ALLEGHENY COUNTY HEALTH DEPARTMENT
AIR QUALITY PROGRAM

July 24, 2024

SUBJECT: **Reasonably Available Control Technology (RACT III) Determination**
Springdale Energy, LLC
Springdale Power Station
Butler Street Extension
Springdale, PA 15144
Allegheny County

RACT Installation Permit No. 0580-I005

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I. Executive Summary

Springdale Energy is defined as a major source of NO_X and VOC emissions and was subjected to a Reasonably Achievable Control Technology III (RACT III) review by the Allegheny County Health Department (ACHD) required for the 2015 Ozone National Ambient Air Quality Standard (NAAQS). The findings of this review established that the Springdale Energy is subject to case-by-case RACT III requirements. These requirements are summarized in the tables **Table 1** A and B below:

Table 1A Technically and Financially Feasible Control Options Summary for NO_X

Unit ID	Emissions Unit	Financially Feasible Control Option	Current NO_X PTE	RACT Reduction	Revised NO_X PTE	Annualized Control Cost ($/yr)	Cost Effectiveness ($/ton NO_X removed)
There are no additional technically and financially feasible control options available for NO_X reduction from RACT II to RACT III.							

Table 1B Technically and Financially Feasible Control Options Summary for VOC

Unit ID	Emissions Unit	Financially Feasible Control Option	Current VOC PTE	RACT Reduction	Revised VOC PTE	Annualized Control Cost ($/yr)	Cost Effectiveness ($/ton VOC removed)
There are no additional technically and financially feasible control options available for VOC reduction from RACT II to RACT III.							

These findings are based on the following documents:

- RACT III evaluation performed by Environmental Resource Management, Inc. on behalf of Springdale Energy dated December 14, 2022.
- RACT III analysis received from the facility was considered administratively complete on January 6, 2023 and considered technically complete on February 6, 2023.
- RACT II permit No. 0580-I003, issued October 13, 2016
- Title V Operating Permit #0580-OP17 issued on July 21, 2017.
- Additional Case-by-case analysis for the NO_X and VOC emission units deemed as Presumptive sources in the first cited document, received on October 27, 2023.

II. Regulatory Basis

On October 26, 2015, the US EPA revised the ozone NAAQS. To meet the new standards, ACHD requested all major sources of NO_X (potential emissions of 100 tons per year or greater) and all major sources of VOC (potential emissions of 50 tons per year or greater) to reevaluate NO_X and/or VOC RACT for incorporation into Allegheny County's portion of the PA SIP. ACHD has also incorporated by reference 25 Pa. Code, §§129.111-115 under Article XXI, §2105.08 ("RACT III"). The final-form rulemaking was adopted on August 9, 2022. The RACT III final-form regulation establishes 25 Pa. Code, §§ 129.111— 129.115 (relating to additional RACT requirements for major sources of NO_X and VOCs for the 2015 ozone NAAQS) to meet CAA requirements for the control of ground-level ozone. The final-form rulemaking provides for a petition process for an alternative compliance schedule, a facility-wide or system-wide NO_X emissions averaging plan, an alternative RACT proposal petition process, compliance demonstration, and notification and recordkeeping requirements. The final-form rulemaking also amends § 121.1 to revise or add terms to support interpretation of the RACT III final-form regulation.

This document is the result of ACHD's determination of RACT III submitted by the subject sources and supplemented with additional information as needed by ACHD. The provisions of RACT III will replace those of the previous RACT I and RACT II.

III. Facility Description

Springdale Energy, LLC owns the Springdale Power Station located in Springdale, Pennsylvania within Allegheny County.

The primary air pollutant emission sources at the Springdale Power Station are:

- Unit 1 (AE1) and Unit 2 (AE2): Two simple-cycle combustion turbines nominally rated at 48 MWe each. The turbines are designed to combust either natural gas or No. 2 fuel oil.

- Unit 3 (AE3) and Unit 4 (AE4): Two combined-cycle combustion turbines nominally rated at 175 MWe each. The turbines combust natural gas and are equipped with dry low NO_X (DLN) combustion systems and selective catalytic reduction (SCR) technology to limit NO_X emissions. Both units operate in combined-cycle mode through two heat recovery steam generators (HRSGs) without duct burners, one per unit, with an additional 186 MW generated by an axial flow steam turbine generator which utilizes the steam produced by the HRSGs. Each unit has dedicated Continuous Emission Monitors (CEMs) for NO_X emissions and O_2 levels.

Startup and shutdown periods are a normal part of the operation of natural gas and distillate oil fired power plants. They may involve emission rates for certain pollutants, including NO_X and VOC, that are greater than emissions during steady-state operation and that are highly variable. NO_X and VOC emissions may be greater during startup and shutdown for several reasons. One reason is that during startup and shutdown, the turbines are not operating at full load where they are most efficient. Another reason is that the exhaust temperatures are lower than during steady-state operations. NO_X and VOC emissions can be minimized by reducing the duration of the startup and shutdown sequences and through good combustion practices.

Simple-cycle turbines have comparatively low startup emissions because they can quickly come up to full load. This is why they are used to provide peaking power with the capability to rapidly accelerate to synchronous speed, synchronize with the grid, ramp up to 100% load, and then quickly reduce to no load. Simple-cycle turbines are different in this respect than combined-cycle turbines, which incorporate heat recovery steam generators (HRSGs, a form of boiler) that recover some of the waste heat in the turbine exhaust to create steam to generate additional power. The additional steam-generating components associated with combined-cycle systems require additional time to come up to full operating temperature. Nevertheless, simple-cycle turbines still have startup and shutdown periods in which they may not be capable of complying with their steady-state emissions limits.

Table 2 summarizes the facility's emission units that are subject to RACT III Regulations.

Table 2 RACT III affected NO_X and VOC emission sources required by §129.115(a)(5)(i)

Source ID	Description	Unit Capacity	Presumptive RACT II citation	Control Device	NO_X tpy	VOC tpy
AE1 (Unit 1) & AE2 (Unit 2)	Simple-cycle Combustion Turbines: Two General Electric LM 6000-PC [Each has dual fuel capacities and can fire either natural gas or No. 2 fuel oil.]	Each unit (natural gas fired) 424.4 MMBtu/hr 67,800 BHP (44 MW)	**129.97(g)(2)(iv)(A)** 42 ppmvd NOx @ 15% oxygen when natural gas is fired. **129.97(g)(2)(iv)(B)** 96 ppmvd NOx @ 15% oxygen when fuel oil is fired. **129.97(g)(2)(iv)(C) & (D)** 42 ppmvd VOC @ 15% oxygen	Water Injection	98.0 Total	10.0 Total
AE3 (Unit 3) & AE4 (Unit 4)	Combined-cycle Combustion Turbines: Two Siemens Westinghouse 501F each exhausting to a heat recovery steam generator (HRSG) without duct burners [Natural gas fired.]	Each unit: 2,094 MMBtu/hr 175 MWe (1) 188 MW (1)	**129.97(g)(2)(ii)(A)** 4 ppmvd NOx @ 15% oxygen. **129.97(g)(2)(ii)(C)** 2 ppmvd VOC @ 15% oxygen.	Dry Low NO_X Burners and SCR	210.0 (2) Total	48.0 Total
EG01 & EG02	Two Caterpillar C32 Backup Diesel Emergency Generators	1,250 kW 1,829 BHP	NA (Added recently)	None	12.4 Total	0.2 Total
G-02	Emergency Fire Pump Engine	265 BHP	Exempt	None	0.73	0.99
T-3 (3)	Fuel Oil Storage Tank	400,000 gal.	Exempt	None	-	0.04

Source ID	Description	Unit Capacity	Presumptive RACT II citation	Control Device	NO_X tpy	VOC tpy
Total					286.3	59

(1) This is the turbine' s generator output. If the inefficiencies of power transfer from the engine to generator are considered, the turbine output would exceed 180 MW.
(2) Other restrictions effectively limit NO_X emissions to 87.6 tpy for each turbine, or 175.2 tpy total. See conditions IV.22 & IV.23 of Installation Permit #0580-I005. However, these restrictions do not take into account startup and shutdown emissions. All NO_X emissions are monitor by CEMs.
(3) Permitted under installation permit #0580-I004, issued June 24, 2020.

PTE calculations for Unit 1 and Unit 2 are included in the technical support document for installation permit #0580-I005 as well as the original installation permit #0580-I001, dated September 30, 1999. The manufacturer's data indicated that NO_X emissions from the turbines are 41 lb/hr while burning natural gas and 71 lb/hr while burning No. 2 fuel oil. This resulted in an annual emission rate of 98 tpy for both turbines. VOC emissions are 5 lb/hr and 1 lb/hr for natural gas and No. 2 fuel oil, respectively.

PTE calculations for Unit 3 and Unit 4 are included in the technical support document for installation permit #0580-I005 as well as the original installation permit #0580-I002a, dated July 12, 2001, and amended June 6, 2002. Emissions rates are calculated based on LAER/BACT and are 20.3 lbs/hr for NO_X (3-hour average) and 3.8 lb/hr for VOC.

Emission unit changes since the RACT II permit No. 0580-I003 was issued on October 13, 2016, include the following:

- Black Start Generator (G-01) with a rated capacity of 830 hp was removed from service.
- Two (2), new Emergency 1,250 kW Black Start Generators were installed under Minor Source/Minor Modification Installation Permit # 0580-I004 issued on June 24, 2020.

The three Black Start generators above and the storage tank are permitted in Installation Permit No. 0580-I004 issued on June 24, 2020.

The last full compliance evaluation (FCE) at Springdale Energy was conducted on July 22, 2021 and the facility was found to be in compliance. The facility currently has no violations. The facility has been in operation prior to August 3, 2018 and is thus subject to PA code §§ 129.111 through 129.115.

The Station has the potential to emit (PTE) greater than 50 tons per year (TPY) of VOC and greater than 100 TPY of NO_X. Consequently, it is considered a major NO_X emitting facility and a major VOC emitting facility under 25 Pa. Code §121.1.

IV. RACT III Determination

Springdale Energy demonstrated in its December 2022 application that normal operation of the combined cycle combustion turbines (AE3 and AE4), and both black start emergency generators (EG01 and EG02) meet presumptive RACT III limits and requirements. However, since normal and startup/shutdown operations of the simple cycle combustion turbines (AE1 and AE2) and startup/shutdown operations of the combined cycle combustion turbines (AE3 and AE4) were determined to be case-by-case, ACHD required Springdale energy to provide a case-by-case analysis for all the RACT III applicable sources on the facility. This determination is the result of ACHD evaluation of both analyses performed by the facility.

A. NO_X RACT III Analysis

This section provides details of the applicability status of each NO_X source grouped by the categories exempt, presumptive RACT, or case-by-case.

1. Exempt NO_X RACT III Sources

Pursuant to §129.111(c), NO_X sources that have a PTE less than 1 TPY are exempt from the requirements of §129.112 - §129.114. As shown in **Table 3**, the G-02 emergency fire pump engine has a NO_X PTE less than 1 TPY, and thus is exempt from the requirements of §129.112 - §129.114.

Table 3 Facility Sources Exempt from RACT III for NO_X

Source ID	Description	RACT III Category	NO_X PTE (TPY)	Presumptive Limit (RACT III)	RACT III Citation
G-02	Emergency Fire Pump Engine	Exempt PTE < 1 tpy	0.73	-	§129.111(c)

2. Presumptive NO_X RACT III Sources

Presumptive NO_X RACT III sources include NO_X sources which have a PTE greater than or equal to 1 TPY, but less than 5 TPY. Additionally, §129.112 sets presumptive requirements for various types and sizes of sources. It was determined that there are not any NO_X Presumptive sources in this facility.

3. Case-By-Case NO_X RACT III Sources

PA Code §129.112(g)(2)(v) specifies a presumptive RACT III source category for a simple-cycle combustion turbine with a rated output ≥4,100 bhp and < 60,000 bhp that must comply with a RACT III emission limitation of 42 ppmvd NO_X @ 15% O_2 when firing natural gas and 96 ppmvd NO_X @ 15% O_2 when firing fuel oil. However, Units 1 and 2 at the Springdale Power Station fall just outside this source category because the output of each turbine, 67,800 bhp, slightly exceeds 60,000 bhp[1]. According to §129.114(b), a NO_X source with a PTE ≥ 5.0 TPY that is not subject to the presumptive requirements in §129.112 located at a major NO_X emitting facility must propose an alternative NO_X RACT requirement or RACT emission limitation in accordance with §129.114(d). Also, PADEP has stated that the RACT presumptive limitations are applicable at all times, including startup and shutdown[2] and there is no presumptive RACT requirement or emission limitation for startup and shutdown operations. Thus, an alternative case-by-case NO_X RACT III analysis was performed for Units 1 and 2 operations (including startup and shutdown) pursuant to §129.114(d) and the limits determined to be RACT III are listed below in Table 4.

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[1] PADEP shows that 60,000 bhp output is equivalent to 42.5 MW (see Appendix 21 of PADEP's Technical Support Document for Final-Form Rulemaking, Environmental Quality Board [25 Pa. Code Chs. 121 and 129], Additional RACT Requirements for Major Sources of NO_X and VOCs for the 2015 ozone NAAQS (RACT III), April 2022.). The generator outputs of Units 1 and 2 are 48 MW and do not consider the inefficiencies of power transfer from the engines to the generators. Therefore, the turbine outputs are greater than 48 MW and exceed 60,000 bhp, but only by a little more than 10%.

[2] Volume 52, *Pennsylvania Bulletin*, Page 6983, November 12, 2022.

An alternative NO_X RACT III analysis was also performed for Units 3 and 4 for normal and startup/shutdown operations pursuant to §129.114(b) since the facility was determined to be case-by-case in regard to RACT III regulations. Unit 3 and Unit 4 each consist of a combined-cycle combustion turbine with rated outputs ≥ 180 MW and shall comply with the RACT III case-by-case emission limitations proposed by the facility or set by the Department pursuant to §129.114(b). The applicable RACT III limits are shown in **Table 4** below.

Table 4 summarizes the sources subject to Case-By-Case NO_X RACT III. Case-By-Case analyses for these sources are included in Section V below.

Table 4 Facility Sources Subject to Case-by-Case RACT III for NO_X as per §129.114(b)

Source ID	Description	Unit Capacity	Presumptive Limit (RACT II)	Case-by-Case Limit (RACT III)
Unit 1 AE1	Simple-cycle Combustion Turbine [Dual fuel] (Normal Operation)	424 MMBtu/hr 67,800 BHP (48 MWe)	**§129.97(g)(2)(iv)(A) & (B)** 42 ppmvd NO_X @ 15% oxygen for natural gas 96 ppmvd NO_X @ 15% oxygen for fuel oil	41.0 lb/hr NO_X (gas) (25 ppmvd NO_X @ 15% oxygen) 71.0 lb/hr NO_X (oil) (42 ppmvd NO_X @ 15% oxygen)
Unit 1 AE1	Simple-cycle Combustion Turbine [Dual fuel] (Startup/Shutdown)	424 MMBtu/hr 67,800 BHP (48 MWe)	NA	Maintain and operate the source in accordance with the manufacturer's specifications and with good operating practices.
Unit 2 AE2	Simple-cycle Combustion Turbine (Normal Operation)	424 MMBtu/hr 67,800 BHP (48 MWe)	**§129.97(g)(2)(iv)(A) & (B)** 42 ppmvd NO_X @ 15% oxygen for natural gas 96 ppmvd NO_X @ 15% oxygen for fuel oil	41.0 lb/hr NO_X (gas) (25 ppmvd NO_X @ 15% oxygen) 71.0 lb/hr NO_X (oil) (42 ppmvd NO_X @ 15% oxygen)
Unit 2 AE2	Simple-cycle Combustion Turbine (Startup/Shutdown)	424 MMBtu/hr 67,800 BHP (48 MWe)	NA	Maintain and operate the source in accordance with the manufacturer's specifications and with good operating practices.
Unit 3 AE3	Combined cycle Combustion Turbine [Natural gas fired] (Normal Operations)	2,094 MMBtu/hr 188 MW	**129.97(g)(2)(ii)(A)** 4 ppmvd NOx @ 15% oxygen	2.5 ppmvd NO_X @ 15% O_2 (for any four-hour time period at or above 70% of full load or after a combustion turbine has achieved steady state operation above 70% load and is subsequently turned down to 50% load) 20.0 lb/hr NO_X
Unit 3 AE3	Combined-cycle Combustion Turbine (Startup/Shutdown)	2094 MMBtu/hr 188 MWe	NA	Maintain and operate the source in accordance with the manufacturer's specifications and with good operating practices. Adhere to permit conditions pertaining to start-ups and shutdowns.
Unit 4 AE4	Combined-cycle Combustion Turbine [Natural gas fired] (Normal Operation)	2,094 MMBtu/hr 188 MW	**129.97(g)(2)(ii)(A)** 4 ppmvd NO_X @ 15% oxygen	2.5 ppmvd NO_X @ 15% O_2 (for any four-hour time period at or above 70% of full load or after a combustion turbine has achieved steady state operation above 70% load and is subsequently turned down to 50% load)

Source ID	Description	Unit Capacity	Presumptive Limit (RACT II)	Case-by-Case Limit (RACT III)
				20.0 lb/hr NO_X
Unit 4 AE4	Combined-cycle Combustion Turbine (Startup/Shutdown)	2094 MMBtu/hr 188 MWe	NA	Maintain and operate the source in accordance with the manufacturer's specifications and with good operating practices. Adhere to permit conditions pertaining to start-ups and shutdowns.
EG01	Caterpillar C32 Backup Diesel Emergency Generator	1,250 kW 1,829 BHP	NA	Install, maintain and operate the source in accordance with the manufacturer's specifications and with good operating practices.
EG02	Caterpillar C32 Backup Diesel Emergency Generator	1,250 kW 1,829 BHP	NA	Install, maintain and operate the source in accordance with the manufacturer's specifications and with good operating practices.

B. VOC RACT III Analysis

This section provides details of the applicability status of each VOC source grouped by the categories exempt, presumptive RACT, or case-by-case.

1. Exempt VOC RACT III Sources

Pursuant to §129.111(c), VOC sources that have a PTE less than 1 TPY are exempt from the requirements of §129.112 - §129.114. As shown in **Table 5**, the G-02 emergency fire pump engine and the fuel oil storage tank have a VOC PTE less than 1 TPY, and thus are exempt from the requirements of §129.112 - §129.114.

Table 5 Facility Sources Exempt from RACT III for VOC

Source ID	Description	RACT III Category	VOC PTE (TPY)	Presumptive Limit (RACT III)	RACT III Citation
G-02	Emergency Fire Pump Engine	Exempt PTE < 1 tpy	0.99	-	§129.111(c)
T-3	Fuel Oil Tank	Exempt PTE < 1 tpy	0.04	-	§129.111(c)

2. Presumptive VOC RACT III Sources

Presumptive VOC RACT III sources include VOC sources which have a PTE greater than or equal to 1 TPY, but less than 2.7 TPY. Additionally, §129.112 sets presumptive requirements for various types and sizes of sources. It was determined that there are no Presumptive VOC sources for this facility.

3. Case-By-Case VOC RACT III Sources

PA Code §129.112(g)(2)(v) specifies a presumptive RACT III source category of a simple-cycle combustion turbine with a rated output ≥4,100 bhp and < 60,000 bhp that must comply with a RACT III emission limitation of 9 ppmvd VOC (as propane) @ 15% O_2 when firing both natural gas and firing fuel oil. However, Units 1 and 2 at the Springdale Power Station fall just outside this source category because the output of each turbine, 67,800 bhp, slightly exceeds 60,000 bhp as was explained in Section IV.A.3 above. Therefore, Springdale Energy was required to propose an alternative VOC RACT requirement or RACT emission limitation in accordance with §129.114(d). Also, there is no presumptive source category for Units 1 and 2 during startup and shutdown operations, thus a VOC case-by-case analysis is performed for both normal and start up/shut down operations of Units 1 and 2 pursuant to §129.114(c) and the limits determined to be RACT III are listed below in **Table 6** below.

An alternative VOC RACT III analysis was also performed for Units 3 and 4 for normal and startup/shutdown operations pursuant to §129.114(b) since the facility was determined to be case-by-case in regard to RACT III regulations. Unit 3 and Unit 4 are combined-cycle combustion turbines with rated outputs ≥ 180 MW and shall comply with the RACT III case-by-case emission limitations proposed by the facility or set by the Department pursuant to §129.114(b). The applicable RACT III limits are shown in **Table 6** below. This analysis also includes startup/shutdown operations for these units, since, as mentioned above PADEP has stated that RACT presumptive limitations are applicable at all times, including startup and shutdown and there is no presumptive RACT requirement or emission limitation for startup and shutdown operations.

The summary of sources subject to Case-By-Case VOC RACT III are provided in **Table 6** below.

Table 6 Facility Sources Subject to Case-by-Case RACT III for VOC as per §129.114(c)

Source ID	Description	Unit Capacity	Presumptive Limit (RACT II)	Case-by-Case Limit (RACT III)
Unit 1 AE1	Simple-cycle Combustion Turbine [Dual fuel] (Normal Operations)	67,800 BHP (48 MWe)	**§129.97(g)(2)(iv)(C) & (D)** 9 ppmvd VOC @ 15% oxygen	5.0 lb/hr VOC (gas) (2.8 ppmvd VOC @ 15% oxygen) 1.0 lb/hr VOC (oil) (0.6 ppmvd VOC @ 15% oxygen)
Unit 1 AE1	Simple-cycle Combustion Turbine [Dual fuel] (Startup/Shutdown)	67,800 BHP (48 MWe)	NA	Maintain and operate the source in accordance with the manufacturer's specifications and with good operating practices.
Unit 2 AE2	Simple-cycle Combustion Turbine [Dual fuel] (Normal Operations)	67,800 BHP (48 MWe)	**§129.97(g)(2)(iv)(C) & (D)** 9 ppmvd VOC @ 15% oxygen	5.0 lb/hr VOC (gas) (2.8 ppmvd VOC @ 15% oxygen) 1.0 lb/hr VOC (oil) (0.6 ppmvd VOC @ 15% oxygen)
Unit 2 AE2	Simple-cycle Combustion Turbine [Dual fuel] (Startup/Shutdown)	67,800 BHP (48 MWe)	NA	Maintain and operate the source in accordance with the manufacturer's specifications and with good operating practices.
Unit 3 AE3	Combined-cycle Combustion Turbine (Normal Operations)	2,094 MMBtu/hr 188 MW	**129.97(g)(2)(ii)(C)** 2 ppmvd VOC @ 15% oxygen	2 ppmvd VOC @ 15% O_2 (as propane at or above 70% of full load or after a combustion turbine has achieved steady state operation above 70% load and is subsequently turned down to 50% load) 3.8 lb/hr VOC (as propane)
Unit 3 AE3	Combined-cycle Combustion Turbine (Startup/Shutdown)	2,094 MMBtu/hr 188 MW	NA	Maintain and operate the source in accordance with the manufacturer's specifications and with good operating practices. Adhere to permit conditions in Section V.A.1.i pertaining to start-ups and shutdowns.

Source ID	Description	Unit Capacity	Presumptive Limit (RACT II)	Case-by-Case Limit (RACT III)
Unit4 AE4	Combined-cycle Combustion Turbine (Normal Operation)	2,094 MMBtu/hr 188 MW	**129.97(g)(2)(ii)(C)** 2 ppmvd VOC @ 15% oxygen	2 ppmvd VOC @ 15% O_2 (as propane at or above 70% of full load or after a combustion turbine has achieved steady state operation above 70% load and is subsequently turned down to 50% load) 3.8 lb/hr VOC (as propane)
Unit 4 AE4	Combined-cycle Combustion Turbine (Startup/Shutdown)	2,094 MMBtu/hr 188 MW	NA	Maintain and operate the source in accordance with the manufacturer's specifications and with good operating practices. Adhere to permit conditions in Section V.A.1.i pertaining to start-ups and shutdowns.
EG01	Caterpillar C32 Backup Diesel Emergency Generator	1,250 kW 1,829 BHP	NA	Install, maintain and operate the source in accordance with the manufacturer's specifications and with good operating practices.
EG02	Caterpillar C32 Backup Diesel Emergency Generator	1,250 kW 1,829 BHP	NA	Install, maintain and operate the source in accordance with the manufacturer's specifications and with good operating practices.

V. <u>Case-By-Case Analyses – NO_X and VOC RACT III Sources</u>

A detailed case-by-case analysis is provided in this section for the following NO_X and VOC sources that were identified in **Table 4** and **Table 6** above:

- Unit 1 and Unit 2 normal operations
- Unit 1 and Unit 2 startup and shutdown operations
- Unit 3 and Unit 4 normal operations
- Unit 3 and Unit 4 startup and shutdown operations
- Two emergency generators

A. Units 1 and 2: Normal Operations

1. NO_X

Pursuant to Operating Permit No. 0580-OP17, issued July 21, 2017, the NO_X emission limits for Units 1 and 2 are:

- Condition V.A.1.c, when natural gas is burned, each turbine is limited to 41.0 lb/hr;
- Condition V.A.1.c, when No. 2 fuel oil is burned, each turbine is limited to 71.0 lb/hr; and
- Condition V.A.1.c, total emissions from both turbines are limited to 98.0 tons/yr.

The above conditions limit short-term emissions for each turbine to approximately 0.1 lb/MMBtu when natural gas is burned and approximately 0.17 lb/MMBtu during oil firing. In turn, these lb/MMBtu values correspond to approximately 25 ppmvd @ 15% O_2 for gas firing, and 42 ppmvd @ 15% O_2 for No. 2 fuel oil firing. Pursuant to the Operating Permit No. 0580-OP17, issued July 21, 2017, Condition V.A.1.a restricts the total combined hours of operation for both turbines to 4,450 hours per year (consecutive 12-month period). This restriction is being removed from the current installation and operating permits.

The turbines are subject to the New Source Performance Standard Subpart GG for Stationary Combustion Turbines (40 CFR 60, Subpart GG).

Step 1 – Identify Control Options

EPA's Alternative Control Techniques (ACT) document for Stationary Combustion Turbines[3] and additional resources were consulted to determine if any other turbine controls have been demonstrated since 1993 when the ACT was published.

The NO_X controls identified from the ACT are as follows:

- Tune-ups
- Lean Combustion / Reduced Combustor Residence Time
- Lean Premixed Combustors (a.k.a., DLN)
- Rich/Quench/Lean Combustion
- Catalytic Combustion
- Water / Steam Injection (WSI)
- Selective Catalytic Reduction (SCR)
- Selective Non-Catalytic Reduction (SNCR)

No additional control measures were identified for stationary combustion turbines, except for combinations of controls listed above.

Tune-ups

Turbine tune-ups optimize the fuel performance of the combustion turbine unit. Concentrations of O_2, VOC, CO and NO_X are measured while the turbine owner/operator fine tunes the operating parameters to optimize turbine fuel and emissions performance.

Lean Combustion / Reduced Combustor Residence Time

Turbines are designed to operate at or near a stoichiometric amount of air to combust the fuel; perfectly stoichiometric combustion represents an equivalence ratio of 1.0. An equivalence ratio below 1.0 is fuel lean combustion, and a ratio above 1.0 is fuel-rich. With lean combustion, the excess air cools the flame, reduces the peak flame temperature, and reduces the rate of thermal NO_X formation.

Lean combustion has limitations. If the equivalence ratio is reduced too far, CO (and VOC) emissions increase, and flame stability problems occur. NO_X emissions reductions of up to 30% have been achieved using lean primary zone combustion without increasing CO emissions[4].
Turbines are designed to cool high-temperature combustion gases with dilution air. This dilution rapidly cools the gas to temperatures below those required for thermal NO_X formation. With reduced residence

[3] Alternative Control Techniques (ACT) Document – NOx Emissions from Stationary Combustion Turbines (EPA-453/R- 93-007). https://www3.epa.gov/airquality/ctg_act/199301_nox_epa453_r-93-007_gas_turbines.pdf, accessed November 15, 2022.
[4] Ibid.

time combustors, dilution air is added sooner, and combustion gases are at high temperatures for a shorter time, thus reducing thermal NO_X formation.

To avoid increases in CO and VOC emissions, combustors with reduced residence time must incorporate design changes in the air distribution ports to promote turbulence, which improves fuel/air mixing and reduces the time required for complete combustion. Reduced combustor residence time can improve the NO_X emissions by 40%[5].

Lean Premixed Combustors

Lean pre-mix or DLN combustors are designed to control peak combustion temperatures, combustion zone residence time, and combustion zone free oxygen, thereby minimizing thermal NO_X formation. A conventional combustor introduces fuel and air into the combustion zone simultaneously. Variations in air-to-fuel ratios (A/F) can cause fuel-rich pockets that contribute to significant levels of NO_X emissions. Premixing results in a homogeneous mixture, which minimizes localized fuel-rich zones and reduces NO_X formation rates.

Reduced NO_X emissions when burning oil fuel in currently available lean premixed combustor designs have been achieved only with water or steam injection. Lean premix combustor designs are available for liquid fuels, but water injection is required to achieve appreciable NO_X emission reductions[6].

Most commercially available lean premixed combustors, also known as dry low-NO_X or DLN combustors, achieve NO_X emission reductions to 25 ppm. NO_X guarantees as low as 9 ppmvd can be obtained for new turbines[7].

Rich/Quench/Lean Combustion

Rich/quench/lean (RQL) combustors burn fuel-rich in the primary zone and fuel-lean in the secondary zone. Incomplete combustion under fuel-rich conditions in the primary zone produces an atmosphere with high concentrations of CO and hydrogen (H_2). The CO and H_2 replace some oxygen normally available for NO_X formation and reduce agents for any NO_X formed in the primary zone. Therefore, fuel nitrogen is released with minimal conversion to NO_X. The lower peak flame temperatures, due to partial combustion, also reduce the formation of thermal NO_X. RQL staged combustion has achieved NO_X emissions reductions of up to 50% with diesel fired turbines[8].

Catalytic Combustion

With Catalytic Combustion, air and fuel are mixed into a lean fuel mixture and then passed to a catalyst bed. Catalytic Combustion technology features “flameless” combustion that occurs in a series of catalytic reactions to limit the temperature in the combustors. This allows complete mixing of the fuel and air, with the combustion initiated by a catalytic surface and occurring at temperatures below those at which

[5] Ibid.
[6] Ibid.
[7] ERG, 2009, Electricity Framework 5 Year Review – Control Technologies Review, Final Report (January 21 2009), for the Clean Air Strategic Alliance.
[8] Alternative Control Techniques (ACT) Document – NO_X Emissions from Stationary Combustion Turbines (EPA-453/R- 93-007). https://www3.epa.gov/airquality/ctg_act/199301_nox_epa453_r-93-007_gas_turbines.pdf, accessed November 15, 2022.

measurable amounts of NO_X form. In the catalyst bed, the mixture oxidizes without forming a high temperature flame front. Peak combustion temperatures can be limited to below 1540°C (2800°F), which is below the temperature at which significant amounts of thermal NO_X begin to form[9].

This technology was first developed by Catalytica Combustion Systems, Inc. and purchased by Kawasaki in August 2006. Kawasaki uses this technology in its turbine model GPX15X, a 1.4 MW turbine with emissions of 2.5 ppm at 15% O_2[10]. In testing performed in 2000 on a similar turbine, NO_X emissions were measured at 1.13 ppmvd @ 15% O_2[11].No other manufacturer makes a commercially available flameless combustor[12].

<u>Water / Steam Injection (WSI)</u>

Injecting water into a turbine combustor provides a heat sink, lowering the flame temperature and reducing thermal NO_X formation. It is necessary to maintain water purity to prevent erosion and/or formation of deposits in the hot section of the turbine. In a steam injection system, steam replaces water as the injected fluid. There is a physical limit to the amount of water or steam that can be injected before flame instability or cold spots in the combustion zone cause adverse operating conditions for the turbine.

Another technique that is commercially available for oil-fired aeroderivative and industrial turbines uses a water-in-oil emulsion to reduce NO_X emissions. This technique introduces water into the combustion process by emulsifying water in the fuel oil prior to injection. The NO_X control principle is like that of conventional water injection, but the uniform dispersion of the water in the oil provides greater NO_X reduction than conventional water injection at a similar water-to-fuel ratio (WFR).

With this technique, NO_X reduction efficiencies of 70 to 90% are common. For natural gas fuel, WFR's for water or steam injection range from 0.33 to 2.48 to achieve controlled NO_X emission levels ranging from 25 to 75 ppm, corrected to 15% O_2. For oil fuel, WFR's range from 0.46 to 2.28 to achieve controlled NO_X emission levels ranging from 42 to 110 ppm, corrected to 15% O_2[13,14].

<u>Selective Catalytic Reduction (SCR)</u>

SCR is a post-combustion flue gas treatment technology for reducing NO_X emissions that involves the injection of ammonia (NH_3), a reducing agent, into the exhaust gas downstream of the combustion turbine. The exhaust gas then passes through a catalyst bed, which promotes the conversion of NO_X into

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[9] Ibid

[10] Kawasaki Gas Turbine Generator Sets brochure, May 2010. Accessed May 23, 2014 at: https://global.kawasaki.com/en/energy/pdf/20141030Standby.pdf.

[11] EPRI. Xonon® Low-NOx Catalytic Combustion in Practice: Case Study of a 1,400 kW Combustion Turbine. EPRI, Palo Alto, CA; CEC, Sacramento, CA; and SDC, Eldridge, CA: 2006. 1013143.

[12] Green Gas Turbines in CHP, presented by Steve Cernik of Kawasaki at the CATEE Workshop in Plano Texas, December 15, 2008.

[13] Alternative Control Techniques (ACT) Document – NO_X Emissions from Stationary Combustion Turbines (EPA-453/R- 93-007). http://www.epa.gov/groundlevelozone/SIPToolkit/ctg_act/199301_nox_epa453_r-93-007_gas_turbines.pdf, accessed November 15, 2022.

[14] NSPS Subpart KKKK limits new turbines, with a capacity between 50 and 850 MMBtu/hr, firing natural gas to 25 ppm at 15% O_2. New turbines with capacities greater than 50 MMBtu/hr firing fuel other than natural gas are limited to 96 ppm at 15% O_2.

elemental nitrogen and water vapor. The ammonia reagent is typically injected in aqueous form, and reacts with NO_X to form elemental nitrogen and water with the following basic reaction pathways:

$$4NH_3 + 4NO + O_2 \rightarrow 4N_2 + 6H_2O$$
$$8NH_3 + 6NO_2 \rightarrow 7N_2 + 12H_2O$$

Depending on system design, NO_X removal of 70-90% can be achieved under optimum conditions[15].

The catalyst lowers the activation energy of these reactions, which allows the NO_X conversions to take place at lower temperatures. The optimum temperatures can range from 350°F to 1,100°F, but are typically designed to occur between 600°F and 750°F, depending on the catalyst[16] Typical SCR catalysts include metal oxides (titanium oxide and vanadium), noble metals (combinations of platinum and rhodium), zeolite (alumino-silicates), and ceramics. Water vapor and elemental nitrogen are released into the atmosphere as part of the exhaust stream.

Factors affecting SCR performance include space velocity (volume per hour of flue gas divided by the volume of the catalyst bed), ammonia/ NO_X molar ratio, and catalyst bed temperature. Space velocity is a function of catalyst bed depth. Decreasing the space velocity (increasing catalyst bed depth) will improve NO_X removal efficiency by increasing residence time but will also cause an increase in catalyst bed pressure drop.

Reaction temperatures are critical for proper SCR operation. Below the minimum temperature, reduction reactions will not proceed. At temperatures exceeding the optimal range, ammonia oxidation will increase NO_X emissions.

SCR catalyst can be deactivated by several mechanisms. Loss of catalyst activity can occur from thermal degradation, where the catalyst is exposed to excessive temperatures over a long time. Catalyst deactivation can also occur due to chemical poisoning. Principal poisons include arsenic, sulfur, potassium, sodium, and calcium.

Selective Non-Catalytic Reduction (SNCR)

Like SCR, SNCR operates by promoting the conversion of NO_X into elemental nitrogen and water vapor, typically using aqueous urea $[(NH_2)_2CO]$ or ammonia as a reagent. However, unlike SCR, SNCR does not utilize a catalyst, and therefore requires higher exhaust temperatures on the order of 1,700°F-2,000°F, which is significantly higher than the exhaust temperatures from typical combustion turbine installations, including Springdale Station Units 1 and 2[17].

[15] The Babcock & Wilcox Company. Steam Its Generation and Use, 40th Edition. Ed. S C Stultz and J B Kitto. Barberton, Ohio: 1992

[16] California Environmental Protection Agency - Air Resources Board, and Stephanie Kato. Report to the Legislature: Gas-Fired Power Plant NO_X Emission Controls and Related Environmental Impacts. May: 2004.

[17] Northeast States for Coordinated Air Use Management (NESCAUM), and Praveen Amar. Applicability and Feasibility of NO_X, SO_2, and PM Emissions Control Technologies for Industrial Commercial, and Institutional Boilers. November 2008 (Revised January 2009). http://www.nescaum.org/documents/ici-boilers-20081118-final.pdf, accessed November 15, 2022.

Units with the above flue gas temperatures, residence times less than one second, and elevated levels of uncontrolled NO_X are good candidates for SNCR control. Depending on system design, NO_X removal of 30-50% can be achieved[18].

<u>Step 2 – Eliminate Technically Infeasible Control Options</u>

Each control option listed in Step 1 was evaluated to determine if it is technically feasible for the Units 1 and 2 simple-cycle combustion turbines. Only tune-ups and SCR are considered technically feasible for these units. An economic evaluation of these controls is provided in the next section.

<u>Lean Combustion / Reduced Combustor Residence Time</u>

The simple-cycle combustion turbines have lean combustion and reduced residence time incorporated into their combustors. Therefore, they are removed from further consideration.

<u>Lean Premixed Combustors</u>

The majority of DLN burners available are guaranteed to have NO_X emissions of 25 ppmvd @ 15% O_2 or less. This would be no more effective than the current water injection systems. Therefore, DLN is removed from further consideration.

<u>Rich/Quench/Lean Combustion</u>

These combustors reduce emissions by 40 to 50% compared to conventional combustors. The current control reduces emissions to a greater extent. Therefore, this option would result in higher emissions and is removed from further consideration.

<u>Catalytic Combustion</u>

Catalytic combustion is considered technically infeasible because it is not commercially available for this size turbine (48 MW). The only commercially available turbine model with catalytic combustion is the Kawasaki model GPB15X, which has an output capacity of only 1.4 MW. One source indicated that it was unlikely that catalytic combustion will be used widely on future combustion turbines, because the technology has not been demonstrated to perform better than current lean premixed combustors, especially considering the need for an outlet compressor temperature of above 426°C (~800°F) and the limited load settings available at the low NO_X settings[19].

<u>Water / Steam Injection (WSI)</u>

The simple-cycle combustion turbines are already equipped with water injection. Therefore, it is removed from further consideration.

<u>Selective Non-Catalytic Reduction (SNCR)</u>

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[18] U.S. EPA. Air Pollution Control Technology Fact Sheet; Selective Non-Catalytic Reduction (EPA-452/F-03-031). 2003.
http://www.epa.gov/ttncatc1/dir1/fsncr.pdf, accessed November 15, 2022.
[19] Modern Gas Turbine Systems-High Efficiency, Low Emission, Fuel Flexible Power Generation, Woodhead Publishing, Cambridge, UK, 2013.

The appropriate SNCR temperature window is 1,600°F to 2,000°F, which is well above the exhaust temperature for the simple-cycle combustion turbines of about 850°F. Lower temperatures reduce the reaction rates and unreacted ammonia may slip through and be emitted from the stack. Therefore, SNCR is considered technically infeasible for controlling NO_X emissions from these units.

Step 3 – Evaluate Control Options

Emissions and Emission Reductions

Collectively, the simple-cycle combustion turbines have a potential to emit (PTE) for NO_X of 98 tons/yr based on the Title V Operating Permit emission limit. The permit also restricts short-term limits for each turbine to 41.0 lb/hr for natural gas firing, and 71.0 lb/hr for No. 2 fuel oil firing.

Recent NO_X CEMS data for January 1 through September 30, 2022, inclusive, obtained from EPA's Clean Air Markets Program Data (CAMPD) shows that actual NO_X emissions for full operating hours on both turbines AE1 and AE2 averaged 0.073 lb/MMBtu with relatively small standard deviations (0.004 lb/MMBtu for AE1 and 0.006 lb/MMBtu for AE2). CAMPD data for the last five full calendar years (2017-2021, inclusive) shows that combined actual annual NO_X emissions AE1 and AE2 ranged from 41.3 to 62.0 tons/yr, averaging 52.9 tons/yr.

Table 7 lists the technically feasible control options with their estimated control efficiencies.

Table 7 Simple-Cycle Combustion Turbines NO_X Technically feasible Control Options

Control Option	Estimated NO_X Control Efficiency	NO_X Emission Reductions (tons/yr)	Controlled NO_X Emissions (lb/MMBtu)
Tune-ups for AE1 and AE2	2%[a]	1.8	0.097 [natural gas] 0.167 [No. 2 fuel oil]
SCR for AE1 and AE2	84%[b]	82.3[c]	0.0155 [natural gas] 0.0268 [No. 2 fuel oil]

(a) Percent reduction in fuel usage.
(b) Percent reductions are calculated from emission rate information provided by Springdale Energy.
(c) Emission reductions shown include both simple-cycle combustion turbines, each requiring an SCR. provided by Springdale Energy.

Economic Analysis

Using information provided by Springdale Energy and collected by ACHD, an economic analysis of installing and operating SCR on the simple-cycle combustion turbines was conducted in October 2016. The analysis estimated the total costs associated with the NO_X control equipment, including the total capital investment of the various components intrinsic to the complete system, the estimated annual operating costs, and the indirect annual costs. All costs, except for direct installation costs, were calculated using the methodology described in Section 6, Chapter 1 of the "EPA Air Pollution Control Cost Manual, Sixth Edition" (document # EPA 452-02-001). Direct capital cost was based on a vendor quote. Annualized costs were based on an interest rate of 7% and an equipment life of 15 years.

Although the vendor quote dates from before October 2016, the fundamental design and performance of the SCR control technology remains the same. For this updated analysis, the vendor cost estimates were scaled from 2016 to 2022 using the Chemical Engineering Plant Cost Index (CEPCI), which indicates a 52% increase in costs during this period. Tune-up costs were escalated for inflation between October 2016 and October 2022 (the most current available data) using the Consumer Price Index (CPI) Inflation Calculator available from the U.S. Bureau of Labor Statistics[20] which indicates a 23% increase in costs during this period.

The basis of cost-effectiveness, used to evaluate the control option, is the ratio of the annualized cost to the amount of NO_X (tons) removed per year. **Table 8** summarizes the $/ton cost-effectiveness values determined in the analysis. The $/ton values are conservatively low because they are based on potential, rather than actual, emissions of NO_X removed.

Table 8 Simple-Cycle Combustion Turbines Economic Analysis of NO_X Technically Feasible Control Options

Control Option	Total Capital Investment ($)	Total Annualized Cost ($/yr)	Potential NO_X Removal from Add-on Control (ton/yr)	Cost Effectiveness ($/ton NO_X removed)
Tune-ups for AE1 and AE2[(a)]	$15,744	$6,394	1.8	$3,500
Two SCR[(b)] (one each for AE1 and AE2)	$9,499,086	$1,428,453	82.3	$17,400

(a) Tune-up costs are $6,400 in initial set-up costs per turbine, annualized over five years and an ongoing annual tune-up cost of $1,300 per year.
(b) Costs and reductions shown include both simple-cycle combustion turbines; each equipped with SCR.

<u>Step 4 – Select RACT</u>

Based on the costs presented in **Table 8**, the installation of a SCR is not a cost-effective NO_X emission control option, but a tune-up for each turbine is cost-effective, and <u>an annual tune-up is considered RACT</u>. The proposed RACT for the Springdale Station Units 1 and 2 simple-cycle turbines is to continue operation under the permitted NO_X emission limits, namely, 41 lb/hr per unit when firing natural gas and 71 lb/hr when firing No. 2 fuel oil., along with continuing to conduct annual tune-ups.

Note that these proposed RACT III mass-based emission limits correspond to 25 and 42 ppmvd @ 15% O_2 for gas and oil firing, respectively are much more stringent than the presumptive RACT III emission limitations of 42 and 96 ppmvd @ 15% O2 for gas and oil firing, respectively, specified in §129.112(g)(2)(v) for simple-cycle turbines with rated outputs equal to or greater than 4,100 bhp and less than 60,000 bhp, the upper range of which is only slightly below the 48 MW (67,800 bhp) outputs of the Units 1 and 2 turbines.

2. VOC

Pursuant to operating permit 0580-OP17, issued July 21, 2017, the VOC emission limits for Units 1 and 2 are:

- Condition V.A.1.c, when natural gas is burned, each turbine is limited to 5.0 lb/hr;

[20] www.bls.gov/inflation_calculator.htm

- Condition V.A.1.c, when No. 2 fuel oil is burned, each turbine is limited to 1.0 lb/hr; and
- Condition V.A.1.c, total emissions from both turbines are limited to 10.0 tons/yr.

The above conditions effectively limit VOC emissions to 0.0118 lb/MMBtu when natural gas is burned, and 0.0024 lb/MMBtu when No. 2 fuel oil is burned. In turn, these lb/MMBtu values correspond to approximately 2.8 ppmvd @ 15% O_2 (as propane) for gas firing, and 0.6 ppmvd @ 15% O_2 (as propane) for No. 2 fuel oil firing. Pursuant to the Operating Permit No. 0580-OP17, issued July 21, 2017, Condition V.A.1.a restricts the total combined hours of operation for both turbines to 4,450 hours per year (consecutive 12-month period). This restriction is being removed from the current installation and operating permits.

Step 1 – Identify Control Options

The control strategies that could potentially be employed to control VOC emissions from the Units 1 and 2 turbines are as follows:

- Tune-up
- Oxidation Catalyst

Tune-ups

Turbine tune-ups optimize the fuel performance of the combustion turbine unit. Concentrations of O_2, VOC, CO and NO_X are measured while the turbine owner/operator fine tunes the operating parameters to optimize turbine fuel and emissions performance.

Oxidation Catalysts

As the name implies, oxidation catalysts, or catalytic oxidizers, are oxidation systems (like thermal oxidizers) that control VOC (and CO) emissions. Catalytic oxidizers use a catalyst to promote the oxidation of VOC to carbon dioxide (CO_2) and water. The catalyst (typically platinum group metals) allows oxidation to occur at lower temperatures (650°F-1,000°F). Oxidation catalysts are a common technique for reducing VOC emissions from combustion turbines. No reagents are required. Typical exhaust gas VOC levels achievable with the use of catalytic oxidation are in the range of 1 to 5 ppmvd @15% O_2.

Step 2 — Eliminate Technically Infeasible Control Options

Tune-ups and oxidation catalysts are both considered technically feasible for controlling VOC emissions.

Step 3 — Evaluate Control Options

The table below contains the technically feasible VOC emission control technologies for turbines, ranked in order of control efficiency.

Emissions and Emission Reductions

Table 9 lists the technically feasible control options with their estimated control efficiencies.

Table 9 Simple-Cycle Combustion Turbines – VOC Technically Feasible Control Options

Control Option	Estimated VOC Control Efficiency	VOC Emission Reductions – both units (tons/yr)	Post-Control VOC Emissions – per Unit
Tune-ups for AE1 and AE2	2%[a]	0.4	5.0
Oxidation Catalysts for AE1 and AE2	70%	7.0	1.5
(a) Percent reduction in fuel usage.			

Economic Analysis

Using information provided by Springdale Energy and collected by ACHD, an economic analysis of installing and operating oxidation catalysts on the simple-cycle combustion turbines was conducted in October 2016. The analysis estimated the total costs associated with the equipment, including the total capital investment of the various components intrinsic to the complete system, the estimated annual operating costs, and the indirect annual costs. All costs, except for direct installation costs, were calculated using the methodology described in Section 6, Chapter 1 of the "EPA Air Pollution Control Cost Manual, Sixth Edition" (document # EPA 452-02-001). Direct capital costs were based on a review of construction permit application which included comparable emission units, comparable controls, and cost provided by equipment vendors. Annualized costs were based on an interest rate of 7% and an equipment life of 15 years.

For this updated analysis, the SCR cost estimates were scaled from 2016 to 2022 using the CPECI, which indicates a 52% increase in costs during this period. Tune-up costs were escalated for inflation between October 2016 and October 2022 (the most current available data) using the CPI Inflation Calculator, which indicates a 23% increase in costs during this period.

The basis of cost-effectiveness, used to evaluate the control option, is the ratio of the annualized cost to the amount of VOC (tons) removed per year. **Table 10** summarizes the cost-effectiveness results. The $/ton values are conservatively low because they are based on potential, rather than actual, emissions of VOC removed.

Table 10 Simple-Cycle Combustion Turbine Economic Analysis of VOC Technically Feasible Control Options

Control Option	Total Capital Investment ($)	Total Annualized Cost ($/yr)	Potential VOC Removal from Add-on Control (ton/yr)	Cost Effectiveness ($/ton VOC removed)
Tune-ups for AE1 and AE2[a]	$15,744	$6,394	0.4	$14,400

Two Oxidation Catalysts[b] (one each for AE1 and AE2)	$1,346,110	$424,046	7.0	$60,600
(a) Tune-up costs are $6,400 in initial set-up costs per turbine, annualized over five years and an ongoing annual tune-up cost of $1,300 per year.				
(b) Costs and reductions shown include both simple-cycle combustion turbines; each equipped with an oxidation catalyst.				

<u>Step 4 – Select RACT</u>

Based on the costs presented in **Table 10,** the installation of oxidation catalysts is not a cost-effective VOC emission control option. A tune-up for each turbine is marginally cost-effective for VOC (using a cost effectiveness threshold of $12,000/ton), but cost-effective for NO_X and, hence, annual tune-ups will be performed to satisfy RACT for NO_X and VOC. The proposed RACT for the Springdale Station Units 1 and 2 simple-cycle turbines is to continue operation under the permitted VOC emission limits, namely, 5.0 lb/hr per unit when firing natural gas and 1.0 lb/hr when firing No. 2 fuel oil, along with continuing to conduct annual tune-ups.

Note that these proposed RACT III mass-based emission limits correspond to 2.8 ppmvd @ 15% O_2 (as propane) for gas firing, and 0.6 ppmvd @ 15% O_2 (as propane) for No. 2 fuel oil firing. They are much more stringent than the presumptive RACT III emission limit of 9 ppmvd VOC @ 15% O_2 (as propane) when firing either natural gas or firing fuel oil specified in §129.112(g)(2)(v) for simple-cycle turbines with rated outputs equal to or greater than 4,100 bhp and less than 60,000 bhp, the upper range of which is only slightly below the 48 MW (67,800 bhp) outputs of the Units 1 and 2 turbines.

B. Units 1 and 2: Startup/Shutdown Operations

1. NO_X and VOC

The Springdale Station Units 1 and 2 turbines are designed for quick starts and the ability to respond to rapidly changing loads to meet electrical system needs. Because emissions are typically greater during startup and shutdown periods than during steady-state operations, the RACT limits established for steady-state operations are not technically feasible during these periods. The only available and practical approach to reducing startup and shutdown emissions from simple-cycle turbines is to use good operating practices. By following the plant equipment manufacturers' recommendations, operators can limit the duration of each startup and shutdown to the minimums necessary to safely achieve steady-state operating conditions. There are no other available control technologies or techniques that can effectively reduce startup and shutdown emissions from the Units 1 and 2 turbines, other than maintaining and operating the sources in accordance with the manufacturer's specifications and with good operating practices. So, these practices are required as RACT for Unit 1 and Unit 2 startup and shutdown operations. It is important to note that these practices are presumptive RACT III for a number of sources and source categories prescribed in the regulations at §129.112(c).

C. Units 3 and 4: Normal Operation

Units 3 and 4 each consist of a single natural gas-fired Siemens Westinghouse 501F combined-cycle combustion turbine. Each turbine has a nominal capacity of 2,094 MMBtu/hr (209 MWe, net), each exhausting to a heat recovery steam generator (without duct burners) driving one steam turbine generator rated at 186 MW (nominal). The turbines are equipped with Dry Low NO_X burners and SCR for NO_X emission control. Each unit has dedicated Continuous Emission Monitors (CEMs) for NO_X emissions and O_2 levels. The turbines were installed in 2001 (installation permit ID: 0580-I002).

1. NO_X

Pursuant to the Operating Permit No. 0580-OP17, issued July 21, 2017, the NO_X emission limits for Units 3 and 4 are:

- Condition V.B.1.d, each turbine is limited to 2.5 ppmvd @ 15% O2 during any three hour time period at or above 50% of full load;
- Condition V.B.1.i, each turbine is limited to 20.0 lb/hr, based on a rolling, 3-hour average;
- Condition V.B.1.i, turbine emissions are limited to 210 tons/year, combined, with a year defined as any 12 consecutive months, and annual emissions to include emissions during startup and shutdown.

The turbines are subject to the New Source Performance Standard Subpart GG for Stationary Combustion Turbines (40 CFR 60, Subpart GG).

Similar detail analysis as conducted for NO_X emissions from unit 1 and unit 2 normal operations is performed for unit 3 and 4 normal operations.

<u>Step 1 – Identify Control Options</u>

The same NO_X control options identified in step 1 in section V.A.1 above for normal operation of the Units 1 and 2 applies for the Units 3 and 4 normal operations.

<u>Step 2 – Eliminate Technically Infeasible Control Options</u>

Each control option listed in Step 1 was evaluated to determine if it is technically feasible for the Units 3 and 4 combined-cycle combustion turbines during normal operation. Tune-ups, DLN, and SCR are technically feasible for these units, and are currently being implemented on the units. A summary of technically feasible control options is provided in **Table 11**.

Table 11 Combined-Cycle Combustion Turbines – NO_X Technically Feasibility by Control

Source ID	Description	Control Options							
		Tune-ups	**Lean/Reduced Combustor Residence Time**	**DLN**	**RQL**	**Catalytic Combustion**	**WSI**	**SCR**	**SNCR**
AE3	Combined-cycle Combustion Turbine (Normal Operations)	Feasible and Implemented	Infeasible	Feasible and Implemented	Infeasible	Infeasible	Infeasible	Feasible and Implemented	Infeasible
AE4	Combined-cycle Combustion Turbine (Normal Operations)	Feasible and Implemented	Infeasible	Feasible and Implemented	Infeasible	Infeasible	Infeasible	Feasible and Implemented	Infeasible

Several control options identified are not technically feasible for Units 3 and 4 during normal operation. This section presents the rationale explaining why each control option is not technically feasible.

Lean Combustion / Reduced Combustor Residence Time

The combined-cycle combustion turbines have preexisting DLN burners already installed for NO_X emission control. Lean combustion and reduced residence time, if not already incorporated into the combustors, would not be necessary for sufficient control of NO_X emissions. Therefore, they are removed from further consideration.

Rich/Quench/Lean Combustion

These combustors reduce emissions by 40 to 50% compared to conventional combustors. The current control reduces emissions to a greater extent. Therefore, this option would result in higher emissions and is removed from further consideration.

Catalytic Combustion

Catalytic combustion is considered technically infeasible because it is not commercially available for this size turbine (209 MWe, net). The only commercially available turbine model with catalytic combustion is the Kawasaki model GPB15X, which has an output capacity of only 1.4 MW. One source indicated that it was unlikely that catalytic combustion will be used widely on future combustion turbines, because the technology has not been demonstrated to perform better than current lean premixed combustors, especially considering the need for an outlet compressor temperature of above 426°C (~ 800°F) and the limited load settings available at the low NO_X settings. [21]

Water / Steam Injection

Modern water injection technology can offer NO_X emissions of 25 ppmvd @ 15% O_2 or less. The DLN technology currently equipped onto the combined-cycle combustion turbines offers similarly effective emission reductions to that of water injection systems. Installation of water or steam injection would be

[21] Modern Gas Turbine Systems-High Efficiency, Low Emission, Fuel Flexible Power Generation, Woodhead Publishing, Cambridge, UK, 2013.

no more effective than the DLN technology already equipped to the turbines. Therefore, it is removed from further consideration.

Selective Non-Catalytic Reduction (SNCR)

The appropriate SNCR temperature window is 1,600°F to 2,000°F, which is well above the stack temperature for the combined-cycle combustion turbines of about 250°F. Lower temperatures reduce the reaction rates and unreacted ammonia may slip through and be emitted from the stack. Additionally, SNCR is generally not used for gas turbines because low NO_X concentrations in the flue gas make SNCR less efficient than other available control methods. [22] Therefore, SNCR is considered technically infeasible for controlling NO_X emissions from these units.

Step 3 - Evaluate Control Options

Tune-ups
Annual tune-ups are currently required under Condition V.B.6.d of the facility's Title V permit, and include:

- Inspection, adjustment, cleaning, or necessary replacement of fuel-burning equipment, including the burners and moving parts necessary for proper operation as specified by the manufacturer;

- Inspection of the flame pattern or characteristics and adjustments necessary to minimize total emissions of NO_X, and to the extent practicable minimize emissions of CO; and

- Inspection of the air-to-fuel ratio control system and adjustments necessary to ensure proper calibration and operation as specified by the manufacturer.

Lean Premixed Combustors (DLN)

DLN burners are currently equipped on the combined-cycle combustion turbines. Both turbines are not allowed to operate unless the DLN burners are in place and operating according to the manufacturer's specifications.
Selective Catalytic Reduction (SCR)

Selective Catalytic Reduction technology is currently equipped on the combined-cycle combustion turbines. Both turbines are not allowed to operate unless the SCR technology is in place and operating according to the manufacturer's specifications.

Step 4 – Select RACT

In the PADEP technical support document for RACT III [23], the Bureau of Air Quality states that the natural gas-fired combined-cycle combustion turbines with a rated output equal to or greater than 180 MW in the Commonwealth are equipped with DLN and SCR control technology. The PADEP has analyzed NO_X

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[22] Sorrels, John L., et al. "Selective catalytic reduction." US Environmental Protection Agency Research Triangle Park, NC 27711 2019.
[23] Technical Support Document for Final-Form Rulemaking Environmental Quality Board [25 Pa. Code Chs. 121 and 129] - Additional RACT requirements for Major Sources of NO_X and VOCs for the 2015 ozone NAAQS (RACT III), April 2022.

emissions test results for these subject turbines and determined that these turbines are able to comply with a NO_X emissions rate of 4 ppmvd NO_X @ 15% oxygen. This is the basis for the presumptive RACT requirement established in 25 Pa. Code §129.112(g)(2)(iii)(A) for the owners and operators of combined-cycle combustion turbines with a rated output equal to or greater than 180 MW.

Based on this case-by-case evaluation, ACHD has determined that RACT III for normal operations of the Springdale Station Units 3 and 4 combined-cycle turbines is to meet the current permit limits for NO_X and continuing to conduct annual tune-ups. The RACT III limits are:

- NO_X ≤ 20 lb/hr, per unit (based on a rolling, 4-hour average);
- NO_X ≤ 210 tons/year, combined; and
- NO_X ≤ 2.5 ppmvd @ 15% O_2, per unit (for any four-hour time period at or above 70% or full load or after a combustion turbine has achieved steady state operation above 70% load and is subsequently turned down to 50% load)

The selected RACT limit of 2.5 ppmvd NO_X @ 15% O_2 for any four-hour time period at or above 70% of full load is more stringent than the presumptive RACT III emission limitations of 4 ppmvd NO_X @ 15% O_2 for combined-cycle turbines with a rated output greater than or equal to 180 MW, specified in §129.112(g)(2)(iii).

2. VOC

The current limits for VOC emissions from Units 3 and 4, established in Operating Permit #0580-OP17, issued July 21, 2017, are as follows:

- Condition V.B.1.i, each turbine is limited to 3.8 lb/hr;
- Condition V.B.1.i, total emissions from both turbines are limited to 48 tons/yr.

These conditions limit VOC emissions to 0.0181 lb/MMBtu. Recent stack tests for these units, under these conditions, corresponded to approximately 0.17 ppmvd @ 15% O_2 (as propane) for Unit 3 and 0.16 ppmvd @ 15% O_2 (as propane) for Unit 4.

The analysis conducted for VOC emissions from Unit 1 and Unit 2 normal operations was also performed for Unit 3 and 4 normal operations. The results for Units 3 and 4 normal operations are reported in the following section.

<u>**Step 1 — Identify Control Options**</u>

The control strategies that could potentially be employed to control VOC emissions from the Units 3 and 4 turbines are listed below:

- Tune-up
- Oxidation Catalyst

Tune-ups

Turbine tune-ups optimize the fuel performance of the combustion turbine unit. Concentrations of O_2, VOC, CO and NO_X are measured while the turbine owner/operator fine tunes the operating parameters to optimize turbine fuel and emissions performance.

Oxidation Catalysts

Oxidation catalysts, or catalytic oxidizers, are oxidation systems (like thermal oxidizers) that control VOC (and CO) emissions. Catalytic oxidizers use a catalyst to promote the oxidation of VOC to carbon dioxide (CO_2) and water. The catalyst (typically platinum group metals) allows oxidation to occur at lower temperatures (650°F-1,000°F). Oxidation catalysts are a common technique for reducing VOC emissions from combustion turbines. No reagents are required. Typical exhaust gas VOC levels achievable with the use of catalytic oxidation are in the range of 1 to 5 ppmvd @15% O_2.

Step 2 — Eliminate Technically Infeasible Control Options

Tune-ups and oxidation catalysts are both considered technically feasible for controlling VOC emissions from combined-cycle combustion turbines. As discussed above, annual tune ups are already required under Condition V.B.6.d of operating permit #0580-OP17. Therefore, tune-ups are not discussed further in the following sections.

Step 3 — Evaluate Control Options

The remaining control option is an oxidation catalyst. **Table 12** lists the relevant information:

Table 12 Combined-Cycle combustion Turbines – VOC Technically Feasible Control Options

Control Option	Estimated VOC Control Efficiency	VOC Emission Reduction for both units (ton/yr)	Post-Control VOC Emissions per unit (lb/hr)
Oxidation Catalysts for Units 3 & 4	70%	33.6	1.14

Economic Analysis

ACHD performed a RACT II economic analysis for the installation and operating oxidation catalysts on the combined-cycle combustion turbines in October 2016. [24] The analysis estimated the total costs associated with the equipment, including the total capital investment of the various components intrinsic to the complete system, the estimated annual operating costs, and the indirect annual costs. All costs, except for direct installation costs, were calculated using the methodology described in Section 6, Chapter 1 of the "EPA Air Pollution Control Cost Manual, Sixth Edition" (document # EPA 452-02-001). Direct capital costs were based on a review of construction permit applications which included comparable emission units, comparable controls, and cost provided by equipment vendors. Annualized costs were based on an interest rate of 7% and an equipment life of 15 years.

[24] Technical Support Document (TSD) for Installation Permit # 0580-I003, Issued October 13, 2016 – Reasonably Available Control Technology (RACT) Determination, Allegheny County Health Department, Office of Air Quality.

For this updated analysis, the oxidation catalyst cost estimates were scaled from 2016 to 2022 using the Consumer Price Index (CPI), which is a measure of the average change over time in the prices paid by urban consumers for a market basket of consumer goods and services. [25] The change in CPI from 2016 to 2022 indicates a 22% increase in costs. [26]

The basis of cost-effectiveness, used to evaluate the control option, is the ratio of the annualized cost to the amount of VOC (tons) removed per year. **Table 13** summarizes the cost-effectiveness results. The $/ton values are conservatively low because they are based on potential, rather than actual, emissions of VOC removed. The full cost analysis can be found in Appendix A of the additional case-by-case analysis for the NO_X and VOC emission for Units 3 & 4. [27]

Table 13 Combined-Cycle Combustion Turbines Economic Analysis of VOC Technically Feasible Control Options

Control Option	Total Capital Investment ($)	Total Annualized Cost ($/yr)	Potential VOC Removal from Add-on Control (ton/yr)	Cost Effectiveness ($/ton VOC removed)
Two Oxidation Catalysts [1] (one each for AE3 and AE4)	5,326,177	1,334,797	33.6	39,990

[1] Costs and reductions include both Units 3 and 4.

<u>Step 4 - Select RACT</u>

Based on the costs presented in **Table 13**, the installation of oxidation catalysts is not a cost-effective VOC emission control option using a cost effectiveness threshold of $12,000/ton found in 25 Pa. Code §129.114(i)(l)(i).

Additionally, the results from the recent stack tests for Unit 3 and Unit 4, show the average emission rates of 0.17 ppmvd VOC @ 15% O_2 (as propane), and 0.16 ppmvd VOC @ 15% O_2 (as propane) respectively. These values are lower than the presumptive RACT III emission limitations of 2 ppmvd VOC (as propane) @ 15% O_2 for combined-cycle turbines with a rated output greater than or equal to 180 MW, specified in §129.112(g)(2)(iii)(B).

Based on this case-by-case evaluation and a review of the most recent stack test data, ACHD has determined that the alternative RACT III limit for VOC emissions from Units 3 and 4 is 2.0 ppmvd VOC @ 15% O_2 (as propane) for each unit. Continuing operation under the permitted VOC emission limits, namely, 3.8 lb VOC/hr per unit, along with continuing to conduct annual tune-ups, will meet this alternative RACT III Requirement. The RACT III requirements are summarized as the following bullet points:

- VOC ≤ 3.8 lb/hr, each unit

[25] CPI Home: U.S. Bureau of Labor Statistics (bls.gov)
[26] Consumer Price Index for All Urban Consumers: All Items in U.S. City Average (CPIAUCSL) | FRED | St. Louis Fed (stlouisfed.org)
[27] Environmental Resource Management. (October 27, 2023). RACT III Case-by-Case Analysis for AE3, AE4, EG01, EG02.

- VOC ≤ 48 tons/year combined
- VOC ≤ 2.0 ppmvd @ 15% O_2 (as propane at or above 70% of full load or after a combustion turbine has achieved steady state operation above 70% load and is subsequently turned down to 50% load)

D. Units 3 and 4: Startup/Shutdown Operations

1. NO_X and VOC

The additional steam-generating components associated with combined-cycle systems require additional time to come up to full operating temperature. Because emissions are typically greater during startup and shutdown periods than during steady-state operations, the RACT limits established for steady-state operations are not technically feasible during these periods. The only available and practical approach to reducing startup and shutdown emissions is to use good operating practices. By following the plant equipment manufacturers' recommendations, operators can limit the duration of each startup and shutdown to the minimum duration achievable. There are no other available control technologies or techniques that can effectively reduce startup and shutdown emissions from the Units 3 and 4 turbines, other than installing, maintaining, and operating the sources in accordance with the manufacturer's specifications and with good operating practices, and adhering to the requirements pertaining to the start-ups and shutdowns for Units 3 and 4 specified in Condition V.B.1.i of installation permit #0580-I005, which are:

1) A cold startup shall be defined as an event that occurs after the combustion turbine has not been operating for at least 48 hours. A cold start-up shall not last longer than 6.25 hours after ignition, unless NERC reliability testing requires extended low-load operation.

2) A warm startup shall be defined as an event that occurs after the combustion turbine has not been operating for 8 hours to 48 hours. A warm start-up shall not last longer than 3.75 hours after ignition, unless NERC reliability testing requires extended low-load operation.

3) A hot startup shall be defined as an event that occurs after the combustion turbine has not been operating for less than 8 hours. A hot start-up shall not last longer than 2.5 hours after ignition, unless NERC reliability testing requires extended low-load operation.

4) A start-up shall be defined as the period after ignition until the unit reaches stable compliance with short-term NO_X and CO emission limits (lb/hr) as determined by NO_X and CO CEMS or 70% of full load, whichever occurs first.

5) A shutdown shall be defined as the period after the load is reduced below 70% of full load or when in compliance with short-term NO_X and CO emission limits (lb/hr) as determined by NO_X and CO CEMS, whichever occurs last.

6) Emission limitations contained in Conditions V.B.1.d and V.B.1.f above as well as V.B.1.q below (emission limitations for the normal operations) shall not apply during start-up and shutdown, tuning and NERC reliability testing.

7) Emissions during startup, warm up and shutdown, tuning, and NERC reliability testing shall be included in the 12-month rolling emissions totals for nitrogen oxides, sulfur oxides, volatile organic compounds, carbon monoxide, PM/PM_{10} and formaldehyde.

These conditions define startups and shutdowns, establish maximum durations for cold, warm, and hot startups, and require that emissions of pollutants, including NO_X and VOC, be included in the 12-month rolling emissions for the units.

E. Black Start Emergency Generators (EG01 & EG02)

1. NO_X and VOC

Emergency standby engines EG01 and EG02 consist of two Caterpillar C32 diesel-fired emergency generator units, each rated at a unit capacity of 1,829 BHP. EG01 and EG02 are designated as emergency engines at the Station as each engine is expected to operate for less than 500 hours in a 12-month period.

Step 1 – Identify Control Options

PADEP's Technical Support Document (TSD) for final-form rulemaking for RACT III and additional resources were consulted to determine what control options are available for a combustion engine like the two diesel-fired emergency engines, EG01 and EG02.

The NO_X controls identified are as follows:

- Tune-ups
- Selective Catalytic Reduction (SCR)
- Selective Non-Catalytic Reduction (SNCR)
- Three Way Catalytic Converters
- Fuel Injection
- NOx Adsorber Catalyst
- Exhaust gas recirculation (EGR)
- Lean NOx Catalyst

The VOC controls identified are as follows:

- Tune-ups
- Diesel Oxidation Catalysts

No additional control measures were identified for diesel-fired emergency generator engines, except for combinations of controls listed above.

Tune-ups (NO_X and VOC Control)

Generator tune-ups optimize the fuel performance of the generator engine units. Concentrations of O_2, VOC, CO and NO_X are measured while the generator owner/operator fine tunes the operating parameters to optimize generator fuel and emissions performance.

Selective Catalytic Reduction (SCR)

SCR systems selectively reduce NO_X emissions by injecting ammonia (NH_3) into the exhaust gas stream upstream of a catalyst. NO_X, NH_3 and oxygen (O_2) react on the surface of the catalyst to form nitrogen (N_2) and water (H_2O). The exhaust gas must contain a minimum amount of O_2 and be within a particular temperature range (typically 450°F to 850°F) in order for the SCR system to operate properly. The temperature range is dictated by the catalyst material which is typically made from noble metals, including base metal oxides such as vanadium and titanium, or zeolite-based material. The removal efficiency of an SCR system in good working order is typically from 65—90%. Exhaust gas temperatures greater than the upper limit (850°F) cause NO_X and NH_3 to pass through the catalyst unreacted. Ammonia emissions, called NH_3 slip, may be a consideration when specifying an SCR system.

Selective Non-Catalytic Reduction (SNCR)

Like SCR, SNCR operates by promoting the conversion of NO_X into elemental nitrogen and water vapor, typically using aqueous urea [$(NH_2)2CO$] or ammonia as a reagent. However, unlike SCR, SNCR does not utilize a catalyst, and therefore requires higher exhaust temperatures. [28]

Three-way Catalytic Converters

Three-way catalytic converters are designed to be able to operate on internal combustion engines and can provide high-performance reductions in all major exhaust emissions. Reactions occurring in the three-way catalytic converter include the reduction of nitrogen oxides to nitrogen, and the oxidation of carbon, hydrocarbons, and carbon monoxide to carbon dioxide.

Fuel Injection

The purpose of a fuel injection system of a diesel generator is to deliver fuel into the engine cylinders, while precisely controlling the injection timing, fuel atomization, and other parameters. Fuel injection systems can determine combustion efficiency, and therefore emission totals. Different systems have been developed to implement and control the fuel injection process for diesel generator engines, which include both mechanical and electronic system upgrades. [29]

NO_X Adsorber Catalyst

NO_X adsorber-catalyst systems have been developed to control NO_X emissions from diesel engines. Adsorbers chemically bind nitrogen oxides during lean engine operation. After the adsorber capacity is saturated, the system is regenerated during a period of rich engine operation, and released NO_X is catalytically reduced to nitrogen. [30]

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[28] Northeast States for Coordinated Air Use Management (NESCAUM), and Praveen Amar. Applicability and Feasibility of NO_X, SO_2, and PM Emissions Control Technologies for Industrial Commercial, and Institutional Boilers. November 2008. (Revised January 2009). http://www.nescaum.org/documents/ici-boilers-20081118-final.pdf, accessed November 15, 2022.
[29] Khair, M. K., & Jääskeläinen, H. (2013). Diesel fuel injection. https://dieselnet.com/tech/diesel_fi.php.
[30] Majewski, W. A. (2007). NO_X adsorbers. DieselNet Technology Guide 2007. https://dieselnet.com/tech/cat_nox-trap.php.

Exhaust Gas Recirculation (EGR)

EGR is an emission control technology allowing NO_X emission reductions from most types of diesel engines. EGR works by routing, cooling, and feeding a controlled amount of exhaust gas created during combustion back into an engine's intake air system. This process reduces NO_X through lowering the oxygen concentration in the combustion chamber of the engine, which reduces the engine's peak combustion temperature. The lower temperature means less NO_X is formed during combustion. [31]

Lean NO_X Catalysts

Lean NO_X Catalysts promote selective catalytic reduction of NO_X by the usage of hydrocarbons, carbon monoxide, alcohols, or other exhaust gas components. In the application of lean NO_X catalysts for diesel engines, diesel fuel is used as the source of hydrocarbons necessary for reaction with NO_X to form nitrogen, CO_2, and water, and controlling emissions. [32]

Diesel Oxidation Catalyst (VOC Control)

Diesel Oxidation catalysts are catalytic converters that are designed specifically for diesel engines and equipment and are used to reduce hydrocarbon and CO emissions. Specifically, diesel oxidation catalysts are effective for the control of CO, gas phase hydrocarbons, VOCs, and other emissions. Diesel oxidation catalysts consist of a substrate made up of thousands of small channels. Each channel is coated with a highly porous layer containing precious metal catalysts, such as platinum or palladium. As exhaust gas travels down the channel, hydrocarbons and CO react with O_2 within the porous catalyst layer to form CO_2 and water vapor. The resulting gases then exit the channels and flow through the rest of the exhaust system. [33]

Step 2 – Eliminate Technically Infeasible Control Options

The identified control options are considered technically feasible for usage on diesel-fired generator engines for both NO_X and VOC emissions control.

Step 3 - Evaluate Control Options

While many of the control options mentioned are available and technically feasible for usage on diesel-fired generator engines for both NO_X and VOC emissions control, none of the control options presented would be economically feasible for usage on the two emergency generators used by Springdale Energy. The size, rating, emission totals, and overall purpose of the engines are not conducive to the installation of control technology. The two black start diesel-fired engines are not expected to be used regularly and will only be used during emergencies when required by the Station, with an expected usage limitation of 500 hours of operation per year, each. Rough cost estimates for even tune-up controls on the engines, based on 500 hours per year of actual operating hours, show an estimated cost effectiveness value of \$25,600 per ton of NO_X removed, and \$3,180,200 per ton of VOC removed; both values are considered

[31] Khair, M. K., & Jääskeläinen, H. (2006). Exhaust gas recirculation. DieselNet Technology Guide. https://dieselnet.com/tech/engine_egr.php.
[32] Majewski, W. A. (2010). Lean NO_X Catalyst. DieselNet Technology Guide. https://dieselnet.com/tech/cat_lean-nox.php.
[33] Majewski, W. A. (2012). Diesel oxidation catalyst. DieselNet Technology Guide. https://dieselnet.com/tech/cat_doc.php.

significantly higher than any pre-determined cost effectiveness benchmark, and any other control technology would potentially be magnitudes higher in value. Thus, there are no NO_X or VOC control options that are cost effective for the emergency generators. The cost analysis for the tune-up control option can be found in in Appendix A of the additional Case-by-case analysis for the NO_X and VOC emission for Units 3 & 4. [34]

<u>Step 4 – Select RACT</u>

Given that no cost-effective NO_X or VOC controls are available for the Station's two diesel-fired emergency generators Units EG01 and EG02, ACHD has determined that RACT III for the emergency generators is compliance with the regulations set in 25 Pa. Code §129.112(c)(10) regarding alternative limitations for emergency standby engines operating less than 500 hours per year is as follows:

- Install, maintain, and operate the source in accordance with the manufacturer's specifications and with good operating practices.

Springdale Energy proposed these practices as RACT for emergency generators Unit EG01 and EG02 and noted that these practices are presumptive RACT III for the sources and source categories prescribed in the regulations at §129.112(c).

VI. <u>RACT III Compliance Demonstration</u>

Pursuant to §129.115, Springdale Energy must comply with certain RACT III compliance demonstration and recordkeeping requirements for the units specified in this document. The following section details how Springdale Energy shall demonstrate compliance with RACT III for the various source categories (exempt, presumptive, and case-by-case). Relevant RACT III recordkeeping requirements are outlined in section VII below.

A. Exempt Sources

The Station's fire pump fire engine is exempt from both NO_X and VOC RACT III. Pursuant to §129.115(a)(7)(ii), the §129.115 notification must demonstrate that the PTE for the engine is less < 1 TPY of NO_X and < 1 TPY of VOC. This document also serves as Springdale Energy's §129.115 notification, and such demonstration is included in sections IV.A.1 and IV.B.1 above.

B. Presumptive Sources

Emergency standby engines EG01 and EG02 are subject to presumptive RACT III requirements as described in section VI.C.4 below.

C. Case-By-Case Sources

1. Units 1 and 2: Normal Operation

[34] Environmental Resource Management. (2023). RACT III Case-by-Case Analysis for AE3, AE4, EG01, EG02.

For normal operation of Units 1 and 2, ACDH has determined that the NO_X and VOC emission limits currently included in Title V Operating Permit #0580-OP17 are considered as RACT III. Therefore, compliance shall be demonstrated using the monitoring and testing requirements currently prescribed for Unit 1 and 2 in the operating permit.

2. Units 3 and 4: Normal Operation

Units 3 and 4 compliance demonstration requirements are different for NO_X and VOC. Both proposed methods for demonstrating compliance and recordkeeping and reporting requirements are in accordance with 25 Pa. Code §129.114(d)(6) and are described below.

Units 3 and 4 Compliance Determination - NO_X

Both units are equipped with NO_X CEMs. As required by §129.115, compliance with the RACT alternative under normal operations, 2.5 ppmvd @ 15% O_2 (for any four-hour time period at or above 70% of full load or after a combustion turbine has achieved steady state operation above 70% load and is subsequently turned down to 50% load), shall be monitored in accordance with the requirements of Chapter 139, Subchapter C and Springdale Energy shall maintain records of compliance with the emission rate limitation per §129.115(f). The NO_X monitoring data shall be submitted to the Department according to the reporting schedule established in the Title V permit and 40 CFR Part 75.

A 3-hour average was utilized in the ACHD Operating Permit No. 0580-OP17, issued July 21, 2017, for NO_X emission limitations. The 3-hour average is being updated to a 4-hour averaging period in order to harmonize with the 40 CFR Part 60 Subpart GG. Using a 4-hour average demonstrates compliance with RACT at a more stringent level than the 30-operating day rolling average as referenced in 25 Pa. Code §129.115(b)(1). Meeting the current 4-hour average permit limit shall demonstrate compliance for the two combined-cycle turbines at a more stringent level than current presumptive RACT III level of 4 ppmvd NO_X @ 15% O_2.

Units 3 and 4 Compliance Determination – VOC

For VOC, compliance with the RACT III alternative requirement under normal operations, shall be demonstrated with stack testing. As required by §129.115(b)(6), testing shall be in accordance with an emissions source test approved by the ACHD that meets the requirements of Chapter 139, Subchapter A (relating to sampling and testing methods and procedures). The Station's Title V permit requires VOC emissions testing on Units 3 and 4 in accordance with Article XXI, §2108.02.d and §2108.02.e once every three years. The Station shall continue to source test per these requirements to demonstrate compliance with the alternative RACT III requirement.

Springdale Energy conducted triennial VOC source testing on Units 3 and 4 on September 21 and 22, 2021. [35]

The three-run average VOC emission rates were 0.17 and 0.16 ppmvd VOC (as propane) @ 15% O_2 for Unit 3 and Unit 4 respectively.

3. Units 1, 2, 3 and 4: Startup/Shutdown Operations

[35] Source Test Report, 2021 Compliance Testing, Springdale Energy, LLC – Unit 3 (AE3) and 4 (AE4), dated November 19, 2021 and attached to a letter from Eric Kuper to Jayme Graham.

The RACT III determined for startup and shutdown operations of all four Station units is maintaining and operating the units in accordance with the manufacturer's specifications and with good operating practices. Compliance shall be demonstrated by complying with the site-level good operating practice Condition IV.5 of the permit and maintaining records per §129.115(f).

4. Emergency Standby Engines (EG01 & EG02)

Springdale Energy shall comply with the requirements of RACT alternative for the EG01 and EG02 black start emergency generators by maintaining and operating the units in accordance with the manufacturer's specifications and with good operating practices. The compliance method of this RACT alternative matches that of presumptive RACT III requirements for emergency standby engines operating less than 500 hours in a 12-month rolling period as established in §129.112(c)(10).

VII. RACT III Recordkeeping Requirements

As required by the rule at §129.115(f), Springdale Energy shall keep records to demonstrate compliance with §§ 129.111 - 129.114 and submit reports to ACHD in accordance with the applicable regulations in 25 Pa. Code, Part I, Subpart C, Article III and as specified in RACT Installation Permit #0580-I005. Records will be retained for 5 years and made available to ACHD upon receipt of a written request from ACHD.

VIII. RACT III Summary and Revised RACT III Permit Conditions

The Department has analyzed the facility's proposal for the RACT III requirements and also performed an independent analysis. A detailed case-by-case analysis was performed for all the NO_X and VOC sources subject to 25 PA Code §129.111 that were identified in **Table 4** and **Table 6** above. In summary, PA Code §129.112(g)(2)(v) specifies that a presumptive RACT III source category for a simple-cycle combustion turbine with a rated output ≥4,100 bhp and < 60,000 bhp must comply with a RACT III emission limitation of 42 ppmvd NO_X @ 15% O_2 when firing natural gas and 96 ppmvd NO_X @ 15% O_2 when firing fuel oil. However, Units 1 and 2 at the Springdale Power Station fall just outside this source category because the output of each turbine, 67,800 bhp, exceeds 60,000 bhp. According to §129.114(b), a NO_X source with a PTE ≥ 5.0 TPY that is not subject to the presumptive requirements in §129.112 located at a major NO_X emitting facility must propose an alternative NO_X RACT requirement or RACT emission limitation in accordance with §129.114(d). Also, under RACT II, all of the units at the Springdale Energy facility were considered presumptive. However, because the simple-cycle and the combined cycle turbines were considered case-by-case for startup and shutdown, they also had to be considered case-by-case for normal operations and thus the facility had to perform a case-by-case or alternative analysis for RACT III. Based on the information provided by the facility and independently verified by the Department, ACHD has determined that the RACT III for the Springdale Station is to continue the operation under the permitted emission limits, along with continuing to conduct annual tune-ups.

Table 14 RACT III Installation Permit #0580-I005 Conditions

Unit ID	Permit Condition No.	RACT III Requirement
AE1 & AE2: Two Simple-cycle Combustion Turbines each 424 MMBtu/hr, 67,800 BHP, (48 MWe)	V.A.1.b-g	§129.114
AE1 & AE2: Two Simple-cycle Combustion Turbines each 424 MMBtu/hr, 67,800 BHP, (48 MWe)	V.A.2.d-i	§129.115
AE1 & AE2: Two Simple-cycle Combustion Turbines each 424 MMBtu/hr, 67,800 BHP, (48 MWe)	V.A.3.a-f	§129.115
AE1 & AE2: Two Simple-cycle Combustion Turbines each 424 MMBtu/hr, 67,800 BHP, (48 MWe)	V.A.4.a-g	§129.115
AE1 & AE2: Two Simple-cycle Combustion Turbines each 424 MMBtu/hr, 67,800 BHP, (48 MWe)	V.A.5.b-c	§129.115
AE1 & AE2: Two Simple-cycle Combustion Turbines each 424 MMBtu/hr, 67,800 BHP, (48 MWe)	V.A.6.a-d	§129.114
AE3 & AE4: Two Combined-cycle Combustion Turbines each 2,094 MMBtu/hr, 188 MW	V.B.1.b-e, i-l	§129.114
AE3 & AE4: Two Combined-cycle Combustion Turbines each 2,094 MMBtu/hr, 188 MW	V.B.1.n & p	§129.115
AE3 & AE4: Two Combined-cycle Combustion Turbines each 2,094 MMBtu/hr, 188 MW	V.B.2.c	§129.115
AE3 & AE4: Two Combined-cycle Combustion Turbines each 2,094 MMBtu/hr, 188 MW	V.B.3.a-c, l, m	§129.115
AE3 & AE4: Two Combined-cycle Combustion Turbines each 2,094 MMBtu/hr, 188 MW	V.B.4.a-j, l	§129.115
AE3 & AE4: Two Combined-cycle Combustion Turbines each 2,094 MMBtu/hr, 188 MW	V.B.5.a-c	§129.115
AE3 & AE4: Two Combined-cycle Combustion Turbines each 2,094 MMBtu/hr, 188 MW	V.B.6.a-b	§129.114