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ENGINEERING EVALUATION / FACT SHEET

BACKGROUND INFORMATION

Application No.:	G70-A143A
Plant ID No.:	095-00057
Applicant:	Antero Resources Corporation
Facility Name:	Estlack Pad
Location:	Middlebourne, Tyler County
NAICS Code:	211111
Application Type:	Modification
Received Date:	July 30, 2015
Engineer Assigned:	Roy F. Kees, P.E.
Fee Amount:	$1500.00
Date Received:	July 31, 2015
Complete Date:	September 3, 2015
Due Date:	October 18, 2015
Applicant Ad Date:	August 5, 2015
Newspaper:	*Tyler Star News*
UTM's:	Easting: 510.546 km Northing: 4,362.693 km Zone: 17S
Description:	Modification to increase condensate production, add ten (10) wells, fourteen (14) GPUs, twenty (20) line heaters, five (5) high pressure VRU engines, four (4) Vapor Recovery Towers, and four (4) Cimmaron Enclosed Combutors. Also, the removal of one (1) Abutec combustor and one (1) Kubota engine.

DESCRIPTION OF PROCESS

This pad has 15 condensate and gas wells and one gas only deep well.

A mixture of condensate, water, and entrained gas from the condensate and gas wells enters the facility through a series of line heaters (LH001-015) and gas production units (H001-H015) which are 3-phase separators where the gas, condensate, and produced water are separated. The GPUs are fueled by a slip stream of the separated gas. The gas from the 3 phase separators is sent to the sales gas line. The condensate from the

3-phase separator is sent to a low pressure 2-phase separator where flashing emissions are recovered and sent to the sales gas lines through the high pressure VRU driven by gas fueled engines (ENG001-003). The condensate then flows to the vapor recovery towers (VRT001-004) where gas is further separated. Gas from the VRTs is recovered via the low pressure VRU driven by gas fueled engines (ENG004-005) and sent to the sales gas line through the high pressure compressor. The condensate from the VRTs flows to the condensate storage tanks (TANKSCOND001-010). The water from the 3 phase separator is sent to the produced water tanks (TANKPW001-002).

A mixture of gas and water from the deep well enters the facility though a series of line heaters (LH016-020) and gas production units (H016-H020) where the gas is separated from the water. The gas stream is routed to the sales gas line. The separated water is sent to the produced water tanks (TANKPW001-002).

The line heaters (LH001-020) are only used during the first several months from start of production and will be removed once production has normalized.

The facility has ten (10) tanks (TANKCOND001-010) on site to store condensate and two (2) tanks (TANKPW001-002) to store produced water prior to removal from the site. Flashing, working, and breathing losses from the tanks are routed to up to four enclosed combustors (EC001-004) to control the emissions. The enclosed combustors that will be used to control emissions are designed to achieve a VOC destruction efficiency of 98 percent.

Condensate and produced water are transported off site on an as needed basis via tanker truck. The maximum annual throughput will be 24,282,720 gallons per year and 54,697,440 gallons per year for condensate and produced water, respectively. Truck loading connections are in place to pump condensate (L001) and produced water (L002) from the storage tanks into tanker trucks. Emissions from the loading operations are vented to the atmosphere.

Emissions from sources associated with the condensate and gas wells were calculated using the extended analysis of the condensate and gas from Sweeny No. 2H, one of the wells in the Forest Pad. Emissions from the deep well were calculated using the produced water analysis from Tom's Fork, one of the wells in Erwin Hilltop pad. The extended analyses are considered representative of the materials from Estlack well pad, being in the same Marcellus rock formation.

SITE INSPECTION

A site inspection was conducted on February 4, 2015 by James Robertson of the enforcement section. ". I think I was at the entrance to the site but it was blocked off with ribbon and warning signs saying "Danger - High Pressure Testing". The entrance road was only partially based so I don't think I could have accessed the site even if it hadn't been blocked off.

The pad will be located on a hill overlooking CR 30/1 to the south and CR 48 to the north. I drove the length of each in the area of the pad and there are only scattered houses along each road. The pad will be located well over 300' from any residence.

In my opinion this site is suitable for a General Permit."

From Middlebourne, WV, head south on WV-18S for 11.1 miles. Turn right onto Purgatory Run and continue for 2.5 miles. Take a sharp right onto the facility entrance.

ESTIMATE OF EMISSIONS BY REVIEWING ENGINEER

Maximum controlled point source emissions listed below were calculated by Antero and reviewed for accuracy by the writer. Heater treater and enclosed combustor emissions were calculated using AP-42 emission factors. Engine emissions were calculated using manufacturer data as well as AP-42. Storage tank and loading emissions were calculated using ProMax, TANKS 4.0.9 and AP-42.

Emission Unit	Pollutant	Maximum Hourly Emissions (lb/hr)	Maximum Annual Emissions (tpy)
H001-H020 (20) 1.50 mmBtu/hr Heater Treaters (Combined)	Nitrogen Oxides	2.41	10.54
	Carbon Monoxide	2.02	8.85
	Volatile Organic Compounds	0.13	0.58
	Sulfur Dioxide	0.01	0.06
	Particulate Matter-10	0.18	0.80

LH001-LH020 (20) 2.00 mmBtu/hr Line Heaters (Combined)	Nitrogen Oxides	3.21	14.05
	Carbon Monoxide	2.69	11.80
	Volatile Organic Compounds	0.18	0.77
	Sulfur Dioxide	0.02	0.08
	Particulate Matter-10	0.24	1.07
	CO_2e (All Above Heaters)	6,775.87	29,678.31
TANKCOND001-010 (10) 400 bbl Condensate Tanks (Combined)	Volatile Organic Compounds	4.21	18.45
	Total HAPs	0.33	1.46
TANKPW001-002 (2) 400 bbl Produced Water Tanks (Combined)	Volatile Organic Compounds	0.08	0.35
	Total HAPs	<0.01	0.01
ENG001-003 72 hp Zenith ZPP 428 (Combined)	Nitrogen Oxides	0.96	4.19
	Carbon Monoxide	1.56	6.84
	Volatile Organic Compounds	0.07	0.10
	Sulfur Dioxide	<0.01	0.01
	Particulate Matter - 10	0.02	0.10
	Formaldehyde	0.04	0.21
ENG004-005 98 hp Zenith ZPP 644 (Combined)	Nitrogen Oxides	0.87	3.80
	Carbon Monoxide	1.42	6.21
	Volatile Organic Compounds	0.06	0.25
	Sulfur Dioxide	<0.01	0.01
	Particulate Matter - 10	0.02	0.09
	Formaldehyde	0.04	0.18

L001 Cond. Loading	Volatile Organic Compounds	7.91	9.52
	Total HAPs	0.05	0.06
L002 P.W. Loading	Volatile Organic Compounds	1.14	0.35
	Total HAPs	<0.01	<0.01
Enclosed Combustors EC001-004	Nitrogen Oxides	0.27	1.17
	Carbon Monoxide	0.22	0.98
Fugitives F001	Volatile Organic Compounds	6.42	28.11
	Total HAPs	0.57	2.52

The total facility potential to emit (PTE) is shown in the following table:

Pollutant	**Facility Wide Emissions (tons/year)**
Nitrogen Oxides	33.75
Carbon Monoxide	34.68
Volatile Organic Compounds	58.49
Particulate Matter-10/2.5	2.33
Sulfur Dioxide	0.16
Total HAPs	4.94
Carbon Dioxide Equivalent	36,493.78

REGULATORY APPLICABILITY

The proposed Antero natural gas production facility is subject to substantive requirements in the following state and federal air quality rules and regulations: 45CSR2, and 45CSR13. Each applicable rule (and ones that have reasoned 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

The Heater Treaters (H001-H020) & Line Heaters (LH001-LH020) have been determined to meet the definition of a "fuel burning unit" under 45CSR2 and are, therefore, subject to the applicable requirements therein. However, pursuant to the exemption given under §45-2-11, as the MDHI of the unit is less than 10 mmBtu/hr, it 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 line heaters are subject to an opacity limit of 10%. Proper maintenance and operation of the unit (and the use of natural gas as fuel) should keep the opacity of the unit well below 10% during normal operations.

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

The purpose of this rule is to prevent and control air pollution from combustion of refuse. Antero has four (4) enclosed combustors at the facility. The enclosed combustor is subject to section 4, emission standards for incinerators. The enclosed combustor has an allowable emission rate of 0.65 pounds of particulate matter per hour (assuming a natural gas density of 0.044 lb/ft^3). The enclosed combustor has negligible amounts of particulate matter emissions per hour. Therefore, the facility's enclosed combustor should demonstrate compliance with this section. The facility will demonstrate compliance by maintaining records of the amount of natural gas consumed by the enclosed combustor and the hours of operation. The facility will also monitor the flame of the enclosed combustor and record any malfunctions that may cause no flame to be present during operation.

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 construction of the Estlack natural gas production facility has a potential to emit a regulated pollutant in excess of six (6) lbs/hour and ten (10) TPY and, therefore, pursuant to §45-13-2.24, the facility 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 registration under 45CSR13 for the construction and operation of the natural gas production 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 August 5, 2015 in *The Tyler Star News.*

45CSR22 Air Quality Management Fee Program

The Estlack Facility is not subject to 45CSR30. The facility is subject to 40CFR60 Subpart OOOO, however they are exempt from the obligation to obtain a permit under 40 CFR part 70 or 40 CFR part 71, provided they are not required to obtain a permit for a reason other than their status as an area source, therefore, the facility is not subject and will pay its annual fees through the Rule 22 program.

40CFR60 Subpart JJJJ (Standards of Performance for Stationary Spark Ignition Internal Combustion Engines (SI ICE))

40CFR60.4230 states that a source that commenced construction after June 12, 2006 whose SI ICE was less than 500 hp and was manufactured on or after July 1, 2008 is subject to this rule. Antero has proposed to install three (3) 72 HP SI ICE and two (2) 98 HP SI ICE. Since the SI ICEs that Antero will install was manufactured in 2013, Antero is subject to this rule. However, since all of the engines are certified by the manufacturer so no additional testing will be necessary.

40 CFR 60, Subpart OOOO Standards of Performance for Crude Oil and Natural Gas Production, Transmission and Distribution

Subpart OOOO applies to facilities that commence construction, reconstruction, or modification after August 23, 2011 (October 15, 2012 for well completions). Since the Estlack pad will begin operation after August 23, 2011 it is subject to the requirements of Subpart OOOO. The tanks at the Estlack facility will utilize a enclosed combustor, therefore the tanks will not have the potential to emit more than 6 tpy of VOC's, therefore the tanks will not be subject to the rule. The site will also include pneumatic controllers that were ordered and installed after August 23, 2011, therefore the controllers will be subject to the applicable provisions of Subpart OOOO. The proposed controllers have a bleed rate of 6.6 scf/day. The gas wells at the Estlack pad will also be affected facilities subject to Subpart OOOO.

Non Applicability Determinations

45CSR10: To Prevent and Control Air Pollution from the Emission of Sulfur Oxides

Pursuant to the exemption given under §45-10-10.1, as the MDHI of the Heater Treaters (H001-H020) and Line Heaters (LH001-LH020) are less than 10 mmBtu/hr, the units are not subject to the substantive sections of 45CSR10.

45CSR14*: *Permits for Construction and Major Modification of Major Stationary Sources of Air Pollution for the Prevention of Significant Deterioration.

The facility-wide potential-to-emit of the Estlack natural gas production facility is below the levels that would define the source as "major" under 45CSR14 and, therefore, the construction evaluated herein is not subject to the provisions of 45CSR14.

Classifying multiple facilities as one "stationary source" under 45CSR13, 45CSR14, and 45CSR19 is based on the definition of "Building, structure, facility, or installation" as given in §45-14-2.13 and §45-19-2.12. The definition states:

> "Building, Structure, Facility, or Installation" means all of the pollutant-emitting activities which belong to the same industrial grouping, are located on one or more contiguous or adjacent properties, and are under the control of the same person (or persons under common control). Pollutant-emitting activities are a part of the same industrial grouping if they belong to the same "Major Group" (i.e., which have the same two (2)-digit code) as described in the Standard Industrial Classification Manual, 1987 (United States Government Printing Office stock number GPO 1987 0-185-718:QL 3).

Estlack shares the same SIC code as several other well pads owned by Antero in the area. Therefore, the potential classification of the Estlack facility as one stationary source any other facility depends on the determination if these stations are considered "contiguous or adjacent properties."

"Contiguous or Adjacent" determinations are made on a case by case basis. These determinations are proximity-based, and it is important to focus on this and whether or not it meets the common sense notion of one stationary source. The terms "contiguous" or "adjacent" are not defined by USEPA. Contiguous has a dictionary definition of being in actual contact; *touching along a boundary or at a point.* Adjacent has a dictionary definition of not distant; nearby; *having a common endpoint or border.*

The Estlack natural gas production facility is not located contiguous with, or directly adjacent to any other Antero facility. The nearest Antero facility (Graff Pad) is approximately 1.92 miles away.

40 CFR 60 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

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 largest storage tanks located at the Estlack facility are each 16,800 gallons, or 63.5 m^3. Therefore, Subpart Kb does not apply to any of the storage tanks.

TOXICITY OF NON-CRITERIA REGULATED POLLUTANTS

This section provides an analysis for those regulated pollutants that may be emitted from the Estlack natural gas production facility 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 programs designed to limit their emissions and public exposure. These programs include federal source-specific Hazardous Air Pollutants (HAPs) standards 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. Antero included the following HAPs as emitted in substantive amounts in their emissions estimate: Benzene, n-Hexane, Toluene, and Trimethylpentane The following table lists each HAP's carcinogenic risk (as based on analysis provided in the Integrated Risk Information System (IRIS)):

Potential HAPs - Carcinogenic Risk

HAPs	Type	Known/Suspected Carcinogen	Classification
n-Hexane	VOC	No	Inadequate Data
Benzene	VOC	Yes	Category A - Known Human Carcinogen
Toluene	VOC	No	Inadequate Data
Xylene	VOC	No	Inadequate Data
Trimethylpentane	VOC	No	Inadequate Data

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 from the proposed Estlack natural gas production facility are less than applicability thresholds that would define the proposed facility as a "major stationary source" under 45CSR14 and, therefore, no air quality impacts modeling analysis was required. Additionally, based on the nature of the proposed construction, modeling was not required under 45CSR13, Section 7.

MONITORING OF OPERATIONS

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

- For the purposes of demonstrating compliance with maximum limit for the aggregate production of condensate/liquids from the wells set forth in Section 4.0 of the general permit registration, Antero shall be required to monitor and record the monthly and rolling twelve month total of condensate/liquids (in gallons) produced in the wells. Monitoring and recording the monthly and rolling twelve month total of condensate/liquids (in gallons) unloaded from the storage tanks can be used to show compliance with this requirement.

- For the purposes of demonstrating compliance with visible emissions limitations set forth in Section 7.0 of the G70-A general permit, Antero shall be required to:

  (1) Conduct an initial Method 22 visual emission observation on the heater treaters 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 line heaters.

  (2) Conduct monthly Method 22 visible emission observations of the heater treater stack to ensure proper operation for a minimum of ten (10) minutes each month the line heaters are in operation.

  (3) In the event visible emissions are observed in excess of the limitations given under Section 7.5 of the G70-A general permit, Antero shall be required to take immediate corrective action.

- Antero shall be required to maintain records of all visual emission observations pursuant to the monitoring required under Section 7.2 of the G70-A general permit including any corrective action taken.

- Antero shall be required to report 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 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.

RECOMMENDATION TO DIRECTOR

Information supplied in the registration application indicates that compliance with all applicable regulations will be achieved. Therefore it is the recommendation of the writer that general permit modification G70-A143A for the construction of a natural gas production facility near Middlebourne, Tyler County, be granted to Antero Resources Corporation.

Roy F. Kees, P.E.
Engineer - NSR Permitting

10/6/15
DATE