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ENGINEERING EVALUATION / FACT SHEET

BACKGROUND INFORMATION

Application No.:	R13-3002
Plant ID No.:	085-00023
Applicant:	Antero Resources Appalachian Corporation
Facility Name:	White Oak Compressor Station
Location:	Near Pullman, Ritchie County
NAICS Code:	486210
Application Type:	Construction
Received Date:	October 9, 2012
Engineer Assigned:	Joe Kessler
Fee Amount:	$2,000
Date Received:	October 12, 2012
Complete Date:	November 8, 2012
Due Date:	February 6, 2013
Applicant's Ad Date:	October 10, 2012
Newspaper:	*The Exponent-Telegram*
UTM's:	Easting: 509.781 km Northing: 4,338.144 km Zone: 17
Description:	Construction of a natural gas compressor station.

DESCRIPTION OF PROCESS

Antero Resources Appalachian Corporation (Antero) is proposing to construct a natural gas compressor station to be located approximately 3.5 miles east of Pullman, Ritchie County, WV. The proposed White Oak Compressor Station will consist of five (5) Waukesha L7044GSI 4-Stroke Rich Burn (4SRB) 1,627 horsepower (hp) compressor engines, two (2) Capstone C200 200kW (output) Microturbines, one (1) Valerus GLY-GCR-1.5MM 60 mmscf/day triethylene glycol (TEG) dehydration unit (GDU), and ten (10) storage tanks.

Raw natural gas produced in area wells will enter into the facility and, after passing through an inlet separator to removed produced liquids, will be compressed by the engines. Water and condensate removed from the natural gas shall be directed to one of the five (5) 16,880 gallon storage tanks (T01 through T05). Tanks T01 and T02 shall be used for produced water only, tank

T03 shall be used for as a settling tank for both condensate and produced water, and tanks T04 and T05 shall be used for condensate. Five smaller 1,000 gallon storage tanks (T06 through T10) shall be used at the site for miscellaneous storage (waste oil, bulk TEG storage, lube oil storage, and bulk coolant storage). Emissions from the condensate/produced water storage tanks (working/breathing/ flashing) shall be routed to a vapor recovery unit (VRU) for control. The VRU will capture and recycle the vapors back into the compressor engines for transportation into the production line. Emissions from the other storage tanks will be nominal.

The engines (CE-01 through CE-05) are designed to compress the natural gas produced from the wells and send it through the GDU for dehydration and then into a gathering pipeline for transport. The engines proposed for the White Oak Compressor Station will use catalytic converters (C-02 through C-06) to control CO, NO_x, and VOC emissions.

Glycol dehydration is a liquid desiccant system used for the removal of water from natural gas. Lean, water-free glycol is fed to the top of an absorber (known as a "contactor") where it is contacted with the wet natural gas stream. The glycol removes water from the natural gas by physical absorption and is carried out the bottom of the column. The dry natural gas leaves the top of the absorption column and is fed into a pipeline for transportation.

After leaving the absorber, the glycol stream - now referred to as “rich” glycol - is fed to a flash vessel where hydrocarbon vapors are removed and recycled to a 1.5 mmBtu/hr reboiler (RBV-1) and any liquid hydrocarbons are skimmed from the glycol. After leaving the flash vessel, the rich glycol is fed to the Glycol Regenerator Column. The Regenerator Column consists of a column, an overhead condenser, and the reboiler. The glycol is thermally regenerated to remove excess water and regain high purity. The hydrocarbons produced in the glycol regeneration process are sent to a flare (C-01) for control (98.00% combustion efficiency).

The hot, lean glycol is cooled by the heat-exchanger and is then fed to a pump where it is sent to the glycol absorber for reuse. Liquids produced in the regeneration process are sent to one of the facility storage tanks.

Additionally, the facility will utilize a truck loadout (EPLOR) to remove condensate and produced water from the site (estimated to be a maximum of 4,600,000 gallons/year). The Microturbines (GEN-1, GEN-2) will be used to produce power for the facility.

SITE INSPECTION

On November 28, 2012 the writer conducted an inspection of the proposed location of the White Oak Compressor Station. At the time of the inspection, site activities were underway that appeared to be within the limitations allowed pursuant to Section 5 of 45CSR13. Other observations from the inspection include:

- The proposed facility will lie approximately 0.25 miles west of Possum Run Road south of County Route (CR) 9 in Ritchie County. The area is rural in nature with scattered homes and farms within several miles of the proposed location. Much natural gas construction activity (pipelines, well-heads, etc.) was observed in the area.

- The nearest confirmed occupied dwelling was located at the CR9 - Possum Run Road junction approximately 0.5 miles to the north of the facility.

Directions: [Latitude: 39.19249, Longitude: -80.88673] From the junction of WV State Route (SR) 74 and the Harrisville-Pullman-Oxford Road (CR 9), travel east on CR 9 for approximately 4.3 miles and turn right on Possum Run Road. Proceed on Possum Run Road for approximately 0.5 miles to the proposed site of the facility.

AIR EMISSIONS AND CALCULATION METHODOLOGIES

Compressor Engines

Potential emissions from each of the five (5) Waukesha L7044GSI 4-Stroke Rich Burn (4SRB) 1,627 hp compressor engines were based on post-control emission factors provided by the catalyst manufacturer and as given in AP-42, Section 3.2 (7/00). Hourly emissions were based on maximum design heat input (MDHI) of the engine of 13.50 mmBtu/hr. Annual emissions were based on 8,760 hours of operation per year. The following table details the potential-to-emit (PTE) of each compressor engine:

Table 1: Per-Compressor Engine PTE

Pollutant	Emission Factor	Source	Hourly (lb/hr)	Annual (ton/yr)
CO(1)	0.63 g/hp-hr (controlled)	Catalyst Vendor	2.26	9.90
NO_X(1)	0.50 g/hp-hr (controlled)	Catalyst Vendor + 0.18 g/hp-hr buffer	1.79	7.84
$PM_{2.5}$(2)	19.41×10^{-3} lb/mmBtu	AP-42, Table 3.2-3	0.13	0.56
PM_{10}(2)	19.41×10^{-3} lb/mmBtu	AP-42, Table 3.2-3	0.13	0.56
PM(2)	19.41×10^{-3} lb/mmBtu	AP-42, Table 3.2-3	0.13	0.56
SO_2	5.88×10^{-4} lb/mmBtu	AP-42, Table 3.2-3	<0.01	0.04
VOCs(1)	0.30 g/hp-hr (controlled)	Catalyst Vendor	1.08	4.71
Formaldehyde	0.10 g/hp-hr	Catalyst Vendor	0.36	1.57
CH_4	1.14 g/hp-hr	Engine Vendor	4.09	17.91
CO_2	532 g/hp-hr (controlled)	Engine Vendor	1,910.74	8,369.04
CO_2e(4)	n/a	n/a	n/a	8,745.24

(1) Based on post-control emission factors provided by catalytic converter vendor.
(2) Filterable + Condensable as calculated by the writer.
(3) Based on multiplying the mass amount of emissions for each of the six greenhouse gases by the gas's associated global warming potential published at Table A-1 to Subpart A of 40 CFR Part 98 - Global Warming Potentials. Used to determine major source status of facilities under 45CSR14.

Microturbines

Emissions from the two (2) Capstone C200 200kW natural gas-fired microturbines (GEN-1, GEN-2) were based on the emission factors provided by the vendor. Hourly emissions were based on information provided by the vendor and annual emissions were based on an annual operation of 8,760 hours. The PTE generated by the microturbines and the emission factor/emission factor source are given in the following table:

Table 2: Per-Microturbine PTE(1)

Pollutant	Emission Factor	Source	Hourly (lb/hr)	Annual (ton/yr)(2)
NO_X	0.14 g/hp-hr	Vendor Information	0.10	0.44
CO	0.37 g/hp-hr	Vendor Information	0.26	1.15
VOC	0.034 g/hp-hr	Vendor Information	0.02	0.11
CO_2	1,330 lb/MWh	Vendor Information	319.20	1,398.10
CO_2e(3)	n/a	n/a	n/a	0.00

(1) Final emissions increase by 20% to account for richer gas burned at PEN-15.
(2) Based on 8,760 hours operation/year.
(3) Based on multiplying the mass amount of emissions for each of the six greenhouse gases by the gas's associated global warming potential published at Table A-1 to Subpart A of 40 CFR Part 98 - Global Warming Potentials. Used to determine major source status of facilities under 45CSR14.

Glycol Regenerator Column Emissions

VOC, Hazardous Air Pollutant (HAP), and methane emissions from the glycol regenerator still vent (RSV-1), as controlled by the flare (C-01), are based on the emissions calculation program GRI-GLYCalc Version 4.0. GRI-GLYCalc is a well-known program for estimating air emissions from glycol units using triethylene glycol (TEG). Included in the application is a copy of the appropriate GLY-Calc analysis sheets. A minimum hydrocarbon flare combustion efficiency of 98% was used to determine the controlled emission rate.

Additionally, small amounts of emissions are created from the combustion of the hydrocarbons (in the waste gas) at the flare. These emissions were based on information provided by the flare vendor.

The PTE of emissions generated by the glycol regenerator (as flared) and the emission factor/emission factor source are given in the following table:

Table 3: GDU PTE

Pollutant	Emission Factor	Source	Hourly (lb/hr)	Annual (ton/yr)
CO	0.5496 lb/mmBtu	Flare Vendor	**1.40**	**6.13**
NO_x	0.0641 lb/mmBtu	Flare Vendor	**0.13**	**0.57**
VOC	n/a	GLYCalc Results	**0.68**	**2.04**

Pollutant	Emission Factor	Source	Hourly (lb/hr)	Annual (ton/yr)
Hexane	*n/a*	*GLYCalc Results*	*0.11*	*0.48*
Benzene	*n/a*	*GLYCalc Results*	*0.05*	*0.22*
Toluene	*n.a*	*GLYCalc Results*	*0.10*	*0.43*
Ethyl-benzene	*n/a*	*GLYCalc Results*	*0.01*	*0.02*
Xylene	*n/a*	*GLYCalc Results*	*0.06*	*0.26*
		Total HAPs ➜	**0.33**	**1.43**
CH_4	n/a	GLYCalc Results	**n/a**	**4.29**
$CO_2e^{(1)}$	n/a	n/a	**n/a**	**90.02**

(1) Based on multiplying the mass amount of emissions for each of the six greenhouse gases by the gas's associated global warming potential published at Table A-1 to Subpart A of 40 CFR Part 98 - Global Warming Potentials. Used to determine major source status of facilities under 45CSR14.

Reboiler Exhaust Emissions

Emissions from the 1.5 mmBtu/hr natural gas-fired reboiler (RBV-1) were based on the emission factors provided for natural gas combustion as given in AP-42 Section 1.4. Hourly emissions were based on the maximum design heat input (MDHI) of the unit (1.5 mmBtu/hr) and annual emissions were based on an annual operation of 8,760 hours. A natural gas heat content value of 1,282 Btu/ft^3 was used in the calculations. The PTE generated by the reboiler and the emission factor/emission factor source are given in the following table:

Table 4: Reboiler Exhaust PTE

Pollutant	Emission Factor	Source	Hourly (lb/hr)	Annual (ton/yr)[1]
NO_X	100 lb/mmscf	AP-42, Table 1.4-1	0.12	0.51
CO	84 lb/mmscf	AP-42, Table 1.4-1	0.10	0.43
VOC	5.5 lb/mmscf	AP-42, Table 1.4-2	0.01	0.04
PM[2]	7.6 lb/mmscf	AP-42, Table 1.4-2	0.01	0.04
SO_2	0.6 lb/mmscf	AP-42, Table 1.4-2	~0.00	~0.00
CO_2	120,000 lb/mmscf	AP-42, Table 1.4-2	140.40	614.95
$CO_2e^{(3)}$	n/a	n/a	140.40	614.95

(1) Based on 8,760 hours operation/year.
(2) All PM emissions are assumed to be$PM_{2.5}$ or less and includes condensables.
(3) Based on multiplying the mass amount of emissions for each of the six greenhouse gases by the gas's associated global warming potential published at Table A-1 to Subpart A of 40 CFR Part 98 - Global Warming Potentials. Used to determine major source status of facilities under 45CSR14.

Storage Tanks

Antero provided an estimate of the uncontrolled emissions produced from the five (5) 16,880 gallon (T01 through T05) produced water and condensate storage tanks using the TANKS 4.09d program (working/breathing losses) as provided under AP-42, Section 7 and using E&P Tanks (flashing losses). However, as noted above, emissions from the tanks shall be routed to a VRU for control. The VRU will capture and recycle all the vapors back into the into compressor engines for transportation into the production line. Therefore, the PTE from these tanks shall be negligible. Based on the size of tanks and the material stored, potential emissions from the other storage tanks will be nominal.

Fugitives

Antero calculated three sources of fugitive emissions at the proposed White Oak Compressor Station: equipment leaks, maintenance and emergency events, and truck loadouts.

Equipment Leaks

Antero based their VOC and methane fugitive equipment leak calculations on emission factors and control methodology effectiveness taken from the document EPA-453/R-95-017 - "Protocol for Equipment Leak Emission Estimates." Emission factors were taken from Table 2-4 and no control efficiency, as based on a Leak Detection and Repair (LDAR) protocol, was applied.

Maintenance and Emergency Events

Antero also included in their fugitive emission estimate a certain number of scenarios where natural gas is released for emergency or maintenance purposes. These include compressor blowdown events (24 events/year), station emergency shutdowns (2 events/year), and pigging blowdowns (52 events/year). VOC and methane emissions from these events were based on the representative mol fractions of VOCs/methane (8.849%/76.214%) in the natural gas.

Truck Loadouts

Air emissions from condensate truck loading operations (EPLOR) occur as fugitive emissions generated by displacement of vapors when loading trucks. The emission factor used to generate the VOC emissions is based on Equation (1) of AP-42 Section 5.2-4. In this equation, EQT used variables specific to the liquids loaded and to the method of loading - in this case "submerged filling - dedicated normal service." Additionally, worst-case annual emissions were based on a maximum loading rate of 4,599,000 gal/year of condensate. As no maximum hourly pumping rate was provided, hourly emissions were based on 1,000 hours of loading per year (4,600 gal/hour).

Emissions Summary

Based on the above estimation methodology, which is determined to be appropriate, the PTE of the proposed White Oak Compressor Station is given in the following tables:

Table 5: Facility-Wide Aggregate Hourly (lb/hr) Criteria Pollutant PTE Summary.

Source	CO	NO_x	PM[1]	SO_2	VOCs	HAPs
Compressor Engine (CE-01)	2.26	1.79	0.13	<0.01	1.08	0.36
Compressor Engine (CE-02)	2.26	1.79	0.13	<0.01	1.08	0.36
Compressor Engine (CE-03)	2.26	1.79	0.13	<0.01	1.08	0.36
Compressor Engine (CE-04)	2.26	1.79	0.13	<0.01	1.08	0.36
Compressor Engine (CE-05)	2.26	1.79	0.13	<0.01	1.08	0.36
Microturbine (GEN-1)	0.26	0.10	~0.00	~0.00	0.02	~0.00
Microturbine (GEN-1)	0.26	0.10	~0.00	~0.00	0.02	~0.00
Reboiler Exhaust (RBV-1)	0.10	0.12	0.01	~0.00	0.01	<0.01
GDU Still Vent (RSV-1)[2]	1.40	0.13	~0.00	~0.00	0.68	0.33
Equipment Leaks	0.00	0.00	0.00	0.00	1.99	0.00
Truck Loading	0.00	0.00	0.00	0.00	32.75	0.00
Natural Gas Releases	0.00	0.00	0.00	0.00	n/a	0.00
Facility-Wide Totals ➜	**13.32**	**9.40**	**0.66**	**0.05**	**40.87**	**2.14**

(1) All particulate matter emissions are assumed to be less than 2.5 microns. Includes condensables.
(2) As controlled and emitted from the flare - includes products of combustion.

Table 6: Facility-Wide Aggregate Annual (ton/yr) Criteria Pollutant/GHG PTE Summary.

Source	CO	NO_x	PM[1]	SO_2	VOCs	HAPs	CO_2e
Compressor Engine (CE-01)	9.90	7.84	0.56	0.04	4.73	1.58	8,745.24
Compressor Engine (CE-02)	9.90	7.84	0.56	0.04	4.73	1.58	8,745.24
Compressor Engine (CE-03)	9.90	7.84	0.56	0.04	4.73	1.58	8,745.24
Compressor Engine (CE-04)	9.90	7.84	0.56	0.04	4.73	1.58	8,745.24
Compressor Engine (CE-05)	9.90	7.84	0.56	0.04	4.73	1.58	8,745.24
Microturbine (GEN-1)	1.15	0.44	~0.00	~0.00	0.11	~0.00	1,398.10
Microturbine (GEN-1)	1.15	0.44	~0.00	~0.00	0.11	~0.00	1,398.10
Reboiler Exhaust (RBV-1)	0.43	0.51	0.04	~0.00	0.04	~0.00	614.95
GDU Still Vent (RSV-1)[2]	6.13	0.57	~0.00	~0.00	2.04	1.43	90.02
Equipment Leaks	0.00	0.00	0.00	0.00	8.70	0.00	458.43
Truck Loading	0.00	0.00	0.00	0.00	16.37	0.00	0.00
Natural Gas Releases	0.00	0.00	0.00	0.00	10.90	0.00	1,905.54
Facility-Wide Totals ➜	**58.36**	**41.16**	**2.84**	**0.20**	**61.92**	**9.33**	**49,591.34**

(1) All particulate matter emissions are assumed to be less than 2.5 microns. Includes condensables.
(2) As controlled and emitted from the flare - includes products of combustion.

Table 7: Facility-Wide Aggregate Annual (ton/yr) Speciated HAP Summary.

Pollutant	ton/yr
Formaldehyde	7.90
Hexane	0.48
Benzene	0.22
Toluene	0.43
Xylene	0.26
Ethylbenzene	0.02
Total HAPs	9.31

REGULATORY APPLICABILITY

The proposed White Oak Compressor Station is subject to the following substantive state and federal air quality rules and regulations: 45CSR2, 45CSR6, 45CSR13, and 40 CFR 60 Subpart JJJJ. Each applicable rule (and those that have questionable non-applicability) and Antero's compliance therewith will be discussed in detail below.

45CSR2: To Prevent and Control Particulate Air Pollution from Combustion of Fuel in Indirect Heat Exchangers

Pursuant to the definition of "fuel burning unit" under 45CSR2 ("producing heat or power by indirect heat transfer"), 45CSR2 does not apply to the compressor engines.

The GDU Reboiler has been determined to meet the definition of a "fuel burning unit" under 45CSR2 and is, therefore, subject to the applicable requirements therein. However, pursuant to the exemption given under §45-2-11, as the MDHI of the GDU Reboiler is less than 10 mmBtu/hr, the unit is not subject to sections 4, 5, 6, 8 and 9 of 45CSR2. The only remaining substantive requirement is under Section 3.1 - Visible Emissions Standards.

Pursuant to 45CSR2, Section 3.1, the reboiler is subject to an opacity limit of 10%. Proper maintenance and operation of the reboiler (and the use of regenerator vapors/natural gas as fuel) should keep the opacity of the unit well below 10% during normal operations.

45CSR6: To Prevent and Control Particulate Air Pollution from Combustion of Refuse

Antero has proposed flaring for control of the waste gas produced from GDU. The flare meets the definition of an "incinerator" under 45CSR6 and is, therefore, subject to the requirements therein. The substantive requirements applicable to the flare are discussed below.

45CSR6 Emission Standards for Incinerators - Section 4.1

Section 4.1 limits PM emissions from incinerators to a value determined by the following

formula:

Emissions (lb/hr) = F x Incinerator Capacity (tons/hr)

Where, the factor, F, is as indicated in Table I below:

Table I: Factor, F, for Determining Maximum Allowable Particulate Emissions

Incinerator Capacity	Factor F
A. Less than 15,000 lbs/hr	5.43
B. 15,000 lbs/hr or greater	2.72

Based on information included in the application, the maximum vapor mass sent to the flare will be 340.5 lb/hr (0.17 tons/hour). Based on the above equation, the particulate matter limit of the flare is 0.09 lbs/hr. Particulate matter emissions from the flare are expected to be negligible and in compliance with the limit calculated under Section 4.1.

45CSR6 Opacity Limits for - Section 4.3, 4.4

Pursuant to Section 4.3, and subject to the exemptions under 4.4, the flare has a 20% limit on opacity during operation. Proper design and operation of the flare should prevent any substantive opacity from the flares.

45CSR10: To Prevent and Control Air Pollution from the Emission of Sulfur Oxides (non-applicability)

Pursuant to the definition of "fuel burning unit" under 45CSR10 ("producing heat or power by indirect heat transfer"), the limitations on fuel burning units under 45CSR10 do not apply to the compressor engines.

45CSR10 has requirements limiting SO_2 emissions from "fuel burning units," limiting in-stack SO_2 concentrations of "manufacturing processes," and limiting H_2S concentrations in process gas streams. The only potential applicability of 45CSR10 to the White Oak Compressor Station is the limitations on fuel burning units. The GDU Reboiler has been determined to meet the definition of a "fuel burning unit" under 45CSR10. However, pursuant to the exemption given under §45-10-10.1, as the MDHI of the GDU Reboiler is less than 10 mmBtu/hr, the unit is not subject to the limitations on fuel burning units under 45CSR10.

45CSR13: Permits for Construction, Modification, Relocation and Operation of Stationary Sources of Air Pollutants, Notification Requirements, Administrative Updates, Temporary Permits, General Permits, and Procedures for Evaluation

The proposed construction of the White Oak Compressor Station has a potential to emit in excess of six (6) lbs/hour and ten (10) TPY of a regulated pollutant and, therefore, pursuant to §45-13-2.24, the construction is defined as a "stationary source" under 45CSR13. Pursuant to §45-13-5.1, "[n]o person shall cause, suffer, allow or permit the construction . . . and operation of any stationary source to be commenced without . . . obtaining a permit to construct." Therefore, Antero is required to obtain a permit under 45CSR13 for the construction and operation of the facility.

As required under §45-13-8.3 ("Notice Level A"), Antero placed a Class I legal advertisement in a "newspaper of *general circulation* in the area where the source is . . . located." The ad ran on October 10, 2012 in *The Exponent-Telegram* and the affidavit of publication for this legal advertisement was submitted on November 9, 2012.

As noted above, based on comments from residents near the proposed site of the compressor station, Antero reran their legal advertisement in two local County newspapers: the *Pennsboro News* and the *Ritchie Gazette* on December 12, 2012. As of the time of this writing, the affidavits of publication have not yet been submitted.

45CSR14: Permits for Construction and Major Modification of Major Stationary Sources of Air Pollution for the Prevention of Significant Deterioration - (NON APPLICABILITY)

The White Oak Compressor Station is proposed to be located in Ritchie County, WV. Ritchie County is classified as "in attainment" with all National Ambient Air Quality Standards. Therefore, as the facility is not a "listed source" under §45-14-2.43, the individual major source applicability threshold for all pollutants is 250 TPY. As given above in Table 6, the facility-wide PTE of the proposed White Oak Compressor Station is less than 250 TPY for all criteria pollutants and less than 100,000 TPY of CO_2e. Therefore, the facility is not defined as a "major stationary source" under either 45CSR14 and the rule does not apply.

45CSR27: To Prevent and Control the Emissions of Toxic Air Pollutants - (NON APPLICABILITY)

Pursuant to §45-27-3.1, the "owner or operator of a plant that discharges or may discharge a toxic air pollutant into the open air in excess of the amount shown in the Table A [of 45CSR27] shall employ [Best Available Technology] at all chemical processing units emitting the toxic air pollutant." As shown in Table 5 above, the facility-wide PTE of formaldehyde is 7.94 TPY - greater than the 1,000 pound per year threshold given in Table A of 45CSR27. However, internal combustion engines do no meet the definition of "chemical processing units" under §45-27-2.4 and, therefore, they are not subject to BAT under 45CSR27.

45CSR30: Requirements for Operating Permits - (NON APPLICABILITY)

45CSR30 provides for the establishment of a comprehensive air quality permitting system consistent with the requirements of Title V of the Clean Air Act. The proposed White Oak Compressor Station does not meet the definition of a "major source under §112 of the Clean Air Act" as outlined under §45-30-2.26 and clarified (fugitive policy) under 45CSR30b. The proposed facility-wide PTE of any regulated pollutant does not exceed 100 TPY (and, in the case of CO_2e, does not exceed 100,000 TPY). Additionally, the facility-wide PTE does not exceed 10 TPY of any individual HAP or 25 TPY of aggregate HAPs.

However, as the facility is subject to two New Source Performance Standard (NSPS) - 40 CFR 60, Subpart JJJJ and Subpart OOOO - the facility would, in most cases, be subject to Title V as a "deferred source." However, pursuant to §60.4230(c) and §60.5370(c), as a non-major "area source," Antero is not required to obtain a Title V permit for the proposed facility. Therefore, the

White Oak Compressor Station is not subject to 45CSR30.

Subpart Kb—Standards of Performance for Volatile Organic Liquid Storage Vessels (Including Petroleum Liquid Storage Vessels) for Which Construction, Reconstruction, or Modification Commenced After July 23, 1984 - (NON APPLICABILITY)

Pursuant to §60.110b, 40 CFR 60, Subpart Kb applies to "each storage vessel with a capacity greater than or equal to 75 cubic meters (m^3) that is used to store volatile organic liquids (VOL) for which construction, reconstruction, or modification is commenced after July 23, 1984." The storage tanks proposed for the White Oak Compressor Station are each 16,880 gallons, or 64 m^3. Therefore, Subpart Kb does not apply to the storage tanks.

40 CFR 60 Subpart JJJJ: Standards of Performance for Stationary Spark Ignition Internal Combustion Engines.

Antero's five (5) Waukesha L7044GSI 4-Stroke Rich Burn (4SRB) 1,627 hp compressor engines proposed for the White Oak Compressor Station are defined under 40 CFR 60, Subpart JJJJ as stationary spark-ignition internal combustion engines (SI ICE) and are each, pursuant to §60.4230(a)(4)(i), subject to the applicable provisions of the rule. Pursuant to §60.4233(e): "Owners and operators of stationary SI ICE with a maximum engine power greater than or equal to 75 KW (100 HP) (except gasoline and rich burn engines that use LPG) must comply with the emission standards in Table 1 to this subpart for their stationary SI ICE." Therefore, as the proposed Antero's engines are greater than 100 HP, each engine must comply with the emission standards under Table 1 for "Non-Emergency SI ICE ≥ 500 hp manufactured after July 1, 2010:" NO_x - 1.0 g/HP-hr, CO - 2.0 g/HP-hr, and VOC - 0.7 g/HP-hr. The emission standards and the proposed compliance therewith of the engines are given in the following table:

Table 8: Subpart JJJJ Compliance

Pollutant	Standard (g/HP-hr)	Uncontrolled Emissions (g/bhp)(1)	Control Percentage	Controlled Emissions (g/bhp)(1)	JJJJ Compliant?
NO_x	1.0	13.9	96.40%	0.50	Yes
CO	2.0	12.7	95.04%	0.63	Yes
VOC	0.7	0.61	50.82%	0.30	Yes

(1) Based on the EMIT Technologies, Inc. Model ELS-4200T-1616F-60CEE-361 catalytic converter specification sheet included in the permit application. Controlled emissions of NO_x increased from 0.32 g/bhp by Antero to include a safety factor.

The Waukesha L7044GSI is not a "certified" engine under Subpart JJJJ so Antero will have to show compliance with the emission standards pursuant to §60.4243(b)(2)(ii): conducting an initial performance test and thereafter conducting subsequent performance testing every 8,760 hours or 3 years, whichever comes first, to demonstrate compliance. Performance testing requirements are given under §60.4244 of Subpart JJJJ. Antero will additionally have to meet all applicable monitoring, recording, and record-keeping requirements under Subpart JJJJ.

40 CFR 60, Subpart OOOO: Standards of Performance for Crude Oil and Natural Gas

Production, Transmission and Distribution

On April 27, 2012, the USEPA issued a final rule (Federal Register Date: August 16, 2012) that consists of federal air standards for natural gas wells that are hydraulically fractured, along with requirements for several other sources of pollution in the oil and gas industry that currently are not regulated at the federal level. Each potentially applicable section of Subpart OOOO is discussed below.

Compressor Engines

Pursuant to §60.5365(c), "[e]ach reciprocating compressor affected facility, which is a single reciprocating compressor located between the wellhead and the point of custody transfer to the natural gas transmission and storage segment" that is constructed after August 23, 2011 is subject to the applicable provisions of Subpart OOOO. As the White Oak Compressor Station is located before the point of custody transfer, the compressor engines are applicable to Subpart OOOO. The substantive requirements for the engines are given under §60.5385(a): the engines' "rod packing" must replaced according to the given schedule and the engine must meet applicable MRR given under §60.5410(c), §60.5415(c), and §60.5420(b)(1).

Pneumatic Controllers

Pursuant to §60.5365(d)(2), "[f]or the natural gas production segment (between the wellhead and the point of custody transfer to the natural gas transmission and storage segment and not including natural gas processing plants), each pneumatic controller affected facility, which is a single continuous bleed natural gas-driven pneumatic controller operating at a natural gas bleed rate greater than 6 scfh" that is constructed after August 23, 2011 is subject to the applicable provisions of Subpart OOOO. As the White Oak Compressor Station is located before the point of custody transfer, all pneumatic controllers that meet the above definition will be required to meet the substantive requirement for pneumatic controllers as given under §60.5390.

Storage Tanks

Pursuant to §60.5365(e), for "[e]ach storage vessel affected facility, which is a single storage vessel, located in the oil and natural gas production segment, natural gas processing segment or natural gas transmission and storage segment" that is constructed after August 23, 2011 and, pursuant to §60.5395 has "VOC emissions equal to or greater than 6 tpy" must meet the control requirements under §60.5395 as of October 15, 2013. The substantive requirement is to "reduce VOC emissions by 95.0 percent or greater."

Antero has three storage tanks that have maximum uncontrolled emissions that are greater than 6 TPY: T03, T04, and T05. However, the PTE of these tanks is zero as the VRU captures and recycles all of the emissions from these tanks. Based on a letter from USEPA to the American Petroleum Instituted dated September 28, 2012, applicability of storage vessels to Subpart OOOO is based on individual tank PTE - which *includes federally enforceable control devices*. However, in the same letter, EPA has made it clear that a VRU *is not considered a control device* yet it is an acceptable method of meeting the requirement to reduce VOC emissions by 95.0%.

Therefore, as of October 15, 2013 (the storage tanks in question are designed to be permanently installed), tanks T03, T04, and T05 shall be subject to the requirements under §60.5395 and shall comply through the use of a VRU. Use of the VRU shall require Antero, pursuant to §60.5395(b), to "equip the storage vessel with a cover that meets the requirements of § 60.5411(b) and is connected through a closed vent system that meets the requirements of § 60.5411(a) to a control device that meets the conditions specified in § 60.5412."

Additionally, Antero must meet the compliance, notification, recordkeeping, and reporting requirements relating to applicable storage tanks as given under §60.5410, §60.5415, and §60.5420.

40 CFR 63 Subpart HH: National Emission Standards for Hazardous Air Pollutants From Oil and Natural Gas Production Facilities (NON-DELEGATION)

The proposed GDU appears to be subject to the area source (as shown above in Table 6, the individual and aggregate HAP emission rates of the facility define the proposed facility as an"area source" of HAPs) requirements of 40 CFR 63, Subpart HH. However, the DAQ has not been delegated authority from USEPA to enforce the area source requirements of this rule. Therefore, unless otherwise stated, DAQ did not formally determine whether the permittee is subject to an area source air toxics standard requiring Generally Achievable Control Technology (GACT) promulgated after January 1, 2007 pursuant to 40 CFR 63, including the area source air toxics provisions of 40 CFR 63, Subpart HH.

40 CFR 63 Subpart ZZZZ: Standards of Performance for Stationary Spark Ignition Internal Combustion Engines - (NON-DELEGATION)

The proposed Waukesha L7044GSI compressor engines appear to be subject to the area source (as shown above in Table 6, the individual and aggregate HAP emission rates of the facility define the proposed facility as an"area source" of HAPs) requirements of 40 CFR 63, Subpart ZZZZ. However, the DAQ has not been delegated authority from USEPA to enforce the area source requirements of this rule. Therefore, unless otherwise stated, DAQ did not formally determine whether the permittee is subject to an area source air toxics standard requiring Generally Achievable Control Technology (GACT) promulgated after January 1, 2007 pursuant to 40 CFR 63, including the area source air toxics provisions of 40 CFR 63, Subpart ZZZZ.

TOXICITY OF NON-CRITERIA REGULATED POLLUTANTS

This section provides an analysis for those regulated pollutants that may be emitted from the proposed White Oak Compressor Station and that are not classified as "criteria pollutants." Criteria pollutants are defined as Carbon Monoxide (CO), Lead (Pb), Oxides of Nitrogen (NO_x), Ozone, Particulate Matter (PM), Particulate Matter less than 10 microns (PM_{10}), Particulate Matter less than 2.5 microns ($PM_{2.5}$), and Sulfur Dioxide (SO_2). These pollutants have National Ambient Air Quality Standards (NAAQS) set for each that are designed to protect the public health and welfare. Other pollutants of concern, although designated as non-criteria and without national concentration standards, are regulated through various federal and programs designed to limit their emissions and public exposure. These programs include federal source-specific Hazardous Air Pollutants (HAPs) limits promulgated under 40 CFR 61 (NESHAPS) and 40 CFR 63 (MACT). Any potential

applicability to these programs were discussed above under REGULATORY APPLICABILITY.

The majority of non-criteria regulated pollutants fall under the definition of HAPs which, with some revision since, were 188 compounds identified under Section 112(b) of the Clean Air Act (CAA) as pollutants or groups of pollutants that EPA knows or suspects may cause cancer or other serious human health effects. As noted above, the proposed White Oak Compressor Station has the potential to emit the following HAPs: Hexane, Benzene, Toluene, Ethyl-benzene, Xylene, and Formaldehyde. The following table lists each HAP's carcinogenic risk (as based on analysis provided in the Integrated Risk Information System (IRIS)):

Table 9: Potential HAPs - Carcinogenic Risk

HAPs	Type	Known/Suspected Carcinogen	Classification
Hexane	VOC	No	Inadequate Data
Benzene	VOC	Yes	Category A - Known Human Carcinogen
Toluene	VOC	No	Inadequate Data
Ethyl-benzene	VOC	No	Category D - Not Classifiable
Xylene	VOC	No	Inadequate Data
Formaldehyde	VOC	Yes	B1 - Probable Human Carcinogen

All HAPs have other non-carcinogenic chronic and acute effects. These adverse health affects may be associated with a wide range of ambient concentrations and exposure times and are influenced by source-specific characteristics such as emission rates and local meteorological conditions. Health impacts are also dependent on multiple factors that affect variability in humans such as genetics, age, health status (e.g., the presence of pre-existing disease) and lifestyle. As stated previously, *there are no federal or state ambient air quality standards for these specific chemicals*. For a complete discussion of the known health effects of each compound refer to the IRIS database located at *www.epa.gov/iris*.

AIR QUALITY IMPACT ANALYSIS

The estimated maximum emissions of the proposed facility are less than applicability thresholds that would define the proposed facility as "major" under 45CSR14 and, therefore, no air quality impacts modeling analysis was required. Additionally, based on the nature and location of the proposed source, an air quality impacts modeling analysis was not required under 45CSR13, Section 7.

MONITORING, COMPLIANCE DEMONSTRATIONS, REPORTING, AND RECORDING OF OPERATIONS

The following substantive monitoring, compliance demonstration, and record-keeping requirements (MRR) shall be required:

- For the purposes of demonstrating compliance with the maximum wet gas throughput limit set forth in 4.1.4. of the draft permit, Antero shall be required to monitor daily, monthly and rolling twelve month records of the wet gas throughput of the Glycol Dehydration Unit.

- For the purposes of demonstrating compliance with visible emissions limitations set forth in 4.1.6(d) and 4.1.7(d) of the draft permit, Antero shall be required to :

    - Conduct an initial Method 22 visual emission observation on the Reboiler exhaust and flare to determine the compliance with the visible emission provisions. Antero shall be required to take a minimum of two (2) hours of visual emissions observations on the units.

    - Conduct monthly Method 22 visible emission observations of the Reboiler exhaust and flare to ensure proper operation for a minimum of ten (10) minutes each month the units are in operation.

    - In the event visible emissions are observed in excess of the limitations given under 4.1.2(d) of the draft permit, Antero shall be required to take immediate corrective action.

- Operation of the flare shall meet the following Monitoring, Compliance Demonstration and Source-Specific Recordkeeping Requirements:

    - Antero shall be required to maintain records of all startups, shutdowns, and/or malfunctions of the flare. These records shall include the date, time, and duration of each event.

    - Antero shall be required to maintain records of the date, time, and duration each time the Antero does not detect the presence of a pilot flame in the flare.

- For the purposes of demonstrating compliance with the truck loadout throughput limit set forth in 4.1.10(b) of the draft permit, Antero shall be required to monitor and maintain monthly and rolling twelve month records of the amount of liquids loaded out.

- For the purpose of demonstrating compliance with section 4.1.7. and 4.3.2. of the draft permit, Antero shall be required to maintain a record of the flare design evaluation. The flare design evaluation shall include, net heat value calculations, exit (tip) velocity calculations, and all supporting concentration calculations and other related information requested by the Director.

- For the purpose of demonstrating compliance with the requirements set forth in sections 4.1.7 and 4.3.3.of the draft permit, Antero shall be required to maintain records of testing conducted in accordance with 4.3.3.

- For the purpose of demonstrating compliance with section 4.1.7(d) of the draft permit, Antero shall be required to maintain records of the visible emission opacity tests conducted per Section 4.2.3.

- If permittee is required by the Director to demonstrate compliance with section 4.3.3 of the draft permit, then Antero shall be required to submit a testing protocol at least thirty (30) days prior to testing and shall submit a notification of the testing date at least fifteen (15) days prior to testing. Antero shall be required to submit the testing results within sixty (60) days of testing and provide all supporting calculations and testing data.

- Any deviation(s) from the allowable visible emission requirement for any emission source discovered during observations using 40CFR Part 60, Appendix A, Method 9 or 22 shall be reported in writing to the Director of the Division of Air Quality as soon as practicable, but in any case within ten (10) calendar days of the occurrence and shall include at least the following information: the results of the visible determination of opacity of emissions, the cause or suspected cause of the violation(s), and any corrective measures taken or planned.

- Any deviation(s) from the flare design and operation criteria in Section 4.1.7. of the draft permit shall be reported in writing to the Director of the Division of Air Quality as soon as practicable, but in any case within ten (10) calendar days of discovery of such deviation.

- Antero shall be required to meet all applicable Monitoring, Compliance Demonstration and Recordkeeping Requirements as given under 45CS2, 45CSR6 and 40 CFR 60, Subpart JJJJ, and Subpart OOOO.

PERFORMANCE TESTING OF OPERATIONS

The following substantive performance testing requirements shall be required:

- At such reasonable time(s) as the Secretary may designate, in accordance with the provisions of 3.3 of the draft permit, Antero shall be required to conduct or have conducted test(s) to determine compliance with the emission limitations established in this permit and/or applicable regulations.

- The Director may require the permittee to conduct a flare compliance assessment to demonstrate compliance with section 4.1.7. of the draft permit. This compliance assessment testing shall be conducted in accordance with Test Method 18 for organics and Test Method 2, 2A, 2C, or 2D in appendix A to 40 CFR part 60, as appropriate, or other equivalent testing approved in writing by the Director. Also, Test Method 18 may require the permittee to conduct Test Method 4 in conjunction with Test Method 18.

- In order to demonstrate compliance with 4.1.5. of the draft permit, upon request of the Director, Antero shall be required to demonstrate compliance with the HAP emissions thresholds using GLYCalc Version 4.0 or higher. Antero shall be required to sample in accordance with GPA Method 2166 and analyze the samples utilizing the extended GPA Method 2286 as specified in the GRI-GLYCalc V4 Technical Reference User Manual and Handbook.

- Antero shall be required to meet all applicable Performance Testing Requirements as given under 45CS2, 45CSR6 and 40 CFR 60, Subpart JJJJ, and Subpart OOOO.

RECOMMENDATION TO DIRECTOR

The information provided in the permit application indicates that compliance with all applicable regulations will be achieved. Therefore, I recommend to the Director the issuance of a Permit Number R13-3002 to Antero Resources Appalachian Corporation for the proposed construction and operation of the White Oak Compressor Station located near Pullman, Ritchie County, WV.

_____
Joe Kessler, PE
Engineer

_____
Date