CITY OF PHILADELPHIA
Department of Public Health
Environmental Protection Division
Air Management Services

InterOffice Memo

To: File

From: Kassahun Sellassie

Date: June 12, 2015

Subject: 1997 8-Hour RACT Analysis for Honeywell International, Frankford Plant

Introduction:

The Clean Air Act (CAA) requires that moderate (or worse) ozone nonattainment areas implement reasonably available control technology (RACT) controls on all major sources of Volatile Organic Compounds (VOC) and Nitrogen Oxides (NOx). Philadelphia County is part of the Philadelphia-Wilmington-Atlantic City moderate ozone nonattainment area for the 1997 8-hour ozone NAAQS. This document presents the findings of a RACT evaluation for the 1997 8-hour ozone standard for this facility.

Company Description:

Honeywell International (formerly Sunoco Chemical) – Frankford Plant owns and operates a chemical manufacturing facility located at 4700 Bermuda Street, Philadelphia, PA 19137-1193. The facility's air emissions sources include two 260 MMBTU/hr boilers, one 381 MMBTU/hr boiler, one (1) 50 HP boiler, six (6) emergency generators, two (2) emergency fire pumps, one (1) non-emergency air compressor, distillation columns, condensers, oxidation processes, reactors, phenol and alpha-methyl styrene loading, and storage tanks. Control devices include scrubbers, charcoal absorbers, a thermal oxidizer, and four catalytic oxidizers.

Applicability for NOx and VOC RACT:

Honeywell is a major source of NOx due to having potential NOx emissions greater than 100 tons per year, the major source threshold in Philadelphia County that is applicable to NOx RACT. This facility is also a major source of VOC having potential VOC emissions greater than 50 tons per year, the major source threshold in Philadelphia County that is applicable to VOC RACT for the 1997 8-hour ozone NAAQS. The facility is a 1-hour RACT source (PA Permit Number 51-1551) dated July27, 1999, and approved into the SIP by EPA on 10/30/2001 (66FR 54710).

Process Descriptions:

I. Boilers
   (1) Boiler #1: 260 MMBTU/hr, firing waste phenol residue, gas or #6 fuel oil
   (2) Boiler #2: 260 MMBTU/hr, firing waste phenol residue, gas or #6 fuel oil
   (3) Boiler #3: 381MMBTU/hr, firing gas or #6 fuel oil only
   (4) Boiler at barge loading facility: 50 HP (below 20 MMBTU/hr), firing #2 fuel oil. -

II. Oxidation Processes: OX-501, OX-401, OX-301/302, OX-201/202. These units are used to manufacture synthetic organic chemicals.

III. Distillation Columns: CL-101, CL-111, CL-112, CL113, CL-114, CL-120, CL-121, CL-200, CL-201, CL-203, CL-204, CL-205, CL-206, CL-208, CL-220, CL-300, CL-301, CL-302, CL-303, CL-304, CL-305, CL-306, CL-308, CL-601, PF-201, PF-301. These units are used to manufacture synthetic organic chemicals.

IV. Reactors: Decomposer Reactor:VT-208 and VT-307, Springer Reactor: VT-612, pH adjustment Reactor:VT-613, Plug Flow Reactors:PFR-1, PFR-2, PFR-3. These units are used to manufacture synthetic organic chemicals.

V. Barge Loading

VI. Tank Truck, Rail Car, and Drum Loading

VII. Storage Tanks: VT-609, VT-610, VT-332, VT-629, VT-630, VT-504, VT-119, VT-243, VT-117, VT-129, VT-131, VT-133, VT-229, VT-354, VT-355, VT-633, VT-234, VT-001, VT-002, VT-119, VT-121, VT-142, VT-143, VT-148, VT-229, VT-243, VT-244, VT-248, VT-248A, VT-249, VT-250, VT-332, VT-335, VT-650, VT-609, VT-610, VT-614, VT-617, VT-635, VT-610

VIII. Fugitive Emission Sources: pumps, valves, flanges, compressors, pressure relief valves, and rupture disks

IX. Rail Car Cleaning

X. Wastewater Facilities

XI. Emergency Generators (6) and Diesel Pumps (2): Each burns diesel.

XII. Portable Air Compressor: 140 HP, burns diesel.

RACT Analysis:

Presumptive or CTG RACT requirements

The following emissions units are subject to presumptive or CTG RACT requirements

I. Barge Loading Facility Boiler: The boiler at the barge loading facility is complying with presumptive RACT requirements of PA 129.93(c). This boiler has a capacity of less than 20 MMBTU/hr.

II. Oxidation Processes: These reactors shall be compliance with the regulation AMR V Section XVI (the VOC CTG for SOCMI). All VOC emissions for each oxidation process shall be controlled by an overall control efficiency of 98% or maintain a Total Resource Effectiveness (TRE) > 1. These are SOCMI sources use for cumene oxidation use for phenol, acetone, and alpha-methyl styrene production.

III. Distillation Columns: These distillation columns shall be compliance with the regulation AMR V Section XVI (the VOC CTG for SOCMI). All VOC emissions for each distillation column shall be controlled by an overall control efficiency of 98% or maintain a TRE > 1. These are SOCMI sources use for phenol, acetone, and alpha-methyl styrene production.

IV. Reactors: These Reactors shall be compliance with the regulation AMR V Section XVI (the VOC CTG for SOCMI). All VOC emissions for each reactor shall be controlled by an overall control efficiency of 98% or maintain a
TRE > 1 or operate with a vent stream flow rate less than 0.011 scm/min. These are SOCMI sources use for phenol, acetone, and alpha-methyl styrene production and decomposition.

V. Storage Tanks: Besides storage tanks VT-609 and VT-610, all storage tanks are subject to and comply with 25 PA Code Section 129.56 or 129.57, which is the applicable VOC CTG RACT regulation.

VI. Fugitive Emission Sources (Equipment Leaks): Honeywell has implemented a Leak Detection And Repair (LDAR) program for fugitive VOC emission sources. At a minimum this would comply with AMS Regulation AMR V Section XIII (B) (the VOC CTG for Equipment Leaks) for process Equipment Leaks and presumptive RACT.

VII. Emergency Generators and Fire Pumps: Each unit shall be in compliance with the presumptive RACT requirements of 25 Pa Code Section 129.93(c)(5), which requires each to be installed, maintained, and operated in accordance with manufacturers specifications. Each unit is limited to operating less than 500 hours per rolling 12-month period, as approved in Title V/State Operating Permit No. V95-047 for the emergency generators and Installation Permit Nos. 12095 & 12096 dated 8/22/12 for the emergency fire pumps.

De Minimis Emissions Sources

The following are considered sources with de minimis emissions of VOC, for which RACT will not be further evaluated:

I. Truck, Rail, and Drum Loading: Truck, rail and drum loading at Honeywell are considered to be de minimis VOC sources. The VOC PTE for these processes is 1.6 tons per rolling 12-month. Adding controls to a source with this emission level is economically unreasonable.

Other:- Non-Stationary Sources

The 140 HP air compressor is a portable unit that is required by a permit condition in Installation Permit No. 12016A to meet the definition of a nonroad engine 40 CFR 89.2, which includes not remaining at a location for 12 consecutive months for a source that is not seasonal. It is not a stationary source under Federal regulations and is therefore **not applicable to RACT**. ~~It will become a stationary source applicable to RACT should it fail to meet the definition of nonraod engine in the future.~~

Case-by-Case RACT Analysis

Barge Loading

As approved in the 1-hour RACT determination, Honeywell shall not load any VOC with a vapor pressure in excess of 1.5 psia at 20 degrees Celsius without Air Management Services (AMS) approval. Due to the fact that the VOC potential to emit (PTE) for this unit is 4.2 tons per rolling 12-months, AMS determines that this is a de minims emission source that does not require further evaluation. AMS determines that the 1-hour RACT continue to represent RACT for the 1997 8-hour ozone standard.

Storage Tanks VT-609 and VT-610

As approved in the 1-hour RACT determination, Honeywell shall install and maintain internal floating roofs on tanks VT-609 and VT-610. These tanks store phenol and wastewater which has a vapor pressure of less than 1.5 psi. AMS determines that these are de minimis emission sources that do not require any further evaluation. AMS determines that the 1-hour RACT continue to represent RACT for the 1997 8-hour ozone standard.

Rail Car Cleaning

As approved in the 1-hour RACT determination, rail car cleaning emissions shall not exceed 2.7 tons per rolling 12-month period. AMS determines that this is a de minims emission source that does not require further evaluation. AMS determines that the 1-hour RACT continue to represent RACT for the 1997 8-hour ozone standard.

Wastewater Facilities

As approved in the 1-hour RACT determination, the thermal oxidizer will control VOC emissions from the air stripper at the wastewater facility and will have destruction efficiency not less than 95%. This requirement has been approved as RACT in the 1-hour RACT determination. Due to the fact that the VOC PTE for this unit is 1.6 tons per rolling 12 –month period, AMS determines that this is a de minims emission source that does not require further evaluation. AMS proposes that the 1-hour RACT continue to represent RACT for the 1997 8-hour ozone standard.

Boilers #1 and #2

Units Description:
Boiler #1: 260 MMBTU/hr, firing waste residue, gas or #6 fuel oil
Boiler #2: 260 MMBTU/hr, firing waste residue, gas or #6 fuel oil

The following case-by-case requirements are contained in in Condition 2A and 3A of the SIP-approved 1-hour RACT plan approval for Boilers #1 & #2:

- During the period of May 1st through September 30th, Boiler #1 and #2 shall only burn natural gas and waste phenol residue except if there is a natural gas emergency. An emergency may include natural gas curtailment due to supply line failure into the plant or cases of a required environmental compliance-testing program. During such emergencies, #6 fuel oil may be used.

- Honeywell shall operate Boilers #1 and #2 on phenol residue (a non-fossil fuel) at 51% or greater annual heat input based on BTU value. Boiler #1 and #2 each has a NOx emission limitation not to exceed 0.35 pounds of NOx per MMBTU, and a combined NOx emissions limitation not to exceed 272 tons per year.

- Honeywell shall perform, at a minimum, the annual combustion tuning specifications as cited in 25 PA 129.93(b)(2) through (5).

Source Modification:

Improved efficiencies at the facility have reduced the amount of waste phenol residue produced, making it harder for the facility to meet the 51% minimum annual heat input requirement from this fuel. As a result, Honeywell requested changing the condition to be able to burn waste phenol residue and natural gas combined in order to meet the 51% or greater limit and, when natural gas curtailments and test programs occur, #6 fuel oil could use up to 49%.

Under the Second Amendment to a Consent Decree between EPA, several states, the City of Philadelphia, and Sunoco, Inc. (Civil Action No.05-02866), Honeywell (at that time Sunoco Chemicals, which had common ownership with Sunoco, Inc.) was required to eliminate fuel oil burning in Boilers #1 and #2, except during natural gas curtailments, losses of supply, and during stack test programs.

Under this amendment to the Consent Decree, oil usage was allowed during natural gas curtailments or other supply losses because it could significantly curtail or shut down the boilers if they were not allowed to burn No. 6 oil and there was not a sufficient supply of waste phenol residue at the time. This would cause the operation of the entire plant to be severely curtailed or shut down.

Under this amendment to the Consent Decree, oil usage was allowed during stack test programs because it creates a larger range of emissions, which allows for better verification of CEMS performance during Relative Accuracy Test Audits (RATAs) and better combustion tuning. Better CEMS performance improves the monitoring of emissions and better combustion tuning helps reduce emissions.

Because of the above items, Plan Approval No. 07163 dated January 23, 2013 was issued. The first two paragraphs of Condition 2A of the 1-hour RACT plan approval (the first two bullet points above) were replaced by the following:

- Boiler #1 and Boiler #2 shall only burn natural gas and waste phenol residue except if there is a natural gas curtailments and other losses of supply (e.g. PGW supply line failure or maintenance activity) or during stack testing programs (e.g. annual CEM RATA testing, annual combustion tuning, and combustion performance testing, as required). During such events, No. 6 fuel oil may be used.

These modifications were never incorporated into the SIP.

<u>Proposed Modifications to the 1-hour RACT SIP</u>

Based on a statistical analysis of CEM data from 1/1/13 through 11/1/14 and noting NOx emissions as high as 0.26 lbs/MMBTU, AMS determined that Boilers #1 and #2 could meet a NOx emission limit of 0.28 lbs/MMBTU on a rolling 30-day average during normal operation (while burning natural gas, waste phenol residue, or a combination of the two) under their existing technologies. Thus, AMS has determined this NOx emission limit to be RACT for each boiler for burning natural gas, waste phenol residue, or a combination of the two fuels. AMS is also proposing to keep the existing 0.35 lbs/MMBTU limit for each boiler to apply when burning no. 6 oil.

The limitation that only allows burning No. 6 oil during times of natural gas supply loss is more stringent than the implied maximum 49% No. 6 oil requirement from Plan Approval No. 07163. Additionally, AMS is removing the minimum 51% phenol waste limit from RACT and, for the reason mentioned above, is not replacing it with the maximum of 49% No. 6 oil limit in Plan Approval No. 07163. Because of the restriction on No. 6 oil use, residual phenol waste will be replaced with natural gas in all but limited occasions. CEMS data has shown lower emissions from burning natural gas than burning waste phenol residue, over 30% lower during a one-month sample period. The calculations provided below compare the 1-hour RACT and 8-hour RACT potential emissions and show that these modifications will result in the same level of emissions (in terms of NOx PTE) due to the existing combined annual NOx limit of 272 tpy for these boilers.

Emission Comparison between the 1 – hour RACT and the proposed modification (8-hour RACT) for Boiler #1 and Boiler #2

	Capacity (MMBTU/hr)	Emission Limit (lbs/MMBTU)	NOx PTE (lbs/hr)	NOx PTE (tpy)
1-hour RACT	260	0.35	91	272[2]
8-hour RACT	260	0.35[1]	91	272[2]
Change			0	0

[1]Used the No. 6 oil limit since it is the highest emission limit under 8-hour RACT. This assumes a worst case scenario where natura gas is interrupted for the entire year. The NOx emission limit while burning natural gas, waste phenol residue, or a combination of these fuels under the 8-hour RACT plan approval is 0.28 lbs/MMBTU and the associated NOx PTE is 72.8 lbs/hr.
[2]Used the combined annual NOx emission limit of 272 tpy as the annual NOx PTE for both boilers under both the 1-hour and 8-hour RACT. This is lower than a calculated annual PTE for each boiler based on the 260 MMBTU/hr rated capacity, 0.35 lbs/MMBTU NOx emission limit for each boiler, and 8,760 hrs/yr, which is 398.6 tpy NOx. It is also lower than a calculated annual PTE for each boiler using the 8-hour NOx limit of 0.28 lbs/MMBTU for normal operation, which is 318.9 tpy NOx, or any calculated annual PTE assuming a certain amount or percentage of No. 6 oil.

The table shows there is no change in potential NOx emissions for these boilers on either an hourly or annual basis. Since the boilers will only be allowed to burn No. 6 oil in limited situations, actual NOx emissions will be lower than indicated in the above table.

AMS is making the following changes to the 1-hr RACT determination for Boilers #1 and #2:

The first two paragraphs of Condition 2A of the 1 hr RACT plan approval will be replaced by the following:

- Boilers #1 and #2 shall only burn natural gas and waste phenol residue except if there is a natural gas curtailment, other loss of supply (e.g. PGW supply line failure or maintenance activity), or during stack testing programs (e.g. annual CEM RATA testing, annual combustion tuning, and combustion performance testing, as required). During such events No. 6 fuel oil may be used. Boiler #3 shall only burn natural gas and waste phenol residue except if there is a natural gas curtailment, other loss of supply, or during stack testing programs. During such events No. 6 fuel oil may be used.

Condition 4A will be modified by revising the language below:

- The emission rates for Boilers #1 and #2

  (1) Shall not exceed 0.28 pounds of NOx per MMBTU each, on a rolling 30-day average, while burning natural gas, waste phenol residue, or a combination of these fuels;
  (2) Shall not exceed and 0.35 pounds of NOx per MMBTU each while burning No. 6 oil;
  (3) The combined NOx emissions for Boiler #1 and Boiler #2 shall not exceed 272 tons per year.

For clarity, the Boiler #3 emission limits will be moved to a new Condition 4B:

- The emission rate of Boiler #3 shall not exceed 0.12 pounds of NOx per MMBTU on a rolling 30-day average while burning natural gas or 0.3pounds of NOx per MMBTU while burning No. 6 oil.

Testing, Monitoring, and Recordkeeping: Condition 7.B has been modified as follows (wording in bold underlined was added to the existing condition):

B. The records shall provide sufficient data and calculations to clearly demonstrate that the requirements of §129.91-129.94 are met. These shall include:

  (1) Continuous nitrogen oxides and oxygen monitor records for Boiler # 1, Boiler #2, and Boiler #3.
  (2) Fuel type and monthly fuel usage.
  (3) Monthly records demonstrating compliance with the combined tons per year NOx limit for Boilers #1 and Boiler #2 in Condition 4.A.
  (4) Records of each time No. 6 oil is burned and the reason why.

<u>8-hour RACT</u>

AMS is evaluating other control technologies that could further reduce NOx emissions from Boilers #1 and #2 as RACT. The following NOx control technologies were evaluated for case-by-case RACT.

- Selective Catalytic Reduction (SCR)
- Selective Non-Catalytic Reduction (SNCR)
- Low-NOx Burners (LNB)
- Ultra Low NOx Burner (ULNB)
- Fuel Switching
- Flue Gas Recirculation (FGR)
- Staged Combustion Air (SCA)

Boiler #1 and Boiler #2 are each subject to a Carbon Monoxide (CO) emission limit of 100 ppm per EPA's requirement in 40 CFR 63.1217(a) of the Hazardous Waste Combustor MACT regulation (40 CFR 63 Subpart EEE). This impacts the technological feasibility of some of the NOx control technologies.

The following technologies were considered technologically infeasible:

- SCR – There is not enough room in the boiler house to house an SCR unit capable of treating the flue gas for the boilers. There are also concerns that frequent load swings and low load operation (10-15% capacity for significant periods) makes placement of the catalyst difficult and makes it difficult to maintain a proper ammonia injection rate for the varying NOx emission levels.
- SNCR – Load and NOx concentration variations with the boilers makes placement of the SCNR difficult and makes it difficult to maintain a proper ammonia injection rate.
- ULNB, LNB, FGR & SCA – All of these technologies make it difficult to comply with the existing 100 ppm CO limit. A representative from boiler manufacturer Babcock & Wilcox also expressed concern that these technologies would likely result in less complete combustion of the phenol residue. As required, Honeywell needs all burners in these boilers to be able to burn waste phenol residue, so it is not technologically feasible to compartmentalize burners and install these controls only for gas or oil burning.
- Fuel Switching – The facility has already eliminated No. 6 oil burning under most situations. Eliminating waste phenol burning would have a harmful effect on the facility's management of waste phenol residue and the overall operation of the facility.

None of these technologies were considered technologically feasible. Thus, no additional controls are determined as RACT for Boilers # 1 and 2.

Therefore, AMS determines that RACT for Boilers #1 and #2 for the 1997 8-hour ozone standard shall be as stated previously and summarized as follows: Boilers #1 and #2 shall only burn natural gas and waste phenol residue except if there is a natural gas curtailment, loss of supply, or during stack testing programs. In those cases No. 6 fuel oil may be used. Honeywell shall also install and operate continuous nitrogen oxide and oxygen monitors and recorders on both boilers. In addition, RACT shall also include the following emission rates: (1) Boilers #1 and #2 shall not exceed 0.28 lbs NO_x per MMBtu, each, on a rolling 30-day average while burning natural gas, waste phenol residue, or any combination of those fuels; (2) Each boiler shall not exceed 0.35 lbs NO_x per MMBtu while burning No. 6 fuel oil; and (3) The combined NO_x emissions from both boilers shall not exceed 272 tons per year.

Boiler #3
Unit description: 381MMBTU/hr, firing gas or #6 fuel oil only

The following case-by-case RACT requirements are contained in Conditions 2A and 3A of the SIP-approved 1-hour RACT plan approval for Boiler #3:

- Boiler #3: Honeywell shall maintain and operate the low NO_X burners and internal FGR installed on Boiler #3 on May 31, 1995.

- Boiler #3 shall not exceed 0.3 pounds of NOx per MMBtu.

- Honeywell shall perform, at a minimum, the annual combustion tuning specifications as cited in 25 PA 129.93(b)(2) through (5).

Under the Second Amendment to a Consent Decree the facility was required to eliminate fuel oil burning in Boiler #3, except during natural gas curtailments, other losses of supply, and during stack test programs. AMS is incorporating this requirement into the 8-hour RACT for Boiler #3.

After reviewing CEMS data for Boiler #3, AMS has determined the 0.3 lbs/MMBTU NOx emission limit is still appropriate as RACT for Boiler #3 under existing technology while burning No. 6 oil. AMS has determined Boiler #3 can achieve a NOx emission limit of 0.12 lbs/MMBTU on a rolling 30-day average while burning natural gas. AMS has determined this limit to be NOx RACT for the 1997 8-hour ozone standard under the existing technology while burning natural gas.

AMS is evaluating other control technologies that could further NOx emissions from Boiler #3 as RACT.

Boiler #3, which has a capacity of 381 MMBTU/hr. Boiler #3 has a Low NOx burners and has a NOx emission limitation not to exceed 0.3 pounds of NOx per MMBTU.

The following were considered possible NOx controls for Boiler # 3:

- Water/Steam Injection (WI)
- Staged Combustion Air (SCA)
- Ultra Low-NO Burners (ULNB)
- Selective Non-Catalytic Reduction (SNCR)
- Selective Catalytic Reduction (SCR) and
- Ultra Low-NO Burners (ULNB) & Flue Gas Recirculation (FGR)

Detail analysis for each emission control technology as shown below:

- Water /Steam Injection – Water/steam injection is used to reduce the flame temperature, thereby reducing the formation of thermal NO_x, it is not effective in reducing fuel NO_x formation. Water/steam injection is generally not employed in boilers because of a direct reduction in thermal efficiency and greater losses from the stack resulting from increase in moisture content of the flue gas. It is also unsafe combustion conditions result from poor fuel rate control. The boiler configuration fire box does not provide sufficient minimum residence time for water injection at the current combustion temperature for acceptable steam generation to prevent process upset. Furthermore, it is not effective in reducing fuel NO_x formation. For No. 6 fuel oil for Boiler #3, water/steam injection is not effective. This method is used in gas turbine, reciprocating engines, and other internal combustion engines. This technology is ***considered technically infeasible***.
- Staged Combustion Air (SCA)- Not considered retrofit to package boiler due to installation difficulties. This technology is considered ***technically infeasible.***
- Selective Non-Catalytic Reduction (SNCR). This technology is intended for optimum exhaust gas temperature range of 1,200 ^{o}F to 2,000 ^{o}F, however, the normal operational temperature of Boiler # 3 is 300 ^{o}F. In addition, the residence time for ammonia also becomes a problem since the time required is 3 to 5 seconds. This technology is considered ***technically infeasible.***
- SCR – This technology ***considered technically feasible***.
- ULNB + FGR– ULNB is a description sometimes given to burners that emit very low levels of NOx. They typically have a longer flame than LNB, which increases the uniformity of temperature and reduces thermal NOx emissions. These technologies ***considered technically feasible.***

Further Analysis for SCR and ULNB +FGR:

The following NOx controls were determined technologically feasible for Boiler No. 3 and a summary of the cost-effectiveness for each control option is provided below. The baseline emission for Boiler #3 when burning No. 6 oil is 500.6 tons per year (tpy) and was determined based on the rated capacity of 381 MMBTU/hr, operating for 8,760 hours per year, with a 0.30 lbs/MMBTU NOx emission limit (this is the worst case scenario, assuming natural gas is interrupted for the entire year). If the baseline assumed the boiler would burn mostly natural gas with a 0.12 lbs/MMBTU NOx limit, the baseline and reductions would be reduced by more than half and the cost effectiveness in $/ton more than doubled. For more detailed calculations, please see the Appendix.

Source	Control Technology	Baseline NOx Emissions (tpy)	NOx Reduction (%)	NOx Reduction (tpy)	Total Annualized Cost	Cost Effectiveness ($/Ton)

Boiler #3	SCR	500.6	80	400	$2,499,693	$6,249
	ULNB +FGR	500.6	45	225	$5,791,297	$25,739

Additionally, the limitation on times the boiler can burn No. 6 oil and the new lower lbs/MMBTU limit for natural gas means the actual emissions will be well below this baseline for Boiler #3. All of these control options have been determined economically unreasonable for Boiler #3. Thus, for Boiler #3, AMS determines that RACT for the 1997 8-hour ozone standard shall be the following emission limits: For No. 6 oil – not to exceed 0.3 lbs/MMBtu; for natural gas – 0.12 lbs/MMBtu on a rolling 30-day average. In addition, Honeywell shall install and operate continuous nitrogen oxide and oxygen monitors and recorders and continue to implement the following conditions from the 1-hour RACT plan approval: Honeywell is required to operate the low NO_x burners and internal FGR as well as perform annual combustion tuning.

Conclusions and Recommendations for Boilers #1, #2, and #3:

AMS determines 1-hour RACT plus the modifications described above as NOx RACT for the 1997 8-hour ozone standard for Honeywell Boilers #1, #2, and #3. This includes the following requirements:

- Boilers #1 and #2 shall only burn natural gas and waste phenol residue except if there is a natural gas curtailments and other losses of supply (e.g. PGW supply line failure or maintenance activity) or during stack testing programs (e.g. annual CEM RATA testing, annual combustion tuning, and combustion performance testing, as required). During such events No. 6 fuel oil may be used. Boiler #3 shall only burn natural gas except if there is a natural gas curtailment, other loss of supply, or during stack testing programs. During such events No. 6 fuel oil may be used.

- **Boiler #3: Honeywell shall maintain and operate the low NO_X burners and FGR on Boiler #3.**

- The emission rates for Boilers #1 and #2

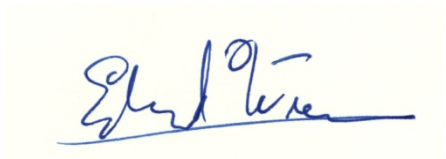
  (1) Shall not exceed 0.28 pounds of NOx per MMBTU each, on a rolling 30-day average, while burning natural gas, waste phenol residue, or a combination of these fuels;
  (2) Shall not exceed and 0.35 pounds of NOx per MMBTU each while burning No. 6 oil;
  (3) The combined NOx emissions for Boiler #1 and Boiler #2 shall not exceed 272 tons per year.

- The emission rate of Boiler #3 shall not exceed 0.12 pounds of NOx per MMBTU on a rolling 30-day average while burning natural gas or 0.3pounds of NOx per MMBTU while burning No. 6 oil.

- Continuous nitrogen oxides and oxygen monitors and recorders shall be operated on Boiler # 1, Boiler #2, and Boiler #3 in order to measure and record the concentrations of these gases emitted from the boiler stack.

- The records shall provide sufficient data and calculations to clearly demonstrate that the requirements of §129.91-129.94 are met. These shall include:

  - Continuous nitrogen oxides and oxygen monitor records for Boiler # 1, Boiler #2, and Boiler #3.
  - Fuel type and monthly fuel usage.
  - Monthly records demonstrating compliance with the combined tons per year NOx limit for Boiler #1 and Boiler #2 in Condition 4.A.
  - Records of each time No. 6 oil is burned in Boilers #1, #2, or #3 and the reason why. If the reason is gas curtailment or other loss of supply, it shall be reported to AMS.



6/12/15

Edward Wiener, Chief of Source Registration **Date**

Appendix

Detail Calculations Summary for Boiler #3

The following costs are calculated in order to evaluate the cost effectiveness of each emission control technology:

- Total Capital Investment (TCI)
- Direct Annual Cost (DAC) ($/yr)
- NOx Emission Reduction (tons/yr)
- Cost Effectiveness ($/ton)

o Capital Recovery = Convert from P (present Value) to A(Annual amount),

A=P(A/P,i%,n), $CR = \frac{i(1+i)^n}{(1+i)^n - 1}$ 15% interest and 10 yrs = A/P=0.1993

Where i= Annual interest Rate; n= control system life; Annual Cost = TCI x CRF

For the SCR Catalyst, The catalyst life is 5 years. The annual cost is given by the sinking fund factor, the amount of money the facility will need to set aside each year to be able to replace the catalyst at the end of its life, based on the lifespan of the catalyst and the interest rate.
Sinking Fund Factor (SFF) = Convert from F (Future) to A(Annual amount), A=F(A/F,i%,n),

$SFF = \frac{i}{(1+i)^n - 1}$ 10% interest and 5 yrs = A/F=0.1638

Where i= Annual interest Rate (10%); n= catalyst system life (5 years);

Catalyst Annual Cost = SFF x Catalyst Cost

$2NH_3 + 2NO + 1/2O_2 \longrightarrow 2N_2 + 3H_2O$

Ammonia Cost = (17/30 * 2moles of NH_3/2 moles of NO *1.05 * NOx emission (tpy) *$410/ton x 1.55 (price escalation from 1999 to 2014)
NH_3 = Ammonia, NO = Nitric Oxide; O_2 = Oxygen; H_2O = Water; 1.05= 5% of Ammonia slip & waste Ammonia

Honeywell Boiler #3

Table 1 Detail Calculations for Honeywell Boiler #3 SCR

BOILER # 3 381 MMBTU/hr			
Total capital Cost			
Total Capital Investment Cost (TCI)	$5,341,400	3,142,000	TCI from the January 2007 Best Available Retrofit Technology (BART) submittal plus inflation adjustment to 2014 US dollars. The TCI includes equipment cost estimates from vendor-supplied estimates for similar units or industry data gathered for similar projects. This was used because it is similar to RACT analysis and it is more recent. See Attachment A, which includes the relevant cost information form the BART submittal.
Capital Recovery	**$1,064,541**	**0.1993**	**10 yrs @15% - A/p=0.1993**
Annual Operating Costs			
Direct Annual Cost			
Electricity Cost[2]	$70,080		100kw @ $0.08/kwh, 8760 hrs/yr (PA DEP RACT State Implementation Plan (SIP) revision, Sep, 2006, page 18)
Maintenance[3]	$80,121.00		1.5%*TCI
Ammonia[3]	$189,288		17/30 * 2moles of NH_3/2 moles of NO *1.05 * NOx emission (tpy) *$410/ton*1.55
Catalyst Cost[3]	190,000	0.1638	Sinking Fund Factor
Annual Catalyst Replacement Cost I= 10%, n=5yrs[3]	31,122		I= 10%, n=5yrs

Total Direct Annual Cost	**$370,611**		
Indirect Annual Cost			
Total Indirect Annual Cost[3]	**$1,064,541**		CFR x TCI
Total Annual Operating Costs	**$2,499,693**		
NOx Emission Reduction (TPY)	400		
Cost Effectiveness ($/ton NOx removed)	**$6,249**		

Table 2 Detail Calculations for Honeywell ULNB + FGR

Boiler #3	381 MMBTU/hr		
Total capital Cost			
Total Capital Investment Cost (TCI)	$23,621,000		TCI from the 2006 Best Available Control Technology (BART) submittal plus inflation adjustment. The TCI includes equipment cost estimates from vendor-supplied estimates for similar units or industry data gathered for similar projects. This was used because it is similar to RACT analysis and it is more recent. See Attachment A, which includes the relevant cost information form the BART submittal.
Capital Recovery	$4,707,665	0.1993	**10 yrs @15% -OAQPS[1] A/P=0.1993**
Annual Operating Costs			
Direct Annual Cost			
Electricity Cost[3]	$70,080		100kw @ $0.08/kwh, 8760 hrs/yr
Operator[3]	$16,425		0.5hr/shift, 3 shift/day, $30/hr
Supervisor[3]	$2,463.75		15% of Operator
Maintenance[3]	$19,162.50		0.5hr/shift, 3 shift/day, $35/hr
Material[3]	$19,162.50		100% of Maintenance
Total Direct Annual Cost	$127,294		

Indirect Annual Cost			
Overhead[3]	$11,498		60% of maintenance-OAQPS[1]
Administrative Charge[3]	$472,420		2% of TCI-OAQPS[1]
Property Taxes[3]	$236,210		1% of TCI-OAQPS[1]
Insurance[3]	$236,210		1% of TCI-OAQPS[1]
Total Indirect Annual Cost	$956,338		
Total Annual Operating Costs	$5,791,297		
NOx Emission Reduction (TPY)	225		
Cost Effectiveness ($/ton NOx removed)	$25,739		

References:

- [1]Office of Air Quality Planning and standards (OAQPS) Environmental Protection Agency (EPA) Air Pollution Control Manual, Six Edition, EPA/452/B-02-001, January 2002.
- [2] Electricity cost: A.1 Vendor Information, A-2 Cost Calculation
- [3]Cost calculations for each elements are from references: North East States for Coordinated Air Use Management (NESCAUM), EPA' s Office of Air Quality Planning and standards (OAQPS) edition 6, 2002; Cost analysis and engineering economics book (Michael R. Lindeburg), from Facility, [1]Office of Air Quality Planning and standards (OAQPS) Environmental Protection Agency (EPA) Air Pollution Control Manual, Six Edition, EPA/452/B-02-001, January 2002 (page 2-27(2.5.5), I-52 table 1.13, Appendix A) and other States US Bureau of Labor Statics, Cost analysis and engineering economics book (Michael R. Lindeburg)