yr)	NOx Emission Rate (lb/MMBtu) !	NOx After (tons/yr)	Total Annualized Cost ($/yr)	Cost Effectiveness ($ / ton NOx Reduced)	
							Average	Incremental
1	FGR @ 4.5% recirculation	Natural Gas	46.0	0.100	30.7	$181,700	$11,850	
		No. 6 Fuel Oil	46.0	0.36	41.4	$181,700	$39,500	
2	FGR @ 15% recirculation + FD fan	Natural Gas	46.0	0.050	15.3	$246,426	$8,036	$4,221
		No. 6 Fuel Oil	46.0	0.28	32.2	$246,426	$17,857	$7,035
3	FGR @ 15% recirculation + FD fan + LNB	Natural Gas	46.0	0.036	11.0	$338,388	$9,679	$21,420
		No. 6 Fuel Oil	46.0	0.20	23.0	$338,388	$14,713	$9,996
							↑	
							All > $8000	

!: Vendor guarantee for natural gas firing, engineering estimate for No. 6 fuel oil firing (the costs are the same for each boiler)

Current NOx Emission Rates

Natural Gas	0.15	lb/MMBtu
No. 6 Fuel Oil	0.40	lb/MMBtu

Estimated Maximum Annual Fuel Use @ Current NOx Emission Rates

Natural Gas	584	MMscf @ 1050 Btu/scf	equivalent to	613,333	MMBtu/yr
No. 6 Fuel Oil	1,533,333	gal @ 150,000 Btu/gal	equivalent to	230,000	MMBtu/yr

ATTACHMENT C

CERTIFICATION

TRUTH, ACCURACY, AND COMPLETENESS CERTIFICATION BY RESPONSIBLE OFFICIAL		
I certify that, based on information and belief formed after reasonable inquiry, the statements and information contained in the attached RACT III case-by-case proposal are true, accurate and complete.		
Signature		Date 12-16-2022
Responsible Official Name	David S. Fiebig	
Responsible Official Title	Plant Manager	