PROJECT REPORT

SWN Production Company, LLC
Ridgetop Land Ventures

G70-A Permit Application

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June 2015

Trinity Consultants

Environmental solutions delivered uncommonly well

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SWN Production Company, LLC (SWN) is submitting this Class II General Permit (G70-A) application to the West Virginia Department of Environmental Protection (WVDEP) for the Ridgetop Land Ventures facility, a natural gas production well pad, located in Wetzel County, West Virginia.

1.1. FACILITY AND PROJECT DESCRIPTION

The Ridgetop Land Ventures Wellpad is a new natural gas production facility that will consist of three (3) natural gas wells. Natural gas and liquids (including water and condensate) will be extracted from deposits underneath the surface. Natural gas will be transported from the well to a gas line for additional processing and compression, as necessary. The liquids produced will be stored in storage vessels.

This application seeks to permit the following equipment at the Ridgetop Land Ventures pad:

- Two (2) natural gas-fired 145-hp Caterpillar G3306NA flash gas compressor engines equipped with a NSCR catalyst;
- Five (5) 1.0-MMBtu/hr natural gas-fired GPU burners;
- Two (2) 0.5-MMBtu/hr natural gas-fired heater treaters;
- Four (4) 400-bbl condensate storage tanks controlled by the vapor recovery units (VRUs), and one (1) vapor combustor (for backup purposes);
- Four (4) 400-bbl produced water storage tanks controlled by the vapor recovery unit (VRU), and one (1) vapor combustor (for backup purposes);
- One (1) 15.0-MMBtu/hr vapor combustor with one (1) 50-SCFH natural gas-fired pilot.
- One (1) Vapor recovery unit (VRU) powered by one (1) 92 HP General Motors Vortec 5.7 L natural gas engine equipped with a NSCR catalyst;
- One (1) Vapor recovery unit (VRU) powered by one (1) 77 HP Zenith 4.4 L natural gas engine equipped with a NSCR catalyst.

A process flow diagram is included as Attachment D.

1.2. SOURCE STATUS

WVDEP must make stationary source determinations on a case-by-case basis using the guidance under the Clean Air Act (CAA) and EPA's and WVDEP's implementing regulations. The definition of stationary source in 40 CFR 51.166(b) includes the following:

> *"(6) Building, structure, facility, or installation means all of the pollutant emitting activities which belong to the same industrial grouping, are located on or more contiguous or adjacent properties, and are under control of the same person (or persons under common control)."*

Other additional pollutant emitting facilities should be aggregated with the proposed Ridgetop Land Ventures for air permitting purposes if, and only if, all three elements of the "stationary source" definition above are fulfilled.

There are no Marcellus facilities within a quarter-mile radius of the Ridgetop Land Ventures Pad. Therefore, the Ridgetop Land Ventures should be considered a separate stationary source with respect to permitting programs, including Title V and Prevention of Significant Deterioration (PSD). As discussed in this application, the facility is a minor source of air emissions with respect to New Source Review (NSR) and Title V permitting.

1.3. G70-A APPLICATION ORGANIZATION

This West Virginia Code of State Regulations, Title 45 (CSR) Series 13 (45 CSR 13) G70-A permit application is organized as follows:

- Section 2: Sample Emission Source Calculations;
- Section 3: Regulatory Discussion;
- Section 4: G70-A Application Forms;
- Attachment A: Current Business Certificate;
- Attachment B: Process Description;
- Attachment C: Description of Fugitive Emissions;
- Attachment D: Process Flow Diagram;
- Attachment E: Plot Plan;
- Attachment F: Area Map;
- Attachment G: Emission Unit Data Sheets and G70-A Section Applicability Form;
- Attachment H: Air Pollution Control Device Sheets;
- Attachment I: Emission Calculations;
- Attachment J: Class I Legal Advertisement;
- Attachment K: Electronic Submittal;
- Attachment L: General Permit Registration Application Fee;
- Attachment M: Siting Criteria Waver (*not applicable*);
- Attachment N: Material Safety Data Sheet (*not applicable*); and
- Attachment O: Emissions Summary Sheet.

2. SAMPLE EMISSION SOURCE CALCULATIONS

The characteristics of air emissions from the natural gas production operations, along with the methodology for calculating emissions, are briefly described in this section of the application. Detailed emission calculations are presented in Attachment I of this application.

Emissions from this project will result from natural gas combustion in the line heaters, GPU burners, compressor engines, VRU engine and heater treaters, as well as storage of organic liquids in storage tanks and loading of organic liquids into tank trucks. In addition, fugitive emissions will result from component leaks from the operation of the station. The methods by which emissions from each of these source types are calculated are summarized below.

- **Compressor and VRU Engines:** Potential Emissions of VOC, NO_X, CO, and formaldehyde are calculated using manufacturer's emission data. Emissions of all other criteria pollutants and HAPs are calculated using U.S EPA's AP-42 factors for natural gas internal combustion engines. Emission of other greenhouse gases are calculated in accordance with 40 CFR 98, Subpart C for natural gas combustion.

- **Line Heaters, GPU Burners, and Heater Treaters:** Potential emissions of criteria pollutants and HAPs are calculated using U.S. EPA's AP-42 factors for natural gas external combustion.[1] These calculations assume a site-specific heat content of natural gas. Greenhouse gas emissions are calculated according to 40 CFR 98 Subpart C.[2] Please note that potential emissions of NO_X, CO, PM, SO_2 and GHGs from the combustors are also calculated according to the aforementioned methodologies.

- **Fugitive Equipment Leaks:** Emissions of VOC and HAPs from leaking equipment components have been estimated using facility estimated component counts and types along with *Table 2-4: Oil & Gas Production Operations Average Emission Factors, Protocol for Equipment Leak Emission Estimates, EPA 453/R-95-017, November 1995.* Emission factors used are based on average measured TOC from component types indicated in gas service at O&G Production Operations. Greenhouse gas emissions from component leaks are calculated according to the procedures in 40 CFR 98 Subpart W.[3]

- **Storage Tanks:** Working, breathing and flashing emissions of VOC and HAPs from the condensate/produced water stored in the tanks at the facility are calculated using Bryan Research Engineering ProMax® Software. Emissions are controlled by a vapor recovery unit and a backup combustor.

- **Tank Truck Loading:** Emissions of VOC and HAPs from the loading of organic liquids from storage tanks to tank truck are calculated using Bryan Research Engineering ProMax® Software. Truck loading is vapor balanced and emissions are controlled by a vapor recovery unit and a backup combustor.

- **Haul Roads:** Fugitive dust emitted from facility roadways has been estimated using projected vehicle miles traveled along with U.S. EPA's AP-42 factors for unpaved haul roads.[4]

[1] U.S. EPA, AP 42, Fifth Edition, Volume I, Chapter 1.4, Natural Gas Combustion, Supplement D, July 1998.

[2] 40 CFR 98 Subpart C, *General Stationary Fuel combustion Sources*, Tables C-1 and C-2.

[3] 40 CFR 98 Subpart W, *Petroleum and Natural Gas Systems*, Section 98.233(r), *Population Count and Emission Factors*.

[4] U.S. EPA, AP 42, Fifth Edition, Volume I, Section 13.2.2, Unpaved Roads, November 2006.

This section documents the applicability determinations made for Federal and State air quality regulations. In this section, applicability or non-applicability of the following regulatory programs is addressed:

- Prevention of Significant Deterioration (PSD) permitting;
- Title V of the 1990 Clean Air Act Amendments;
- New Source Performance Standards (NSPS);
- National Emission Standards for Hazardous Air Pollutants (NESHAP); and
- West Virginia State Implementation Plan (SIP) regulations.

This review is presented to supplement and/or add clarification to the information provided in the WVDEP G70-A permit application forms.

In addition to providing a summary of applicable requirements, this section of the application also provides non-applicability determinations for certain regulations, allowing the WVDEP to confirm that identified regulations are not applicable to the wellpad. Note that explanations of non-applicability are limited to those regulations for which there may be some question of applicability specific to the operations at the wellpad. Regulations that are categorically non-applicable are not discussed (e.g., NSPS Subpart J, Standards of Performance for Petroleum Refineries).

3.1. PREVENTION OF SIGNIFICANT DETERIORATION (PSD) SOURCE CLASSIFICATION

Federal construction permitting programs regulate new and modified sources of attainment pollutants under Prevention of Significant Deterioration (PSD). PSD regulations apply when a major source makes a change, such as installing new equipment or modifying existing equipment, and a significant increase in emissions results from the change. The wellpad is not a major source with respect to the PSD program since its potential emissions are below all the PSD thresholds. As such, PSD permitting is not triggered by this construction activity. SWN will monitor future construction activities at the site closely and will compare any future increase in emissions with the PSD thresholds to ensure these activities will not trigger this program.

3.2. TITLE V OPERATING PERMIT PROGRAM

Title 40 of the Code of Federal Regulations Part 70 (40 CFR 70) establishes the federal Title V operating permit program. West Virginia has incorporated the provisions of this federal program in its Title V operating permit program in West Virginia Code of State Regulations (CSR) 45-30. The major source thresholds with respect to the West Virginia Title V operating permit program regulations are 10 tons per year (tpy) of a single HAP, 25 tpy of any combination of HAP and 100 tpy of all other regulated pollutants.[5] The potential emissions of all regulated pollutants are below the corresponding threshold(s) at this facility after the proposed project. Therefore, the wellpad is not a major source for Title V purposes.

3.3. NEW SOURCE PERFORMANCE STANDARDS

New Source Performance Standards (NSPS), located in 40 CFR 60, require new, modified, or reconstructed sources to control emissions to the level achievable by the best demonstrated technology as specified in the applicable

[5] On June 23, 2014, the U.S Supreme Court decision in the case of *Utility Air Regulatory Group v. EPA* effectively changed the permitting procedures for GHGs under the PSD and Title V programs.

provisions. Moreover, any source subject to an NSPS is also subject to the general provisions of NSPS Subpart A, except where expressly noted. The following is a summary of applicability and non-applicability determinations for NSPS regulations of relevance to the wellpad.

3.3.1. NSPS Subparts D, Da, Db, and Dc

These subparts apply to steam generating units of various sizes, all greater than 10 MMBtu/hr. The proposed project does not include any steam generating units, therefore the requirements of these subparts do not apply.

3.3.2. NSPS Subparts K, Ka, and Kb

These subparts apply to storage tanks of certain sizes constructed, reconstructed, or modified during various time periods. Subpart K applies to storage tanks constructed, reconstructed, or modified prior to 1978, and Subpart Ka applies to those constructed, reconstructed, or modified prior to 1984. Both Subparts K and Ka apply to storage tanks with a capacity greater than 40,000 gallons. Subpart Kb applies to volatile organic liquid (VOL) storage tanks constructed, reconstructed, or modified after July 23, 1984 with a capacity equal to or greater than 75 m^3 (~19,813 gallons). All of the tanks at the wellpad have a capacity of 19,813 gallons or less. As such, Subparts K, Ka, and Kb do not apply to the storage tanks at the wellpad.

3.3.3. NSPS Subparts JJJJ – Stationary Spark Ignition Internal Combustion Engines

New Source Performance Standards 40 CFR Part 60 Subpart JJJJ (NSPS JJJJ) affects owners and operators of stationary spark ignition internal combustion engines (SI ICE) that commence construction, reconstruction or modification after June 12, 2006. Applicability dates are based on the date the engine was ordered by the operator. The proposed engines (VRUs and Compressor engines) at the Ridgetop Land Ventures wellpads are 4-stroke rich burn, spark ignition engines manufactured after July 1, 2008, and is subject to this subpart. The engines will be equipped with a non-selective catalytic reduction device for CO, NO_X, and VOC emissions control and will comply with the emission standards in Table 1 of the Subpart. SWN will operate the engine according to the manufacturer's recommended practices and demonstrate compliance with the requirements specified in 40 CFR §60.4244 (testing methods) and 40 CFR§60.4243(b)(2) (maintenance plan/records and performance testing frequency) for noncertified affected SI ICE at the facility or by purchasing a certified engine.

3.3.4. NSPS Subpart OOOO—Crude Oil and Natural Gas Production, Transmission, and Distribution

Subpart OOOO – *Standards of Performance for Crude Oil and Natural Gas Production, Transmission, and Distribution*, applies to affected facilities that commenced construction, reconstruction, or modification after August 23, 2011. This NSPS was published in the Federal Register on August 16, 2012, and amended in the Federal Register on September 23, 2013[6]. The list of potentially affected facilities includes:

- Gas wellheads
- Centrifugal compressors located between the wellhead and the point of custody transfer to the natural gas transmission and storage segment
- Reciprocating compressors located between the wellhead and the point of custody transfer to the natural gas transmission and storage segment

[6] 78 FR 54816 (*http://www.gpo.gov/fdsys/pkg/FR-2013-09-23/pdf/2013-22010.pdf*)

- Continuous bleed natural gas-driven pneumatic controllers with a bleed rate of > 6 scfh located between the wellhead and the point of custody transfer to the natural gas transmission and storage segment (excluding natural gas processing plants)
- Continuous bleed natural gas-driven pneumatic controllers located at natural gas processing plants
- Storage vessels in the production, processing, or transmission and storage segments
- Sweetening units located onshore that process natural gas produced from either onshore or offshore wells

There will be four (4) condensate storage vessels and four (4) produced water storage vessels at the wellpad. Emissions from the storage vessels will be controlled by two (2) vapor recovery units and one (1) enclosed combustor (the combustor will operate as the primary control measure only in instances when the VRUs are down). The enclosed combustor has a destruction efficiency greater than 95 percent. The storage vessels at the facility will each have potential VOC emissions less than 6 tpy based on the permit application materials and enforceable limits to be included in the G70-A permit. As such, per 60.5365(e), the tanks are not storage vessel affected facilities under the rule.

40 CFR 60.5385 requires owners and operators of affected reciprocating compressors to change the rod packing prior to operating 26,000 hours or prior to 36 months since start up or the last packing replacement. However, according to §60.5365, compressors located at well sites are not affected facilities under Subpart OOOO.

The pneumatic controllers were ordered and installed after August 23, 2011 and are therefore potentially subject to NSPS OOOO. Per 60.5365(d)(2), a pneumatic controller affected facility is a single continuous bleed natural gas driven pneumatic controller operating at a natural gas bleed rate greater than 6 scfh. No pneumatic controllers installed will meet the definition of a pneumatic controller affected facility. Therefore, these units are not subject to the requirements of Subpart OOOO.

3.3.5. Non-Applicability of All Other NSPS

NSPS are developed for particular industrial source categories. Other than NSPS developed for natural gas processing plants (Subparts OOOO) and associated equipment (Subparts D-Dc and K-Kb), the applicability of a particular NSPS to the wellpad can be readily ascertained based on the industrial source category covered. All other NSPS are categorically not applicable to the proposed project.

3.4. NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS (NESHAP)

Part 63 NESHAP allowable emission limits are established on the basis of a maximum achievable control technology (MACT) determination for a particular major source. A HAP major source is defined as having potential emissions in excess of 25 tpy for total HAP and/or potential emissions in excess of 10 tpy for any individual HAP. The wellpad is an Area (minor) source of HAP since its potential emissions of HAP are less than the 10/25 major source thresholds. NESHAP apply to sources in specifically regulated industrial source categories (Clean Air Act Section 112(d)) or on a case-by-case basis (Section 112(g)) for facilities not regulated as a specific industrial source type. Besides 40 CFR 63 Subpart A (NESHAP Subpart A), which is similar to 40 CFR 60 Subpart A (NSPS Subpart A), the following NESHAP could potentially apply to the wellpad:

- 40 CFR Part 63 Subpart HH – Oil and Natural Gas Production Facilities
- 40 CFR Part 63 Subpart ZZZZ – Stationary Reciprocating Internal Combustion Engines
- 40 CFR Part 63 Subpart JJJJJJ – Industrial, Commercial, and Institutional Boilers

The applicability of these NESHAP Subparts is discussed in the following sections.

3.4.1. 40 CFR 63 Subpart HH – Oil and Natural Gas Production Facilities

This standard contains requirements for both major and area sources of HAP. At area sources, the only affected source is a triethylene glycol (TEG) dehydration unit (§63.760(b)(2)). The wellpad does not include a triethylene glycol dehydration unit; therefore the requirements of this subpart do not apply.

3.4.2. 40 CFR 63 Subpart ZZZZ – Stationary Reciprocating Internal Engines

The original rule, published on February 26, 2004, initially affected new (constructed or reconstructed after December 19, 2002) reciprocating internal combustion engines (RICE) with a site-rating greater than 500 brake horsepower (HP) located at a major source of hazardous air pollutant (HAP) emissions. On January 18, 2008, EPA published an amendment that promulgated standards for RICE constructed or reconstructed after June 12, 2006 with a site rating less than or equal to 500 HP located at major sources, and for engines constructed and reconstructed after June 12, 2006 located at area sources. On August 10, 2010, EPA published another amendment that promulgated standards for existing (constructed or reconstructed before June 12, 2006) RICE at area sources and existing RICE (constructed or reconstructed before June 12, 2006) with a site rating of less than or equal to 500 HP at major sources.

40 CFR §63.6590(c) states that a new or reconstructed stationary RICE located at an area HAP source must meet the requirements of NESHAP Subpart ZZZZ by meeting the requirements of NSPS Subpart JJJJ. No further requirements apply for such engines under NESHAP Subpart ZZZZ. The Ridgetop Land Ventures wellpad is a minor (area) source of hazardous air pollutants and the proposed compressor engines and VRU engines are considered new stationary RICE. Therefore, the requirements contained in §63.6590(c) are applicable. SWN will be in compliance with applicable requirements of 40 CFR 63 Subpart ZZZZ by meeting the applicable requirements of 40 CFR 60 Subpart JJJJ.

3.4.3. 40 CFR 63 Subpart JJJJJJ – Industrial, Commercial, and Institutional Boilers

This MACT standard applies to industrial, commercial, and institutional boilers of various sizes and fuel types at area sources. The wellpad does not include any boilers, or gas fired heaters; therefore the requirements of this subpart do not apply.

3.5. WEST VIRGINIA SIP REGULATIONS

The wellpad is potentially subject to regulations contained in the West Virginia Code of State Regulations, Chapter 45 (Code of State Regulations). The Code of State Regulations fall under two main categories, those regulations that are generally applicable (e.g., permitting requirements), and those that have specific applicability (e.g., PM standards for manufacturing equipment).

3.5.1. 45 CSR 2: To Prevent and Control Particulate Air Pollution from Combustion of Fuel in Indirect Heat Exchangers

45 CSR 2 applies to fuel burning units, defined as equipment burning fuel "for the primary purpose of producing heat or power by indirect heat transfer". The GPU burners, heater treaters, and line heaters are fuel burning units and therefore must comply with this regulation. Per 45 CSR 2-3, opacity of emissions from units shall not exceed 10 percent. Per 45 CSR 2-4, PM emissions from the unit will not exceed a level of 0.09 multiplied by the heat design input in MMBtu/hr of the unit.

3.5.2. 45 CSR 4: To Prevent and Control the Discharge of Air Pollutants into the Air Which Causes or Contributes to an Objectionable Odor

According to 45 CSR 4-3:

No person shall cause, suffer, allow or permit the discharge of air pollutants which cause or contribute to an objectionable odor at any location occupied by the public.

The wellpad is generally subject to this requirement. However, due to the nature of the process at the wellpad, production of objectionable odor from the wellpad during normal operation is unlikely.

3.5.3. 45 CSR 6: Control of Air Pollution from the Combustion of Refuse

45 CSR 6 applies to activities involving incineration of refuse, defined as "the destruction of combustible refuse by burning in a furnace designed for that purpose. For the purposes of this rule, the destruction of any combustible liquid or gaseous material by burning in a flare or flare stack, thermal oxidizer or thermal catalytic oxidizer stack shall be considered incineration." The enclosed combustor is an incinerator and therefore must comply with this regulation. Per 45 CSR 6-4.3, opacity of emissions from this unit shall not exceed 20 percent, except as provided by 4.4. PM emissions from this unit will not exceed the levels calculated in accordance with 6-4.1

3.5.4. 45 CSR 16: Standards of Performance for New Stationary Sources

45 CSR 16-1 incorporates the federal Clean Air Act (CAA) standards of performance for new stationary sources set forth in 40 CPR Part 60 by reference. As such, by complying with all applicable requirements of 40 CFR Part 60 at the wellpad, SWN will be complying with 45 CSR 16.

3.5.5. 45 CSR 17: To Prevent and Control Particulate Matter Air Pollution from Materials Handling, Preparation, Storage and Other Sources of Fugitive Particulate Matter

According to 45 CSR 17-3.1:

No person shall cause, suffer, allow or permit fugitive particulate matter to be discharged beyond the boundary lines of the property lines of the property on which the discharge originates or at any public or residential location, which causes or contributes to statutory air pollution.

Due to the nature of the activities at the wellpad, it is unlikely that fugitive particulate matter emissions will be emitted under normal operating conditions. However, SWN will take measures to ensure any fugitive particulate matter emissions will not cross the property boundary should any such emissions occur.

3.5.6. 45 CSR 21-28: Petroleum Liquid Storage in Fixed Roof Tanks

45 CSR 21-28 applies to any fixed roof petroleum liquid storage tank with a capacity greater than 40,000 gallons. The capacity of each storage tank proposed for the wellpad is less than 40,000 gallons; therefore, 45 CSR 21-28 will not apply to the petroleum liquid storage tanks at this wellpad

3.5.7. 45 CSR 34: Emissions Standards for Hazardous Air Pollutants

45 CSR 34-1 incorporates the federal Clean Air Act (CAA) national emissions standards for hazardous air pollutants (NESHAPs) as set forth in 40 CPR Parts 61 and 63 by reference. As such, by complying with all applicable requirements of 40 CFR Parts 61 and 63 at the wellpad, SWN will be complying with 45 CSR 34.

3.5.8. Non-Applicability of Other SIP Rules

A thorough examination of the West Virginia SIP rules with respect to applicability at the wellpad reveals many SIP regulations that do not apply or impose additional requirements on operations. Such SIP rules include those specific to a particular type of industrial operation that is categorically not applicable to the wellpad.

4. G70-A APPLICATION FORMS

The WVDEP permit application forms contained in this application include all applicable G70-A application forms including the required attachments.

WEST VIRGINIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF AIR QUALITY
601 57th Street, SE
Charleston, WV 25304
Phone: (304) 926-0475 • *www.dep.wv.gov/daq*

APPLICATION FOR GENERAL PERMIT REGISTRATION

CONSTRUCT, MODIFY, RELOCATE OR ADMINISTRATIVELY UPDATE

A STATIONARY SOURCE OF AIR POLLUTANTS

☒ CONSTRUCTION ☐ MODIFICATION ☐ RELOCATION ☐ CLASS I ADMINISTRATIVE UPDATE
☐ CLASS II ADMINISTRATIVE UPDATE

CHECK WHICH TYPE OF GENERAL PERMIT REGISTRATION YOU ARE APPLYING FOR:

☐ **G10-D –** Coal Preparation and Handling
☐ **G20-B –** Hot Mix Asphalt
☐ **G30-D –** Natural Gas Compressor Stations
☐ **G33-A –** Spark Ignition Internal Combustion Engines
☐ **G35-A –** Natural Gas Compressor Stations (Flare/Glycol Dehydration Unit)
☐ **G40-C –** Nonmetallic Minerals Processing
☐ **G50-B –** Concrete Batch
☐ **G60-C** - Class II Emergency Generator
☐ **G65-C –** Class I Emergency Generator
☒ **G70-A –** Class II Oil and Natural Gas Production Facility

SECTION I. GENERAL INFORMATION

1. Name of applicant (as registered with the WV Secretary of State's Office):
SWN Production Company, LLC

2. Federal Employer ID No. **(FEIN):**
26-4388727

3. Applicant's mailing address:

10000 Energy Drive
Spring, TX 77389

4. Applicant's physical address:

Harland Ridge Road, Wetzel County, West Virginia

5. If applicant is a subsidiary corporation, please provide the name of parent corporation:

6. **WV BUSINESS REGISTRATION.** Is the applicant a resident of the State of West Virginia? ☒ **YES** ☐ **NO**

- IF **YES,** provide a copy of the Certificate of **Incorporation/ Organization / Limited Partnership** (one page) including any name change amendments or other Business Registration Certificate as **Attachment A**.
- IF **NO,** provide a copy of the **Certificate of Authority / Authority of LLC / Registration** (one page) including any name change amendments or other Business Certificate as **Attachment A**.

SECTION II. FACILITY INFORMATION

7. Type of plant or facility (stationary source) to be constructed, modified, relocated or administratively updated (e.g., coal preparation plant, primary crusher, etc.): Oil & Natural gas production wellpad

8a. Standard Industrial Classification AND 8b. North American Industry

Classification (SIC) code: 1311 System (NAICS) code: 211111

9. DAQ Plant ID No. (for existing facilities only):

10. List all current 45CSR13 and other General Permit numbers associated with this process (for existing facilities only):

_____

_____

A: PRIMARY OPERATING SITE INFORMATION

11A. Facility name of primary operating site:	12A. Address of primary operating site:
Ridgetop Land Venture Wellpad	Mailing: Physical: 1066 Harland Ridge Road, New Martinsville, WV 26155

13A. Does the applicant own, lease, have an option to buy, or otherwise have control of the proposed site? ☒ **YES** ☐ **NO**

– IF **YES**, please explain: Southwestern is leasing the land on which the site is constructed

– IF **NO**, YOU ARE NOT ELIGIBLE FOR A PERMIT FOR THIS SOURCE.

14A. – For **Modifications or Administrative Updates** at an existing facility, please provide directions to the present location of the facility from the nearest state road;

– For Construction or Relocation permits, please provide directions to the proposed new site location from the nearest state road. Include a **MAP** as **Attachment F**.

From the Route 7 Staging area, take Brock Ridge (CR1/15) for 4 miles to the intersection with route 89. Turn right on Route 89 and travel 2 miles to Hollman Ridge (CR 1/17) . Turn right on Hollman ridge and travel 0.6 miles, then veer right onto Harland Ridge Road (CR1-19) and follow 0.7 miles and entrance is on the left.

15A. Nearest city or town:	16A. County:	17A. UTM Coordinates:
New Martinsville	Wetzel	Northing (KM): 4,390.714 Easting (KM): 528.013 Zone: 17

18A. Briefly describe the proposed new operation or change (s) to the facility:	19A. Latitude & Longitude Coordinates (NAD83, Decimal Degrees to 5 digits):
Construction and operation of a natural gas wellpad.	Latitude: 39.665780° Longitude: -80.673410°

B: 1ST ALTERNATE OPERATING SITE INFORMATION (only available for G20, G40, & G50 General Permits)

11B. Name of 1st alternate operating site:	12B. Address of 1st alternate operating site:
_N/A_	Mailing:_____ Physical:_____

13B. Does the applicant own, lease, have an option to buy, or otherwise have control of the proposed site? ☐ **YES** ☐ **NO**

– IF **YES**, please explain: _____

– IF **NO**, YOU ARE NOT ELIGIBLE FOR A PERMIT FOR THIS SOURCE.

14B. – For **Modifications or Administrative Updates** at an existing facility, please provide directions to the present location of the facility from the nearest state road;

– For Construction or Relocation permits, please provide directions to the proposed new site location from the nearest state road. Include a **MAP** as **Attachment F**.

15B. Nearest city or town:	16B. County:	17B. UTM Coordinates: Northing (KM): _____ Easting (KM): _____ Zone: _____
18B. Briefly describe the proposed new operation or change (s) to the facility:		19B. Latitude & Longitude Coordinates (NAD83, Decimal Degrees to 5 digits): Latitude: _____ Longitude: _____

C: 2ND ALTERNATE OPERATING SITE INFORMATION (only available for G20, G40, & G50 General Permits):

11C. Name of 2nd alternate operating site: _N/A_____ _____	12C. Address of 2nd alternate operating site: Mailing:_____ Physical:_____ _____

13C. Does the applicant own, lease, have an option to buy, or otherwise have control of the proposed site? ☐ **YES** ☐ **NO**

- IF **YES**, please explain: _____

_____

- IF **NO**, YOU ARE NOT ELIGIBLE FOR A PERMIT FOR THIS SOURCE.

14C. – For **Modifications or Administrative Updates** at an existing facility, please provide directions to the present location of the facility from the nearest state road;

– For Construction or Relocation permits, please provide directions to the proposed new site location from the nearest state road. Include a **MAP** as **Attachment F**.

_____

_____

_____

15C. Nearest city or town:	16C. County:	17C. UTM Coordinates: Northing (KM): _____ Easting (KM): _____ Zone: _____
18C. Briefly describe the proposed new operation or change (s) to the facility:		19C. Latitude & Longitude Coordinates (NAD83, Decimal Degrees to 5 digits): Latitude: _____ Longitude: _____

20. Provide the date of anticipated installation or change: __10___/__12___/__2015___ ☐ If this is an **After-The-Fact** permit application, provide the date upon which the proposed change did happen: : _____/_____/_____	21. Date of anticipated Start-up if registration is granted: ___10___/___12___/___2015___

22. Provide maximum projected **Operating Schedule** of activity/activities outlined in this application if other than 8760 hours/year. (Note: anything other than 24/7/52 may result in a restriction to the facility's operation).

Hours per day__24_____ Days per week ____7____ Weeks per year ___52_____ Percentage of operation ___100_____

SECTION III. ATTACHMENTS AND SUPPORTING DOCUMENTS

23. Include a check payable to WVDEP – Division of Air Quality with the appropriate **application fee** (per 45CSR22 and 45CSR13).

24. Include a **Table of Contents** as the first page of your application package.

All of the required forms and additional information can be found under the Permitting Section (General Permits) of DAQ's website, or requested by phone.

25. Please check all attachments included with this permit application. Please refer to the appropriate reference document for an explanation of the attachments listed below.

- ☒ ATTACHMENT A : CURRENT BUSINESS CERTIFICATE
- ☒ ATTACHMENT B: PROCESS DESCRIPTION
- ☒ ATTACHMENT C: DESCRIPTION OF FUGITIVE EMISSIONS
- ☒ ATTACHMENT D: PROCESS FLOW DIAGRAM
- ☒ ATTACHMENT E: PLOT PLAN
- ☒ ATTACHMENT F: AREA MAP
- ☒ ATTACHMENT G: EQUIPMENT DATA SHEETS AND REGISTRATION SECTION APPLICABILITY FORM
- ☒ ATTACHMENT H: AIR POLLUTION CONTROL DEVICE SHEETS
- ☒ ATTACHMENT I: EMISSIONS CALCULATIONS
- ☒ ATTACHMENT J: CLASS I LEGAL ADVERTISEMENT
- ☒ ATTACHMENT K: ELECTRONIC SUBMITTAL
- ☒ ATTACHMENT L: GENERAL PERMIT REGISTRATION APPLICATION FEE
- ☐ ATTACHMENT M: SITING CRITERIA WAIVER *(Not Applicable)*
- ☐ ATTACHMENT N: MATERIAL SAFETY DATA SHEETS (MSDS) *(Not Applicable)*
- ☒ ATTACHMENT O: EMISSIONS SUMMARY SHEETS
- ☐ OTHER SUPPORTING DOCUMENTATION NOT DESCRIBED ABOVE (Equipment Drawings, Aggregation Discussion, etc.) *(Not Applicable)*

Please mail an original and two copies of the complete General Permit Registration Application with the signature(s) to the DAQ Permitting Section, at the address shown on the front page of this application. Please DO NOT fax permit applications. For questions regarding applications or West Virginia Air Pollution Rules and Regulations, please refer to the website shown on the front page of the application or call the phone number also provided on the front page of the application.

SECTION IV. CERTIFICATION OF INFORMATION

This General Permit Registration Application shall be signed below by a Responsible Official. A Responsible Official is a President, Vice President, Secretary, Treasurer, General Partner, General Manager, a member of a Board of Directors, or Owner, depending on business structure. A business may certify an Authorized Representative who shall have authority to bind the Corporation, Partnership, Limited Liability Company, Association, Joint Venture or Sole Proprietorship. Required records of daily throughput, hours of operation and maintenance, general correspondence, Emission Inventory, Certified Emission Statement, compliance certifications and all required notifications must be signed by a Responsible Official or an Authorized Representative. If a business wishes to certify an Authorized Representative, the official agreement below shall be checked off and the appropriate names and signatures entered. Any administratively incomplete or improperly signed or unsigned Registration Application will be returned to the applicant.

FOR A CORPORATION (domestic or foreign)

☒ I certify that I am a President, Vice President, Secretary, Treasurer or in charge of a principal business function of the corporation

FOR A PARTNERSHIP

☐ I certify that I am a General Partner

FOR A LIMITED LIABILITY COMPANY

☐ I certify that I am a General Partner or General Manager

FOR AN ASSOCIATION

☐ I certify that I am the President or a member of the Board of Directors

FOR A JOINT VENTURE

☐ I certify that I am the President, General Partner or General Manager

FOR A SOLE PROPRIETORSHIP

☐ I certify that I am the Owner and Proprietor

☒ *I hereby certify that* (please print or type) *Paul Geiger*

is an Authorized Representative and in that capacity shall represent the interest of the business (e.g., Corporation, Partnership, Limited Liability Company, Association Joint Venture or Sole Proprietorship) and may obligate and legally bind the business. If the business changes its Authorized Representative, a Responsible Official shall notify the Director of the Office of Air Quality immediately, and/or,

I hereby certify that all information contained in this General Permit Registration Application and any supporting documents appended hereto is, to the best of my knowledge, true, accurate and complete, and that all reasonable efforts have been made to provide the most comprehensive information possible.

Signature _____ 6/18/2015 6/19/15
(please use blue ink) Responsible Official Date

Name & Title Paul Geiger, Sr. Vice President Ops Management
(please print or type)

Signature _____
(please use blue ink) Authorized Representative (if applicable) Date

Applicant's Name Kristi Evans, HSE Coordinator

Phone & Fax 304-884-1652
Phone Fax

Email Kristi_Evans@swn.com

ATTACHMENT A

Current Business Certificate

WEST VIRGINIA
STATE TAX DEPARTMENT

BUSINESS REGISTRATION
CERTIFICATE

ISSUED TO:
SWN PRODUCTION COMPANY, LLC
5400D BIG TYLER RD
CHARLESTON, WV 25313-1103

BUSINESS REGISTRATION ACCOUNT NUMBER: **2307-3731**

This certificate is issued on: **12/8/2014**

This certificate is issued by the West Virginia State Tax Commissioner in accordance with Chapter 11, Article 12, of the West Virginia Code

The person or organization identified on this certificate is registered to conduct business in the State of West Virginia at the location above.

This certificate is not transferrable and must be displayed at the location for which issued.

This certificate shall be permanent until cessation of the business for which the certificate of registration was granted or until it is suspended, revoked or cancelled by the Tax Commissioner.

Change in name or change of location shall be considered a cessation of the business and a new certificate shall be required.

TRAVELING/STREET VENDORS: Must carry a copy of this certificate in every vehicle operated by them.
CONTRACTORS, DRILLING OPERATORS, TIMBER/LOGGING OPERATIONS: Must have a copy of this certificate displayed at every job site within West Virginia.

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ATTACHMENT B

Process Description

ATTACHMENT B: PROCESS DESCRIPTION

This project involves the construction and operation of a natural gas production wellpad (Ridgetop Land Ventures).

The Ridgetop Land Ventures wellpad will consist of three wells. The facility is an oil and natural gas exploration and production facility, responsible for the production of condensate and natural gas. Storage of condensate and produced water will also occur on-site. Condensate, gas, and water coming from the wellhead will pass through the production units, where the first stage of separation occurs. Fluids (condensate and produced water) will be sent to the heater treaters. The flash gas from the heater treaters will be captured, compressed, and sent into the pipeline using natural gas-fired engines. Produced water from the heater treaters flows into the produced water storage tanks. Condensate flows from the heater treaters into the low pressure towers, where flash gas is recovered by the flash gas compressors and then compressed to the pipeline. The condensate then flows into the condensate storage tanks.

The natural gas stream will exit the facility for transmission via pipeline. Condensate and produced water are transported offsite via truck. Working, breathing and flashing vapors from the condensate and produced water storage tanks will be recovered by one of two (2) vapor recovery units (VRUs). During periods of VRU downtime, vapors from both storage tanks will be routed to a combustor for control. The combustor has a destruction efficiency of at least 98%. The vapor combustor has natural gas-fired pilots to ensure a constant flame for combustion. Loading emissions will be controlled with vapor return, which has at least 70% capture efficiency, and will be routed to the VRUs.

A process flow diagram is included as Attachment D.

ATTACHMENT C

Description of Fugitive Emissions

G70-A FUGITIVE EMISSIONS SUMMARY SHEET

FUGITIVE EMISSIONS SUMMARY	All Regulated Pollutants - Chemical Name/CAS [1]	Maximum Potential Uncontrolled Emissions [2]		Maximum Potential Controlled Emissions [3]		Est. Method Used [4]
		lb/hr	ton/yr	lb/hr	ton/yr	
Haul Road/Road Dust Emissions Paved Haul Roads	N/A	---	---	---	---	---
Unpaved Haul Roads	PM PM_{10} $PM_{2.5}$	0.95 0.24 0.02	4.17 1.06 0.11	0.95 0.24 0.02	4.17 1.06 0.11	O[A]
Loading/Unloading Operations (Condensate and Produced Water)	VOC HAP Benzene Toluene Ethylbenzene	34.36 0.80 0.011 0.016 0.004	150.50 3.53 0.05 0.07 0.019	11.51 0.27 0.004 0.005 0.001	50.42 1.18 0.02 0.02 0.006	O[B]
Equipment Leaks	VOC CO_2e HAP	Does not apply	2.97 652 0.08	Does not apply	2.97 652 0.08	O[C]
Blowdown Emissions	N/A	---	---	---	---	---
Other	N/A	---	---	---	---	---

[A] AP-42, Section 13.2.2.

[B] AP-42 Section 5.2.

[C] Protocol for Equipment Leak Estimates (EPA-453/R-95-017), Table 2-1, Nov. 1995.

[1] List all regulated air pollutants. Speciate VOCs, including all HAPs. Follow chemical name with Chemical Abstracts Service (CAS) number. LIST Acids, CO, CS_2, VOCs, H_2S, Inorganics, Lead, Organics, O_3, NO, NO_2, SO_2, SO_3, all applicable Greenhouse Gases (including CO_2 and methane), etc. DO NOT LIST H_2, H_2O, N_2, O_2, and Noble Gases.

[2] Give rate with no control equipment operating. If emissions occur for less than 1 hr, then record emissions per batch in minutes (e.g. 5 lb VOC/20 minute batch).

[3] Give rate with proposed control equipment operating. If emissions occur for less than 1 hr, then record emissions per batch in minutes (e.g. 5 lb VOC/20 minute batch).

[4] Indicate method used to determine emission rate as follows: MB = material balance; ST = stack test (give date of test); EE = engineering estimate; M = modeling; O = other (specify).

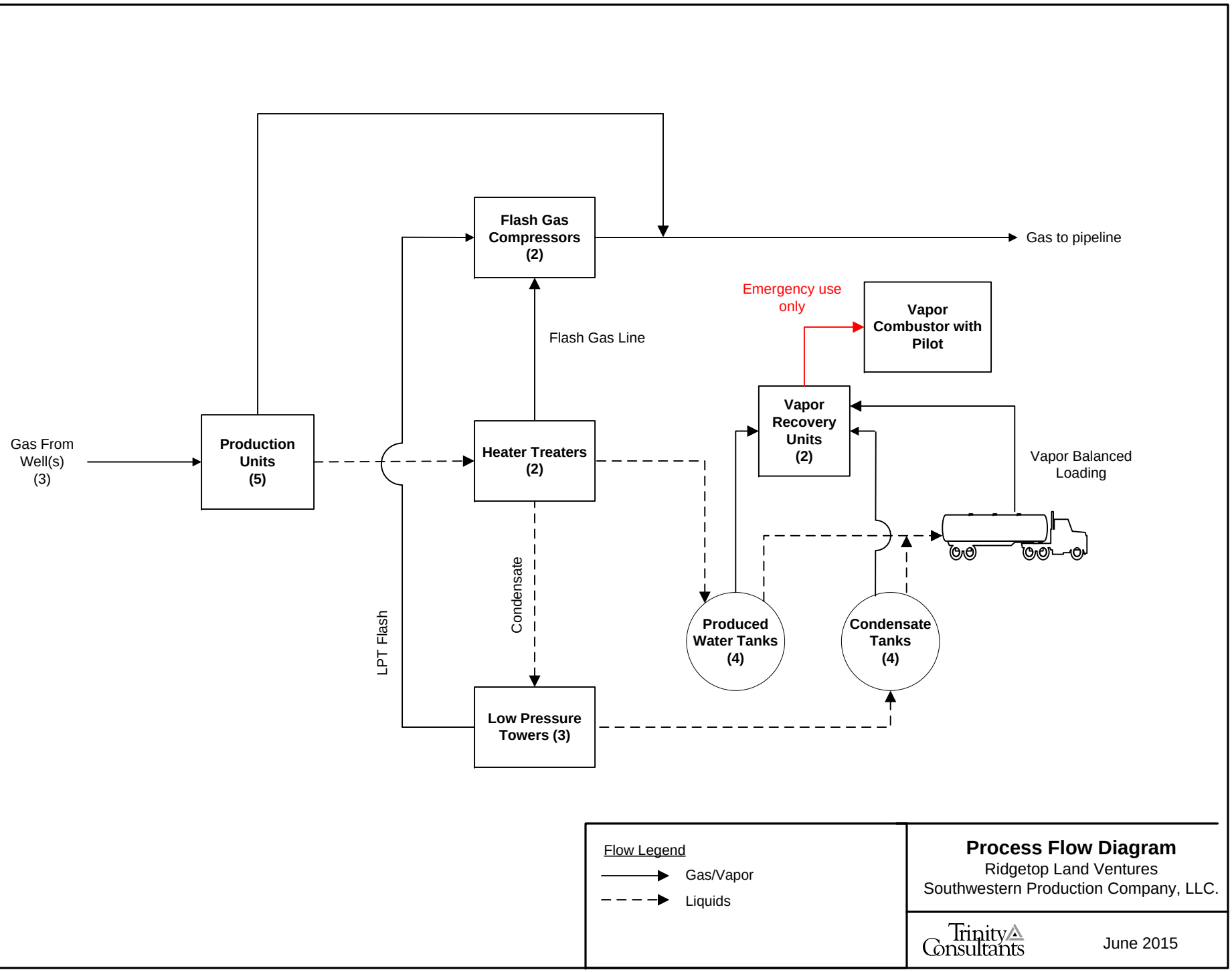
LEAK SOURCE DATA SHEET

Source Category	Pollutant	Number of Source Components	Number of Components Monitored by Frequency	Average Time to Repair (days)	Estimated Annual Emission Rate (lb/yr)[1]
Pumps	light liquid VOC	---	TBD	TBD	---
	heavy liquid VOC	---	TBD	TBD	---
	Non-VOC	---	TBD	TBD	---
Valves	Gas VOC	90	TBD	TBD	1,575
	Light Liquid VOC	118	TBD	TBD	1,147
	Heavy Liquid VOC	---	TBD	TBD	---
	Non-VOC	---	TBD	TBD	---
Safety Relief Valves	Gas VOC	32	TBD	TBD	1,095
	Non VOC	---	TBD	TBD	---
Open-ended Lines	VOC	0	TBD	TBD	---
	Non-VOC	---	TBD	TBD	---
Sampling Connections (*Connectors*)	VOC	888	TBD	TBD	709
	Non-VOC	---	TBD	TBD	---
Compressors (Seals)	VOC	12	TBD	TBD	411
	Non-VOC	---	TBD	TBD	---
Flanges	VOC	888	TBD	TBD	837
	Non-VOC	---	TBD	TBD	---
Other	VOC	---	TBD	TBD	---
	Non-VOC	---	TBD	TBD	---

[1] U.S. EPA. Office of Air Quality Planning and Standards. Protocol for Equipment Leak Emission Estimates. Table 2-1. (Research Triangle Park, NC: U.S. EPA EPA-453/R-95-017, 1995). SOCMI factors were used as it was representative of natural gas liquids extraction

ATTACHMENT D

Process Flow Diagram


Flash Gas Compressors (2)
Gas to pipeline
Emergency use only
Vapor Combustor with Pilot
Flash Gas Line
Vapor Recovery Units (2)
Gas From Well(s) (3)
Production Units (5)
Heater Treaters (2)
Vapor Balanced Loading
Condensate
LPT Flash
Produced Water Tanks (4)
Condensate Tanks (4)
Low Pressure Towers (3)
Flow Legend
Gas/Vapor
Liquids
Process Flow Diagram
Ridgetop Land Ventures
Southwestern Production Company, LLC.
Trinity Consultants
June 2015

ATTACHMENT E

Plot Plan

ATTACHMENT F

Area Map

ATTACHMENT F: AREA MAP

Figure 1 - Map of Ridgetop Land Ventures Wellpad Location

UTM Northing (KM):	4,390.7
UTM Easting (KM):	528.0
Elevation:	~1,465 ft

ATTACHMENT G

Emission Unit Data Sheets and G70-A Section Applicability Form

General Permit G70-A Registration
Section Applicability Form

General Permit G70-A was developed to allow qualified applicants to seek registration for a variety of sources. These sources include natural gas well affected facilities, storage tanks, natural gas-fired compressor engines (RICE), natural gas producing units, natural gas-fired in-line heaters, pneumatic controllers, heater treaters, tank truck loading, glycol dehydration units, completion combustion devices, flares, enclosed combustion devices, and vapor recovery systems. All registered facilities will be subject to Sections 1.0, 2.0, 3.0, and 4.0.

General Permit G70-A allows the registrant to choose which sections of the permit they are seeking registration under. Therefore, please mark which additional sections that you are applying for registration under. If the applicant is seeking registration under multiple sections, please select all that apply. Please keep in mind, that if this registration is approved, the issued registration will state which sections will apply to your affected facility.

Section 5	Natural Gas Well Affected Facility	☒
Section 6	Storage Vessels*	☒
Section 7	Gas Producing Units, In-Line Heaters, Heater Treaters, and Glycol Dehydration Reboilers	☒
Section 8	Pneumatic Controllers Affected Facility (NSPS, Subpart OOOO)	☐
Section 9	*Reserved*	☐
Section 10	Natural gas-fired Compressor Engine(s) (RICE) **	☒
Section 11	Tank Truck Loading Facility ***	☒
Section 12	Standards of Performance for Storage Vessel Affected Facilities (NSPS, Subpart OOOO)	☐
Section 13	Standards of Performance for Stationary Spark Ignition Internal Combustion Engines (NSPS, Subpart JJJJ)	☒
Section 14	Control Devices not subject to NSPS, Subpart OOOO	☒
Section 15	National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines (40CFR63, Subpart ZZZZ)	☒
Section 16	Glycol Dehydration Units	☐
Section 17	Dehydration Units With Exemption from NESHAP Standard, Subpart HH § 63.764(d) (40CFR63, Subpart HH)	☐
Section 18	Dehydration Units Subject to NESHAP Standard, Subpart HH and Not Located Within an UA/UC (40CFR63, Subpart HH)	☐
Section 19	Dehydration Units Subject to NESHAP Standard, Subpart HH and Located Within an UA/UC (40CFR63, Subpart HH)	☐

***** *Applicants that are subject to Section 6 may also be subject to Section 12 if the applicant is subject to the NSPS, Subpart OOOO control requirements or the applicable control device requirements of Section 14.*

****** *Applicants that are subject to Section 10 may also be subject to the applicable RICE requirements of Section 13 and/or Section 15.*

******* *Applicants that are subject to Section 11 may also be subject to control device requirements of Section 14.*

Emission Units Table

(includes all emission units and air pollution control devices that will be part of this permit application review, regardless of permitting status)

Emission Unit ID[1]	Emission Point ID[2]	Emission Unit Description	Year Installed/ Modified	Design Capacity	Type[3] and Date of Change	Control Device[4]
EU-ENGINE1	EP-ENGINE1	Caterpillar G3306NA Engine	2015	145 HP	New	NSCR
EU-ENGINE2	EP-ENGINE2	Caterpillar G3306NA Engine	2015	145 HP	New	NSCR
VRU-1	VRU-1	VRU Engine-1 (General Motors)	2015	92 HP	New	NSCR
VRU-2	VRU-2	VRU Engine -2 (Zenith)	2015	77 HP	New	NSCR
EU-GPU1	EP-GPU1	GPU Burner	2015	1.0 MMBtu/hr	New	None
EU-GPU2	EP-GPU2	GPU Burner	2015	1.0 MMBtu/hr	New	None
EU-GPU3	EP-GPU3	GPU Burner	2015	1.0 MMBtu/hr	New	None
EU-GPU4	EP-GPU4	GPU Burner	2015	1.0 MMBtu/hr	New	None
EU-GPU5	EP-GPU5	GPU Burner	2015	1.0 MMBtu/hr	New	None
EU-HT1	EP-HT1	Heater Treater	2015	0.5 MMBtu/hr	New	None
EU-HT2	EP-HT2	Heater Treater	2015	0.5 MMBtu/hr	New	None
EU-TANKS-COND	EP-TANKS-COND	Four (4) Condensate Tanks	2015	400 bbl each	New	APC-VRU1 APC-VRU2 APC-COMB-TKLD (combustor is emergency use)
EU-TANKS-PW	EP-TANKS-PW	Four (4) Produced Water Tanks	2015	400 bbl each	New	APC-VRU1 APC-VRU2 APC-COMB-TKLD (combustor is emergency use)
EU-LOAD-COND	EP-LOAD-COND	Condensate Truck Loading	2015	12,478,620 gal/yr	New	APC-VRU1 APC-VRU2 APC-COMB-TKLD (combustor is emergency use)

EU-LOAD-PW	EP-LOAD-PW	Produced Water Truck Loading	2015	12,923,190 gal/yr	New	APC-VRU1 APC-VRU2 APC-COMB-TKLD (combustor is emergency use)
APC-COMB-TKLD	APC-COMB-TKLD	Vapor Combustor	2015	15.0 MMBtu/hr	New	None
EU-PILOT	EP-PILOT	Vapor Combustor Pilot	2015	50 scf/hr	New	None
EU-FUG	EP-FUG	Fugitive Emissions	2015	NA	New	None
APC-VRU1	APC-VRU1	Vapor Recovery Unit	2015	NA	New	NA
APC-VRU2	APC-VRU2	Vapor Recovery Unit	2015	NA	New	NA

[1] For Emission Units (or Sources) use the following numbering system:1S, 2S, 3S,... or other appropriate designation.
[2] For Emission Points use the following numbering system:1E, 2E, 3E, ... or other appropriate designation.
[3] New, modification, removal
[4] For Control Devices use the following numbering system: 1C, 2C, 3C,... or other appropriate designation.

NATURAL GAS WELL AFFECTED FACILITY DATA SHEET

Complete this data sheet if you are the owner or operator of a gas well affected facility for which construction, modification, or reconstruction commenced after August 23, 2011. This form must be completed for natural gas well affected facilities regardless of when flowback operations occur (or have occurred).

Please provide the API number(s) for each NG well at this facility:	
TBD	
TBD	
TBD	

Note: This is the same API well number(s) provided in the well completion notification and as provided to the WVDEP, Office of Oil and Gas for the well permit. The API number may be provided on the application without the state code (047).

Every oil and gas well permitted in West Virginia since 1929 has been issued an API (American Petroleum Institute) number. This API is used by agencies to identify and track oil and gas wells.

The API number has the following format: 047-001-00001

Where,
047 = State code. The state code for WV is 047.
001 = County Code. County codes are odd numbers, beginning with 001 (Barbour) and continuing to 109 (Wyoming).
00001= Well number. Each well will have a unique well number.

STORAGE VESSEL EMISSION UNIT DATA SHEET

Provide the following information for each new or modified bulk liquid storage tank.

I. GENERAL INFORMATION (required)

1. Bulk Storage Area Name Condensate Storage Tanks	2. Tank Name Four (4) 400-bbl Condensate Storage Tanks
3. Emission Unit ID number EU-TANKS-COND	4. Emission Point ID number EP-TANKS-COND
5. Date Installed or Modified *(for existing tanks)* TBD	6. Type of change: ☒ New construction ☐ New stored material ☐ Other
7A. Description of Tank Modification *(if applicable)*	
7B. Will more than one material be stored in this tank? *If so, a separate form must be completed for each material.* ☐ Yes ☒ No	
7C. Provide any limitations on source operation affecting emissions. (production variation, etc.) None	

II. TANK INFORMATION (required)

8. Design Capacity *(specify barrels or gallons).* Use the internal cross-sectional area multiplied by internal height. 400 bbl	
9A. Tank Internal Diameter (ft.) ~12	9B. Tank Internal Height (ft.) ~20
10A. Maximum Liquid Height (ft.) ~20	10B. Average Liquid Height (ft.) ~10
11A. Maximum Vapor Space Height (ft.) ~20	11B. Average Vapor Space Height (ft.) ~10
12. Nominal Capacity *(specify barrels or gallons).* This is also known as "working volume. 400 bbl	
13A. Maximum annual throughput (gal/yr) ~12,478,620 gal/yr (total for all tanks)	13B. Maximum daily throughput (gal/day) ~8,547 (per tank)
14. Number of tank turnovers per year ~186 per tank	15. Maximum tank fill rate (gal/min) TBD
16. Tank fill method ☐ Submerged ☒ Splash ☐ Bottom Loading	
17. Is the tank system a variable vapor space system? ☐ Yes ☒ No If yes, (A) What is the volume expansion capacity of the system (gal)? (B) What are the number of transfers into the system per year?	
18. Type of tank (check all that apply): ☒ Fixed Roof _X__ vertical ___ horizontal __ flat roof _X__ cone roof ___ dome roof ___ other (describe) ☐ External Floating Roof ___ pontoon roof ___ double deck roof ☐ Domed External (or Covered) Floating Roof ☐ Internal Floating Roof ___ vertical column support ___ self-supporting ☐ Variable Vapor Space ___ lifter roof ___ diaphragm ☐ Pressurized ___ spherical ___ cylindrical ☐ Underground ☐ Other (describe)	

III. TANK CONSTRUCTION AND OPERATION INFORMATION *(check which one applies)*

☐ Refer to enclosed TANKS Summary Sheets
☒ Refer to the responses to items 19 – 26 in section VII

IV. SITE INFORMATION *(check which one applies)*

☐ Refer to enclosed TANKS Summary Sheets
☒ Refer to the responses to items 27 – 33 in section VII

V. LIQUID INFORMATION *(check which one applies)*

☐ Refer to enclosed TANKS Summary Sheets
☒ Refer to the responses to items 34 – 39 in section VII

VI. EMISSIONS AND CONTROL DEVICE DATA (required)

40. Emission Control Devices (check as many as apply):

☐ Does Not Apply
☐ Carbon Adsorption[1]
☒ Vent to Vapor Combustion Device[1] (vapor combustor) – Secondary
☐ Condenser[1]
☒ Other[1] (describe) Vapor Recovery Unit (Primary); Vacuum Setting Pressure Setting
☐ Rupture Disc (psig)
☐ Inert Gas Blanket of _____
☐ Conservation Vent (psig)
☒ Emergency Relief Valve (psig)

[1] Complete appropriate Air Pollution Control Device Sheet

41. Expected Emission Rate (submit Test Data or Calculations here or elsewhere in the application).

Material Name and CAS No.	Flashing Loss		Breathing Loss		Working Loss		Total Emissions Loss		Estimation Method[1]
	lb/hr	Tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	
See Attached Emission Calculations									

[1] EPA = EPA Emission Factor, MB = Material Balance, SS = Similar Source, ST = Similar Source Test, Throughput Data, O = Other (specify)

Remember to attach emissions calculations, including TANKS Summary Sheets and other modeling summary sheets if applicable.

SECTION VII (required if did not provide TANKS Summary Sheets)

TANK CONSTRUCTION AND OPERATION INFORMATION

19. Tank Shell Construction:

☐ Riveted ☐ Gunite lined ☐ Epoxy-coated rivets ☒ Other (describe) Welded

20A. Shell Color: Gray	20B. Roof Color: Gray	20C. Year Last Painted: New

21. Shell Condition (if metal and unlined):

☒ No Rust ☐ Light Rust ☐ Dense Rust ☐ Not applicable

22A. Is the tank heated? ☐ Yes ☒ No	22B. If yes, operating temperature:	22C. If yes, how is heat provided to tank?

23. Operating Pressure Range (psig): -0.03 to 0.03 psig

24. Is the tank a **Vertical Fixed Roof Tank**? ☒ Yes ☐ No	24A. If yes, for dome roof provide radius (ft):	24B. If yes, for cone roof, provide slop (ft/ft): 0.06

25. Complete item 25 for **Floating Roof Tanks** ☐ Does not apply ☒

25A. Year Internal Floaters Installed:

25B. Primary Seal Type *(check one):* ☐ Metallic (mechanical) shoe seal ☐ Liquid mounted resilient seal ☐ Vapor mounted resilient seal ☐ Other (describe):			
25C. Is the Floating Roof equipped with a secondary seal? ☐ Yes ☐No			
25D. If yes, how is the secondary seal mounted? *(check one)* ☐ Shoe ☐ Rim ☐ Other (describe):			
25E. Is the floating roof equipped with a weather shield? ☐ Yes ☐ No			
25F. Describe deck fittings:			
26. Complete the following section for **Internal Floating Roof Tanks** ☒ Does not apply			
26A. Deck Type: ☐ Bolted ☐ Welded		26B. For bolted decks, provide deck construction:	
26C. Deck seam. Continuous sheet construction: ☐ 5 ft. wide ☐ 6 ft. wide ☐ 7 ft. wide ☐ 5 x 7.5 ft. wide ☐ 5 x 12 ft. wide ☐ other (describe)			
26D. Deck seam length (ft.):	26E. Area of deck (ft^2):	26F. For column supported tanks, # of columns:	26G. For column supported tanks, diameter of column:
SITE INFORMATION:			
27. Provide the city and state on which the data in this section are based: Charleston, WV			
28. Daily Avg. Ambient Temperature (°F): 54.98		29. Annual Avg. Maximum Temperature (°F): 65.75	
30. Annual Avg. Minimum Temperature (°F): 44.21		31. Avg. Wind Speed (mph): 6.05	
32. Annual Avg. Solar Insulation Factor (BTU/ft^2-day): 1,250.6		33. Atmospheric Pressure (psia): 14.25	
LIQUID INFORMATION::			
34. Avg. daily temperature range of bulk liquid (°F):	34A. Minimum (°F):	34B. Maximum (°F):	
35. Avg. operating pressure range of tank (psig):	35A. Minimum (psig): 0.1791	35B. Maximum (psig): 0.3117	
36A. Minimum liquid surface temperature (°F):		36B. Corresponding vapor pressure (psia):	
37A. Avg. liquid surface temperature (°F):		37B. Corresponding vapor pressure (psia):	
38A. Maximum liquid surface temperature (°F): 61.48		38B. Corresponding vapor pressure (psia):	
39. Provide the following for each liquid or gas to be stored in the tank. Add additional pages if necessary.			
39A. Material name and composition:	Produced Fluid		
39B. CAS number:	TBD		
39C. Liquid density (lb/gal):	TBD		
39D. Liquid molecular weight (lb/lb-mole):	97.01		
39E. Vapor molecular weight (lb/lb-mole):	46.31		
39F. Maximum true vapor pressure (psia):	TBD		
39G. Maxim Reid vapor pressure (psia):	TBD		
39H. Months Storage per year. From: To:	12 (All year)		

STORAGE VESSEL EMISSION UNIT DATA SHEET

Provide the following information for each new or modified bulk liquid storage tank.

I. GENERAL INFORMATION (required)

1. Bulk Storage Area Name Produced Water	2. Tank Name Four (4) 400 bbl Produced Water Storage Tanks
3. Emission Unit ID number EU-TANKS-PW	4. Emission Point ID number EP-TANKS-PW
5. Date Installed or Modified *(for existing tanks)* TBD	6. Type of change: ☒ New construction ☐ New stored material ☐ Other
7A. Description of Tank Modification *(if applicable)*	
7B. Will more than one material be stored in this tank? *If so, a separate form must be completed for each material.* ☐ Yes ☒ No	
7C. Provide any limitations on source operation affecting emissions. (production variation, etc.) None	

II. TANK INFORMATION (required)

8. Design Capacity *(specify barrels or gallons).* Use the internal cross-sectional area multiplied by internal height. 400 bbl	
9A. Tank Internal Diameter (ft.) ~12	9B. Tank Internal Height (ft.) ~20
10A. Maximum Liquid Height (ft.) ~20	10B. Average Liquid Height (ft.) ~10
11A. Maximum Vapor Space Height (ft.) ~20	11B. Average Vapor Space Height (ft.) ~10
12. Nominal Capacity *(specify barrels or gallons).* This is also known as "working volume. 140 bbl	
13A. Maximum annual throughput (gal/yr) ~12,923,190 (Total for all tanks)	13B. Maximum daily throughput (gal/day) ~8,852 (per tank)
14. Number of tank turnovers per year ~193 per tank	15. Maximum tank fill rate (gal/min) TBD
16. Tank fill method ☐ Submerged ☒ Splash ☐ Bottom Loading	
17. Is the tank system a variable vapor space system? ☐ Yes ☒ No If yes, (A) What is the volume expansion capacity of the system (gal)? (B) What are the number of transfers into the system per year?	
18. Type of tank (check all that apply): ☒ Fixed Roof _X_ vertical ___ horizontal ___ flat roof _X__ cone roof ___ dome roof ___ other (describe) ☐ External Floating Roof ___ pontoon roof ___ double deck roof ☐ Domed External (or Covered) Floating Roof ☐ Internal Floating Roof ___ vertical column support ___ self-supporting ☐ Variable Vapor Space ___ lifter roof ___ diaphragm ☐ Pressurized ___ spherical ___ cylindrical ☐ Underground ☐ Other (describe)	

III. TANK CONSTRUCTION AND OPERATION INFORMATION *(check which one applies)*

☐ Refer to enclosed TANKS Summary Sheets
☒ Refer to the responses to items 19 – 26 in section VII

IV. SITE INFORMATION *(check which one applies)*

☐ Refer to enclosed TANKS Summary Sheets
☒ Refer to the responses to items 27 – 33 in section VII

V. LIQUID INFORMATION *(check which one applies)*

☐ Refer to enclosed TANKS Summary Sheets
☒ Refer to the responses to items 34 – 39 in section VII

VI. EMISSIONS AND CONTROL DEVICE DATA (required)

40. Emission Control Devices (check as many as apply):

☐ Does Not Apply
☐ Carbon Adsorption[1]
☒ Vent to Vapor Combustion Device[1] (vapor combustor) (Secondary)
☐ Condenser[1]
☒ Other[1] (describe) Vapor Recovery Unit (Primary) Vacuum Setting Pressure Setting
☐ Rupture Disc (psig)
☐ Inert Gas Blanket of _____
☐ Conservation Vent (psig)
☐ Emergency Relief Valve (psig)

[1] Complete appropriate Air Pollution Control Device Sheet

41. Expected Emission Rate (submit Test Data or Calculations here or elsewhere in the application).

Material Name and CAS No.	Flashing Loss		Breathing Loss		Working Loss		Total Emissions Loss		Estimation Method[1]
	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	
See Attached Emission Calculations									

[1] EPA = EPA Emission Factor, MB = Material Balance, SS = Similar Source, ST = Similar Source Test, Throughput Data, O = Other (specify)

Remember to attach emissions calculations, including TANKS Summary Sheets and other modeling summary sheets if applicable.

SECTION VII (required if did not provide TANKS Summary Sheets)

TANK CONSTRUCTION AND OPERATION INFORMATION

19. Tank Shell Construction:
☐ Riveted ☐ Gunite lined ☐ Epoxy-coated rivets ☒ Other (describe) Welded

20A. Shell Color: Gray	20B. Roof Color: Gray	20C. Year Last Painted: New

21. Shell Condition (if metal and unlined):
☒ No Rust ☐ Light Rust ☐ Dense Rust ☐ Not applicable

22A. Is the tank heated? ☐ Yes ☒ No	22B. If yes, operating temperature:	22C. If yes, how is heat provided to tank?

23. Operating Pressure Range (psig): -0.03 to 0.03 psig

24. Is the tank a **Vertical Fixed Roof Tank**? ☒ Yes ☐ No	24A. If yes, for dome roof provide radius (ft):	24B. If yes, for cone roof, provide slop (ft/ft): 0.06

25. Complete item 25 for **Floating Roof Tanks** ☐ Does not apply ☒

25A. Year Internal Floaters Installed:

25B. Primary Seal Type *(check one):* ☐ Metallic (mechanical) shoe seal ☐ Liquid mounted resilient seal ☐ Vapor mounted resilient seal ☐ Other (describe):

25C. Is the Floating Roof equipped with a secondary seal? ☐ Yes ☐ No

25D. If yes, how is the secondary seal mounted? *(check one)* ☐ Shoe ☐ Rim ☐ Other (describe):

25E. Is the floating roof equipped with a weather shield? ☐ Yes ☐ No			
25F. Describe deck fittings:			
26. Complete the following section for **Internal Floating Roof Tanks** ☒ Does not apply			
26A. Deck Type: ☐ Bolted ☐ Welded		26B. For bolted decks, provide deck construction:	
26C. Deck seam. Continuous sheet construction: ☐ 5 ft. wide ☐ 6 ft. wide ☐ 7 ft. wide ☐ 5 x 7.5 ft. wide ☐ 5 x 12 ft. wide ☐ other (describe)			
26D. Deck seam length (ft.):	26E. Area of deck (ft^2):	26F. For column supported tanks, # of columns:	26G. For column supported tanks, diameter of column:
SITE INFORMATION:			
27. Provide the city and state on which the data in this section are based: Charleston, WV			
28. Daily Avg. Ambient Temperature (°F): 54.98		29. Annual Avg. Maximum Temperature (°F): 65.75	
30. Annual Avg. Minimum Temperature (°F): 44.21		31. Avg. Wind Speed (mph): 6.05	
32. Annual Avg. Solar Insulation Factor (BTU/ft2-day): 1,250.6		33. Atmospheric Pressure (psia): 14.25	
LIQUID INFORMATION:			
34. Avg. daily temperature range of bulk liquid (°F):	34A. Minimum (°F):	34B. Maximum (°F):	
35. Avg. operating pressure range of tank (psig):	35A. Minimum (psig): 0.1791	35B. Maximum (psig): 0.3117	
36A. Minimum liquid surface temperature (°F):		36B. Corresponding vapor pressure (psia):	
37A. Avg. liquid surface temperature (°F):		37B. Corresponding vapor pressure (psia):	
38A. Maximum liquid surface temperature (°F): 61.48		38B. Corresponding vapor pressure (psia):	
39. Provide the following for each liquid or gas to be stored in the tank. Add additional pages if necessary.			
39A. Material name and composition:	Produced Fluid		
39B. CAS number:	TBD		
39C. Liquid density (lb/gal):	TBD		
39D. Liquid molecular weight (lb/lb-mole):	97.01		
39E. Vapor molecular weight (lb/lb-mole):	18.016		
39F. Maximum true vapor pressure (psia):	TBD		
39G. Maxim Reid vapor pressure (psia):	TBD		
39H. Months Storage per year. From:			

NATURAL GAS FIRED FUEL BURNING UNITS
EMISSION DATA SHEET

Complete the information on this data for each Gas Producing Unit(s), Heater Treater(s), and in-line heater(s) at the production pad. Reboiler information should be entered on the Glycol Dehydration Emission Unit Data Sheet.

Emission Unit ID #[1]	Emission Point ID#[2]	Emission Unit Description (Manufacturer / Model #)	Year Installed/ Modified	Type[3] and Date of Change	Control Device[4]	Design Heat Input (mmBtu/hr)[5]	Fuel Heating Value (Btu/scf)[6]
EU-GPU1	EP-GPU1	GPU Burner	TBD	New	None	1.00	~1,287
EU-GPU2	EP-GPU2	GPU Burner	TBD	New	None	1.00	~1,287
EU-GPU3	EP-GPU3	GPU Burner	TBD	New	None	1.00	~1,287
EU-GPU4	EP-GPU4	GPU Burner	TBD	New	None	1.00	~1,287
EU-GPU5	EP-GPU5	GPU Burner	TBD	New	None	1.00	~1,287
EU-HT1	EP-HT1	Heater Treater	TBD	New	None	0.50	~1,287
EU-HT2	EP-HT2	Heater Treater	TBD	New	None	0.50	~1,287

[1] Enter the appropriate Emission Unit (or Sources) identification numbers for each fuel burning unit located at the production pad. Gas Producing Unit Burners should be designated GPU-1, GPU-2, etc. Heater Treaters should be designated HT-1, HT-2, etc. Heaters or Line Heaters should be designated LH-1, LH-2, etc. For sources, use 1S, 2S, 3S…or other appropriate designation. Enter glycol dehydration unit Reboiler Vent data on the *Glycol Dehydration Unit Data Sheet*.

[2] Enter the appropriate Emission Point identification numbers for each fuel burning unit located at the production pad. Gas Producing Unit Burners should be designated GPU-1, GPU-2, etc. Heater Treaters should be designated HT-1, HT-2, etc. Heaters or Line Heaters should be designated LH-1, LH-2, etc. For emission points, use 1E, 2E, 3E…or other appropriate designation.

[3] New, modification, removal

[4] Complete appropriate air pollution control device sheet for any control device.

[5] Enter design heat input capacity in mmBtu/hr.

[6] Enter the fuel heating value in Btu/standard cubic foot.

NATURAL GAS-FIRED COMPRESSOR ENGINE (RICE) EMISSION UNIT DATA SHEET

Complete this section for any natural gas-fired reciprocating internal combustion engine.

Emission Unit (Source) ID No.[1]		EU-ENGINE1		EU-ENGINE2		VRU-1		VRU-2	
Emission Point ID No. [2]		EP-ENGINE1		EP-ENGINE2		VRU-1		VRU-2	
Engine Manufacturer and Model		Caterpillar G3306 NA		Caterpillar G3306 NA		GM Vortec 5.7L NA		Zenith 4.4 L6	
Manufacturer's Rated bhp/rpm		145		145		92		77	
Source Status[3]		NS		NS		NS		NS	
Date Installed/Modified/Removed[4]		TBD		TBD		TBD		TBD	
Engine Manufactured/Reconstruction Date[5]		June 2012		June 2012		> July 2010		2013	
Is this engine subject to 40CFR60, Subpart JJJJ?		Yes		Yes		Yes		Yes	
Is this a Certified Stationary Spark Ignition Engine according to 40CFR60, Subpart JJJJ? (Yes or No)[6]		No		No		No		Yes	
Is this engine subject to 40CFR63, Subpart ZZZZ? (yes or no)		Yes		Yes		Yes		Yes	
Engine, Fuel and Combustion Data	Engine Type[7]	4SRB		4SRB		4SRB		4SRB	
	APCD Type[8]	NSCR		NSCR		NSCR		NSCR	
	Fuel Type[9]	PQNG		PQNG		PQNG		PQNG	
	H_2S (gr/100 scf)	0		0		0		0	
	Operating bhp/rpm	145		145		92		77	
	BSFC (Btu/bhp-hr)	8,625		8,625		8,600		15,454	
	Fuel throughput (ft3/hr)	971		971		615		928	
	Fuel throughput ($MMft^3/yr$)	8.5		8.5		5.4		8.1	
	Operation (hrs/yr)	8760		8760		8760		8760	
Reference[10]	Potential Emissions[11]	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr
MD	NO_X	0.32	1.40	0.32	1.40	0.20	0.89	0.27	1.16
MD	CO	0.64	2.80	0.64	2.80	0.41	1.78	0.76	3.33
MD	VOC	0.07	0.67	0.07	0.67	0.16	0.74	0.29	1.27
AP-42	SO_2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
AP-42	PM_{10}	0.02	0.11	0.02	0.11	0.02	0.07	0.02	0.10
MD	Formaldehyde	0.09	0.38	0.09	0.38	0.02	0.07	0.02	0.10
MRR[12]	Proposed Monitoring:	See Project Report		See Project Report		See Project Report		See Project Report	
	Proposed Recordkeeping:	See Project Report		See Project Report		See Project Report		See Project Report	
	Proposed Reporting:	See Project Report		See Project Report		See Project Report		See Project Report	

Instructions for completing the Engine Emission Unit Data Sheet:

[1] Enter the appropriate Emission Unit (Source) identification number for each natural gas-fueled reciprocating internal combustion compressor/generator engine located at the production pad. Multiple compressor engines should be designated CE-1S, CE-2S, etc. or other

appropriate designation. Generator engines should be designated GE-1S, GE-2S, etc. or other appropriate designation. If more than three (3) engines exist, please use additional sheets.

2 For Emission Points, use the following numbering system: 1E, 2E, etc. or other appropriate designation.

3 Enter the Source Status using the following codes: NS = Construction of New Source (installation); ES = Existing Source; MS = Modification of Existing Source; and RS = Removal of Source

4 Enter the date (or anticipated date) of the engine's installation (construction of source), modification or removal.

5 Enter the date that the engine was manufactured, modified or reconstructed.

6 Is the engine a certified stationary spark ignition internal combustion engine according to 40CFR60 Subpart JJJJ. If so, the engine and control device must be operated and maintained in accordance with the manufacturer's emission-related written instructions. You must keep records of conducted maintenance to demonstrate compliance, but no performance testing is required. If the certified engine is not operated and maintained in accordance with the manufacturer's emission-related written instructions, the engine will be considered a non-certified engine and you must demonstrate compliance according to 40CFR§60.4243a(2)(i) through (iii), as appropriate. ***Provide a manufacturer's data sheet for all engines being registered and a manufacturer's EPA certification of conformity sheet.***

7 Enter the Engine Type designation(s) using the following codes: LB2S = Lean Burn Two Stroke, RB4S = Rich Burn Four Stroke, and LB4S =Lean Burn Four Stroke.

8 Enter the Air Pollution Control Device (APCD) type designation(s) using the following codes: NSCR = Rich Burn & Non-Selective Catalytic Reduction, PSC = Rich Burn & Prestratified Charge, SCR = Lean Burn & Selective Catalytic Reduction, or CAT = Lean Burn & Catalytic Oxidation

9 Enter the Fuel Type using the following codes: PQ = Pipeline Quality Natural Gas, or RG = Raw Natural Gas

10 Enter the Potential Emissions Data Reference designation using the following codes. Attach all referenced data to this *Compressor/Generator Data Sheet(s)*. Codes: MD = Manufacturer's Data, AP = AP-42 Factors, GR = GRI-HAPCalc™ , or OT = Other _____ (please list)

11 Enter each engine's Potential to Emit (PTE) for the listed regulated pollutants in pounds per hour and tons per year. PTE shall be calculated at manufacturer's rated brake horsepower and may reflect reduction efficiencies of listed Air Pollution Control Devices. Emergency generator engines may use 500 hours of operation when calculating PTE. PTE data from this data sheet shall be incorporated in the *Emissions Summary Sheet as Attachment O*.

12 Please propose monitoring, recordkeeping, and reporting in order to demonstrate compliance with the operation of this engine operation and associated air pollution control device. Include operating ranges and maintenance procedures required by the manufacturer to maintain the warranty.

TANK TRUCK LOADING
EMISSION UNIT DATA SHEET

Furnish the following information for each new or modified bulk liquid transfer area or loading rack at the natural gas production pad. This form is to be used for bulk liquid transfer operations to tank trucks.

1. Emission Unit ID: EU-LOAD-COND	2. Emission Point ID: EU-LOAD-COND	3. Year Installed/ Modified: TBD
4. Emission Unit Description: Condensate Liquid Loading		
5. Loading Area Data:		
5A. Number of pumps: 1	5B. Number of liquids loaded:1	5C. Maximum number of tank trucks loading at one time:1
6. Describe cleaning location, compounds and procedure for tank trucks: Point is kept clear. Scotches are provided. Lines kept in good working order and tested periodically		
7. Are tank trucks pressure tested for leaks at this or any other location? ☒ Yes ☐ No If YES, describe: Vessel pressure is tested in accordance with DOT requirements, if applicable:		

8. Projected Maximum Operating Schedule (for rack or transfer point as a whole):

Maximum	Jan. - Mar.	Apr. - June	July - Sept.	Oct. - Dec.
hours/day	24	24	24	24
days/week	5	5	5	5

9. Bulk Liquid Data *(add pages as necessary):*

Liquid Name	Condensate		
Max. daily throughput (1000 gal/day)	34.18		
Max. annual throughput (gal/yr)	12,478,620		
Loading Method [1]	SP		
Max. Fill Rate (gal/min)	TBD		
Average Fill Time (min/loading)	~ 60		
Max. Bulk Liquid Temperature (°F)	61.48		
True Vapor Pressure [2]	TBD		
Cargo Vessel Condition[3]	U		
Control Equipment or Method [4]	O- Vapor return with VRU and combustor controls		
Minimum collection efficiency (%)	70		
Minimum control efficiency (%)	95		

** Continued on next page*

Maximum Emission Rate	Loading (lb/hr)	VOC: 10.90 HAP: 0.27		
	Annual (ton/yr)	VOC: 47.73 HAP: 1.17		
Estimation Method [5]		ProMax Software		

Notes:

[1] BF = Bottom Fill SP = Splash Fill SUB = Submerged Fill

[2] At maximum bulk liquid temperature

[3] B = Ballasted Vessel, C = Cleaned, U = Uncleaned (dedicated service), O = other (describe)

[4] List as many as apply (complete and submit appropriate *Air Pollution Control Device Sheets as Attachment "H"*):
CA = Carbon Adsorption
VB = Dedicated Vapor Balance (closed system)
ECD = Enclosed Combustion Device
F = Flare
TO = Thermal Oxidation or Incineration

[5] EPA = EPA Emission Factor as stated in AP-42
MB = Material Balance
TM = Test Measurement based upon test data submittal
O = other (describe)

10. **Proposed Monitoring, Recordkeeping, Reporting, and Testing**
Please propose monitoring, recordkeeping, and reporting in order to demonstrate compliance with the proposed operating parameters. Please propose testing in order to demonstrate compliance with the proposed emissions limits.

MONITORING *Please list and describe the process parameters and ranges that are proposed to be monitored in order to demonstrate compliance with the operation of this process equipment operation/air pollution control device.* None	RECORDKEEPING *Please describe the proposed recordkeeping that will accompany the monitoring.* None
REPORTING *Please describe the proposed frequency of reporting of the recordkeeping.* None	TESTING *Please describe any proposed emissions testing for this process equipment/air pollution control device.* None

11. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty: N/A

TANK TRUCK LOADING
EMISSION UNIT DATA SHEET

Furnish the following information for each new or modified bulk liquid transfer area or loading rack at the natural gas production pad. This form is to be used for bulk liquid transfer operations to tank trucks.

1. Emission Unit ID: EU-LOAD-PW	2. Emission Point ID: EU-LOAD-PW	3. Year Installed/ Modified: TBD
4. Emission Unit Description: Produced Water Liquid Loading		
5. Loading Area Data:		
5A. Number of pumps: 1	5B. Number of liquids loaded:1	5C. Maximum number of tank trucks loading at one time:1
6. Describe cleaning location, compounds and procedure for tank trucks: Point is kept clear. Scotches are provided. Lines kept in good working order and tested periodically		
7. Are tank trucks pressure tested for leaks at this or any other location? ☒ Yes ☐ No If YES, describe: Vessel pressure is tested in accordance with DOT requirements, if applicable:		

8. Projected Maximum Operating Schedule (for rack or transfer point as a whole):

Maximum	Jan. - Mar.	Apr. - June	July - Sept.	Oct. - Dec.
hours/day	24	24	24	24
days/week	5	5	5	5

9. Bulk Liquid Data *(add pages as necessary):*

Liquid Name	Condensate		
Max. daily throughput (1000 gal/day)	35.41		
Max. annual throughput (gal/yr)	12,923,190		
Loading Method [1]	SUB		
Max. Fill Rate (gal/min)	TBD		
Average Fill Time (min/loading)	~ 60		
Max. Bulk Liquid Temperature (°F)	61.48		
True Vapor Pressure [2]	TBD		
Cargo Vessel Condition[3]	U		
Control Equipment or Method [4]	O- Vapor return with VRU and combustor controls		
Minimum collection efficiency (%)	70		
Minimum control efficiency (%)	95		

** Continued on next page*

Maximum Emission Rate	Loading (lb/hr)	VOC: 0.61 HAP: <0.01		
	Annual (ton/yr)	VOC: 2.69 HAP: 0.01		
Estimation Method [5]		ProMax Software		

Notes:

[1] BF = Bottom Fill SP = Splash Fill SUB = Submerged Fill

[2] At maximum bulk liquid temperature

[3] B = Ballasted Vessel, C = Cleaned, U = Uncleaned (dedicated service), O = other (describe)

[4] List as many as apply (complete and submit appropriate *Air Pollution Control Device Sheets as Attachment "H"*):
CA = Carbon Adsorption
VB = Dedicated Vapor Balance (closed system)
ECD = Enclosed Combustion Device
F = Flare
TO = Thermal Oxidation or Incineration

[5] EPA = EPA Emission Factor as stated in AP-42
MB = Material Balance
TM = Test Measurement based upon test data submittal
O = other (describe)

10. **Proposed Monitoring, Recordkeeping, Reporting, and Testing**
Please propose monitoring, recordkeeping, and reporting in order to demonstrate compliance with the proposed operating parameters. Please propose testing in order to demonstrate compliance with the proposed emissions limits.

MONITORING *Please list and describe the process parameters and ranges that are proposed to be monitored in order to demonstrate compliance with the operation of this process equipment operation/air pollution control device.* None	RECORDKEEPING *Please describe the proposed recordkeeping that will accompany the monitoring.* None
REPORTING *Please describe the proposed frequency of reporting of the recordkeeping.* None	TESTING *Please describe any proposed emissions testing for this process equipment/air pollution control device.* None

11. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty: N/A

G3306 NA

GAS COMPRESSION APPLICATION

GAS ENGINE SITE SPECIFIC TECHNICAL DATA

CATERPILLAR®

ENGINE SPEED (rpm):	1800	FUEL SYSTEM:	LPG IMPCO
COMPRESSION RATIO:	10.5:1		WITH CUSTOMER SUPPLIED AIR FUEL RATIO CONTROL
JACKET WATER OUTLET (°F):	210	**SITE CONDITIONS:**	
COOLING SYSTEM:	JW+OC	FUEL:	Nat Gas
IGNITION SYSTEM:	MAG	FUEL PRESSURE RANGE(psig):	1.5-10.0
EXHAUST MANIFOLD:	WC	FUEL METHANE NUMBER:	84.8
COMBUSTION:	Catalyst	FUEL LHV (Btu/scf):	905
EXHAUST O2 EMISSION LEVEL %:	0.5	ALTITUDE(ft):	500
SET POINT TIMING:	30.0	MAXIMUM INLET AIR TEMPERATURE(°F):	77
		NAMEPLATE RATING:	145 bhp@1800rpm

			MAXIMUM RATING	SITE RATING AT MAXIMUM INLET AIR TEMPERATURE		
RATING	**NOTES**	**LOAD**	**100%**	**100%**	**75%**	**50%**
ENGINE POWER	(1)	bhp	145	145	109	72
INLET AIR TEMPERATURE		°F	77	77	77	77
ENGINE DATA						
FUEL CONSUMPTION (LHV)	(2)	Btu/bhp-hr	7775	7775	8318	9509
FUEL CONSUMPTION (HHV)	(2)	Btu/bhp-hr	8625	8625	9227	10548
AIR FLOW	(3)(4)	lb/hr	922	922	739	556
AIR FLOW WET (77°F, 14.7 psia)	(3)(4)	scfm	208	208	167	125
INLET MANIFOLD PRESSURE	(5)	in Hg(abs)	26.2	26.2	21.8	17.6
EXHAUST STACK TEMPERATURE	(6)	°F	1101	1101	1067	1037
EXHAUST GAS FLOW (@ stack temp, 14.5 psia)	(7)(4)	ft3/min	678	678	532	393
EXHAUST GAS MASS FLOW	(7)(4)	lb/hr	978	978	784	590
EMISSIONS DATA						
NOx (as NO2)	(8)	g/bhp-hr	13.47	13.47	12.15	9.76
CO	(8)	g/bhp-hr	13.47	13.47	11.44	9.56
THC (mol. wt. of 15.84)	(8)	g/bhp-hr	2.20	2.20	2.49	3.22
NMHC (mol. wt. of 15.84)	(8)	g/bhp-hr	0.33	0.33	0.37	0.48
NMNEHC (VOCs) (mol. wt. of 15.84)	(8)(9)	g/bhp-hr	0.22	0.22	0.25	0.32
HCHO (Formaldehyde)	(8)	g/bhp-hr	0.27	0.27	0.31	0.33
CO2	(8)	g/bhp-hr	485	485	525	601
EXHAUST OXYGEN	(10)	% DRY	0.5	0.5	0.5	0.5
HEAT REJECTION						
HEAT REJ. TO JACKET WATER (JW)	(11)	Btu/min	6049	6049	5237	4455
HEAT REJ. TO ATMOSPHERE	(11)	Btu/min	751	751	602	459
HEAT REJ. TO LUBE OIL (OC)	(11)	Btu/min	990	990	857	729
HEAT EXCHANGER SIZING CRITERIA						
TOTAL JACKET WATER CIRCUIT (JW+OC)	(12)	Btu/min	7842			

CONDITIONS AND DEFINITIONS

Engine rating obtained and presented in accordance with ISO 3046/1, adjusted for fuel, site altitude and site inlet air temperature.
100% rating at maximum inlet air temperature is the maximum engine capability for the specified fuel at site altitude and maximum site inlet air temperature.
Max. rating is the maximum capability for the specified fuel at site altitude and reduced inlet air temperature.
Lowest load point is the lowest continuous duty operating load allowed. No overload permitted at rating shown.

For notes information consult page three.

PREPARED BY:
Data generated by Gas Engine Rating Pro Version 3.04.00
Ref. Data Set DM5053-07-000, Printed 31Jan2011

772 Airfield Lane
Sheridan, WY 82801
Office: 307.673.0883
EST@emittechnologies.com

Prepared For:
Jason Stinson
MIDCON COMPRESSION, LP

MANUFACTURED ON OR AFTER 1/1/2011

INFORMATION PROVIDED BY CATERPILLAR

Engine:	G3306 NA
Horsepower:	145
RPM:	1800
Compression Ratio:	10.5:1
Exhaust Flow Rate:	678 CFM
Exhaust Temperature:	1101 °F
Reference:	DM5053-07
Fuel:	Natural Gas
Annual Operating Hours:	8760

Uncontrolled Emissions

NOx:	13.47 g/bhp-hr
CO:	13.47 g/bhp-hr
THC:	2.20 g/bhp-hr
NMHC:	0.33 g/bhp-hr
NMNEHC:	0.22 g/bhp-hr
HCHO:	0.27 g/bhp-hr
Oxygen:	0.50 %

POST CATALYST EMISSIONS

NOx:	<1.0 g/bhp-hr
CO:	<2.0 g/bhp-hr
VOC:	<0.7 g/bhp-hr

CONTROL EQUIPMENT

Catalytic Converter

Model:	**EAH-1200T-0404F-21CEE**
Catalyst Type:	NSCR, Precious group metals
Manufacturer:	EMIT Technologies, Inc.
Element Size:	Round 12 x 3.5
Catalyst Elements:	1
Housing Type:	2 Element Capacity
Catalyst Installation:	Accessible Housing
Construction:	10 gauge Carbon Steel
Sample Ports:	6 (0.5" NPT)
Inlet Connections:	4" Flat Face Flange
Outlet Connections:	4" Flat Face Flange
Configuration:	End In / End Out
Silencer:	Integrated
Silencer Grade:	Hospital
Insertion Loss:	35-40 dBA

Air Fuel Ratio Controller

Model:	**ENG-S-075-T**
Manufacturer:	EMIT Technologies, Inc.
Description:	EDGE NG Air Fuel Ratio Controller 4-Wire Narrowband O2 Sensor Digital Power Valve O2 Sensor Weldment Wiring Harness (2) 25' Type K Thermocouple
Digital Power Valve Size:	0.75" NPT

GM POWERTRAIN Industrial Engines

VORTEC ENGINES

GM Powertrain takes its expertise in designing outstanding Vortec truck and SUV engines and leverages it to make sophisticated yet extremely durable industrial engines.

Applications

Industrial, Agriculture Construction & Oilfield

- **Pumps –** Irrigation, Industrial, Hydraulic, Sludge and Trash
- **Compressors –** Natural Gas and Air
- **Generators –** Prime Power, Standby and Co-Gen
- **Industrial Drives –** Forklifts, Manlifts, Street Sweepers, Wood Chippers, Chillers and Fans
- **Oil and Gas Production –** Gas Compressors, Pump Jacks, Vapor Recovery
- **Wind Machines**
- **Numerous Re-Power & Custom Applications**

Available Factory Installed Options

- Natural Gas and LPG Fuel Systems
- Ignition Systems
- Belt and Pulley Accessory Drives
- Starters and Alternators
- Exhaust Headers and Manifolds
- Mufflers
- SAE 3 Flywheel Housing and Direct Drives
- PTOs: Side Load and In-Line
- Instrument Panel w/Gauges and Safety Shutdowns
- Governors: Electronic and Mechanical
- Engine Mounting Frames and Enclosures
- Three Way Catalyst

Vortec™ 5.7L 8 Cylinder - 350 Cubic Inches

Features & Benefits

- Three way catalyst and closed loop fuel system for EPA/CARB emission certified engines
- Designed for propane and natural gas fuel
- Intake manifold is standard on the engine
- Hydraulic roller lifter camshaft is optimized for maximum performance
- Composite front cover for noise reduction
- Nodular iron crankshaft for increased strength and durability
- High Energy Ignition (HEI) distributor and coil are standard
- Induction-hardened inlet valve seats and sintered powder metal exhaust valve seat inserts for maximum durability
- World-class engine sealing system uses composite cylinder head gasket with steel cores, a one piece main crankshaft seal, a one piece oil pan seal and molded rocker cover seals
- Positive inlet valve stem seals to control oil consumption
- Common GM Powertrain industrial engine rear face for easy housing installation

UE Powertrain
Buck's Engines

Main Office:
20 N. McCormick
Oklahoma City, OK 73127
405-601-1000

515 North I-27
Lubbock, TX 79403
806-762-0455

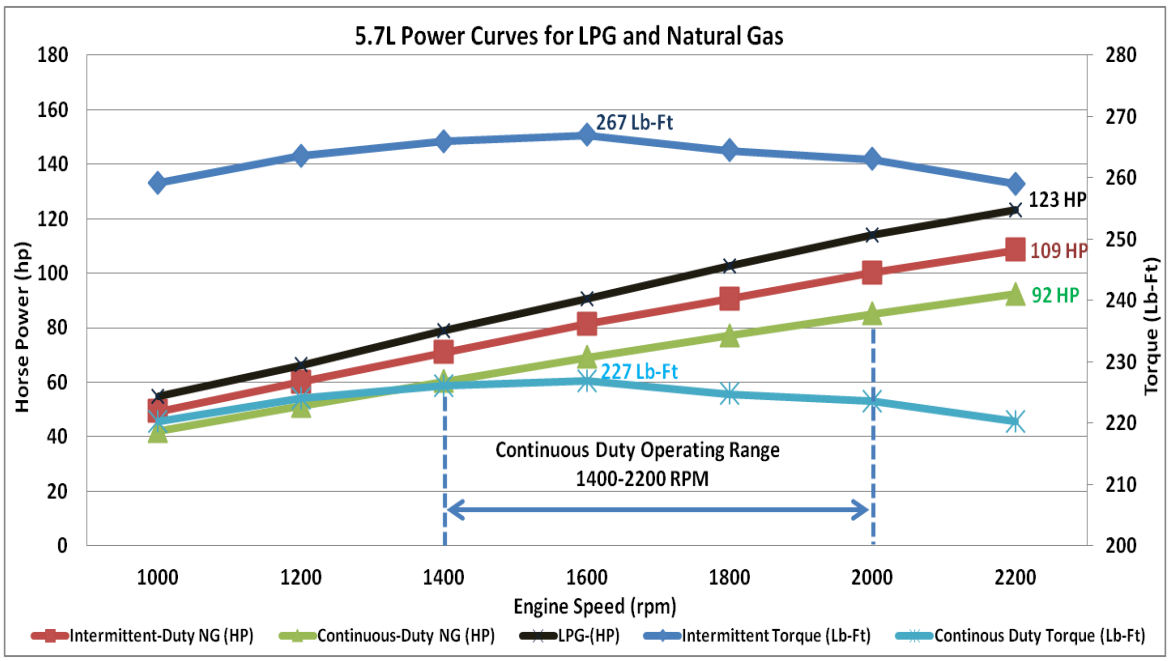
4452 Canyon Dr.
Amarillo, TX 79109
806-355-8228

Buck's Engines combines over 50 years of engine application experience with General Motors' expertise in designing outstanding Vortec engines and utilizes this partnership to manufacture extremely durable industrial engines.

GM POWERTRAIN Industrial Engines

VORTEC ENGINES

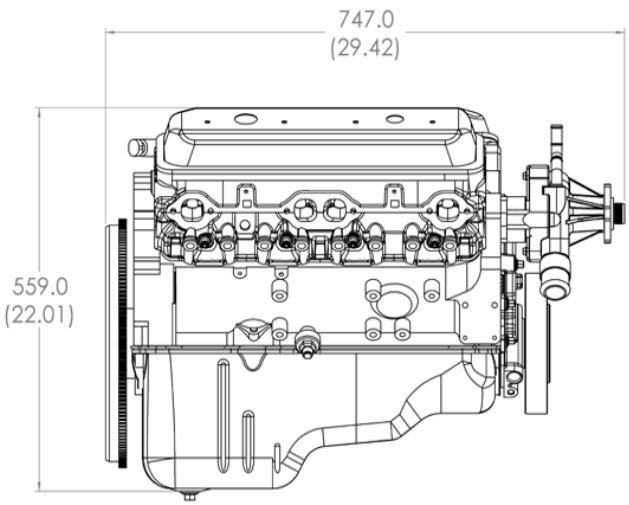
Vortec™ 5.7L 8 Cylinder – 350 Cubic Inches

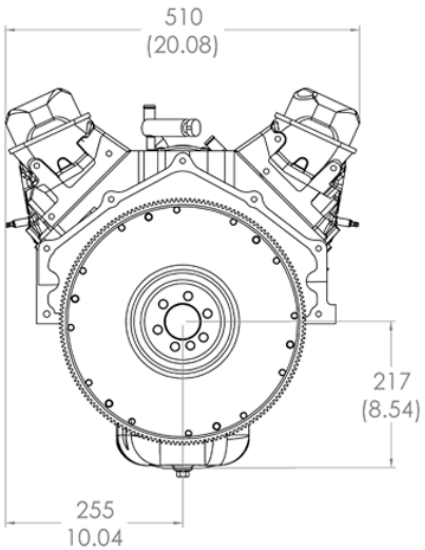


Power and torque values provided by Buck's Engines per SAE1349. Actual power levels may vary depending on fuel selection and quality, calibration, application, altitude and ambient air temperatures.

CONTINUOUS BRAKE HORSEPOWER

GEARHEAD	1x1	6x5	5x4
ENGINE RPM	1760	2112	2200
BHP	73	87	92





Specifications and Materials

- **Type:** 90° 5.7L V8
- **Displacement:** 350 cld (5736 cc)
- **Compression Ratio:** 9.4:1
- **Valve Configuration:** Overhead/Pushrod Actuated
- **Valve Lifters:** Overhead/Pushrod Actuated
- **Bore x Stroke:** 4.00 x 3.48 in (101.60 x 88.39 mm)
- **Main Bearing Caps:** 2-Bolt
- **Balance Method:** External
- **Intake Manifold:** Four Barrel
- **Firing Order:** 1-8-4-3-6-5-7-2
- **Oil Pan Capacity:** 5 qt without oil filter
- **Fuel Type:** Propane or Natural Gas
- **Engine Rotation:** Clockwise (from the front)
- **Paint Protection:** Component Painted
- **Shipping Weight:** 434 lb (197 kg)
- **Block:** Cast Iron
- **Cylinder Head:** Cast Iron
- **Intake Manifold:** Cast Aluminum
- **Final Assembly:** Oklahoma City, OK USA

Manufactured with US, North American and Global Sourced Content

MIRATECH Emissions Control Equipment Specification Summary

Proposal Number: TJ-12-2475

Engine Data

Number of Engines:	1
Application:	Gas Compression
Engine Manufacturer:	General Motors
Model Number:	Vortec 5.7L NA
Power Output:	92 bhp
Lubrication Oil:	0.6 wt% sulfated ash or less
Type of Fuel:	Natural Gas
Exhaust Flow Rate:	650 acfm (cfm)
Exhaust Temperature:	1,200°F

System Details

Housing Model Number:	VXCI-1005-3.5-HSG
Element Model Number:	VX-RE-05XC
Number of Catalyst Layers:	1
Number of Spare Catalyst Layers:	1
System Pressure Loss:	4.0 inches of WC (Fresh)
Sound Attenuation:	28-32 dBA insertion loss
Exhaust Temperature Limits:	750 – 1250°F (catalyst inlet); 1350°F (catalyst outlet)

NSCR Housing & Catalyst Details

Model Number:	VXCI-1005-3.5-XC1
Material:	Carbon Steel
Inlet Pipe Size & Connection:	3.5 inch FF Flange, 150# ANSI standard bolt pattern
Outlet Pipe Size & Connection:	3.5 inch FF Flange, 150# ANSI standard bolt pattern
Overall Length:	43 inches
Weight Without Catalyst:	98 lbs
Weight Including Catalyst:	104 lbs
Instrumentation Ports:	1 inlet/1 outlet (1/2" NPT)

Emission Requirements

Exhaust Gases	Engine Outputs (g/ bhp-hr)	Reduction (%)	Warranted Converter Outputs (g/ bhp-hr)	Requested Emissions Targets
NOx	14.00	93%	1.00	1 g/bhp-hr
CO	11.00	82%	2.00	2 g/bhp-hr
NMNEHC	0.40	0%	0.70	.7 g/bhp-hr
Oxygen	0.5%			

MIRATECH warrants the performance of the converter, as stated above, per the MIRATECH General Terms and Conditions of Sale.

1. INTRODUCTION

This report documents the certification test procedure and results for the 644 engine. The 644 is required to comply with the emissions standards defined in 1048.101 for natural gas (NG) and LPG constant-speed mobile applications and LPG stationary applications. ZPP is voluntarily certifying the 644 per 60.4231(d) for stationary NG applications.

Since the rated power of the NG 644 is less than 100 HP, the engine must comply with the emissions standard specified in 60.4243(c), which references 40 CFR part 1048. ZPP has elected to certify both the NG and LPG versions of the 644 to 2.1 g/kW-hr HC+NOx, 6.0 g/kW-hr CO point on the sliding scale specified in 1048.101(a)(3).

2. UNIT UNDER TEST

The 644 engine is equipped with a 3-way catalyst, air valve carburetor, and a closed-loop A/F control system with pre-cat and post-cat oxygen sensors. The 644 engine configuration is summarized in Table 1 on the following page. Figure 1 is a picture of the test engine and catalyst.

The engine was tested for three fuel system configurations:

- Natural gas (NG) mono-fuel
- LPG mono-fuel
- NG/LPG dual-fuel

The S/N of the certification test engine is 0700006. The S/N of the certification test catalyst is 002.

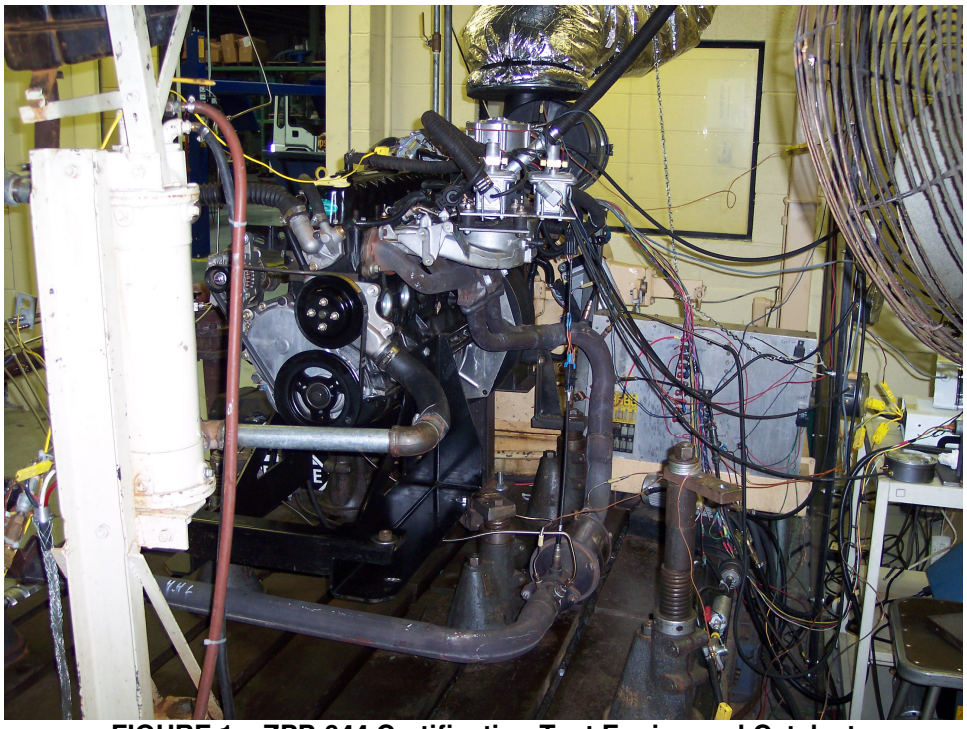


FIGURE 1 – ZPP-644 Certification Test Engine and Catalyst

TABLE 1 – ZPP-644 Engine Specifications

Spec	Units	644		
		Nat Gas	**LPG**	**NG/LPG**
Engine Family code		AZPPB04.4STA		
Base Engine P/N		P644NE	P644LE	P644BF
# of Cylinders		6 In-Line		
Nominal Displacement	L	4.4		
Air Induction		Naturally Aspirated		
Rated Power	HP (kW)	98 (73)	108 (81)	108 (81)
Rated Torque	ft-lbs (N*m)	171 (232)	189 (257)	189 (257)
Rated Speed	RPM	3000		
Torque @ 1800 rpm	ft-lbs (N*m)	191 (259)	218 (296)	218 (296)
Compression Ratio		9.7 : 1		
Valve Configuration		Overhead Valves		
Valve Lifters		Hydraulic		
Firing Order		1-5-3-6-2-4		
Bore x Stroke	mm	98.4 x 91.0		
Cylinder Displacement	cc	692.3		
Total Displacement	cc	4416		
Block Material		Cast Iron		
Head Material		Cast Iron		
Length x Width x Height	mm	1054 x 586 x 810		
Dry Weight	Kg	193		
Catalyst Location		Remote Mount		
Oil Capacity	L	5.7		
Catalyst		3-way ZPP-C674-21		
Fuel Types		Pipeline-quality natural gas Commercial-grade LPG		
Fuel System		Air Valve Carburetor		
Applications		Generator sets, compressors, pumps, etc.		
Speed Operation		Constant Speed		

3. LABORATORY EQUIPMENT

The certification engine test was conducted in ZPP's engine lab. The engine was run on a 400 HP GE 16492 eddy-current dynamometer.

The emissions analyzer used was a SEMTECH-DS. When properly calibrated per Table 1 of 1065.303, the SEMTECH-DS is 1065-compliant for constant-speed certification testing. The SEMTECH-DS uses a raw gas sampling system and a heated sample line.

Emissions mass flow was determined by measuring emissions concentrations and mass fuel flow. Engine speed and torque were measured to determine engine work per 1065 Subparts B-D.

The following is a list of measurement subsystems included in the SEMTECH-DS emission analyzer.

- Heated Flame Ionization Detector (FID) for total hydrocarbon (THC) measurement.
- Non-Dispersive Ultraviolet (NDUV) analyzer for nitric oxide (NO) and nitrogen dioxide (NO2) measurement.
- Non-Dispersive Infrared (NDIR) analyzer for carbon monoxide (CO) and carbon dioxide (CO2) measurement.
- Electrochemical sensor for oxygen (O2) measurement.

Methane and total hydrocarbons were measured with a JUM-109A NMHC analyzer.

The natural gas fuel used for testing was pipeline-quality natural gas which met the requirements for natural gas composition in 40 CFR 1065.715. Composition analyses for the natural gas are included in Appendix 2.

The LPG was commercial-grade LPG per 1065-720(b). A copy of the sales invoice is included in the Appendix 2. The supplier stated that the LPG complies with the HD-5 specification.

LPG fuel flow was measured with a scale and stopwatch. NG fuel flow was measured with an Eldridge mass fuel flow meter.

The key pieces of laboratory equipment that were used to test the 644 engine are listed in Table 2.

TABLE 2 – Certification Engine Test Equipment List

Item	Manufacturer & P/N	S/N
Eddy-Current Dynamometer	GE 16492 400 HP	8245668
Torque transducer	Lebow Load Cell	100541A
5-gas raw gas emissions analyzer	SEMTECH-DS	J06-SDS05
Nonmethane cutter	JUM 109A NMHC Analyzer	205389
Scale for measuring LPG fuel weight	Avery Weigh-Tronix scale P/N E1010	051240314
Natural gas mass flow meter	Eldridge Natural gas flowmeter 8089MPNH-SSS-133-AC115	20082003
Weather station	SEMTECH-DS Weather Station	D1440015

4. TEST PROCEDURE

Testing procedures and emissions calculations follow the guidelines set in 40 CFR 1065.

The following test cycles were used:

- For NG stationary, ISO D1 test cycles per 60.4241 were required.
- For NG constant-speed mobile, ISO D2 test cycles per 1048.505(b)(2) were required.
- For LPG stationary and constant-speed mobile, ISO D2 test cycles per 60.4240 and 1048.505(b)(2) were required.

Test speeds for both fuels/cycles were 3000 rpm (rated speed) and 1800 rpm.

For natural gas, the methane and total hydrocarbons were measured with a JUM 109A NMHC analyzer. The non-methane hydrocarbons were then calculated per 1065.660.

The test engine and catalyst were the same 644 engine and catalyst that were used for mobile certification testing in 2008. At the beginning of the stationary emissions testing, the 644 had accumulated 57 operating hours.

To comply with the 1065.550 drift requirements, each emissions analyzer channel was zeroed and spanned at the beginning and end of each modal test. In addition, each emissions analyzer channel was zeroed between each mode.

Figures 3 and 4 below are the LPG and NG torque & power curves that were obtained from the 644 certification test engine.

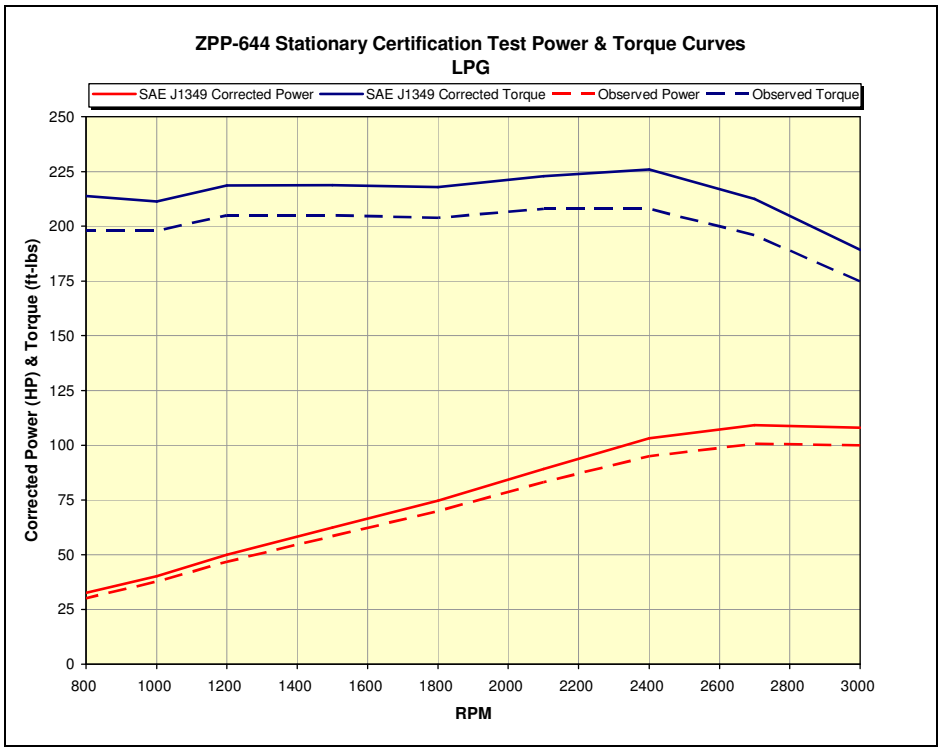


FIGURE 3 – ZPP-644 Stationary Certification Test Engine LPG Power & Torque Curves

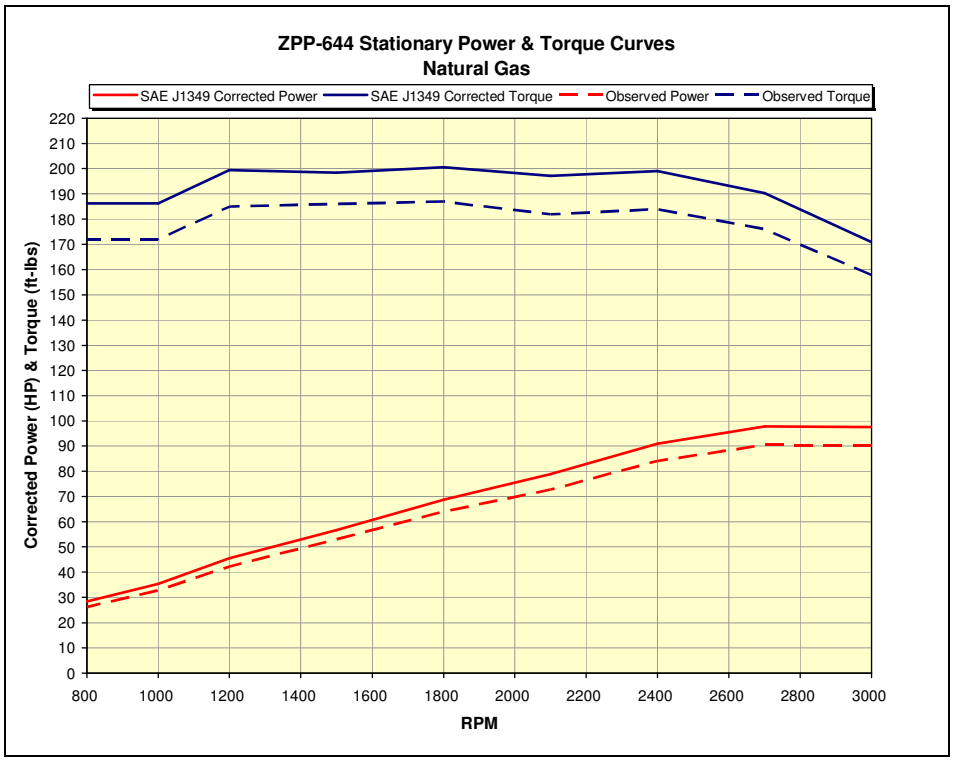


FIGURE 4 – ZPP-644 Stationary Certification Test Engine Natural Gas Power & Torque Curves

5. TEST RESULTS

The ZPP-644's stationary and constant-speed mobile certification test results are summarized in Figure 5 and Table 3. All of the test results complied with the emissions standards with a factor of 2 safety margin or better.

Individual test result summaries are contained in the Appendix 1.

At the end of the stationary and constant-speed mobile certification testing, the 644 test engine had accumulated a total of 110 operating hours. As noted in the "Test Procedure" section, the engine had previously accumulated 57 hours from the gasoline and LPG mobile certification testing in 2008.

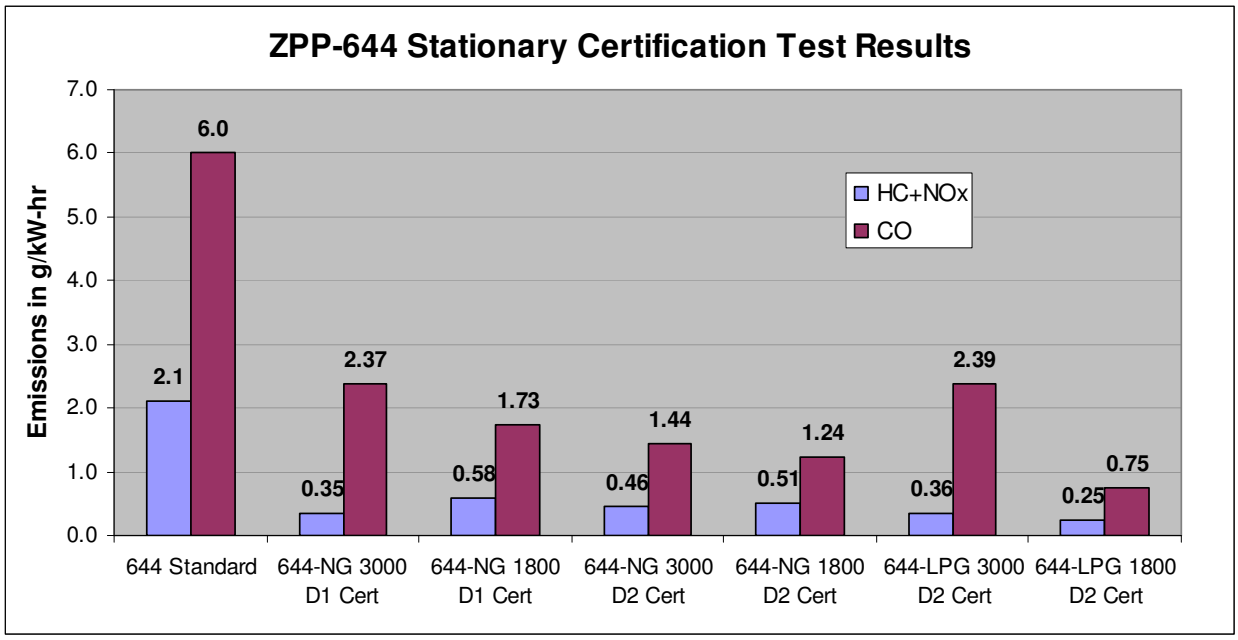


FIGURE 5 – ZPP-644 Stationary and Constant-Speed Mobile Certification Test Results

Test	Emissions in g/kW-hr				
	THC	NMHC	NOx	HC+NOx	CO
644 Standard				2.1	6.0
644-NG 3000 D1 Cert	0.44	0.00	0.35	0.35	2.37
644-NG 1800 D1 Cert	0.51	0.00	0.58	0.58	1.73
644-NG 3000 D2 Cert	0.43	0.00	0.46	0.46	1.44
644-NG 1800 D2 Cert	0.54	0.00	0.51	0.51	1.24
644-LPG 3000 D2 Cert	0.10	NA	0.26	0.36	2.39
644-LPG 1800 D2 Cert	0.09	NA	0.16	0.25	0.75

TABLE 3 – ZPP-644 Stationary and Constant-Speed Mobile Certification Test Results

As evidence that the ZPP-644 engine complies with the 1048.101(c) field test requirement, the brake-specific emissions in each certification test mode were calculated. The modal brake-specific emissions are listed with each test sheet in Appendix 1. All of the modal brake-specific emissions values were less than 13% of the field testing standard (HC+NOx < 3.8 g/kW-hr, CO < 6.5 g/kW-hr).

The emissions test results were drift-checked per 1065.550 and drift-corrected per 1065.672. The results are recorded on the test data sheets in the Appendix 1. All drift values were less than 20% of the +/-4% limit.

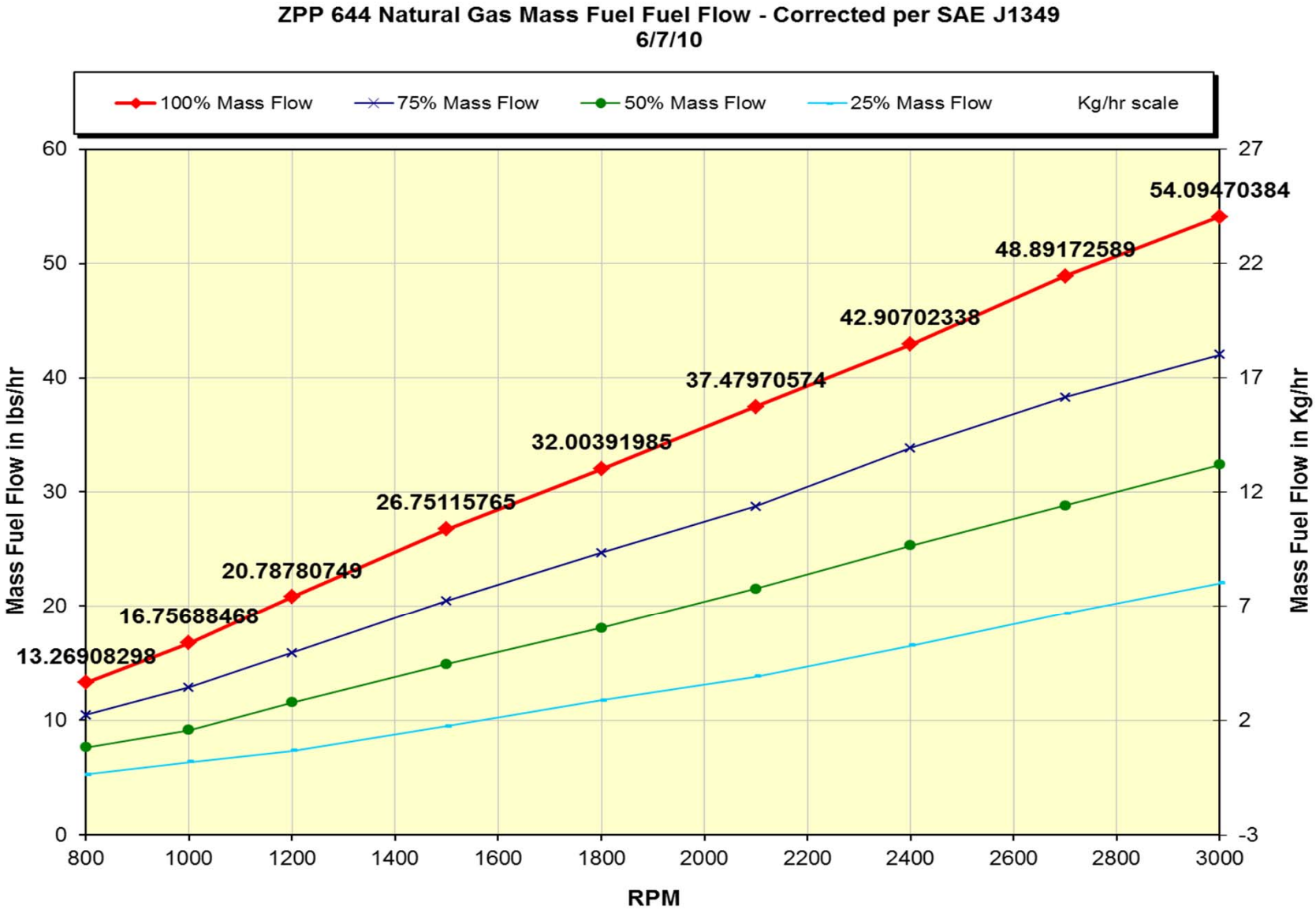
6. SUMMARY

The ZPP-644 certification test results demonstrate that the ZPP-644 engine is fully capable of meeting the stationary emissions standards defined in CFR 40, Part 60, Subpart JJJJ and the constant-speed mobile emission standards defined in CFR 40, Part 1048 for both natural gas and LPG fuels.

HY-BON/EDI VRU Packages w/ HP Ratings

Compressor	Engine	Max HP Natural Gas	EPA Certified
Blackmer 372	Kubota 3 Cylinder	24 HP @ 3600 RPM	Yes
Blackmer 612	Zenith 2.8 L 4 Cylinder	54 HP @ 2200 RPM	Yes
Blackmer 942	Zenith 4.4 L 6 Cylinder	77 HP @ 2200 RPM	Yes
Blackmer 362	Kubota 3 Cylinder	24 HP @ 3600 RPM	Yes
Blackmer 602	Zenith 4.4 L 6 Cylinder	77 HP @ 2200 RPM	Yes
Blackmer 162	Kubota 3 Cylinder	24 HP @ 3600 RPM	Yes
NK-60 (Rotocomp)	Kubota 3 Cylinder	24 HP @ 3600 RPM	Yes
NK-100 (Rotocomp)	Zenith 4.4 L 6 Cylinder	77 HP @ 2200 RPM	Yes

** See fuel rates in tabs below for desired Engines **


ZPP 644 Natural Gas Mass Fuel Fuel Flow - Corrected per SAE J1349
6/7/10
100% Mass Flow
75% Mass Flow
50% Mass Flow
25% Mass Flow
Kg/hr scale
Mass Fuel Flow in lbs/hr
Mass Fuel Flow in Kg/hr
RPM
0
10
20
30
40
50
60
-3
2
7
12
17
22
27
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
13.26908298
16.75688468
20.78780749
26.75115765
32.00391985
37.47970574
42.90702338
48.89172589
54.09470384

Retrograde Gas PVT Fluid Study
for
Chesapeake Energy Corporation
Berisford No. 1-H
Victory Field
Wetzel County, West Virginia

FESCO, Ltd.

Petroleum Engineers

Table of Contents

May 3, 2011

Mr. Brad Claypool
Chesapeake Energy Corporation
P. O. Box 18496
Oklahoma City, Oklahoma 73154

Re:	Well:	Berisford No. 1-H
	Field:	Victory
	Location:	Wetzel County, West Virginia
	Formation:	Marcellus
	Perforations:	Horizontal Completion; Datum - Unavailable
	Test Type:	Retrograde Gas PVT Fluid Study

Dear Mr. Claypool:

The attached report contains results from a laboratory study performed on the recombined separator fluids from the subject well. The study determined the type and character of the reservoir fluid. The fluid study was performed using first-stage separator gas and oil samples obtained from the well on February 25, 2011 by FESCO, Ltd. FESCO then delivered the separator samples to its PVT laboratory in Alice, Texas. Extended compositional analyses were performed on the separator gas (C_{11+}) and on the separator oil (C_{31+}) samples. Tables 1-A through 1-C list the compositional analyses of the separator gas, separator oil and mathematically recombined wellstream fluid through C_{7+}, C_{11+} and C_{31+}, respectively. Table 2 reports the fluid properties measured as the separator oil was flashed from separator conditions to ambient laboratory conditions.

The separator gas and oil were physically recombined in a visual PVT cell at the reservoir temperature of 150 °F and at the reported gas-oil ratio of 63943 Scf/Sep Bbl (83688 Scf/STB). The recombined fluid was evaluated during a Constant Composition Expansion (CCE) process at pressures ranging from 7500 to 960 psig. The resulting CCE data is reported in Table 3. ***A retrograde dew point was observed at 2408 psig.*** The static reservoir pressure is higher than the observed retrograde dew point pressure. Therefore, the reservoir fluid exists as undersaturated (single-phase) gas at static reservoir conditions of 4430 psig and 150 °F. Figures 1 through 7 illustrate the data reported in Table 3.

Chesapeake Energy Corporation
Berisford No. 1-H
May 3, 2011

A Constant Volume Depletion (CVD) study was performed on the reservoir fluid to model wellstream production below the dew point. A CVD study consists of a series of expansions and constant pressure displacements terminating at the original saturated reservoir (dew point) volume. Table 4 provides the displaced wellstream volume and compositional analysis measured at each depletion pressure. Figures 8 and 10 illustrate the gas deviation factors (equilibrium gas and 2-phase) and cumulative produced wellstream volume, respectively, versus pressure as reported in Table 4. Figure 9 shows the corresponding P/Z (equilibrium gas and 2-phase) versus cumulative produced wellstream percent. Figure 11 presents the C_{3+}, C_{4+} and C_{5+} GPM content of the wellstream gas at each depletion pressure.

The cumulative stock tank oil and sales gas recoveries using normal-temperature single-stage separation were calculated from the produced wellstream volumes and their corresponding compositions. The plant liquid products produced during the single-stage separation were also calculated. The total plant products in the wellstream were then determined. The results are shown in Table 5. All recoveries are based on one MMscf of original reservoir fluid at the retrograde dew point and 100 percent plant efficiency.

Table 6 contains the cumulative retrograde liquid volume that condensed during the CVD process at reservoir temperature (150 °F). The maximum observed volume of condensed retrograde liquid was 0.672 percent of the hydrocarbon pore space at 1500 psig. Figures 12 and 13 illustrate the condensed retrograde liquid volume reported in Table 6 versus pressure.

Thank you for this opportunity to serve Chesapeake Energy Corporation. Please call me if you have any questions or concerns regarding this report.

Sincerely,

FESCO, Ltd.

Armando Ramirez
Natural Gas Engineer
Alice, Texas
Phone: 361-661-7015
Email:Armando.Ramirez@FescoInc.com

Eddie Bickham, P. E.
Vice - President
Alice, Texas
Phone: 361-661-7000 Ext. 115
Email: Ed.Bickham@FescoInc.com

FESCO, Ltd.

Petroleum Engineers

WELL SUMMARY

WELL INFORMATION

Company:	Chesapeake Energy Corporation
Well Name:	Berisford No. 1-H
Field:	Victory
Location:	Wetzel County, West Virginia

RESERVOIR INFORMATION

Formation:	Marcellus
Perforations:	Horizontal Completion
Reservoir Datum:	Unavailable
Reservoir Temperature:	150 °F
Static Reservoir Pressure:	4430 psig
Flowing Reservoir Pressure:	Unavailable

SAMPLE INFORMATION

Sampling Date:	2/25/2011
Sampled By:	FESCO, Ltd. - Shinnston, WV
Sample Type:	1st-Stage Separator Gas and Oil
Flowing Tubing Pressure:	1850 psig
1st Stage Separator Pressure:	415 psig
1st Stage Separator Temperature:	94 °F
2nd Stage Separator Pressure:	Not Present
2nd Stage Separator Temperature:	Not Present

PRODUCTION INFORMATION

Test Date:	2/25/2011
1st Stage Separator Gas Rate:	2678 Mcf/d
Stock Tank Oil Rate:	32.00 STB/d
Water Rate:	0.00 STB/d
Stock Tank Gas-Oil Ratio:	83688 Scf 1st Stage Gas / STB
Separator Gas-Oil Ratio:	63943 Scf 1st Stage Gas / Sep Bbl
Separator Oil Volume Factor:	1.30878 Sep Oil Vol / STO Vol

FESCO, Ltd.
Petroleum Engineers

RESULTS SUMMARY

Company:	Chesapeake Energy Corporation
Well:	Berisford No. 1-H
Type of Test:	Retrograde Gas PVT Fluid Study
Reservoir Fluid Type:	Undersaturated Gas
Saturation Conditions:	
Pressure (Retrograde Dew Point):	2408 psig
Temperature:	150 °F
Gas Deviation Factor (Z):	0.79039
Gas Expansion Factor:	0.97845 Mscf/Bbl
Reservoir Conditions:	
Pressure:	4430 psig
Temperature:	150 °F
Gas Deviation Factor (Z):	0.92167
Gas Expansion Factor:	1.54365 Mscf/Bbl
Report Date:	5/3/2011

SAMPLE SUMMARY

Company:	Chesapeake Energy Corporation
Well:	Berisford No. 1-H
Sample Date:	02/25/11

Separator Conditions

Pressure:	415 psig
Temperature:	94 °F

Laboratory Quality Test

Separator Gas:	Pressure	Temperature
Cylinder ID No. G-3390*	382 psig	68 °F
Cylinder ID No. G-2184	271 psig	68 °F

Separator Liquid:	BP Pressure	Temperature
Cylinder ID No. T-657*	338 psig	68 °F
Cylinder ID No. T-547	312 psig	68 °F

Report Date: 5/3/2011

* Samples used in fluid study

TABLE 1-A

COMPOSITIONAL ANALYSIS OF THE SEPARATOR GAS, OIL AND MATHEMATICALLY RECOMBINED WELLSTREAM THROUGH C_{7+}

SEPARATOR GOR.....: 63943 Scf/Sep Bbl
SEPARATOR PRESSURE.....: 415 psig
SEPARATOR TEMPERATURE.....: 94 °F

	SEPARATOR GAS		SEPARATOR OIL		WELLSTREAM	
Component	Mole%	* GPM	Mole %	Liquid Volume %	Mole %	* GPM
Hydrogen Sulfide	0.000	0.000	0.000	0.000	0.000	0.000
Nitrogen	0.433	0.000	0.073	0.021	0.427	0.000
Carbon Dioxide	0.180	0.000	0.043	0.019	0.178	0.000
Methane	77.380	0.000	10.266	4.552	76.241	0.000
Ethane	14.005	3.776	9.016	6.309	13.920	3.753
Propane	4.820	1.337	9.073	6.532	4.892	1.357
Iso-butane	0.622	0.205	2.569	2.198	0.655	0.216
N-butane	1.329	0.422	7.310	6.026	1.431	0.454
2-2 Dimethylpropane	0.018	0.007	0.085	0.085	0.019	0.007
Iso-pentane	0.350	0.129	4.143	3.966	0.414	0.153
N-pentane	0.366	0.134	5.507	5.219	0.453	0.166
2-2 Dimethylbutane	0.012	0.005	0.244	0.267	0.016	0.007
Cyclopentane	0.002	0.001	0.000	0.000	0.002	0.001
2-3 Dimethylbutane	0.014	0.006	0.493	0.529	0.022	0.009
2 Methylpentane	0.091	0.038	2.801	3.041	0.137	0.057
3 Methylpentane	0.054	0.022	1.916	2.046	0.086	0.035
Other Hexanes	0.000	0.000	0.000	0.000	0.000	0.000
n-Hexane	0.121	0.050	5.107	5.494	0.206	0.085
Heptanes Plus	0.203	0.091	41.354	53.698	0.901	0.440
TOTAL	100.000	6.223	100.000	100.000	100.000	6.741

HEPTANES PLUS (C_{7+}) FRACTION CHARACTERISTICS

	Specific Gravity		Molecular Weight	Vapor Volume	Gross Heating Value
COMPONENT	°API	**	lb/lb-mole	Scf/Gal	***
Gas	N/A	3.5037	101.477	22.376	5,433
Oil	56.898	0.7511	117.667	19.985	125,978
Wellstream	N/A	0.7458	114.083	20.469	N/A

TOTAL SAMPLE CHARACTERISTICS

	Specific Gravity		Molecular Weight	Vapor Volume	Gross Heating Value	
					Dry	Saturated
COMPONENT	°API	**	lb/lb-mole	Scf/Gal	***	***
Gas	N/A	0.7304	21.074	160.700	1,287	1,266
Oil	84.807	0.6542	78.925	25.951	N/A	112,067
Wellstream	N/A	0.7615	22.056	50.390	N/A	N/A

* GPM (gallons per Mscf) determined at 14.85 psia and 60 °F

** Gas specific gravity and wellstream specific gravity determined relative to air (SG=1.000).
Oil specific gravity determined relative to water (SG=1.000).

*** Gross Heating Value units for gas (real basis) and oil are BTU/Scf and BTU/Gal, respectively.

TABLE 1-B

COMPOSITIONAL ANALYSIS OF THE SEPARATOR GAS, OIL AND MATHEMATICALLY RECOMBINED WELLSTREAM THROUGH C_{11+}

SEPARATOR GOR.....: 63943 Scf/Sep Bbl
SEPARATOR PRESSURE.....: 415 psig
SEPARATOR TEMPERATURE.....: 94 °F

	SEPARATOR GAS		SEPARATOR OIL		WELLSTREAM	
Component	Mole%	* GPM	Mole %	Liquid Volume %	Mole %	* GPM
Hydrogen Sulfide	0.000	0.000	0.000	0.000	0.000	0.000
Nitrogen	0.433	0.000	0.073	0.021	0.427	0.000
Carbon Dioxide	0.180	0.000	0.043	0.019	0.178	0.000
Methane	77.380	0.000	10.266	4.552	76.241	0.000
Ethane	14.005	3.776	9.016	6.309	13.920	3.753
Propane	4.820	1.337	9.073	6.532	4.892	1.357
Iso-butane	0.622	0.205	2.569	2.198	0.655	0.216
N-butane	1.329	0.422	7.310	6.026	1.431	0.454
2-2 Dimethylpropane	0.018	0.007	0.085	0.085	0.019	0.007
Iso-pentane	0.350	0.129	4.143	3.966	0.414	0.153
N-pentane	0.366	0.134	5.507	5.219	0.453	0.166
2-2 Dimethylbutane	0.012	0.005	0.244	0.267	0.016	0.007
Cyclopentane	0.002	0.001	0.000	0.000	0.002	0.001
2-3 Dimethylbutane	0.014	0.006	0.493	0.529	0.022	0.009
2 Methylpentane	0.091	0.038	2.801	3.041	0.137	0.057
3 Methylpentane	0.054	0.022	1.916	2.046	0.086	0.035
Other Hexanes	0.000	0.000	0.000	0.000	0.000	0.000
n-Hexane	0.121	0.050	5.107	5.494	0.206	0.085
Methylcyclopentane	0.009	0.003	0.457	0.423	0.017	0.006
Benzene	0.002	0.001	0.088	0.065	0.003	0.001
Cyclohexane	0.012	0.004	0.763	0.679	0.025	0.008
2-Methylhexane	0.024	0.011	2.276	2.768	0.062	0.029
3-Methylhexane	0.024	0.011	2.356	2.829	0.064	0.029
2,2,4 Trimethylpentane	0.000	0.000	0.000	0.000	0.000	0.000
Other Heptanes	0.024	0.011	1.904	2.169	0.056	0.025
n-Heptane	0.034	0.016	4.255	5.135	0.106	0.049
Methylcyclohexane	0.020	0.008	2.539	2.670	0.063	0.025
Toluene	0.003	0.001	0.542	0.475	0.012	0.004
Other C-8's	0.031	0.015	7.178	8.802	0.152	0.072
n-Octane	0.008	0.004	2.750	3.684	0.055	0.028
Ethylbenzene	0.000	0.000	0.448	0.453	0.008	0.003
M&P-Xylene	0.002	0.001	0.585	0.594	0.012	0.005
O-Xylene	0.000	0.000	0.832	0.828	0.014	0.005
Other C-9's	0.007	0.004	3.645	4.992	0.069	0.036
n-Nonane	0.001	0.001	1.461	2.152	0.026	0.015
Other C10's	0.001	0.001	3.247	4.888	0.056	0.033
n-Decane	0.001	0.001	0.810	1.301	0.015	0.009
Undecanes Plus	0.000	0.000	5.216	8.794	0.089	0.058
TOTAL	100.000	6.223	100.000	100.000	100.000	6.741

TABLE 1-B

COMPOSITIONAL ANALYSIS OF THE SEPARATOR GAS, OIL AND MATHEMATICALLY RECOMBINED WELLSTREAM THROUGH C_{11+}

SEPARATOR GOR.....: 63943 Scf/Sep Bbl
SEPARATOR PRESSURE.....: 415 psig
SEPARATOR TEMPERATURE.....: 94 °F

UNDECANES PLUS (C_{11+}) FRACTION CHARACTERISTICS					
	Specific Gravity		Molecular Weight	Vapor Volume	Gross Heating Value
COMPONENT	°API	**	lb/lb-mole	Scf/Gal	***
Gas	N/A	0.8250	156.000	16.558	8,400
Oil	44.561	0.8037	163.500	15.391	128,193
Wellstream	N/A	0.8037	163.500	15.391	N/A

TOTAL SAMPLE CHARACTERISTICS						
	Specific Gravity		Molecular Weight	Vapor Volume	Gross Heating Value	
					Dry	Saturated
COMPONENT	°API	**	lb/lb-mole	Scf/Gal	***	***
Gas	N/A	0.7304	21.074	160.700	1,287	1,266
Oil	84.807	0.6542	78.925	25.951	N/A	112,067
Wellstream	N/A	0.7615	22.056	50.390	N/A	N/A

* GPM (gallons per Mscf) determined at 14.85 psia and 60 °F

** Gas specific gravity and wellstream specific gravity determined relative to air (SG=1.000).
Oil specific gravity determined relative to water (SG=1.000).

*** Gross Heating Value units for gas (real basis) and oil are BTU/Scf and BTU/Gal, respectively.

TABLE 1-C

COMPOSITIONAL ANALYSIS OF THE SEPARATOR GAS, OIL AND MATHEMATICALLY RECOMBINED WELLSTREAM THROUGH C_{31+}

SEPARATOR GOR.....: 63943 Scf/Sep Bbl
SEPARATOR PRESSURE.....: 415 psig
SEPARATOR TEMPERATURE.....: 94 °F

	SEPARATOR GAS		SEPARATOR OIL		WELLSTREAM	
Component	Mole%	* GPM	Mole %	Liquid Volume %	Mole %	* GPM
Hydrogen Sulfide	0.000	0.000	0.000	0.000	0.000	0.000
Nitrogen	0.433	0.000	0.073	0.021	0.427	0.000
Carbon Dioxide	0.180	0.000	0.043	0.019	0.178	0.000
Methane	77.380	0.000	10.266	4.552	76.241	0.000
Ethane	14.005	3.776	9.016	6.308	13.920	3.753
Propane	4.820	1.337	9.073	6.531	4.892	1.357
Iso-butane	0.622	0.205	2.569	2.198	0.655	0.216
N-butane	1.329	0.422	7.310	6.026	1.431	0.454
2-2 Dimethylpropane	0.018	0.007	0.085	0.085	0.019	0.007
Iso-pentane	0.350	0.129	4.143	3.966	0.414	0.153
N-pentane	0.366	0.134	5.507	5.219	0.453	0.166
2-2 Dimethylbutane	0.012	0.005	0.244	0.267	0.016	0.007
Cyclopentane	0.002	0.001	0.000	0.000	0.002	0.001
2-3 Dimethylbutane	0.014	0.006	0.493	0.529	0.022	0.009
2 Methylpentane	0.091	0.038	2.801	3.041	0.137	0.057
3 Methylpentane	0.054	0.022	1.916	2.046	0.086	0.035
Other Hexanes	0.000	0.000	0.000	0.000	0.000	0.000
n-Hexane	0.121	0.050	5.107	5.493	0.206	0.085
Methylcyclopentane	0.009	0.003	0.457	0.423	0.017	0.006
Benzene	0.002	0.001	0.088	0.065	0.003	0.001
Cyclohexane	0.012	0.004	0.763	0.679	0.025	0.008
2-Methylhexane	0.024	0.011	2.276	2.768	0.062	0.029
3-Methylhexane	0.024	0.011	2.356	2.828	0.064	0.029
2,2,4 Trimethylpentane	0.000	0.000	0.000	0.000	0.000	0.000
Other Heptanes	0.024	0.011	1.904	2.168	0.056	0.025
n-Heptane	0.034	0.016	4.255	5.135	0.106	0.049
Methylcyclohexane	0.020	0.008	2.539	2.670	0.063	0.025
Toluene	0.003	0.001	0.542	0.475	0.012	0.004
Other C-8's	0.031	0.015	7.178	8.801	0.152	0.072
n-Octane	0.008	0.004	2.750	3.684	0.055	0.028
Ethylbenzene	0.000	0.000	0.448	0.453	0.008	0.003
M&P-Xylene	0.002	0.001	0.585	0.594	0.012	0.005
O-Xylene	0.000	0.000	0.832	0.828	0.014	0.005
Other C-9's	0.007	0.004	3.645	4.991	0.069	0.036
n-Nonane	0.001	0.001	1.461	2.152	0.026	0.015
Other C10's	0.001	0.001	3.247	4.887	0.056	0.033
n-Decane	0.001	0.001	0.810	1.301	0.015	0.009
Undecanes	0.000	0.000	2.371	3.662	0.040	0.024
Dodecanes	0.000	0.000	1.336	2.229	0.023	0.015
Tridecanes	0.000	0.000	0.766	1.371	0.013	0.009

TABLE 1-C

COMPOSITIONAL ANALYSIS OF THE SEPARATOR GAS, OIL AND MATHEMATICALLY RECOMBINED WELLSTREAM THROUGH C_{31+}

SEPARATOR GOR.....: 63943 Scf/Sep Bbl
SEPARATOR PRESSURE.....: 415 psig
SEPARATOR TEMPERATURE.....: 94 °F

	SEPARATOR GAS		SEPARATOR OIL		WELLSTREAM	
Component	Mole%	* GPM	Mole %	Liquid Volume %	Mole %	* GPM
Tetradecanes	0.000	0.000	0.371	0.711	0.006	0.005
Pentadecanes	0.000	0.000	0.165	0.339	0.003	0.002
Hexadecanes	0.000	0.000	0.091	0.199	0.002	0.001
Heptadecanes	0.000	0.000	0.051	0.118	0.001	0.001
Octadecanes	0.000	0.000	0.026	0.065	0.000	0.000
Nonadecanes	0.000	0.000	0.013	0.034	0.000	0.000
Eicosanes	0.000	0.000	0.007	0.018	0.000	0.000
Heneicosanes	0.000	0.000	0.005	0.013	0.000	0.000
Docosanes	0.000	0.000	0.003	0.009	0.000	0.000
Tricosanes	0.000	0.000	0.001	0.004	0.000	0.000
Tetracosanes	0.000	0.000	0.001	0.004	0.000	0.000
Pentacosanes	0.000	0.000	0.001	0.003	0.000	0.000
Hexacosanes	0.000	0.000	0.002	0.006	0.000	0.000
Heptacosanes	0.000	0.000	0.001	0.003	0.000	0.000
Octacosanes	0.000	0.000	0.001	0.003	0.000	0.000
Nonacosanes	0.000	0.000	0.000	0.000	0.000	0.000
Triacontanes	0.000	0.000	0.001	0.002	0.000	0.000
Hentriacontanes Plus	0.000	0.000	0.002	0.009	0.000	0.000
TOTALS	100.000	6.223	100.000	100.000	100.000	6.741

TOTAL SAMPLE CHARACTERISTICS						
	Specific Gravity		Molecular Weight	Vapor Volume	Gross Heating Value	
					Dry	Saturated
COMPONENT	°API	**	lb/lb-mole	Scf/Gal	***	***
Gas	N/A	0.7304	21.074	160.700	1,287	1,266
Oil	84.807	0.6542	78.925	25.951	N/A	112,067
Wellstream	N/A	0.7615	22.056	50.390	N/A	N/A

* GPM (gallons per Mscf) determined at 14.85 psia and 60 °F

** Gas specific gravity and wellstream specific gravity determined relative to air (SG=1.000).
Oil specific gravity determined relative to water (SG=1.000).

*** Gross Heating Value units for gas (real basis) and oil are BTU/Scf and BTU/Gal, respectively.

Chesapeake Energy Corporation
Berisford No. 1-H

HOFFMAN PLOT

EQUILIBRIUM CHECK of SEPARATOR LIQUID and GAS COMPOSITIONAL ANALYSES

Separator Pressure = 415 psig
Separator Temperature = 94 °F

Components	Gas (X) Mole %	Oil (Y) Mole %	Equil. Ratio (K=Y/X)	K*Psep (psiA)	Normal BP (NBP) °R	$T_{NBP}^{-1} - T_{SEP}^{-1}$	Critical Pressure (Pc) psiA	Critical Temperature (Tc) °R	B-Factor	Graph Results	
										B(1/Tb-1/Tsp)	Log(K*Psep)
N2	0.433	0.073	5.934	2550.77	139	0.005373	493	227	548	2.947	3.407
CO2	0.180	0.043	4.230	1818.07	350	0.001048	1071	548	1806	1.892	3.260
C1	77.380	10.266	7.537	3239.92	201	0.003169	668	343	803	2.543	3.511
C2	14.005	9.016	1.553	667.70	332	0.001204	708	550	1408	1.695	2.825
C3	4.820	9.073	0.531	228.36	416	0.000598	616	666	1793	1.072	2.359
IC4	0.622	2.569	0.242	104.08	471	0.000319	529	735	2030	0.647	2.017
NC4	1.329	7.310	0.182	78.15	491	0.000231	551	765	2150	0.497	1.893
IC5	0.368	4.228	0.087	37.41	542	0.000040	490	829	2373	0.095	1.573
NC5	0.366	5.507	0.066	28.57	557	-0.000009	489	845	2474	-0.023	1.456
C6	0.294	10.562	0.028	11.97	615	-0.000181	437	913	2773	-0.502	1.078
C7+	0.203	41.354	0.005	2.11	763	-0.000496	332	1070	3592	-1.781	0.324
Total	100.000	100.000									

(Note: C7+ Critical Properties as C9. The C6 composition includes iso-hexanes.)

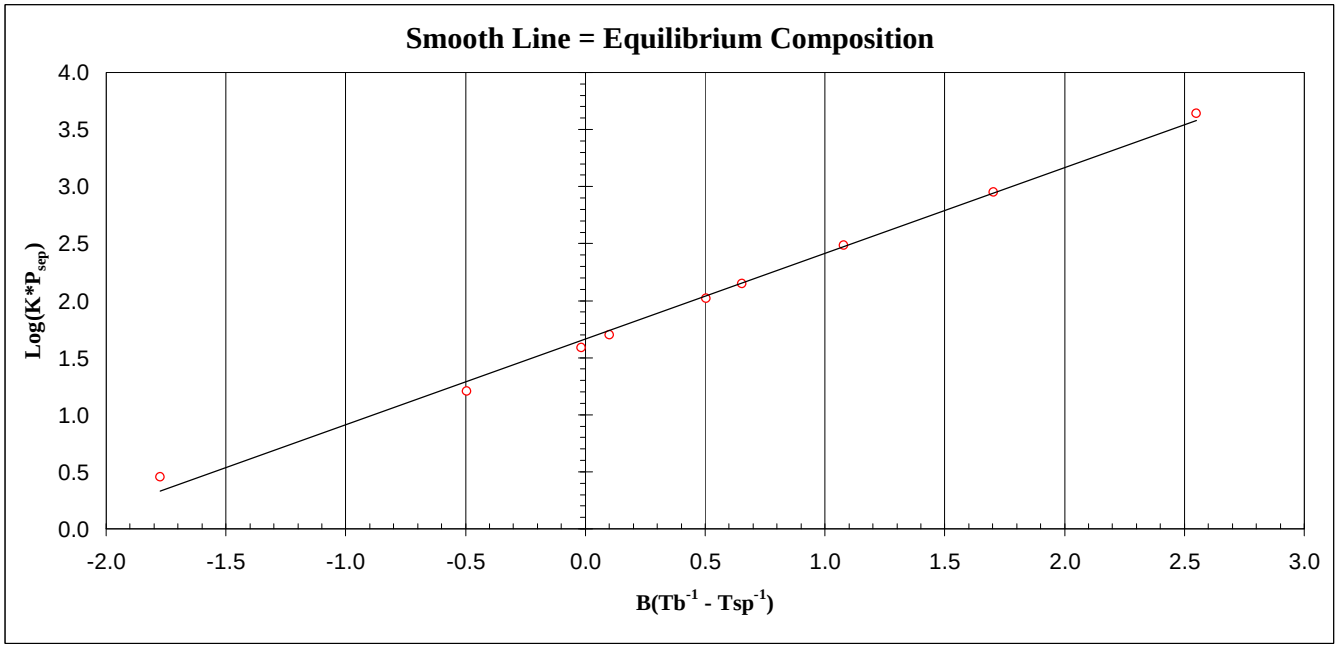


TABLE 2

FLASH LIBERATION OF 1st-STAGE SEPARATOR LIQUID

SEPARATOR CONDITIONS and FLUID PROPERTIES						
Conditions	**Pressure psia**	**Temperature °F**	**GOR (1)**	**Separator Oil Volume Factor (2)**	**Oil Specific Gravity (3)**	**Gas Specific Gravity (4)**
1st Stage Separator	430	94	N/A	1.3088	0.6542	0.7304
Ambient Lab Conditions	14.72	70	486	1.0065	0.7157	1.4993
Stock Tank	14.85	60	0	1.0000	0.7203	1.4993
TOTALS	-----	-----	486		-----	-----

Stock Tank Oil Gravity: 64.95 °API at 60 °F

(1) Gas-Oil Ratio (GOR) is the cubic feet of gas at standard conditions per barrel of stock tank oil.
(2) Barrels of oil at indicated separator conditions per barrel of stock tank oil.
(3) Water = 1.000
(4) Air = 1.000

TABLE 3

PRESSURE-VOLUME RELATION OF A 63943 Scf/Sep Bbl RESERVOIR FLUID AT 150 °F (Constant Composition Expansion)

Pressure, (psig)		Relative Volume	Density, (g/cc)	Y-Function (1)	Retrograde Liquid Volume		Gas Deviation Factor, Z	Gas Expansion Factor, (4)
					% of HC Pore Volume (2)	Bbls / MMscf (3)		
7500		0.50763	0.32724	N/A	N/A	N/A	1.24447	1.93552
7000		0.52007	0.31941	N/A	N/A	N/A	1.19013	1.88897
6000		0.55179	0.30105	N/A	N/A	N/A	1.08271	1.77976
5000		0.59794	0.27782	N/A	N/A	N/A	0.97820	1.64158
4430	Pres	0.63563	0.26134	N/A	N/A	N/A	0.92167	1.54365
4000		0.67334	0.24671	N/A	N/A	N/A	0.88190	1.45668
3500		0.73342	0.22650	N/A	N/A	N/A	0.84095	1.33665
3000		0.82218	0.20204	N/A	N/A	N/A	0.80863	1.19150
2408	Psat	1.00000	0.16612	N/A	0.00%	0.000	0.79039	0.97845
2245		1.07186	N/A	1.00373	0.16%	1.659	N/A	N/A
2174		1.10769	N/A	0.99270	0.23%	2.342	N/A	N/A
2108		1.14396	N/A	0.98168	0.29%	2.968	N/A	N/A
1964		1.23432	N/A	0.95756	0.42%	4.241	N/A	N/A
1841		1.32484	N/A	0.94052	0.53%	5.365	N/A	N/A
1736		1.41553	N/A	0.92367	0.63%	6.361	N/A	N/A
1644		1.50633	N/A	0.90961	0.71%	7.209	N/A	N/A
1562		1.59721	N/A	0.89836	0.76%	7.762	N/A	N/A
1489		1.68819	N/A	0.88797	0.78%	7.965	N/A	N/A
1423		1.77921	N/A	0.87916	0.78%	7.946	N/A	N/A
1362		1.87028	N/A	0.87295	0.78%	7.891	N/A	N/A
1166		2.23497	N/A	0.85167	0.75%	7.578	N/A	N/A
960		2.78275	N/A	0.83318	0.70%	7.117	N/A	N/A

(1) Y - Function = Dimensionless Compressibility = $(P_{sat} - P_i) * [P_i * (RV_i - 1)]^{-1}$

(2) Retrograde liquid volume at the indicated pressure and reservoir temperature as a percent of the hydrocarbon pore volume at the dew point pressure and reservoir temperature.

(3) Retrograde liquid volume at the indicated pressure and reservoir temperature (Bbls) per volume of gas (MMscf) at the dew point pressure and reservoir temperature.

(4) Gas Expansion Factor = the volume of surface gas at standard conditions (Mscf) produced from one barrel of undersaturated gas at the indicated pressure and reservoir temperature.

Relative Volume = volume at indicated pressure per volume at the saturation pressure.

Psat = Saturation (Retrograde Dew Point) pressure at reservoir temperature.

Pres = Current static reservoir pressure.

FIGURE 1
Relative Volume vs Pressure

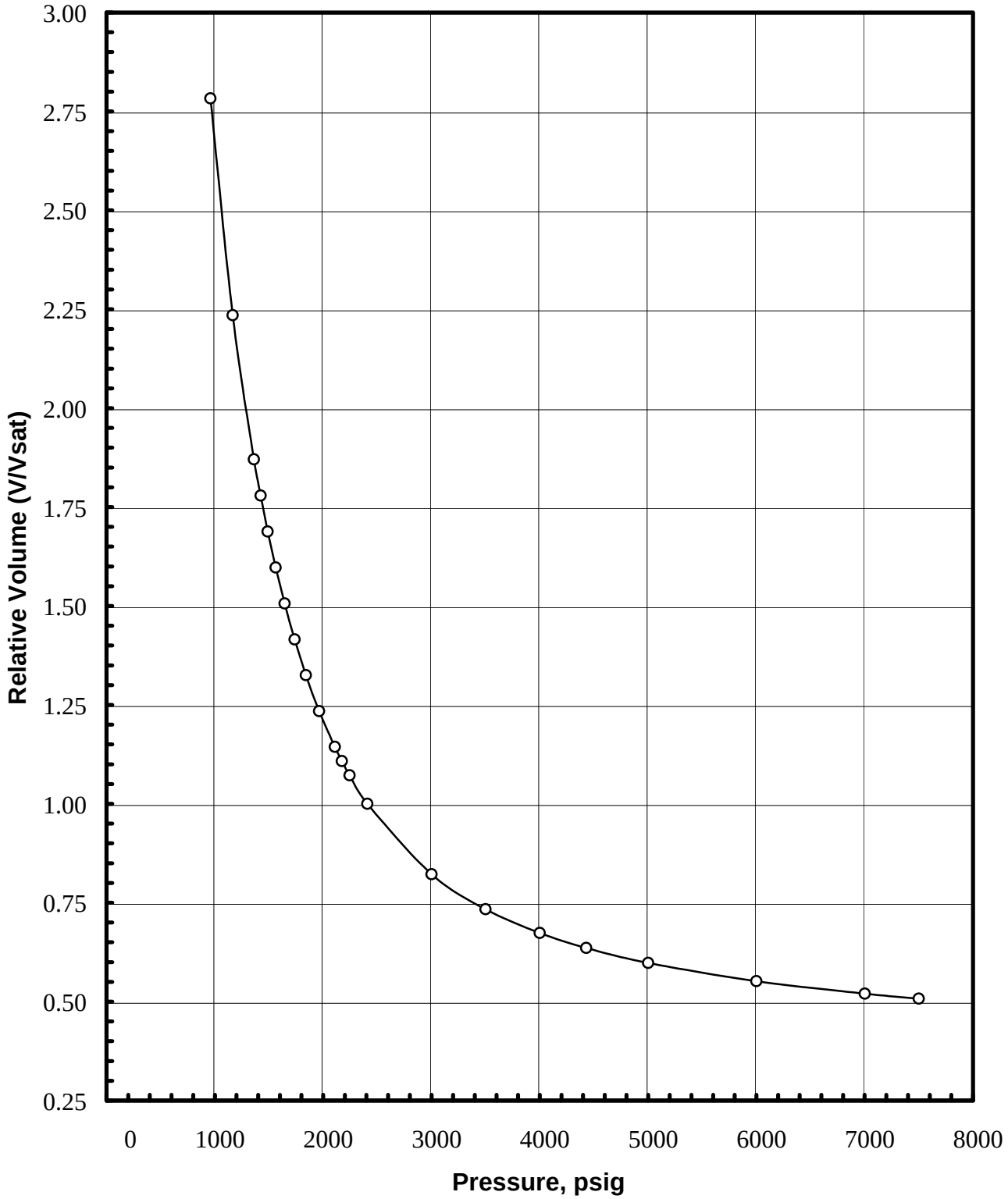


FIGURE 2
Density vs Pressure

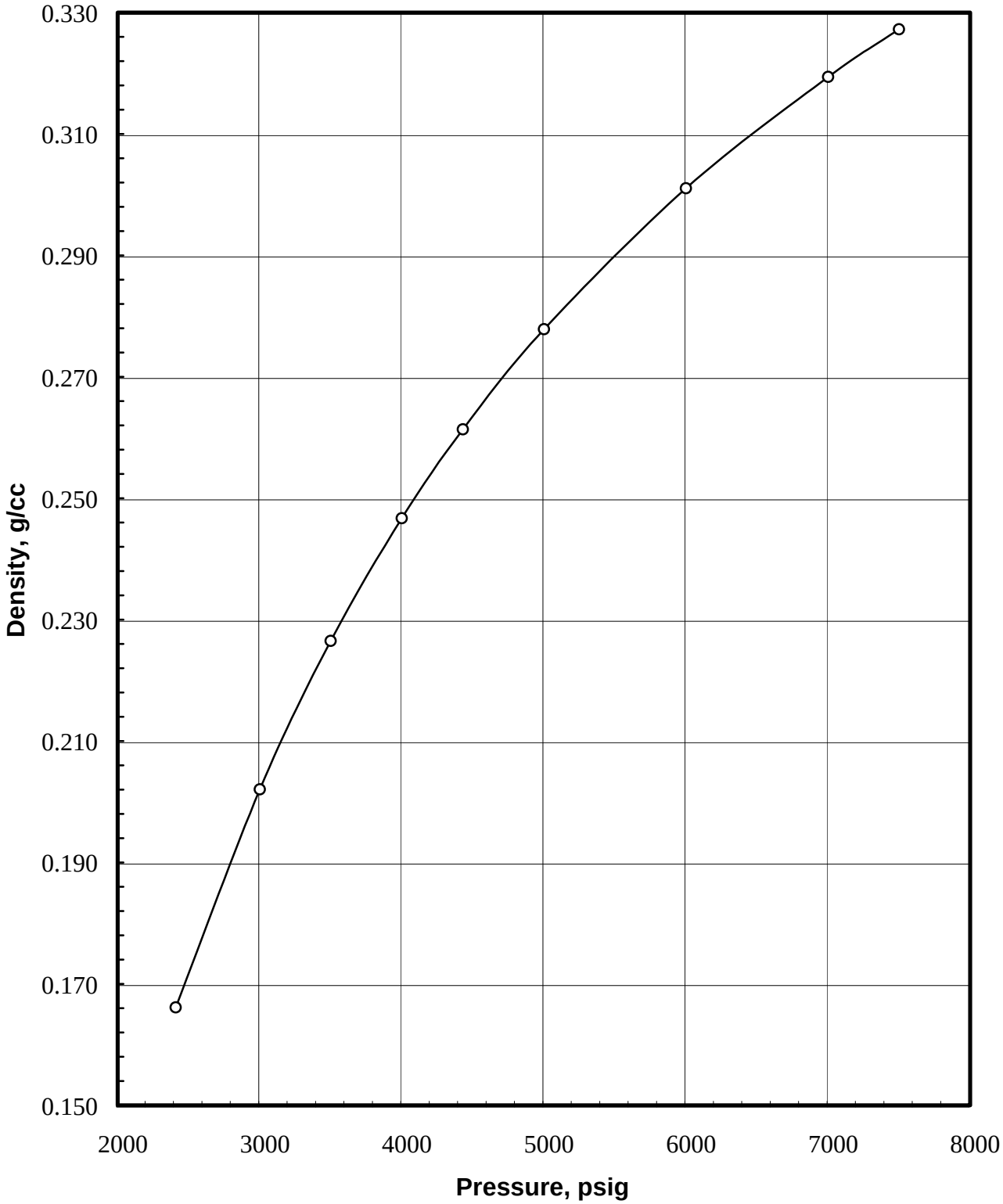


FIGURE 3
Y-Function vs Pressure

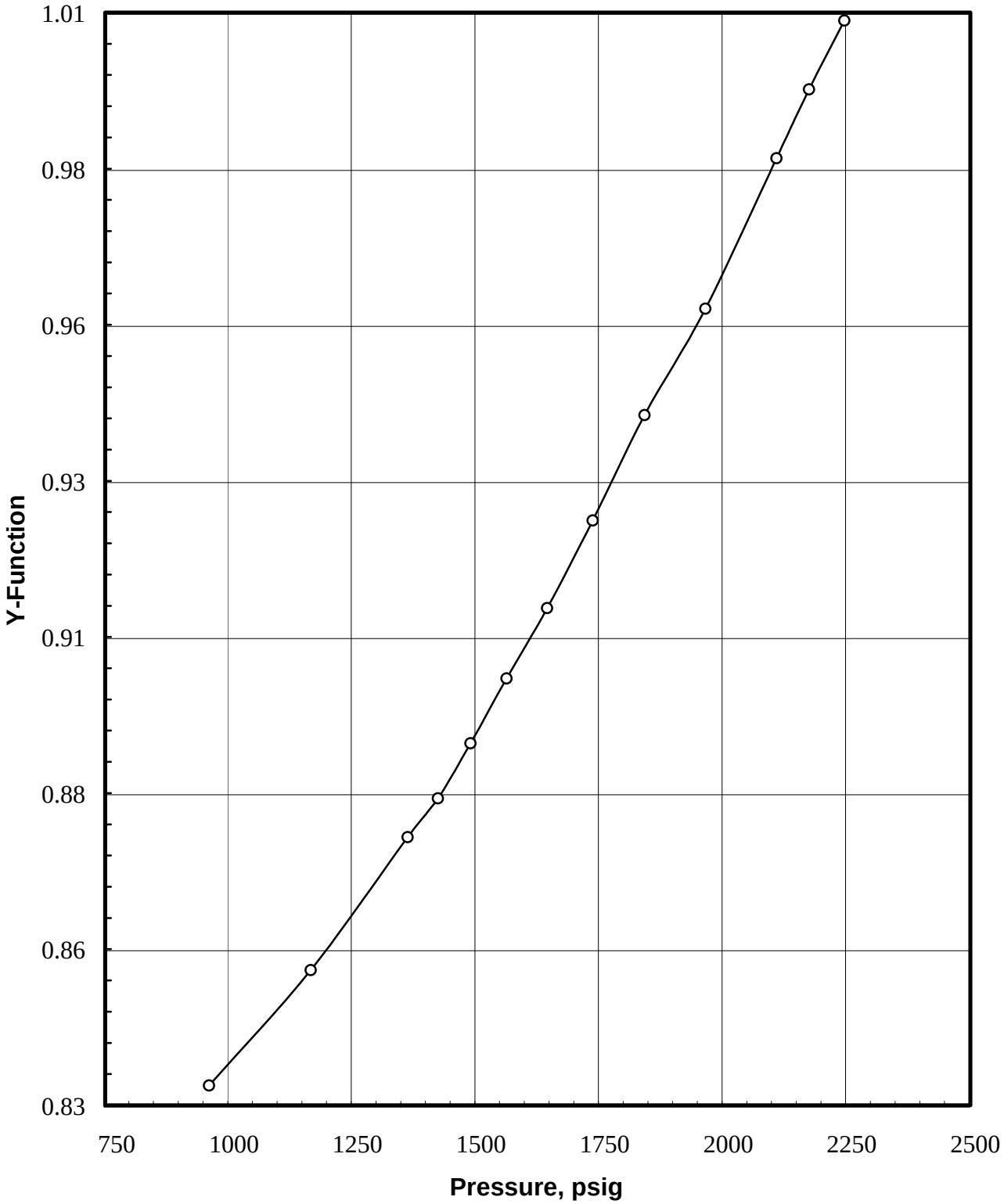


FIGURE 4
Retrograde Liquid Volume vs Pressure

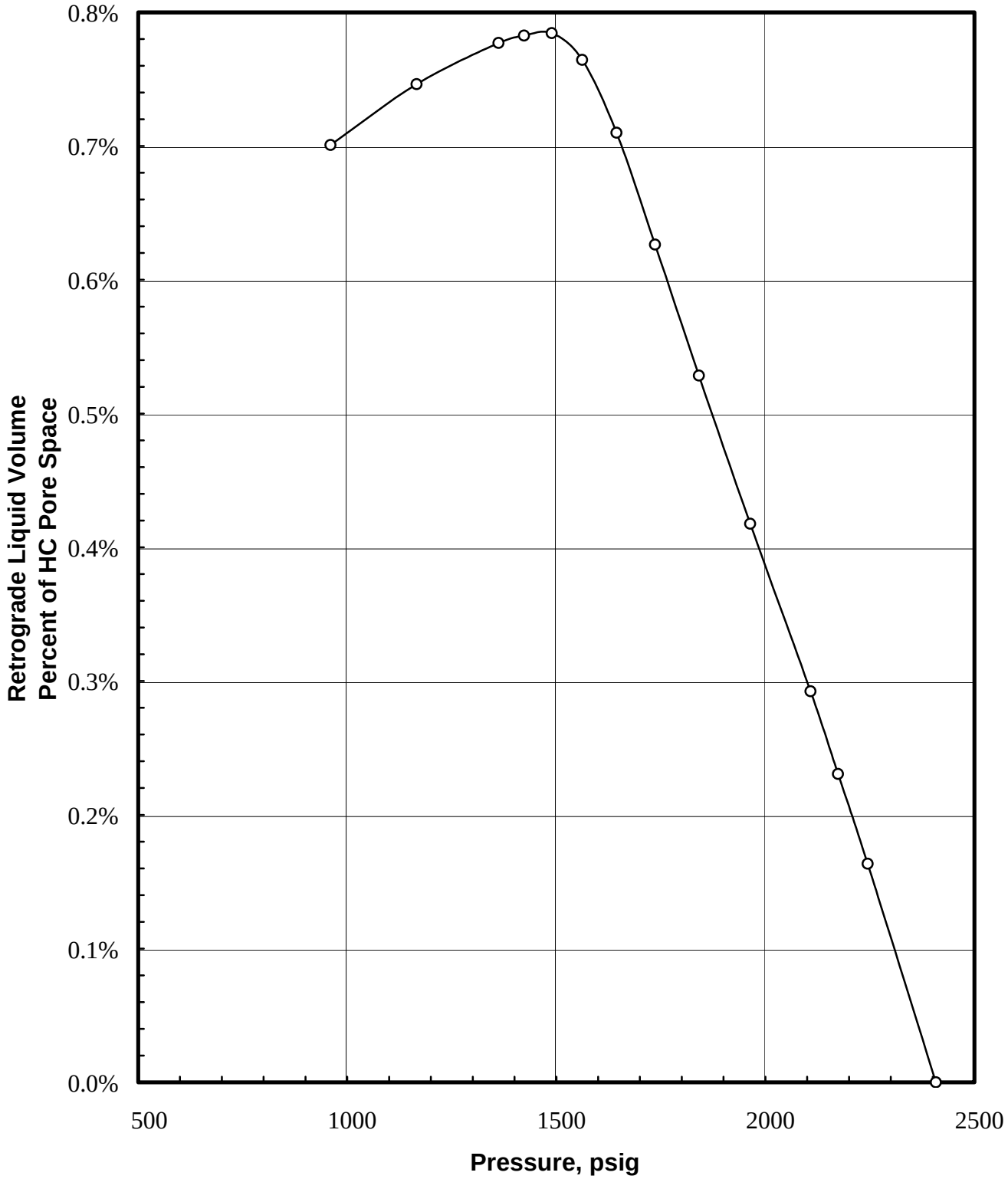


FIGURE 5
Retrograde Liquid Volume vs Pressure

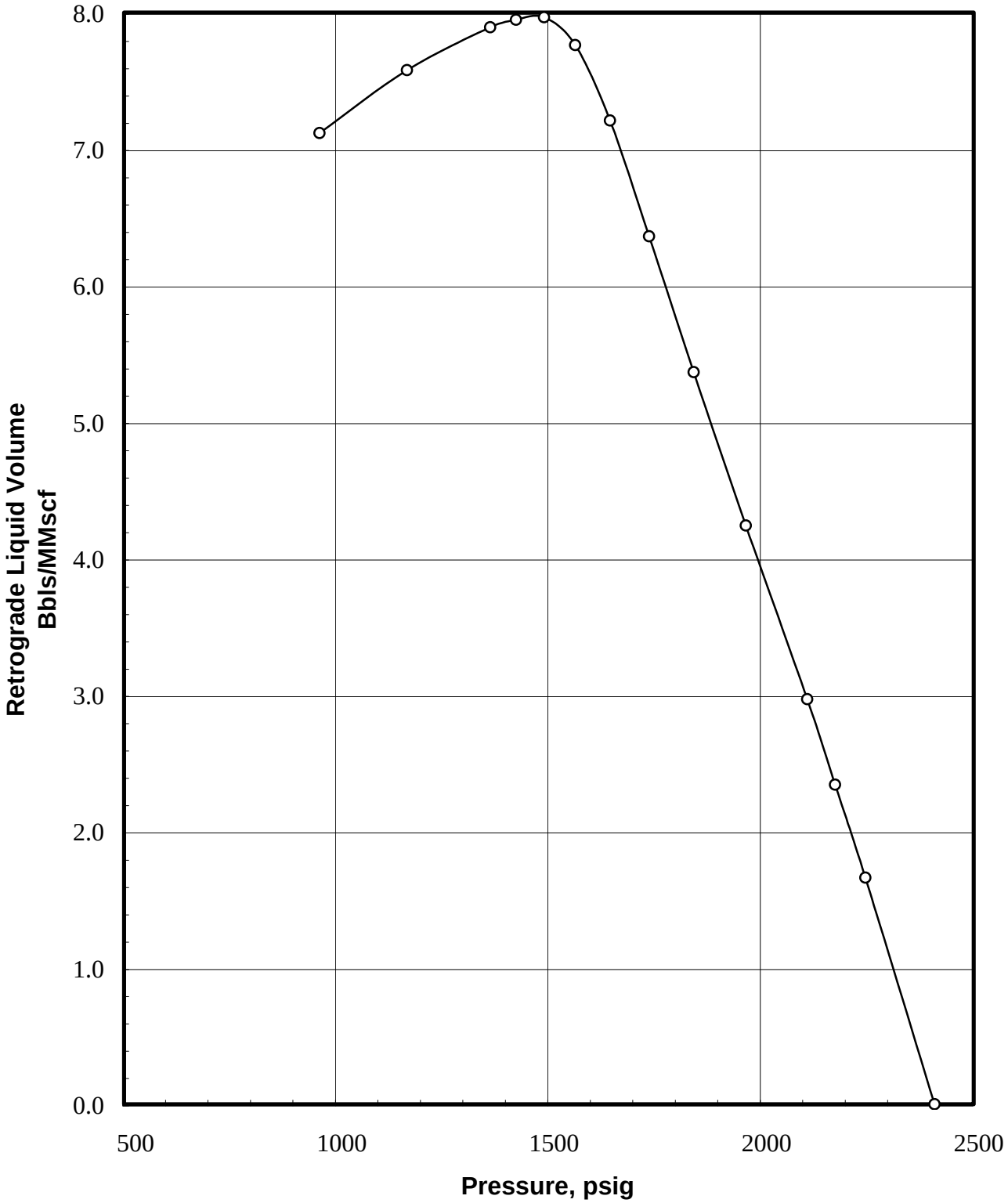


FIGURE 6
Gas Deviation Factor (Z) vs Pressure

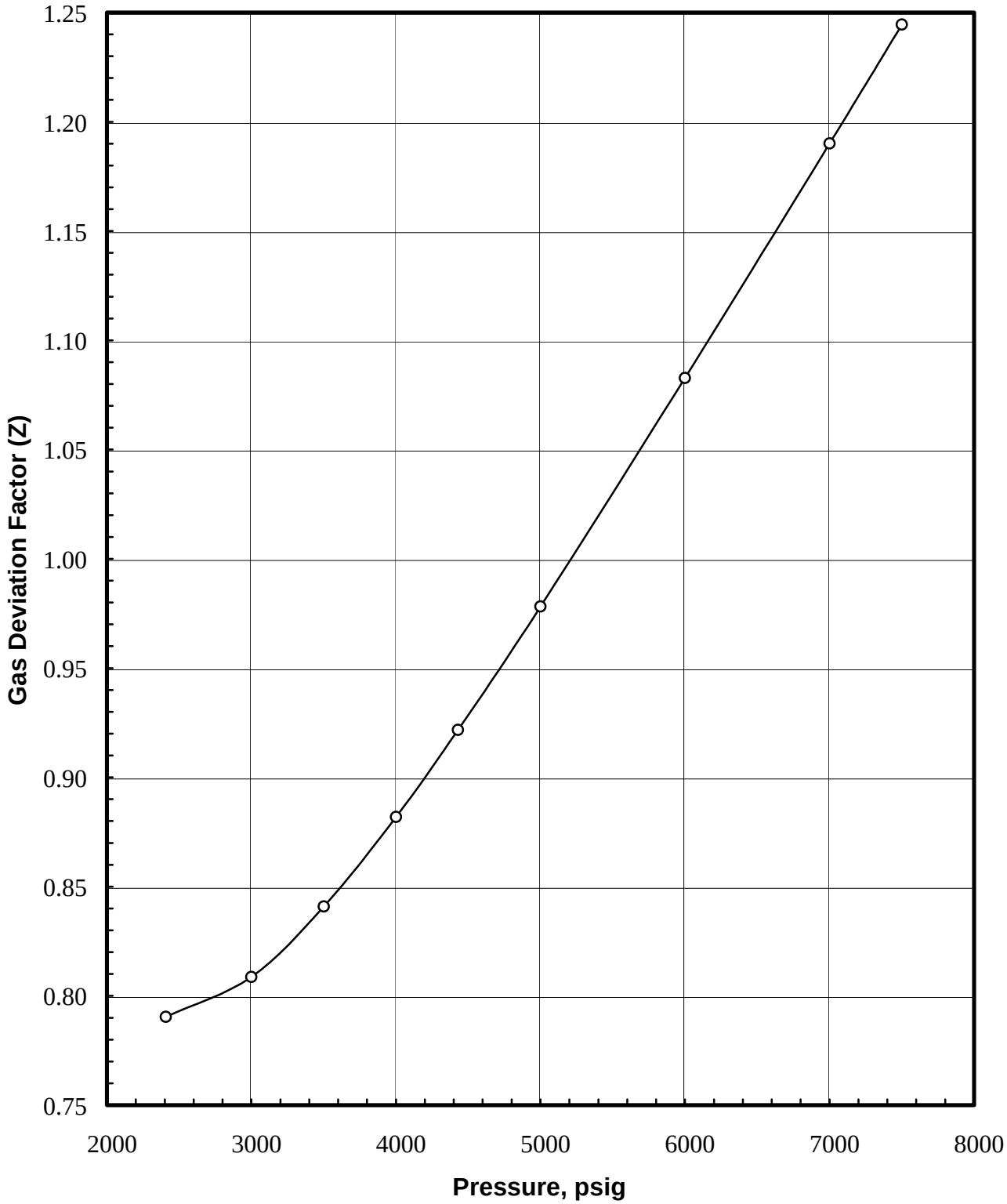


FIGURE 7
Gas Expansion Factor vs Pressure

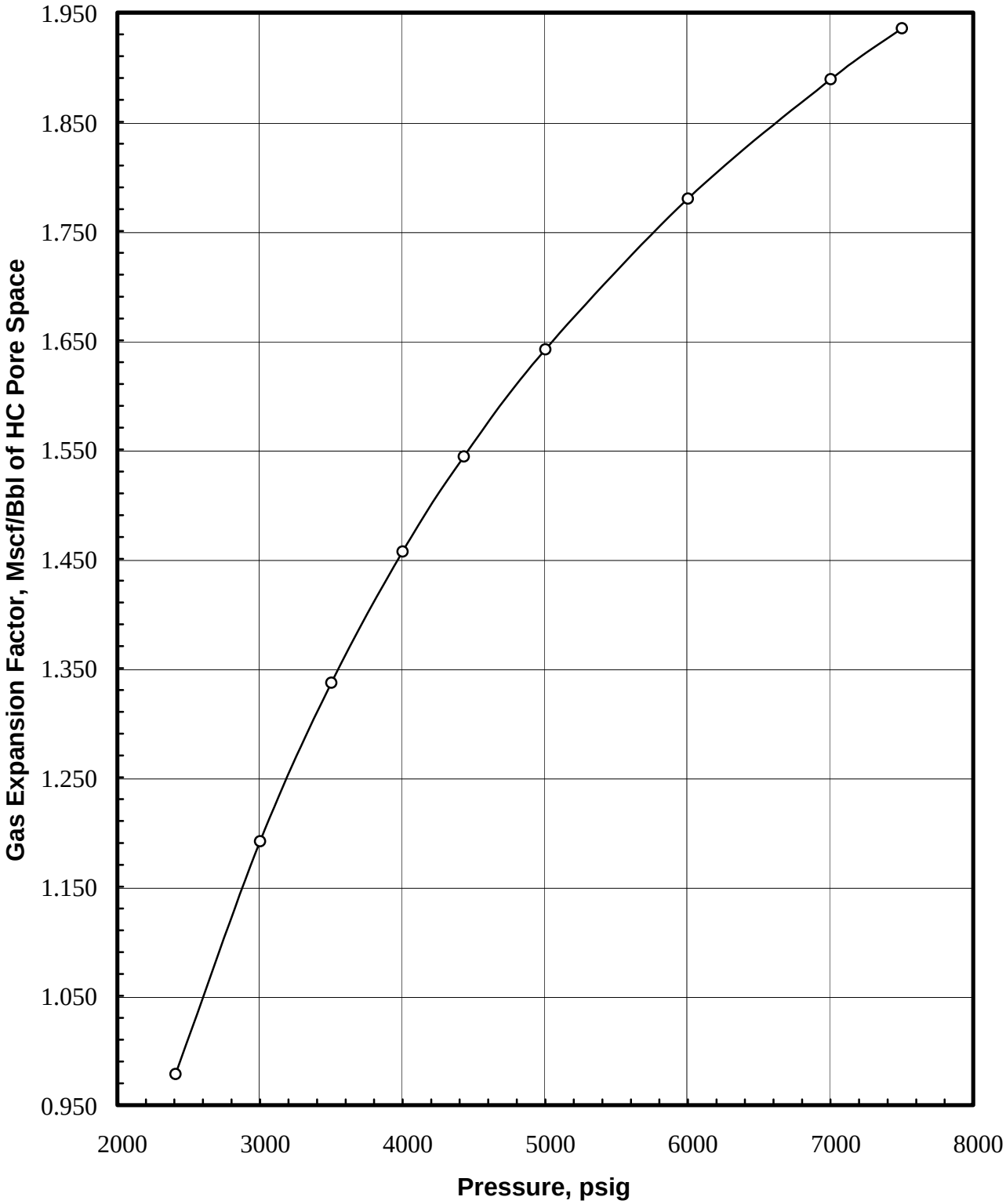


TABLE 4

RESERVOIR GAS DEPLETION STUDY AT 150 °F

Reservoir Pressure, psig	(D.P.) 2408	2100	1800	1500	1100	600	0
Wellstream Components	mole %	mole %	mole %	mole %	mole %	mole %	mole %
Hydrogen Sulfide	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Nitrogen	0.427	0.426	0.427	0.428	0.429	0.428	0.418
Carbon Dioxide	0.178	0.177	0.177	0.178	0.178	0.178	0.175
Methane	76.241	76.409	76.540	76.576	76.954	76.852	75.422
Ethane	13.920	13.931	13.970	14.077	13.940	13.999	13.521
Propane	4.892	4.864	4.825	4.819	4.764	4.826	4.987
Iso-butane	0.655	0.652	0.646	0.640	0.635	0.640	0.689
N-butane	1.431	1.412	1.402	1.387	1.382	1.396	1.462
Iso-pentane	0.434	0.413	0.416	0.413	0.394	0.402	0.512
N-pentane	0.453	0.436	0.428	0.428	0.413	0.420	0.531
Hexanes	0.468	0.452	0.440	0.436	0.416	0.406	0.601
Heptanes Plus	0.901	0.829	0.730	0.619	0.494	0.454	1.683
TOTALS	100.000	100.000	100.000	100.000	100.000	100.000	100.000

HEPTANES PLUS (C_{7+}) FRACTION CHARACTERISTICS							
Molecular Weight	114.083	111.741	110.227	109.437	109.009	108.832	109.753
Specific Gravity	0.7458	0.7423	0.7399	0.7387	0.7380	0.7377	0.7916

CONDENSED RETROGRADE LIQUID VOLUME							
HC Pore Volume %	0.000	0.300	0.536	0.672	0.632	0.546	0.436
Bbls/MMscf of DP Gas	0.000	3.042	5.439	6.822	6.416	5.550	4.425

GAS DEVIATION FACTOR							
Equilibrium Gas	0.7904	0.7913	0.8029	0.8259	0.8687	0.9304	N/A
Two-Phase	0.7904	0.7915	0.8020	0.8212	0.8579	0.9124	N/A

CUMULATIVE PRODUCED WELLSTREAM VOLUME							
Vol % of Initial DP Gas	0.000	12.832	26.181	39.823	57.606	78.016	99.784

GPM FROM CVD WELLSTREAM COMPOSITIONS							
Propane plus (C_{3+})	2.988	2.910	2.836	2.770	2.672	2.677	3.503
Butanes plus (C_{4+})	1.631	1.561	1.497	1.433	1.350	1.338	2.120
Pentanes plus (C_{5+})	0.960	0.897	0.839	0.782	0.702	0.684	1.428

FIGURE 8
Equilibrium Gas Deviation (Z) Factor vs Pressure

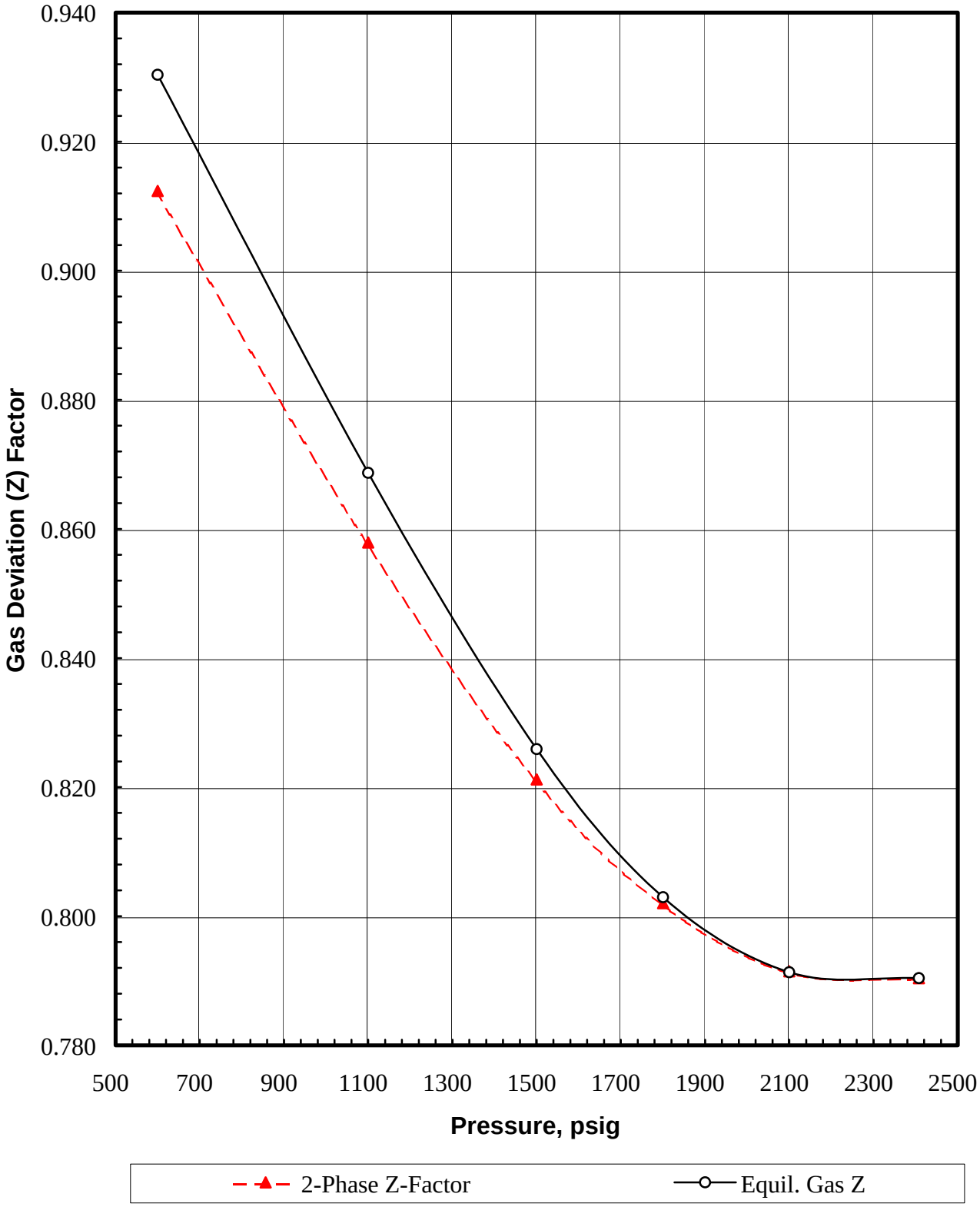


FIGURE 9
P / Z vs Cumulative Produced Wellstream %

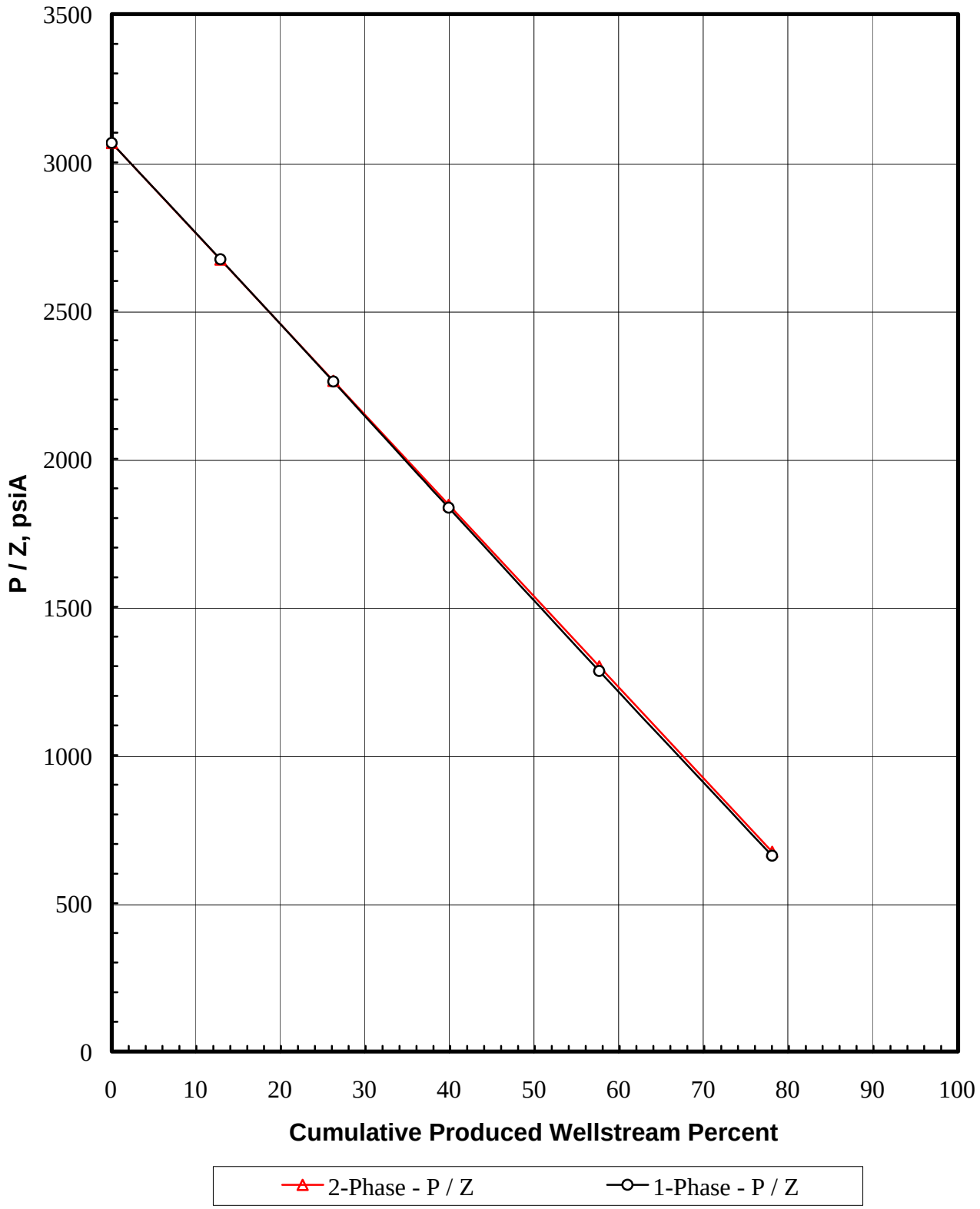


FIGURE 10
Cumulative Produced Wellstream Volume vs Pressure

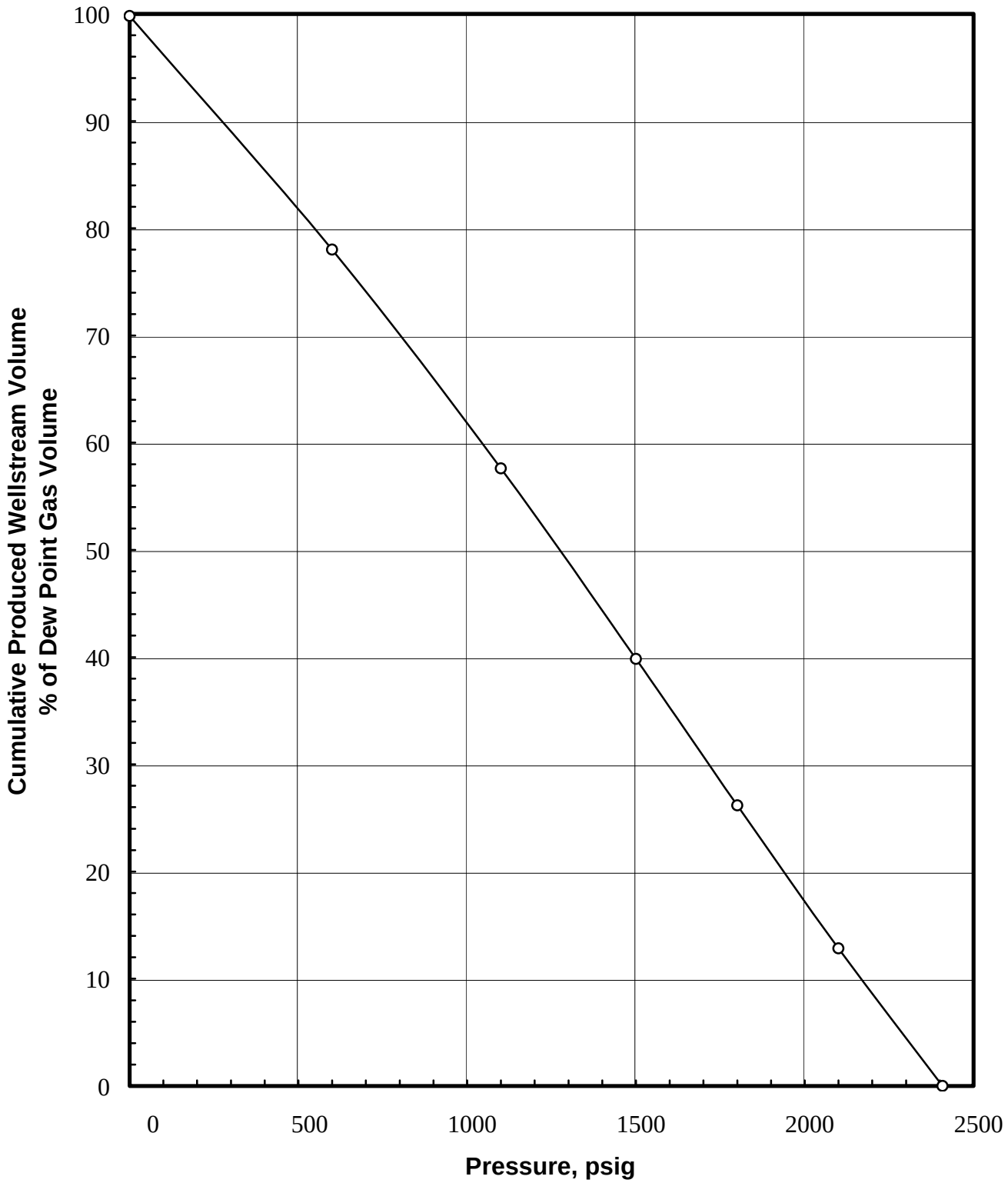


FIGURE 11
C3+, C4+ and C5+ GPM vs Pressure

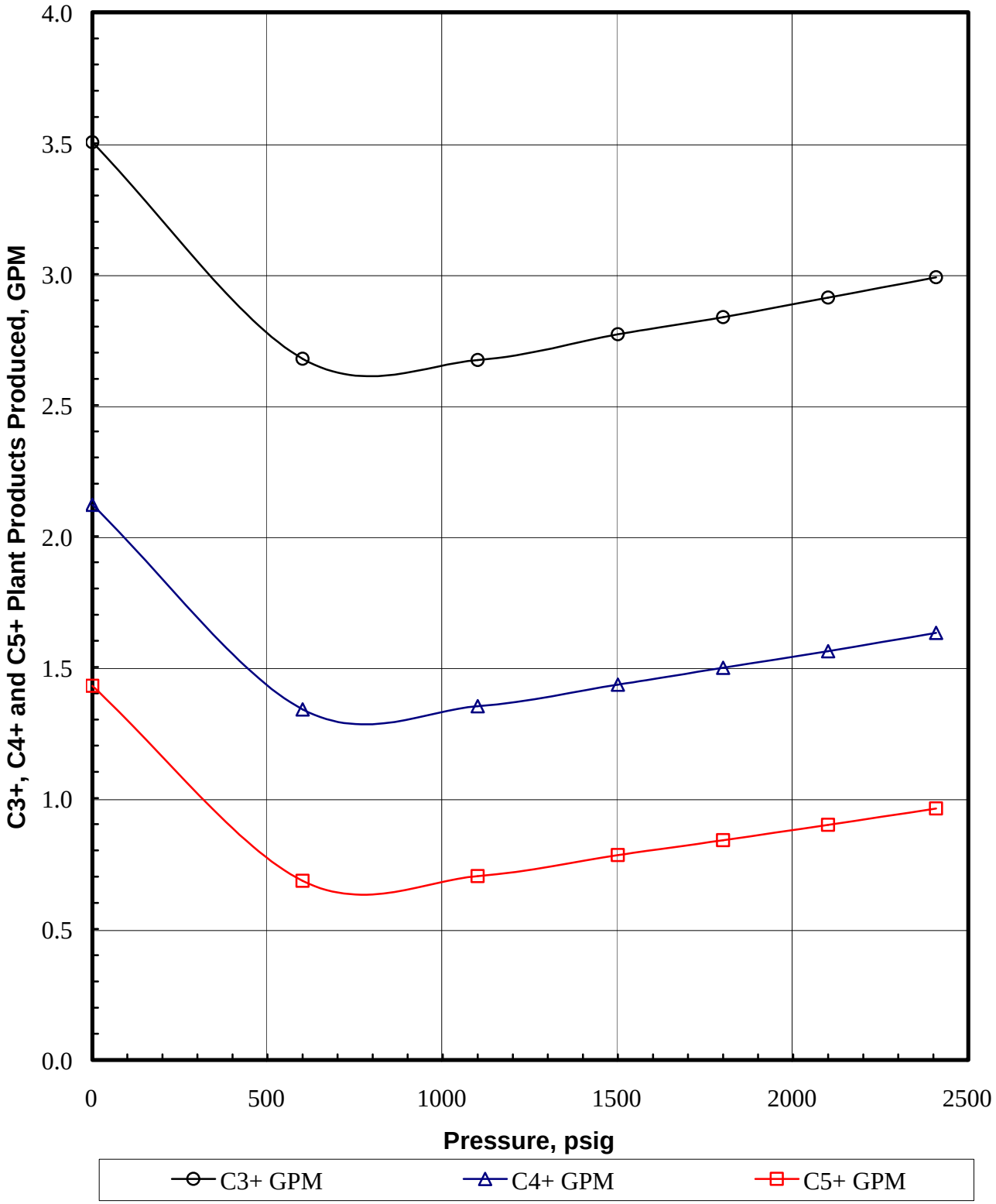


TABLE 5

CALCULATED CUMULATIVE RECOVERY DURING DEPLETION AT 150 °F

Cumulative Fluid Recovery per MMScf of Original Dew Point Gas	Initial Gas in Place	Reservoir Pressure - psig (D.P.) 2408	2100	1800	1500	1100	600
Well Stream (Mcf)	1000.00	0.00	128.32	261.81	398.23	576.06	780.16
*** Normal Temperature Separation**							
Stock Tank Liquid (Bbls)	13.24	0.00	1.57	2.98	4.16	5.31	6.52
Primary Separator Gas (Mcf)	982.55	0.00	126.11	257.53	392.17	568.27	770.51
Second Stage Gas (Mcf)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stock Tank Gas (Mcf)	4.99	0.00	0.70	1.41	2.03	2.65	3.31
Cumulative Total GOR (Scf/STB)	74559	0	80871	86878	94694	107587	118623
Instantaneous Total GOR (Scf/STB)	74559	0	80871	93547	114397	154518	166753
Total Gallons of Ethane Plus (C_{2+}) Plant Products Produced in:							
Well Stream	6741.10	0.00	855.38	1736.78	2632.50	3776.05	5092.73
Primary Separator Gas	6066.53	0.00	773.56	1579.93	2412.22	3494.16	4745.22
Second Stage Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stock Tank Gas	110.25	0.00	15.16	30.26	43.57	56.77	70.98

* Recovery Basis: 1st Stage Separation at 415 psig and 94 °F
2nd Stage Separation: Not Present
Stock Tank Conditions at 14.85 psig and 70 °F
Standard Conditions at 14.85 psig and 60 °F

TABLE 6

RETROGRADE CONDENSATION DURING GAS DEPLETION AT 150 °F

Pressure psig	Condensed Retrograde Liquid Volume	
	(1)	(2)
2408	0.000	0.00
2100	0.300	3.04
1800	0.536	5.44
1500	0.672	6.82
1100	0.632	6.42
600	0.546	5.55
0	0.436	4.42

(1) Retrograde liquid volume condensed at the indicated pressure and reservoir temperature as a percent of the hydrocarbon pore volume at the dew point pressure and reservoir temperature.

(2) Retrograde liquid volume (Bbls) condensed at the indicated pressure and reservoir temperature per volume of gas (MMscf) at the dew point pressure and reservoir temperature.

FIGURE 12
Retrograde Liquid Volume vs Pressure

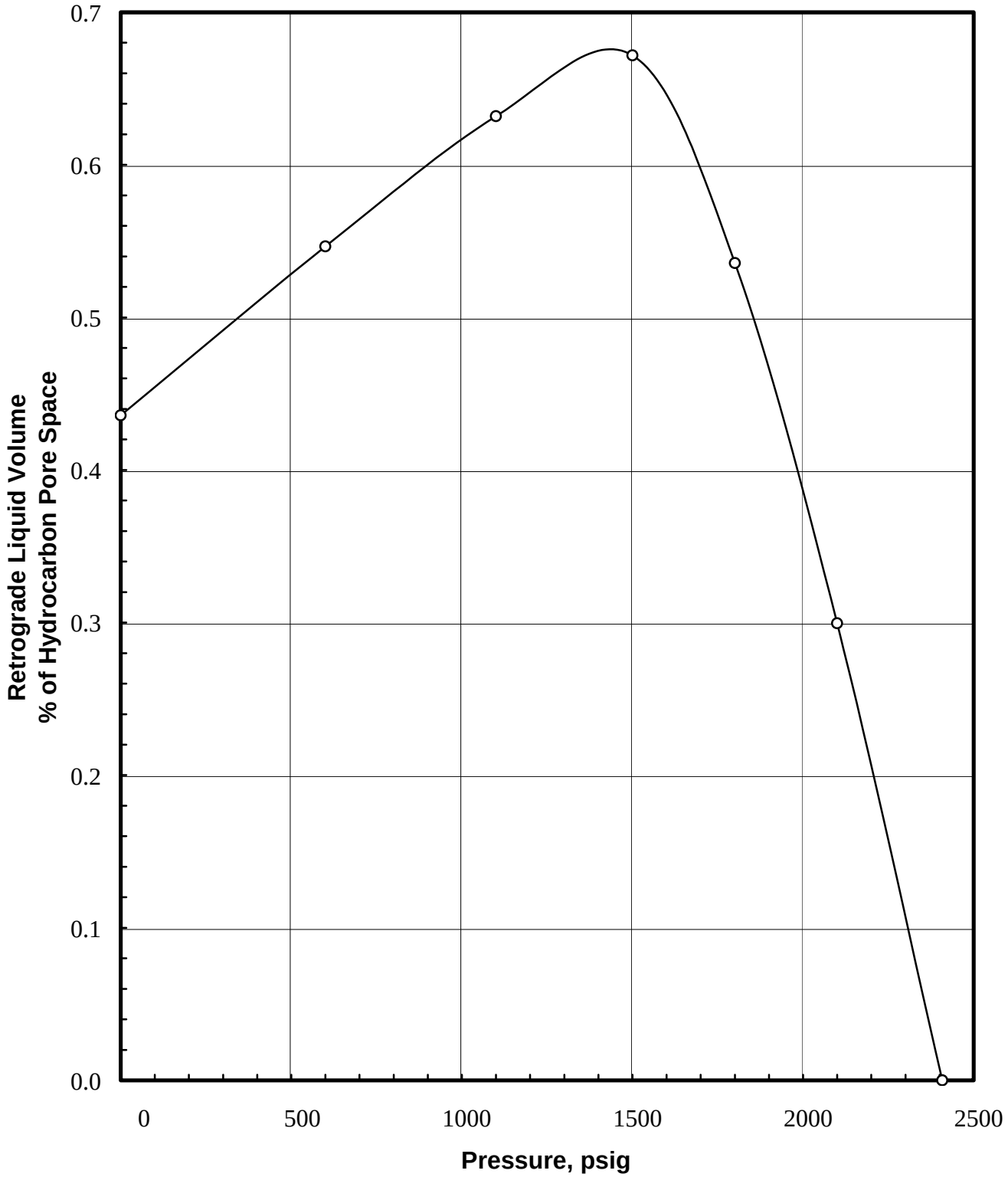
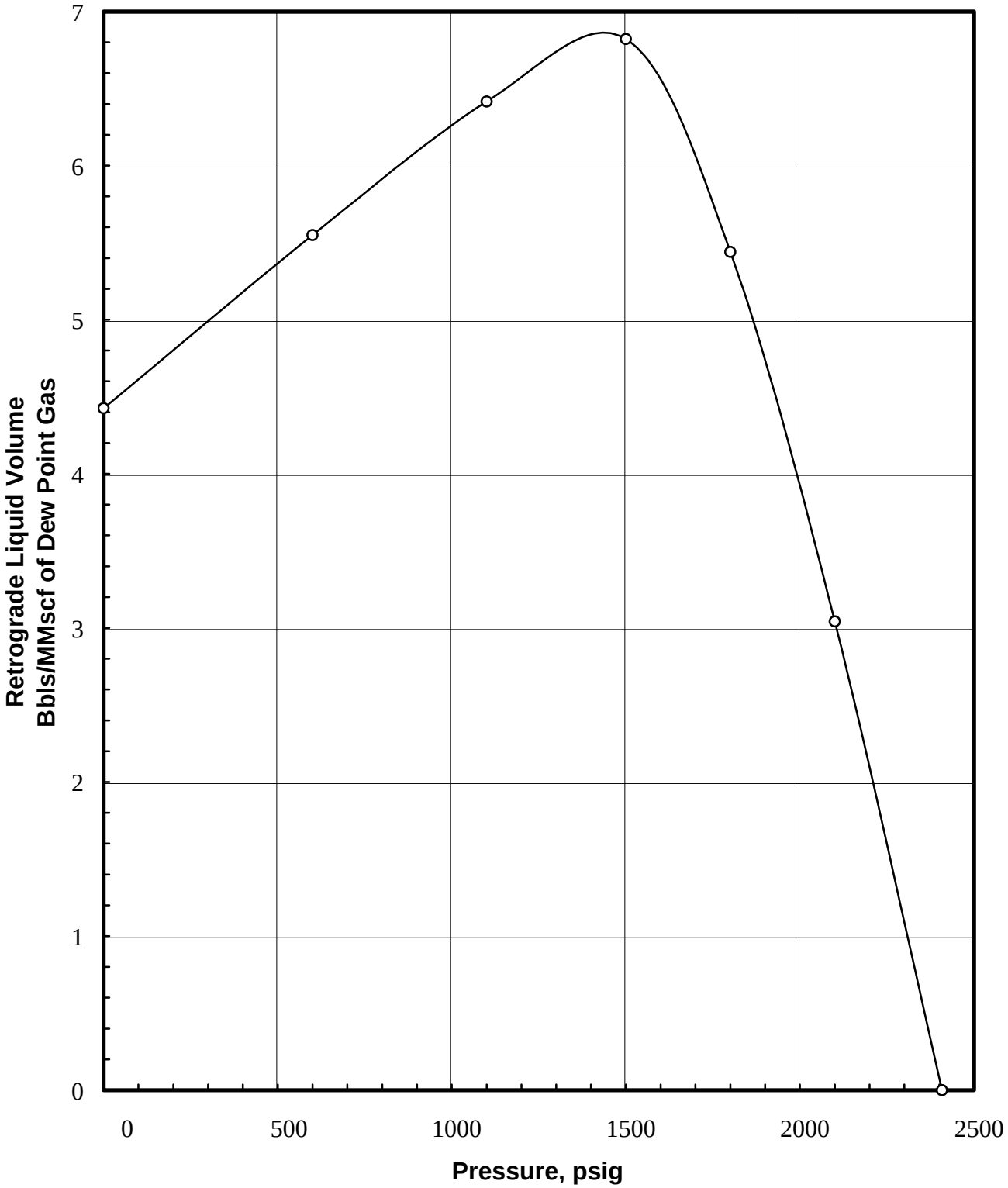


FIGURE 13
Retrograde Liquid Volume vs Pressure



ATTACHMENT H

Air Pollution Control Device Data Sheets

AIR POLLUTION CONTROL DEVICE
Vapor Combustion Control Device Sheet

Complete this vapor combustion control device sheet for each enclosed combustion device, flare, thermal oxidizer, or completion combustion device that is located at the natural gas production pad for the purpose of thermally destructing waste gas to control emissions of regulated pollutants to the atmosphere.

IMPORTANT: READ THE INSTRUCTIONS ACCOMPANYING THIS FORM BEFORE COMPLETING.

General Information

1. Control Device ID#: APC-COMB- TKLD	2. Installation Date: TBD ☒ New	
3. Maximum Rated Total Flow Capacity: ~102 scf/min ~147,000 scfd	4. Maximum Design Heat Input: 15 MMBtu/hr	5. Design Heat Content: 2,450 BTU/scf

Control Device Information

6. Select the type of vapor combustion control device being used: ☒ Enclosed Combustion Device

☐ Elevated Flare ☐ Ground Flare ☐ Thermal Oxidizer ☐ Completion Combustion Device

7. Manufacturer: MRW Technologies Model No.: TBF-5.5-30-147000	8. Hours of operation per year: 8760

9. List the emission units whose emissions are controlled by this vapor combustion control device:
(Emission Point ID#: see below)

10. Emission Unit ID#	Emission Source Description:	Emission Unit ID#	Emission Source Description:
EU-TANKS-COND	Condensate Storage Tanks		
EU-TANKS-PW	Produced Water Storage Tanks		
EU-LOAD-COND	Condensate Liquids Loading (emergency use)		
EU-LOAD-PW	Produced Water Liquid Loading (emergency use)		

If this vapor combustor controls emissions from more than six emission units, please attach additional pages.

11. Assist Type	12. Flare Height	13. Tip Diameter	14. Was the design per §60.18?
☐ Steam - ☐ Air - ☐ Pressure - ☒ Non -	~30 ft	~5.5 ft	☐Yes ☐No **NA**

Waste Gas Information

15. Maximum waste gas flow rate (scfm):	16. Heat value of waste gas stream (BTU/ft3)	17. Temperature of the emissions stream (°F)	18. Exit Velocity of the emissions stream (scf/min)
~102	Variable	~70	

19. Provide an attachment with the characteristics of the waste gas stream to be burned. ***See attached emission calculations.***

Pilot Information

20. Type/Grade of pilot fuel:	21. Number of pilot lights:	22. Fuel flow rate to pilot flame per pilot (scf/hr):	23. Heat input per pilot (BTU/hr):	24. Will automatic re-ignition be used?
Pipeline quality natural gas	1	50	1,287	☐ Yes ☒ No

25. If automatic re-ignition will be used, describe the method:
If the pilot flame is lost, the control system will automatically attempt to relight the pilot. If the re-ignition attempt fails, the pilot solenoid valve will automatically close and a local and remote alarm signal will be generated to indicate loss of pilot flame

26. Describe the method of controlling flame:

27. Is pilot flame equipped with a monitor to detect the presence of the flame?	28. If yes, what type?
☒ Yes ☐ No	☐ Thermocouple ☐ Infra-Red ☐ Ultra Violet ☐ Camera with monitoring control room ☒ Other, describe: Flame Rod

29. Pollutant(s) Controlled	30. % Capture Efficiency	31. Manufacturer's Guaranteed Control Efficiency (%)
HC	100	≥ 98
VOC	100	≥ 98
HAP	100	≥ 98

32. Has the control device been tested by the manufacturer and certified?

33. Describe all operating ranges and maintenance procedures required by the manufacturer to maintain warranty:
See attached specification sheet.

34. Additional Information Attached? ☒ **YES** ☐ **NO**

Please attach a copy of manufacturer's data sheet.
Please attach a copy of manufacturer's drawing.
Please attach a copy of the manufacturer's performance testing.

If any of the requested information is not available, please contact the manufacturer.

Tank Battery Combustor Specification Sheet
MRW Technologies, Inc.
Combustor Model Number: TBF-5.5-30-147000

Expected Destruction Removal Efficiency (DRE):	98% or Greater of Non-Methane Hydrocarbons
Unit Size:	5.5-foot Diameter 30-Foot Overall Height
Design Heat Input:	15 MMBTU/HR
Design Flow Rates:	147,000 SCFD
Design Heat Content:	2450 BTU/SCF
Waste Gas Flame Arrestor:	2" Enardo
Pilot Type:	MRW Electric Ignition
Pilot Operation (Continuous/Intermittent):	Continuous
Pilot Fuel Consumption:	50 SCFH or Less
Pilot Monitoring Device:	Flame Rod
Automatic Re-Ignition:	Included
Remote Alarm Indication:	Included

Description of Control Scheme:

The Combustor pilot is monitored via flame rod. If the pilot flame is lost, the control system will automatically attempt to relight the pilot. If the re-ignition attempt fails, the pilot solenoid valve will automatically close and a local & remote alarm signal will be generated to indicate loss of pilot flame.

ATTACHMENT I

Emission Calculations

Company Name: SWN Production Company, LLC
Facility Name: Ridgetop Land Ventures
Project Description: G-70 Application

Site Wide Summary

Emission Source	Value	Units	Emission Unit ID(s)	Emission Point ID(s)	Control Device
Wells	3	per pad	---	---	---
Compressor Engine	2	per pad	EU-ENGINE1 - EU-ENGINE2	EP-ENGINE1 - EP-ENGINE2	NSCR Catalyst
VRU Engine (GM Engine)	1	per pad	VRU-1	VRU-1	NSCR Catalyst
VRU Engine (Zenith Engine)	1	per pad	VRU-2	VRU-2	----
Condensate Tanks	4	per pad	EU-TANKS-COND	EP-TANKS-COND	Vapor Recovery Unit
Produced Water Tanks	4	per pad	EU-TANKS-PW	EP-TANKS-PW	Vapor Recovery Unit
Line Heaters	0	per pad	---	---	---
GPU Burners	5	per pad	EU-GPU1 - EU-GPU5	EP-GPU1 - EP-GPU5	---
Heater Treaters	2	per pad	EU-HT1 - EU-HT2	EP-HT1 - EP-HT2	---
Dehydrator(s)	0	per pad	---	---	---
Reboiler(s)	0	per pad	---	---	---
Dehy Drip Tank	0	per pad	---	---	---
Vapor Combustor	1	per pad	APC-COMB-TKLD	APC-COMB-TKLD	---
Vapor Combustor Pilot	1	per pad	EU-PILOT	EP-PILOT	---
Vapor Recovery Unit	2	per pad	APC-VRU to APC-VRU1	APC-VRU to APC-VRU1	---
Length of lease road	800	feet	---	---	---
Low Pressure Towers	3	per pad	---	---	---

Constituent	Condensate Tanks (tpy)	Produced Water Tanks (tpy)	Combustor (tpy)	Zenith VRU Engine (tpy)	GM VRU Engine (tpy)	Line Heaters (tpy)	GPU Burners (tpy)	Heater Treaters (tpy)	Fugitive Components (tpy)	Condensate Loading (tpy)	Produced Water Loading (tpy)	Haul Roads (tpy)	Total Emissions (tpy)
Criteria Pollutants													
NO_X	---	---	5.13	1.16	0.89	0.000	1.70	0.34	---	---	---	---	**12.02**
CO	---	---	4.31	3.33	1.78	0.000	1.43	0.29	---	---	---	---	**16.73**
PM Total	---	---	0.39	0.10	0.07	0.000	0.13	0.03	---	---	---	4.17	**5.09**
PM_{10} Total	---	---	0.39	0.10	0.07	0.000	0.13	0.03	---	---	---	1.06	**1.99**
$PM_{2.5}$ Total	---	---	0.39	0.10	0.07	0.000	0.13	0.03	---	---	---	0.11	**1.03**
SO_2	---	---	0.03	0.00	0.00	0.000	0.01	0.00	---	---	---	---	**0.05**
VOC	5.17	0.30	---	1.27	0.74	0.000	0.09	0.02	2.97	47.73	2.69	---	**63.08**
Greenhouse Gases													
CO_2	---	---	7,719.70	612.17	405.45	0.00	2,562.24	512.45	0.17	---	---	---	**13,170**
CH_4	---	---	0.15	0.01	0.01	0.00	4.8E-02	0.01	26.09	---	---	---	**32**
N_2O	---	---	0.01	0.00	0.00	0.00	4.8E-03	0.00	---	---	---	---	**0**
CO_2e	---	---	7,727.67	612.80	405.87	0.00	2,564.89	512.98	652.48	---	---	---	**13,966**
Hazardous Air Pollutants													
Methylnaphthalene (2-)	---	---	---	---	---	0.0E+00	4.1E-07	8.2E-08	---	---	---	---	4.9E-07
Methylchloranthrene (3-)	---	---	---	---	---	0.0E+00	3.1E-08	6.1E-09	---	---	---	---	3.7E-08
Dimethybenz(a)anthracene (7,12-)	---	---	---	---	---	0.0E+00	2.7E-07	5.4E-08	---	---	---	---	3.3E-07
Acenaphthene	---	---	---	---	---	0.0E+00	3.1E-08	6.1E-09	---	---	---	---	3.7E-08
Acenaphthylene	---	---	---	---	---	0.0E+00	3.1E-08	6.1E-09	---	---	---	---	3.7E-08
Anthracene	---	---	---	---	---	0.0E+00	4.1E-08	8.2E-09	---	---	---	---	4.9E-08
Benz(a)anthracene	---	---	---	---	---	0.0E+00	3.1E-08	6.1E-09	---	---	---	---	3.7E-08
Benzene	1.8E-03	5.4E-04	---	8.3E-03	5.5E-03	0.0E+00	3.6E-05	7.1E-06	---	1.1E-02	5.8E-03	---	5.0E-02
Benzo(a)pyrene	---	---	---	---	---	0.0E+00	2.0E-08	4.1E-09	---	---	---	---	2.5E-08
Benzo(b)fluoranthene	---	---	---	---	---	0.0E+00	3.1E-08	6.1E-09	---	---	---	---	3.7E-08
Benzo(g,h,i)perylene	---	---	---	---	---	0.0E+00	2.0E-08	4.1E-09	---	---	---	---	2.5E-08
Benzo(k)fluoranthene	---	---	---	---	---	0.0E+00	3.1E-08	6.1E-09	---	---	---	---	3.7E-08
Chrysene	---	---	---	---	---	0.0E+00	3.1E-08	6.1E-09	---	---	---	---	3.7E-08
Dibenzo(a,h)anthracene	---	---	---	---	---	0.0E+00	2.0E-08	4.1E-09	---	---	---	---	2.5E-08
Dichlorobenzene	---	---	---	---	---	0.0E+00	2.0E-05	4.1E-06	---	---	---	---	2.5E-05
Fluoranthene	---	---	---	---	---	0.0E+00	5.1E-08	1.0E-08	---	---	---	---	6.1E-08
Fluorine	---	---	---	---	---	0.0E+00	4.8E-08	9.5E-09	---	---	---	---	5.7E-08
Formaldehyde	---	---	---	1.1E-01	7.1E-02	0.0E+00	1.3E-03	2.6E-04	---	---	---	---	9.4E-01
Hexane, n-	1.3E-01	1.4E-03	---	---	---	0.0E+00	3.1E-02	6.1E-03	---	1.1E+00	2.6E-04	---	1.3E+00
Indeno(1,2,3-cd)pyrene	---	---	---	---	---	0.0E+00	3.1E-08	6.1E-09	---	---	---	---	3.7E-08
Naphthalene	---	---	---	5.1E-04	3.4E-04	0.0E+00	1.0E-05	2.1E-06	---	---	---	---	1.9E-03
Phenanthrene	---	---	---	---	---	0.0E+00	2.9E-07	5.8E-08	---	---	---	---	3.5E-07
Pyrene	---	---	---	---	---	0.0E+00	8.5E-08	1.7E-08	---	---	---	---	1.0E-07
Toluene	3.2E-03	3.9E-04	---	2.9E-03	1.9E-03	0.0E+00	5.8E-05	1.2E-05	---	2.0E-02	2.7E-03	---	3.8E-02
Arsenic	---	---	---	---	---	0.0E+00	3.4E-06	6.8E-07	---	---	---	---	4.1E-06
Beryllium	---	---	---	---	---	0.0E+00	2.0E-07	4.1E-08	---	---	---	---	2.5E-07
Cadmium	---	---	---	---	---	0.0E+00	1.9E-05	3.7E-06	---	---	---	---	2.2E-05
Chromium	---	---	---	---	---	0.0E+00	2.4E-05	4.8E-06	---	---	---	---	2.9E-05
Cobalt	---	---	---	---	---	0.0E+00	1.4E-06	2.9E-07	---	---	---	---	1.7E-06
Manganese	---	---	---	---	---	0.0E+00	6.5E-06	1.3E-06	---	---	---	---	7.8E-06
Mercury	---	---	---	---	---	0.0E+00	4.4E-06	8.8E-07	---	---	---	---	5.3E-06
Nickel	---	---	---	---	---	0.0E+00	3.6E-05	7.1E-06	---	---	---	---	4.3E-05
Selenium	---	---	---	---	---	0.0E+00	4.1E-07	8.2E-08	---	---	---	---	4.9E-07
Ethylbenzene	9.2E-04	6.5E-05	---	1.3E-04	8.6E-05	---	---	---	---	6.1E-03	2.3E-04	---	7.8E-03
Trimethylpentane (2,2,4-)	---	---	---	---	---	---	---	---	---	---	---	---	0.0E+00
Xylene	2.5E-03	1.8E-04	---	1.0E-03	6.8E-04	---	---	---	---	1.6E-02	5.6E-04	---	2.3E-02
1,1,2,2-Tetrachloroethane	---	---	---	1.3E-04	8.8E-05	---	---	---	---	---	---	---	---
1,1,2-Trichloroethane	---	---	---	8.0E-05	5.3E-05	---	---	---	---	---	---	---	---
1,3-Butadiene	---	---	---	3.5E-03	2.3E-03	---	---	---	---	---	---	---	---
1,3-Dichloropropene	---	---	---	6.6E-05	4.4E-05	---	---	---	---	---	---	---	---
Acetaldehyde	---	---	---	1.5E-02	9.7E-03	---	---	---	---	---	---	---	---
Acrolein	---	---	---	1.4E-02	9.1E-03	---	---	---	---	---	---	---	---
Carbon Tetrachloride	---	---	---	9.3E-05	6.1E-05	---	---	---	---	---	---	---	---
Chlorobenzene	---	---	---	6.7E-05	4.5E-05	---	---	---	---	---	---	---	---
Chloroform	---	---	---	7.2E-05	4.7E-05	---	---	---	---	---	---	---	---
Ethylene Dibromide	---	---	---	1.1E-04	7.4E-05	---	---	---	---	---	---	---	---
Methanol	---	---	---	1.6E-02	1.1E-02	---	---	---	---	---	---	---	---
Methylene Chloride	---	---	---	2.2E-04	1.4E-04	---	---	---	---	---	---	---	---
PAH	---	---	---	7.4E-04	4.9E-04	---	---	---	---	---	---	---	---
Styrene	---	---	---	6.2E-05	4.1E-05	---	---	---	---	---	---	---	---
Vinyl Chloride	---	---	---	3.8E-05	2.5E-05	---	---	---	---	---	---	---	---
Total HAP	0.14	0.00	---	1.7E-01	1.1E-01	0.00	0.03	0.01	0.08	1.17	0.01	---	**2.60**

Company Name: SWN Production Company, LLC
Facility Name: Ridgetop Land Ventures
Project Description: G-70 Application

Condensate Storage Tanks

Throughput Parameter	Value	Units
Operational Hours	8,760	hrs/yr
Total Condensate Throughput	814	bbl/day

Description	Potential Throughput (gal/yr)
Condensate	12,478,620

Condensate Storage Tanks (400 bbl, each) - Uncontrolled *(Total)*

Constituent	Working Emissions tpy	Breathing Emissions tpy	Flashing Emissions tpy	Total Emissions [1] lb/hr	Total Emissions [1] tpy
Propane	9.09	1.65	31.44	9.631	42.18
Isobutane	2.10	0.38	7.72	2.330	10.21
n-Butane	4.82	0.88	17.53	5.304	23.23
Isopentane	1.53	0.28	5.83	1.742	7.63
n-Pentane	1.54	0.28	5.96	1.775	7.77
n-Hexane	0.50	0.09	1.99	0.590	2.59
Methylcyclopentane	0.04	0.01	0.17	0.048	0.21
Benzene	0.00	0.00	0.03	0.008	0.04
Cyclohexane	0.05	0.01	0.22	0.062	0.27
n-Heptane	0.20	0.04	0.85	0.249	1.09
n-Octane	0.10	0.02	0.45	0.131	0.57
n-Nonane	0.02	0.00	0.08	0.022	0.10
n-Decane	0.00	0.00	0.02	0.006	0.03
n-Undecane	0.00	0.00	0.01	0.002	0.01
Dodecane	0.00	0.00	0.00	<0.01	<0.01
Triethylene Glycol	0.00	0.00	0.00	<0.01	<0.01
Cyclopentane	0.00	0.00	0.02	0.005	0.02
Isohexane	0.00	0.00	0.00	<0.01	<0.01
3-Methylpentane	0.61	0.11	2.38	0.708	3.10
Neohexane	0.61	0.11	2.36	0.703	3.08
2,3-Dimethylbutane	0.12	0.02	0.46	0.136	0.60
Methylcyclohexane	0.08	0.01	0.36	0.103	0.45
Isooctane	0.00	0.00	0.00	<0.01	<0.01
Decane, 2-Methyl-	0.00	0.00	0.00	<0.01	<0.01
Toluene	0.01	0.00	0.05	0.015	0.06
m-Xylene	0.01	0.00	0.04	0.011	0.05
Ethylbenzene	0.00	0.00	0.02	0.004	0.02
Total Emissions:	21.437	3.898	77.968	23.585	103.303
Total VOC Emissions:	21.437	3.898	77.968	23.585	103.303
Total HAP Emissions:	0.526	0.096	2.133	0.629	2.755

[1] Emissions calculated using ProMax Software. ProMax software provides estimates for working, breathing, and flashing losses associated with total throughput (i.e emissions from all tanks at the facility).

Company Name: SWN Production Company, LLC
Facility Name: Ridgetop Land Ventures
Project Description: G-70 Application

Condensate Storage Tanks

Condensate Storage Tanks (400 bbl, each) - Controlled *(Total)*

Constituent	Total Emissions [1] lb/hr	tpy
Propane	0.482	2.109
Isobutane	0.117	0.510
n-Butane	0.265	1.162
Isopentane	0.087	0.381
n-Pentane	0.089	0.389
n-Hexane	0.030	0.129
Methylcyclopentane	0.002	0.011
Benzene	0.000	0.002
Cyclohexane	0.003	0.014
n-Heptane	0.012	0.054
n-Octane	0.007	0.029
n-Nonane	0.001	0.005
n-Decane	0.000	0.001
n-Undecane	0.000	0.000
Dodecane	<0.01	<0.01
Triethylene Glycol	<0.01	<0.01
Cyclopentane	0.000	0.001
Isohexane	<0.01	<0.01
3-Methylpentane	0.035	0.155
Neohexane	0.035	0.154
2,3-Dimethylbutane	0.007	0.030
Methylcyclohexane	0.005	0.023
Isooctane	<0.01	<0.01
Decane, 2-Methyl-	<0.01	<0.01
Toluene	0.001	0.003
m-Xylene	0.001	0.002
Ethylbenzene	0.000	0.001
Total Emissions:	1.179	5.165
Total VOC Emissions:	1.179	5.165
Total HAP Emissions:	0.031	0.138

[1] Vapors will be routed to the vapor recovery unit. In the event of VRU downtime, a backup combustor with a 98% control efficiency will be used. An overall control efficiency of 95% is used for the purpose of establishing PTE.

Company Name: **SWN Production Company, LLC**
Facility Name: **Ridgetop Land Ventures**
Project Description: **G-70 Application**

Condensate Storage Tanks

Control Efficiency of Combustor	95%
Pilot Rating	0.06 MMBtu/hr
Combustor Rating	15 MMBtu/hr

Enclosed Combustor Emissions- APC TKLD-COMB [1]

Pollutant [2]	Emission Factor (lb/MMBtu)	Combustor Potential Emissions (lb/hr)	Combustor Potential Emissions (tpy)	Pilot Potential Emissions (lb/hr)	Pilot Potential Emissions (tpy)
NO_x	0.078	1.17	5.10	0.01	0.02
CO	0.065	0.98	4.29	0.00	0.02
PM/PM_{10}	0.006	0.09	0.39	3.8E-04	0.002
SO_2	4.7E-04	0.01	0.03	3.0E-05	1.31E-04
CO_2 (Natural Gas Firing)	116.997	1754.96	7686.72	7.529	32.976
CH_4 (Natural Gas Firing)	0.002	0.03	0.14	1.4E-04	6.21E-04
N_2O (Natural Gas Firing)	2.2E-04	0.00	0.01	1.4E-05	6.21E-05

[1] Emission factors from AP-42 Ch. 1.4 for natural gas combustion were used as they were determined to be most representative of the process. Ch. 5.3 (Natural Gas Processing) was consulted, however, factors contained there are appropriate for amine gas sweetening processes, which is not the case at this facility. Also, Ch. 13.5 (Industrial Flares) was consulted, but since the control device in this case is an enclosed combustor vs. an elevated flare, these factors were also determined to be inappropriate.

[2] GHG Emission factors from Tables C-1 and C-2, 40 CFR 98, Subpart C.

Company Name: **SWN Production Company, LLC**
Facility Name: **Ridgetop Land Ventures**
Project Description: **G-70 Application**

Produced Water Storage Tanks

Throughput Parameter	Value	Units
Operational Hours	8,760	hrs/yr
Total Throughput	843	bbl/day

Description	Potential Throughput (gal/yr)
Produced Water	12,923,190

Produced Water Tanks (400 bbl each) - Uncontrolled *(Total)*

Constituent	Working Emissions tpy	Breathing Emissions tpy	Flashing Emissions tpy	Total Emissions [1] lb/hr	Total Emissions [1] tpy
Propane	3.68	0.00	0.88	1.041	4.56
Isobutane	0.06	0.00	0.11	0.038	0.17
n-Butane	0.38	0.00	0.47	0.193	0.84
Isopentane	0.02	0.00	0.12	0.031	0.14
n-Pentane	0.02	0.00	0.13	0.034	0.15
n-Hexane	0.00	0.00	0.03	0.006	0.03
Methylcyclopentane	0.00	0.00	0.01	0.002	0.01
Benzene	0.01	0.00	0.00	0.002	0.01
Cyclohexane	0.00	0.00	0.01	0.003	0.01
n-Heptane	0.00	0.00	0.01	0.002	0.01
n-Octane	0.00	0.00	0.01	0.001	0.01
n-Nonane	0.00	0.00	0.00	0.001	0.00
n-Decane	0.00	0.00	0.00	0.000	0.00
n-Undecane	0.00	0.00	0.00	0.000	0.00
Dodecane	0.00	0.00	0.00	<0.01	<0.01
Triethylene Glycol	0.00	0.00	0.00	<0.01	<0.01
Cyclopentane	0.00	0.00	0.00	0.000	0.00
Isohexane	0.00	0.00	0.00	<0.01	<0.01
3-Methylpentane	0.00	0.00	0.07	0.016	0.07
Neohexane	0.00	0.00	0.02	0.005	0.02
2,3-Dimethylbutane	0.00	0.00	0.01	0.002	0.01
Methylcyclohexane	0.00	0.00	0.01	0.003	0.02
Isooctane	0.00	0.00	0.00	<0.01	<0.01
Decane,2-Methyl-	0.00	0.00	0.00	<0.01	<0.01
Toluene	0.00	0.00	0.00	0.002	0.01
m-Xylene	0.00	0.00	0.00	0.001	0.00
Ethylbenzene	0.00	0.00	0.00	0.000	0.00
Total Emissions:	4.176	<0.01	1.887	1.384	6.063
Total VOC Emissions:	4.176	<0.01	1.887	1.384	6.063
Total HAP Emissions:	0.015	<0.01	0.036	0.012	0.051

[1] Emissions calculated using ProMax Software. ProMax software provides estimates for working, breathing, and flashing losses associated with total throughput (i.e. emissions from all tanks at the facility).

Company Name: SWN Production Company, LLC
Facility Name: Ridgetop Land Ventures
Project Description: G-70 Application

Produced Water Storage Tanks

Produced Water Tanks (400 bbl each) - Controlled *(Total)*

Constituent	Total Emissions [1] lb/hr	tpy
Propane	0.052	0.228
Isobutane	0.002	0.008
n-Butane	0.010	0.042
Isopentane	0.002	0.007
n-Pentane	0.002	0.007
n-Hexane	0.000	0.001
Methylcyclopentane	0.000	0.000
Benzene	0.000	0.001
Cyclohexane	0.000	0.001
n-Heptane	0.000	0.000
n-Octane	0.000	0.000
n-Nonane	0.000	0.000
n-Decane	0.000	0.000
n-Undecane	0.000	0.000
Dodecane	<0.01	<0.01
Triethylene Glycol	<0.01	<0.01
Cyclopentane	0.000	0.000
Isohexane	<0.01	<0.01
3-Methylpentane	0.001	0.003
Neohexane	0.000	0.001
2,3-Dimethylbutane	0.000	0.000
Methylcyclohexane	0.000	0.001
Isooctane	<0.01	<0.01
Decane,2-Methyl-	<0.01	<0.01
Toluene	0.000	0.000
m-Xylene	0.000	0.000
Ethylbenzene	0.000	0.000
Total Emissions:	0.069	0.303
Total VOC Emissions:	0.069	0.303
Total HAP Emissions:	0.001	0.003

[1] Vapors will be routed to the vapor recovery unit. In the event of VRU downtime, a backup combustor with a 95% control efficiency will be used. An overall control efficiency of 95% is used for the purpose of establishing PTE.

Company Name: **SWN Production Company, LLC**
Facility Name: **Ridgetop Land Ventures**
Project Description: **G-70 Application**

Compressor Engine

Engine Information:

Manufacturer:	Caterpillar
Model No.:	G3306NA
Engine ID	EU-ENGINE1 & EU- ENGINE2
Stroke Cycle:	4-stroke
Type of Burn:	Rich
Rated Horsepower (bhp):	145
Control Device:	NSCR Catalyst

Engine Fuel Information:

Fuel Type:	Natural Gas
Higher Heating Value (HHV) (Btu/scf):	1,287
Specific Fuel Consumption (Btu/bhp-hr):	8,625
Maximum Fuel Consumption at 100% Load (scf/hr):	972
Heat Input (MMBtu/hr):	1.25
Potential Fuel Consumption (MMBtu/yr):	10,955
Max. Fuel Consumption at 100%(MMscf/hr):	0.0010
Max. Fuel Consumption (MMscf/yr):	8.5
Max. Annual Hours of Operation (hr/yr):	8,760

Engine Emissions Data:

Pollutant	Emission Factor	Units	Maximum Potential Emissions		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
NO_X	1.00	g/bhp-hr	0.32	1.40	Vendor Data
VOC (excludes HCHO)	0.22	g/bhp-hr	0.07	0.67	Vendor Data
VOC (includes HCHO)	0.49	g/bhp-hr	0.16	1.05	Vendor Data
CO	2.00	g/bhp-hr	0.64	2.80	Vendor Data
SO_X	0.001	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
PM_{10}	0.02	lb/MMBtu	0.02	0.11	AP-42, Table 3.2-3 (Aug-2000)
$PM_{2.5}$	0.02	lb/MMBtu	0.02	0.11	AP-42, Table 3.2-3 (Aug-2000)
Formaldehyde (HCHO)	0.27	g/bhp-hr	0.09	0.38	Vendor Data
GHG (CO_2e)	See Table Below		170	745	40 CFR 98, Tables C-1 & C-2
Other (Total HAP)	See Table Below		0.10	0.44	AP-42, Table 3.2-3 (Aug-2000)

Notes:

1. PM_{10} and $PM_{2.5}$ are total values (filterable + condensable).
2. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CO_2 (GWP = 1) + CH_4 (GWP = 25) + N_2O (GWP = 298).
3. Total HAP is the summation of all hazardous air pollutants for which there is a published emission factor for this source type.

Company Name: **SWN Production Company, LLC**
Facility Name: **Ridgetop Land Ventures**
Project Description: **G-70 Application**

Compressor Engine

Greenhouse Gas (GHG) & Hazardous Air Pollutant (HAP) Emissions Calculations:

Pollutant	Emission Factor	Units	Maximum Potential Emissions		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
GHGs:					
CO_2	485.00	g/bhp-hr	155.04	679.08	Vendor Data
CH_4	1.870	g/bhp-hr	0.60	2.62	Vendor Data (THC-NMHC)
N_2O	0.0001	kg/MMBtu	0.00	0.00	40 CFR 98, Tables C-2
GHG (CO_2e)			**170**	**745**	
Organic HAPs:					
1,1,2,2-Tetrachloroethane	2.53E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
1,1,2-Trichloroethane	1.53E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
1,3-Butadiene	6.63E-04	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
1,3-Dichloropropene	1.27E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
Acetaldehyde	2.79E-03	lb/MMBtu	0.00	0.02	AP-42, Table 3.2-3 (Aug-2000)
Acrolein	2.63E-03	lb/MMBtu	0.00	0.01	AP-42, Table 3.2-3 (Aug-2000)
Benzene	1.58E-03	lb/MMBtu	0.00	0.01	AP-42, Table 3.2-3 (Aug-2000)
Carbon Tetrachloride	1.77E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
Chlorobenzene	1.29E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
Chloroform	1.37E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
Ethylbenzene	2.48E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
Ethylene Dibromide	2.13E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
Methanol	3.06E-03	lb/MMBtu	0.00	0.02	AP-42, Table 3.2-3 (Aug-2000)
Methylene Chloride	4.12E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
Naphthalene	9.71E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
PAH	1.41E-04	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
Styrene	1.19E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
Toluene	5.58E-04	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
Vinyl Chloride	7.18E-06	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
Xylene	1.95E-04	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
Total HAP			**0.10**	**0.44**	

Company Name: **SWN Production Company, LLC**
Facility Name: **Ridgetop Land Ventures**
Project Description: **G-70 Application**

VRU Engine 1

Engine Information:

Manufacturer:	General Motors
Model No.:	Vortec 5.7L NA
Engine ID	VRU-1
Stroke Cycle:	4-stroke
Type of Burn:	Rich
Rated Horsepower (bhp):	92
Control Device:	NSCR Catalyst

Engine Fuel Information:

Fuel Type:	Natural Gas
Higher Heating Value (HHV) (Btu/scf):	1,287
Specific Fuel Consumption (Btu/bhp-hr):	8,600
Maximum Fuel Consumption at 100% Load (scf/hr):	615
Heat Input (MMBtu/hr):	0.79
Potential Fuel Consumption (MMBtu/yr):	6,931
Max. Fuel Consumption at 100%(MMscf/hr):	0.0006
Max. Fuel Consumption (MMscf/yr):	5.4
Max. Annual Hours of Operation (hr/yr):	8,760

Engine Emissions Data:

Pollutant	Emission Factor	Units	Maximum Potential Emissions		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
NO_X	1.00	g/bhp-hr	0.20	0.89	Vendor Data
VOC (excludes HCHO)	0.70	g/bhp-hr	0.14	0.67	Vendor Data
VOC (includes HCHO)			0.16	0.74	VOC + HCHO
CO	2.00	g/bhp-hr	0.41	1.78	Vendor Data
SO_X	0.001	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
PM_{10}	0.02	lb/MMBtu	0.02	0.07	AP-42, Table 3.2-3 (Aug-2000)
$PM_{2.5}$	0.02	lb/MMBtu	0.02	0.07	AP-42, Table 3.2-3 (Aug-2000)
Formaldehyde (HCHO)	0.02	lb/MMBtu	0.02	0.07	AP-42, Table 3.2-3 (Aug-2000)
GHG (CO_2e)	See Table Below		93	406	40 CFR 98, Tables C-1 & C-2
Other (Total HAP)	See Table Below		0.03	0.11	AP-42, Table 3.2-3 (Aug-2000)

Notes:

1. PM_{10} and $PM_{2.5}$ are total values (filterable + condensable).
2. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CO_2 (GWP = 1) + CH_4 (GWP = 25) + N_2O (GWP = 298).
3. Total HAP is the summation of all hazardous air pollutants for which there is a published emission factor for this source type.

Company Name: **SWN Production Company, LLC**
Facility Name: **Ridgetop Land Ventures**
Project Description: **G-70 Application**

VRU Engine 1

Greenhouse Gas (GHG) & Hazardous Air Pollutant (HAP) Emissions Calculations:

Pollutant	Emission Factor	Units	Maximum Potential Emissions		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
GHGs:					
CO_2	53.06	kg/MMBtu	92.57	405.45	Vendor Data
CH_4	0.001	kg/MMBtu	0.00	0.01	40 CFR 98, Table C-2
N_2O	0.0001	kg/MMBtu	0.00	0.00	40 CFR 98, Table C-2
GHG (CO_2e)			**93**	**406**	
Organic HAPs:					
1,1,2,2-Tetrachloroethane	2.53E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
1,1,2-Trichloroethane	1.53E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
1,3-Butadiene	6.63E-04	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
1,3-Dichloropropene	1.27E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
Acetaldehyde	2.79E-03	lb/MMBtu	0.00	0.01	AP-42, Table 3.2-3 (Aug-2000)
Acrolein	2.63E-03	lb/MMBtu	0.00	0.01	AP-42, Table 3.2-3 (Aug-2000)
Benzene	1.58E-03	lb/MMBtu	0.00	0.01	AP-42, Table 3.2-3 (Aug-2000)
Carbon Tetrachloride	1.77E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
Chlorobenzene	1.29E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
Chloroform	1.37E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
Ethylbenzene	2.48E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
Ethylene Dibromide	2.13E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
Methanol	3.06E-03	lb/MMBtu	0.00	0.01	AP-42, Table 3.2-3 (Aug-2000)
Methylene Chloride	4.12E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
Naphthalene	9.71E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
PAH	1.41E-04	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
Styrene	1.19E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
Toluene	5.58E-04	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
Vinyl Chloride	7.18E-06	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
Xylene	1.95E-04	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
Total HAP			**0.03**	**0.11**	

Company Name: **SWN Production Company, LLC**
Facility Name: **Ridgetop Land Ventures**
Project Description: **G-70 Application**

VRU Engine 2

Engine Information:

Manufacturer:	Zenith
Model No.:	ZPP-644
Engine ID	VRU-2
Stroke Cycle:	4-stroke
Type of Burn:	Rich
Rated Horsepower (bhp):	77
Electrical output (KW)	57
Control Device:	NSCR Catalyst

Engine Fuel Information:

Fuel Type:	Natural Gas
Higher Heating Value (HHV) (Btu/scf):	1,287
Densiy of Natural Gas (lb/scf)	0.04
Specific Fuel Consumption (lbs/hr):	39
Maximum Fuel Consumption at 100% Load (scf/hr):	928
Heat Input (MMBtu/hr):	1.19
Potential Fuel Consumption (MMBtu/yr):	10,465
Max. Fuel Consumption at 100%(MMscf/hr):	0.0009
Max. Fuel Consumption (MMscf/yr):	8.1
Max. Annual Hours of Operation (hr/yr):	8,760

Engine Emissions Data:

Pollutant	Emission Factor	Units	Maximum Potential Emissions		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
NO_X	2.10	g/kw-hr	0.27	1.16	Vendor Data (= NMHC + NO_X)
VOC (excludes HCHO)	2.10	g/kw-hr	0.27	1.16	Vendor Data (= NMHC + NO_X)
VOC (includes HCHO)			0.29	1.27	VOC + HCHO
CO	6.00	g/kw-hr	0.76	3.33	Vendor Data
SO_X	0.001	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
PM_{10}	0.02	lb/MMBtu	0.02	0.10	AP-42, Table 3.2-3 (Aug-2000)
$PM_{2.5}$	0.02	lb/MMBtu	0.02	0.10	AP-42, Table 3.2-3 (Aug-2000)
Formaldehyde (HCHO)	0.02	lb/MMBtu	0.02	0.11	AP-42, Table 3.2-3 (Aug-2000)
GHG (CO_2e)	See Table Below		140	613	40 CFR 98, Tables C-1 & C-2
Other (Total HAP)	See Table Below		0.04	0.17	AP-42, Table 3.2-3 (Aug-2000)

Notes:

1. PM_{10} and $PM_{2.5}$ are total values (filterable + condensable).
2. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CO_2 (GWP = 1) + CH_4 (GWP = 25) + N_2O (GWP = 298).
3. Total HAP is the summation of all hazardous air pollutants for which there is a published emission factor for this source type.

Company Name: **SWN Production Company, LLC**
Facility Name: **Ridgetop Land Ventures**
Project Description: **G-70 Application**

VRU Engine 2

Greenhouse Gas (GHG) & Hazardous Air Pollutant (HAP) Emissions Calculations:

Pollutant	Emission Factor	Units	Maximum Potential Emissions		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
GHGs:					
CO_2	53.06	kg/MMBtu	139.76	612.17	Vendor Data
CH_4	0.001	kg/MMBtu	0.00	0.01	40 CFR 98, Table C-2
N_2O	0.0001	kg/MMBtu	0.00	0.00	40 CFR 98, Table C-2
GHG (CO_2e)			**140**	**613**	
Organic HAPs:					
1,1,2,2-Tetrachloroethane	2.53E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
1,1,2-Trichloroethane	1.53E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
1,3-Butadiene	6.63E-04	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
1,3-Dichloropropene	1.27E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
Acetaldehyde	2.79E-03	lb/MMBtu	0.00	0.01	AP-42, Table 3.2-3 (Aug-2000)
Acrolein	2.63E-03	lb/MMBtu	0.00	0.01	AP-42, Table 3.2-3 (Aug-2000)
Benzene	1.58E-03	lb/MMBtu	0.00	0.01	AP-42, Table 3.2-3 (Aug-2000)
Carbon Tetrachloride	1.77E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
Chlorobenzene	1.29E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
Chloroform	1.37E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
Ethylbenzene	2.48E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
Ethylene Dibromide	2.13E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
Methanol	3.06E-03	lb/MMBtu	0.00	0.02	AP-42, Table 3.2-3 (Aug-2000)
Methylene Chloride	4.12E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
Naphthalene	9.71E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
PAH	1.41E-04	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
Styrene	1.19E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
Toluene	5.58E-04	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
Vinyl Chloride	7.18E-06	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
Xylene	1.95E-04	lb/MMBtu	0.00	0.00	AP-42, Table 3.2-3 (Aug-2000)
Total HAP			**0.04**	**0.17**	

Company Name: **SWN Production Company, LLC**
Facility Name: **Ridgetop Land Ventures**
Project Description: **G-70 Application**

Heater Treaters

Parameter	Value	Units
Fuel Used	Natural Gas	
Higher Heating Value (HHV)	1,287	BTU/scf
Heat Input	0.50	MMBtu/hr (each)
Fuel Consumption	3.89E-04	MMscf/hr (each)
Annual Fuel Consumption	3.40	MMscf/yr (each)
Potential Annual Hours of Operation	8,760	hr/yr

Criteria and Manufacturer Specific Pollutant Emission Rates:

Pollutant	Emission Factor (lb/MMscf)[1]	Potential Emissions (lb/hr)[2]	Potential Emissions (tons/yr)[3]
NO_x	100	3.89E-02	1.7E-01
CO	84	3.26E-02	1.4E-01
SO_2	0.6	2.33E-04	1.0E-03
PM Total	7.6	2.95E-03	1.3E-02
PM Condensable	5.7	2.21E-03	9.7E-03
PM_{10} (Filterable)	1.9	7.38E-04	3.2E-03
$PM_{2.5}$ (Filterable)	1.9	7.38E-04	3.2E-03
VOC	5.5	2.14E-03	9.4E-03
Lead	5.00E-04	1.9E-07	8.5E-07
CO_2 (Natural Gas Firing)[4]	150,576	58	256
CH_4 (Natural Gas Firing)[4]	2.8	1.1E-03	4.8E-03
N_2O (Natural Gas Firing)[4]	0.28	1.1E-04	4.8E-04

Company Name: SWN Production Company, LLC
Facility Name: Ridgetop Land Ventures
Project Description: G-70 Application

Heater Treaters

Hazardous Air Pollutant (HAP) Potential Emissions:

Pollutant	Emission Factor (lb/MMscf)[1]	Potential Emissions (lb/hr)[2]	Potential Emissions (tons/yr)[3]
HAPs:			
Methylnaphthalene (2-)	2.4E-05	9.3E-09	4.1E-08
3-Methylchloranthrene	1.8E-06	7.0E-10	3.1E-09
7,12-Dimethylbenz(a)anthracene	1.6E-05	6.2E-09	2.7E-08
Acenaphthene	1.8E-06	7.0E-10	3.1E-09
Acenaphthylene	1.8E-06	7.0E-10	3.1E-09
Anthracene	2.4E-06	9.3E-10	4.1E-09
Benz(a)anthracene	1.8E-06	7.0E-10	3.1E-09
Benzene	2.1E-03	8.2E-07	3.6E-06
Benzo(a)pyrene	1.2E-06	4.7E-10	2.0E-09
Benzo(b)fluoranthene	1.8E-06	7.0E-10	3.1E-09
Benzo(g,h,i)perylene	1.2E-06	4.7E-10	2.0E-09
Benzo(k)fluoranthene	1.8E-06	7.0E-10	3.1E-09
Chrysene	1.8E-06	7.0E-10	3.1E-09
Dibenzo(a,h) anthracene	1.2E-06	4.7E-10	2.0E-09
Dichlorobenzene	1.2E-03	4.7E-07	2.0E-06
Fluoranthene	3.0E-06	1.2E-09	5.1E-09
Fluorine	2.8E-06	1.1E-09	4.8E-09
Formaldehyde	7.5E-02	2.9E-05	1.3E-04
Hexane	1.8E+00	7.0E-04	3.1E-03
Indo(1,2,3-cd)pyrene	1.8E-06	7.0E-10	3.1E-09
Naphthalene	6.1E-04	2.4E-07	1.0E-06
Phenanthrene	1.7E-05	6.6E-09	2.9E-08
Pyrene	5.0E-06	1.9E-09	8.5E-09
Toluene	3.4E-03	1.3E-06	5.8E-06
Arsenic	2.0E-04	7.8E-08	3.4E-07
Beryllium	1.2E-05	4.7E-09	2.0E-08
Cadmium	1.1E-03	4.3E-07	1.9E-06
Chromium	1.4E-03	5.4E-07	2.4E-06
Cobalt	8.4E-05	3.3E-08	1.4E-07
Manganese	3.8E-04	1.5E-07	6.5E-07
Mercury	2.6E-04	1.0E-07	4.4E-07
Nickel	2.1E-03	8.2E-07	3.6E-06
Selenium	2.4E-05	9.3E-09	4.1E-08
Total HAP		**7.3E-04**	**3.2E-03**

[1] Emission factors from AP-42 Section 1.4 "Natural Gas Combustion" Tables 1.4-1, 1.4-2, 1.4-3, & 1.4-4.
[2] Emission Rate (lb/hr) = Rated Capacity (MMscf/hr) × Emission Factor (lb/MMscf).
[3] Annual Emissions $(tons/yr)_{Potential}$ = $(lb/hr)_{Emissions}$ × (Maximum Allowable Operating Hours, 8760 hr/yr) × (1 ton/2000 lb).
[4] GHG Emission factors from Tables C-1 and C-2, 40 CFR 98, Subpart C.

Company Name: **SWN Production Company, LLC**
Facility Name: **Ridgetop Land Ventures**
Project Description: **G-70 Application**

GPU Burners

Parameter	Value	Units
Fuel Used	Natural Gas	
Higher Heating Value (HHV)	1,287	BTU/scf
Heat Input	1.00	MMBtu/hr (each)
Fuel Consumption [1]	7.77E-04	MMscf/hr (each)
Annual Fuel Consumption	6.81	MMscf/yr (each)
Potential Annual Hours of Operation	8,760	hr/yr

Criteria and Manufacturer Specific Pollutant Emission Rates:

Pollutant	Emission Factor (lb/MMscf)[1]	Potential Emissions (lb/hr)[2]	Potential Emissions (tons/yr)[3]
NO_x	100	7.77E-02	3.4E-01
CO	84	6.53E-02	2.9E-01
SO_2	0.6	4.66E-04	2.0E-03
PM Total	7.6	5.91E-03	2.6E-02
PM Condensable	5.7	4.43E-03	1.9E-02
PM_{10} (Filterable)	1.9	1.48E-03	6.5E-03
$PM_{2.5}$ (Filterable)	1.9	1.48E-03	6.5E-03
VOC	5.5	4.27E-03	1.9E-02
Lead	5.00E-04	3.89E-07	1.7E-06
CO_2 (Natural Gas Firing)[4]	150,576	117.00	512
CH_4 (Natural Gas Firing)[4]	2.8	0.00	9.7E-03
N_2O (Natural Gas Firing)[4]	0.28	0.00	9.7E-04

Company Name: SWN Production Company, LLC
Facility Name: Ridgetop Land Ventures
Project Description: G-70 Application

GPU Burners

Hazardous Air Pollutant (HAP) Potential Emissions:

Pollutant	Emission Factor (lb/MMscf)[1]	Potential Emissions (lb/hr)[2]	Potential Emissions (tons/yr)[3]
HAPs:			
Methylnaphthalene (2-)	2.4E-05	1.9E-08	8.2E-08
3-Methylchloranthrene	1.8E-06	1.4E-09	6.1E-09
7,12-Dimethylbenz(a)anthracene	1.6E-05	1.2E-08	5.4E-08
Acenaphthene	1.8E-06	1.4E-09	6.1E-09
Acenaphthylene	1.8E-06	1.4E-09	6.1E-09
Anthracene	2.4E-06	1.9E-09	8.2E-09
Benz(a)anthracene	1.8E-06	1.4E-09	6.1E-09
Benzene	2.1E-03	1.6E-06	7.1E-06
Benzo(a)pyrene	1.2E-06	9.3E-10	4.1E-09
Benzo(b)fluoranthene	1.8E-06	1.4E-09	6.1E-09
Benzo(g,h,i)perylene	1.2E-06	9.3E-10	4.1E-09
Benzo(k)fluoranthene	1.8E-06	1.4E-09	6.1E-09
Chrysene	1.8E-06	1.4E-09	6.1E-09
Dibenzo(a,h) anthracene	1.2E-06	9.3E-10	4.1E-09
Dichlorobenzene	1.2E-03	9.3E-07	4.1E-06
Fluoranthene	3.0E-06	2.3E-09	1.0E-08
Fluorine	2.8E-06	2.2E-09	9.5E-09
Formaldehyde	7.5E-02	5.8E-05	2.6E-04
Hexane	1.8E+00	1.4E-03	6.1E-03
Indo(1,2,3-cd)pyrene	1.8E-06	1.4E-09	6.1E-09
Naphthalene	6.1E-04	4.7E-07	2.1E-06
Phenanthrene	1.7E-05	1.3E-08	5.8E-08
Pyrene	5.0E-06	3.9E-09	1.7E-08
Toluene	3.4E-03	2.6E-06	1.2E-05
Arsenic	2.0E-04	1.6E-07	6.8E-07
Beryllium	1.2E-05	9.3E-09	4.1E-08
Cadmium	1.1E-03	8.5E-07	3.7E-06
Chromium	1.4E-03	1.1E-06	4.8E-06
Cobalt	8.4E-05	6.5E-08	2.9E-07
Manganese	3.8E-04	3.0E-07	1.3E-06
Mercury	2.6E-04	2.0E-07	8.8E-07
Nickel	2.1E-03	1.6E-06	7.1E-06
Selenium	2.4E-05	1.9E-08	8.2E-08
Total HAP		**1.5E-03**	**6.4E-03**

[1] Emission factors from AP-42 Section 1.4 "Natural Gas Combustion" Tables 1.4-1, 1.4-2, 1.4-3, & 1.4-4.

[2] Emission Rate (lb/hr) = Rated Capacity (MMscf/hr) × Emission Factor (lb/MMscf).

[3] Annual Emissions $(tons/yr)_{Potential}$ = $(lb/hr)_{Emissions}$ × (Maximum Allowable Operating Hours, 8760 hr/yr) × (1 ton/2000 lb).

[4] GHG Emission factors from Tables C-1 and C-2, 40 CFR 98, Subpart C.

Company Name: SWN Production Company, LLC
Facility Name: Ridgetop Land Ventures
Project Description: G-70 Application

Fugitive Equipment Leaks

VOC Fugitive Emissions from Component Leaks

Equipment Type	Emission Factors [1] (lb/hr/source)	Facility Equipment Count [2, 3] (units)	Hourly Fugitive VOC Emissions (lb/hr)	Annual Fugitive VOC Emissions (tpy)	Hourly Fugitive HAP Emissions (lb/hr)	Annual Fugitive HAP Emissions (tpy)
Gas/Vapor Service:						
Connectors	4.41E-04	422	0.04	0.16	0.00	0.00
Valves	9.92E-03	90	0.18	0.79	0.00	0.02
Flanges	8.60E-04	422	0.07	0.32	0.00	0.01
Compressor Seals	1.94E-02	12	0.05	0.21	0.00	0.01
Relief Valves	1.94E-02	32	0.12	0.55	0.00	0.01
Open-Ended Lines	4.41E-05	0	0.00	0.00	0.00	0.00
Light Liquid Service:						
Connectors	4.63E-04	466	0.04	0.19	0.00	0.00
Valves	5.51E-03	118	0.13	0.57	0.00	0.01
Flanges	2.40E-04	466	0.02	0.10	0.00	0.00
Pump Seals	2.87E-02	0	0.00	0.00	0.00	0.00
Relief Valves	1.65E-02	0	0.00	0.00	0.00	0.00
Emission Totals:			**0.66**	**2.89**	**0.02**	**0.08**

Notes:
1. All emission factors are from U.S. EPA's *Protocol for Equipment Leak Emission Estimates* (Table 2-4)
2. "Other" equipment types include compressor seals, relief valves, diaphragms, drains, meters, etc.
3. The component count is estimated based on design.
4. VOC and HAP emissions are based on fractions of site specific gas analysis.

GHG Fugitive Emissions from Component Leaks

Component	Component Count [1]	GHG Emission Factor [2] (scf/hr/component)	CH_4 Emissions [3,4] (tpy)	CO_2 Emissions [3,4] (tpy)	CO_2e Emissions [5] (tpy)
Gas/Vapor Service:					
Connectors	422	3.00E-03	0.18	0.00	4.54
Valves	90	2.70E-02	0.35	0.00	8.72
Flanges	422	3.00E-03	0.18	0.00	4.54
Compressor Seals	12	1.33E+01	22.90	0.15	572.55
Relief Valves	32	4.00E-02	0.18	0.00	4.59
Light Liquid Service:					
Connectors	466	7.00E-03	0.47	0.00	11.70
Valves	118	5.00E-02	0.85	0.01	21.17
Flanges	466	3.00E-03	0.20	0.00	5.02
Pump Seals	0	1.00E-02	0.00	0.00	0.00
Relief Valves	0	3.00E-01	0.00	0.00	0.00
Total			**25.31**	**0.16**	**633**

Notes:
1. Population emission factors for gas service in the Eastern U.S. from *Table W-1A of Subpart W - Default Whole Gas Emission Factors for Onshore Production* , 40 CFR 98, Subpart W.
2. Calculated in accordance with Equations W-31, W-35 and W-36 in Subpart W of 40 CFR 98.
3. Mole fractions of CH_4 and CO_2 based on gas analysis:
   CH_4: 77% CO_2: 0.18%
4. Carbon equivalent emissions (CO_2e) are based on the following Global Warming Potentials (GWP) from 40 CFR Part 98, Table A-1:
   Carbon Dioxide (CO_2): 1
   Methane (CH_4): 25

Company Name: SWN Production Company, LLC
Facility Name: Ridgetop Land Ventures
Project Description: G-70 Application

Fugitive Equipment Leaks

VOC/GHG Fugitive Emissions from Blowdowns:

Blowdown Type	Number of Events	Gas Volume (scf/event)	VOC Emissions (tpy)	HAP Emissions (tpy)	CH_4 Emissions (tpy)	CO_2 Emissions (tpy)	CO_2e Emissions (tpy)
Compressor	48	1,000	0.08	0.00	0.79	0.01	19.66
Total			**0.08**	**0.00**	**0.79**	**0.01**	**19.66**

Notes:

1. The number of compressor blowdowns assumes 2 blowdowns per compressor per month.
2. CH_4 and CO_2 emissions are based on fractions of these pollutants in the site-specific gas analysis.
3. Emissions are calculated in accordance with Equations W-31, W-35 and W-36 in Subpart W of 40 CFR 98.
4. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CO_2 (GWP = 1) + CH_4 (GWP = 25) + N_2O (GWP = 298).

Fugitive Component Emissions Data:

Pollutant	Atmospheric Emissions		Emissions Estimation Method
	lbs/hr	tpy	
VOC	0.68	2.97	EPA Protocol, Table 2-4 and Site-Specific Gas Analysis
HAPs	0.02	0.08	EPA Protocol, Table 2-4 and Site-Specific Gas Analysis
GHG (CO_2e)	149	652	40 CFR 98, Table W-1A and Site-Specific Gas Analysis

Company Name: SWN Production Company, LLC
Facility Name: Ridgetop Land Ventures
Project Description: G-70 Application

Condensate Loading

Liquid Loading Losses:

Description	Maximum Throughput[1] (gal)
Liquids Hauling	12,478,620

[1] Sum of the annual condensate throughput from each well at the pad.

[2] The capture efficiency is 70% and the control efficiency is 95% for an overall reduction efficiency of 66.5 percent.

Constituent	Total Emissions [1] lb/hr	tpy
Propane	4.621	20.240
Isobutane	1.070	4.685
n-Butane	2.452	10.740
Isopentane	0.775	3.396
n-Pentane	0.782	3.427
n-Hexane	0.255	1.118
Methylcyclopentane	0.020	0.086
Benzene	0.002	0.011
Cyclohexane	0.024	0.103
n-Heptane	0.102	0.445
n-Octane	0.052	0.229
n-Nonane	0.009	0.038
n-Decane	0.002	0.010
n-Undecane	0.001	0.004
Dodecane	0.000	0.000
Triethylene Glycol	0.000	0.000
Cyclopentane	0.002	0.008
Isohexane	0.000	0.000
3-Methylpentane	0.308	1.351
Neohexane	0.310	1.356
2,3-Dimethylbutane	0.060	0.261
Methylcyclohexane	0.041	0.181
Isooctane	0.000	0.000
Decane, 2-Methyl-	0.000	0.000
Toluene	0.005	0.020
m-Xylene	0.004	0.016
Ethylbenzene	0.001	0.006
Total Emissions:	10.897	47.730
Total VOC Emissions:	10.897	47.730
Total HAP Emissions:	0.27	1.17

[1] Liquid loading emissions were estimated using ProMax software. Vapor Balance loading and dedicated normal service options were selected and the overall reduction efficiency of 66.5 percent was used.

Company Name: SWN Production Company, LLC
Facility Name: Ridgetop Land Ventures
Project Description: G-70 Application

Produced Water Loading

Liquid Loading Losses:

Description	Maximum Throughput[1] (gal)
Liquids Hauling	12,923,190

[1] Sum of the annual produced water throughput from each well at the pad.
[2] The capture efficiency is 70% and the control efficiency is 95% for an overall reduction efficiency of 66.5 percent.

Constituent	Total Emissions [1] lb/hr	tpy
Propane	0.541	2.368
Isobutane	0.008	0.037
n-Butane	0.056	0.244
Isopentane	0.003	0.014
n-Pentane	0.003	0.011
n-Hexane	0.000	0.000
Methylcyclopentane	0.000	0.001
Benzene	0.001	0.006
Cyclohexane	0.000	0.001
n-Heptane	0.000	0.000
n-Octane	0.000	0.000
n-Nonane	0.000	0.000
n-Decane	0.000	0.000
n-Undecane	0.000	0.000
Dodecane	0.000	0.000
Triethylene Glycol	0.000	0.000
Cyclopentane	0.000	0.000
Isohexane	0.000	0.000
3-Methylpentane	0.001	0.002
Neohexane	0.000	0.000
2,3-Dimethylbutane	0.000	0.000
Methylcyclohexane	0.000	0.000
Isooctane	0.000	0.000
Decane, 2-Methyl-	0.000	0.000
Toluene	0.001	0.003
m-Xylene	0.000	0.001
Ethylbenzene	0.000	0.000
Total Emissions:	0.614	2.688
Total VOC Emissions:	0.614	2.688
Total HAP Emissions:	0.00	0.01

[1] Liquid loading emissions were estimated using ProMax software. Vapor Balance loading and dedicated normal service options were selected and the overall reduction efficiency of 66.5 percent was used.

Company Name: SWN Production Company, LLC
Facility Name: Ridgetop Land Ventures
Project Description: G-70 Application

Haul Roads

Estimated Potential Road Fugitive Emissions

Unpaved Road Emissions

Unpaved Roads: $E\ (lb/VMT) = k(s/12)^a(W/3)^b)*[(365-p)/365]$

	PM		PM_{10}	$PM_{2.5}$	
k Factor (lb/VMT)	4.9		1.5	0.15	AP-42 Table 13.2.2-2 (Final, 11/06)
Silt content, s	4.8	%			AP-42 Table 13.2.2-1 (11/06), for Sand and Gravel Processing
Number of Rain Days, p	150				AP-42 Figure 13.2.1-2
a	0.7		0.9	0.9	AP-42 Table 13.2.2-2 (Final, 11/06)
b	0.45		0.45	0.45	AP-42 Table 13.2.2-2 (Final, 11/06)

Description	Weight of Empty Truck (tons)	Weight of Truck w/ Max Load (tons)	Mean Vehicle Weight (tons)	Length of Unpaved Road Traveled (mile/trip)	Trips Per Year	Mileage Per Year	Control (%)	Emissions (tpy) PM	PM_{10}	$PM_{2.5}$
Liquids Hauling	20	40	30	0.30	6,350	1,924	0	4.12	1.05	0.105
Employee Vehicles	3	3	3	0.30	200	61	0	0.05	0.01	0.001
Total Potential Emissions								**4.17**	**1.06**	**0.11**

Company Name: **SWN Production Company, LLC**
Facility Name: **Ridgetop Land Ventures**
Project Description: **G-70 Application**

Gas Analysis

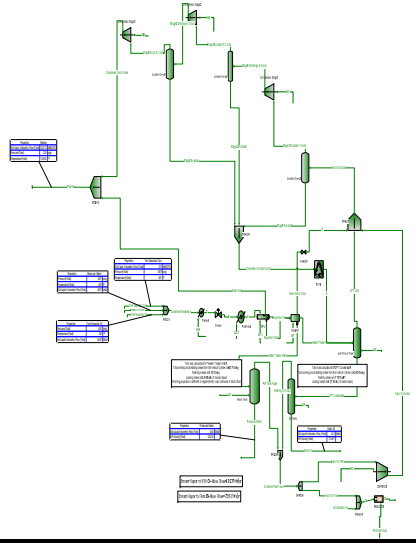
Sample Location: Berisford No. 1-H
Sample Date: 2/25/2011
HHV (Btu/scf): 1,287

Constituent	Natural Gas Stream Speciation (Mole %)	Molecular Weight	Molar Weight	Average Weight Fraction	Natural Gas Stream Speciation (Wt. %)
Carbon Dioxide	0.180	44.01	7.9E-02	3.8E-03	0.38
Nitrogen	0.433	28.01	1.2E-01	5.8E-03	0.58
Methane	77.380	16.04	1.2E+01	5.9E-01	58.92
Ethane	14.005	30.07	4.2E+00	2.0E-01	19.99
Propane	4.820	44.10	2.1E+00	1.0E-01	10.09
Isobutane	0.622	58.12	3.6E-01	1.7E-02	1.72
n-Butane	1.329	58.12	7.7E-01	3.7E-02	3.67
Isopentane	0.350	72.15	2.5E-01	1.2E-02	1.20
n-Pentane	0.384	72.15	2.8E-01	1.3E-02	1.32
Cyclopentane	0.002	70.1	1.4E-03	6.7E-05	0.01
Methylcyclopentane	0.009	84.2	7.6E-03	3.6E-04	0.04
n-Hexane	0.121	86.18	1.0E-01	5.0E-03	0.50
Cyclohexane	0.012	84.16	1.0E-02	4.8E-04	0.05
Other Hexanes	0.219	86.18	1.9E-01	9.0E-03	0.90
Heptanes	0.058	100.21	5.8E-02	2.8E-03	0.28
Methylcyclohexane	0.020	98.19	2.0E-02	9.3E-04	0.09
2,2,4-Trimethylpentane	<0.001	114.23	0.0E+00	0.0E+00	0.00
Benzene*	0.002	78.11	1.6E-03	7.4E-05	0.01
Toluene*	0.003	92.14	2.8E-03	1.3E-04	0.01
Ethylbenzene*	<0.001	106.17	<0.001	<0.001	<0.001
Xylenes*	0.002	106.16	2.1E-03	1.0E-04	0.01
C8 + Heavies	0.049	114.23	5.6E-02	2.7E-03	0.27
Oxygen			0.000	0.000	0.000
Totals	100.00		21.06	1.00	100

TOC (Total)	99.39	99.05
VOC (Total)	8.00	20.1
HAP (Total)	0.13	0.53

Ridgeland Ventures
Plant Schematic

Client Name:	Southwestern Energy	Job: V1.0
Location:	RidgetopWellpad	
Flowsheet:	Ridgeland Ventures	



Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Southwestern Energy	Job: V1.0
Location:	RidgetopWellpad	
Flowsheet:	Ridgeland Ventures	

Connections

	Pipeline	Produced Water	Reservoir Water	Sales Oil	Test Separator Gas
From Block	MIX-101	Water Tanks	--	Oil Tanks	--
To Block	--	--	MIX-102	--	MIX-102

Stream Composition

Mole Fraction	Pipeline	Produced Water	Reservoir Water	Sales Oil	Test Separator Gas
Nitrogen	0.00429754	6.13809E-09	0 *	2.05272E-08	0.00433 *
Methane	0.766798	1.01166E-05	0 *	0.000251091	0.7738 *
CO2	0.00179082	2.5852E-06	0 *	1.50026E-05	0.0018 *
Ethane	0.141581	8.64784E-06	0 *	0.00871455	0.14005 *
Propane	0.0503192	5.86595E-06	0 *	0.0418594	0.04838 *
Isobutane	0.00657793	1.93612E-07	0 *	0.0215077	0.00622 *
n-Butane	0.014015	1.95477E-06	0 *	0.073068	0.01329 *
Isopentane	0.00362414	2.48888E-07	0 *	0.0528971	0.0035 *
n-Pentane	0.0037461	2.72717E-07	0 *	0.0734148	0.00366 *
n-Hexane	0.00113512	1.93351E-08	0 *	0.0742845	0.00121 *
Methylcyclopentane	9.47201E-05	4.50055E-08	0 *	0.00627793	9E-05 *
Benzene	1.90933E-05	8.39482E-07	0 *	0.00126093	2E-05 *
Cyclohexane	0.000126749	1.33315E-07	0 *	0.0105335	0.00012 *
n-Heptane	0.00047547	6.08987E-09	0 *	0.0904915	0.00058 *
n-Octane	0.00024884	2.18787E-09	0 *	0.145231	0.00039 *
n-Nonane	4.18938E-05	2.76211E-09	0 *	0.0736105	8E-05 *
n-Decane	1.16317E-05	4.30088E-10	0 *	0.0577838	2E-05 *
n-Undecane	4.62404E-06	3.37849E-10	0 *	0.0737949	0 *
Dodecane	0	0	0 *	0	0 *
Water	0.00199735	0.999966	1 *	0.00414346	0 *
Triethylene Glycol	0	0	0 *	0	0 *
Oxygen	0	0	0 *	0	0 *
Argon	0	0	0 *	0	0 *
Carbon Monoxide	0	0	0 *	0	0 *
Cyclopentane	1.0582E-05	1.01219E-08	0 *	0.000301819	2E-05 *
Isohexane	0	0	0 *	0	0 *
3-Methylpentane	0.00132295	1.45715E-07	0 *	0.070363	0.00145 *
Neohexane	0.0012534	1.31367E-08	0 *	0.0398288	0.00048 *
2,3-Dimethylbutane	0.000248306	1.12864E-08	0 *	0.0107073	0.00026 *
Methylcyclohexane	0.000194227	6.36062E-08	0 *	0.0360878	0.0002 *
Isooctane	0	0	0 *	0	0 *
Decane, 2-Methyl-	0	0	0 *	0	0 *
Toluene	3.21043E-05	1.22221E-06	0 *	0.00758965	3E-05 *
m-Xylene	2.44643E-05	8.50593E-07	0 *	0.0199245	2E-05 *
Ethylbenzene	8.82005E-06	2.79352E-07	0 *	0.00605712	0 *

Molar Flow	Pipeline lbmol/h	Produced Water lbmol/h	Reservoir Water lbmol/h	Sales Oil lbmol/h	Test Separator Gas lbmol/h
Nitrogen	11.9727	4.18925E-06	0 *	1.72786E-06	11.8856 *
Methane	2136.26	0.00690462	0 *	0.0211353	2124.04 *
CO2	4.98915	0.0017644	0 *	0.00126283	4.94091 *
Ethane	394.438	0.00590216	0 *	0.733537	384.43 *
Propane	140.187	0.00400352	0 *	3.52347	132.801 *
Isobutane	18.3258	0.000132141	0 *	1.81038	17.0736 *
n-Butane	39.045	0.00133413	0 *	6.15041	36.4804 *
Isopentane	10.0967	0.000169866	0 *	4.45255	9.60733 *
n-Pentane	10.4365	0.00018613	0 *	6.1796	10.0465 *
n-Hexane	3.16239	1.31962E-05	0 *	6.25281	3.32139 *
Methylcyclopentane	0.263886	3.07163E-05	0 *	0.528437	0.247046 *
Benzene	0.053193	0.000572947	0 *	0.106137	0.054899 *
Cyclohexane	0.353117	9.09873E-05	0 *	0.886642	0.329394 *

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Southwestern Energy	Job: V1.0
Location:	RidgetopWellpad	
Flowsheet:	Ridgeland Ventures	

Molar Flow	Pipeline lbmol/h	Produced Water lbmol/h	Reservoir Water lbmol/h	Sales Oil lbmol/h	Test Separator Gas lbmol/h
n-Heptane	1.32464	4.15634E-06	0 *	7.61702	1.59207 *
n-Octane	0.693256	1.49322E-06	0 *	12.2247	1.07053 *
n-Nonane	0.116714	1.88514E-06	0 *	6.19608	0.219596 *
n-Decane	0.0324055	2.93536E-07	0 *	4.86389	0.054899 *
n-Undecane	0.0128824	2.30582E-07	0 *	6.2116	0 *
Dodecane	0	0	0 *	0	0 *
Water	5.56451	682.478	688.393 *	0.348771	0 *
Triethylene Glycol	0	0	0 *	0	0 *
Oxygen	0	0	0 *	0	0 *
Argon	0	0	0 *	0	0 *
Carbon Monoxide	0	0	0 *	0	0 *
Cyclopentane	0.029481	6.90821E-06	0 *	0.0254053	0.054899 *
Isohexane	0	0	0 *	0	0 *
3-Methylpentane	3.68567	9.94506E-05	0 *	5.92272	3.98018 *
Neohexane	3.49193	8.96578E-06	0 *	3.35254	1.31758 *
2,3-Dimethylbutane	0.691768	7.70297E-06	0 *	0.901274	0.713687 *
Methylcyclohexane	0.541108	4.34113E-05	0 *	3.03764	0.54899 *
Isooctane	0	0	0 *	0	0 *
Decane, 2-Methyl-	0	0	0 *	0	0 *
Toluene	0.0894411	0.000834161	0 *	0.63885	0.0823486 *
m-Xylene	0.0681564	0.000580531	0 *	1.67712	0.054899 *
Ethylbenzene	0.0245722	0.000190658	0 *	0.509851	0 *

Mass Fraction	Pipeline	Produced Water	Reservoir Water	Sales Oil	Test Separator Gas
Nitrogen	0.00567531	9.54423E-09	0 *	5.92779E-09	0.00575877 *
Methane	0.579903	9.00845E-06	0 *	4.15239E-05	0.589354 *
CO2	0.00371537	6.31513E-06	0 *	6.80627E-06	0.00376093 *
Ethane	0.200691	1.44334E-05	0 *	0.00270123	0.19993 *
Propane	0.1046	1.43574E-05	0 *	0.0190276	0.101283 *
Isobutane	0.0180233	6.24622E-07	0 *	0.0128864	0.0171636 *
n-Butane	0.0384006	6.30638E-06	0 *	0.043779	0.0366727 *
Isopentane	0.0123264	9.96725E-07	0 *	0.0393421	0.0119887 *
n-Pentane	0.0127413	1.09215E-06	0 *	0.0546021	0.0125368 *
n-Hexane	0.00461135	9.24853E-08	0 *	0.06599	0.00495045 *
Methylcyclopentane	0.000375793	2.10238E-07	0 *	0.00544648	0.000359602 *
Benzene	7.03075E-05	3.63974E-06	0 *	0.00101532	7.41691E-05 *
Cyclohexane	0.000502865	6.22763E-07	0 *	0.00913841	0.000479469 *
n-Heptane	0.00224596	3.38709E-08	0 *	0.0934718	0.00275918 *
n-Octane	0.00133998	1.3872E-08	0 *	0.171014	0.00211502 *
n-Nonane	0.000253296	1.96633E-08	0 *	0.097322	0.000487126 *
n-Decane	7.80184E-05	3.39663E-09	0 *	0.0847524	0.0001351 *
n-Undecane	3.40727E-05	2.93121E-09	0 *	0.118906	0 *
Dodecane	0	0	0 *	0	0 *
Water	0.00169628	0.999928	1 *	0.000769486	0 *
Triethylene Glycol	0	0	0 *	0	0 *
Oxygen	0	0	0 *	0	0 *
Argon	0	0	0 *	0	0 *
Carbon Monoxide	0	0	0 *	0	0 *
Cyclopentane	3.4986E-05	3.94027E-08	0 *	0.000218205	6.65929E-05 *
Isohexane	0	0	0 *	0	0 *
3-Methylpentane	0.00537439	6.96995E-07	0 *	0.0625063	0.00593236 *
Neohexane	0.00509188	6.28362E-08	0 *	0.0353815	0.00196382 *
2,3-Dimethylbutane	0.00100873	5.39859E-08	0 *	0.00951173	0.00106373 *
Methylcyclohexane	0.000899008	3.4665E-07	0 *	0.0365263	0.000932301 *
Isooctane	0	0	0 *	0	0 *
Decane, 2-Methyl-	0	0	0 *	0	0 *
Toluene	0.000139447	6.25071E-06	0 *	0.00720874	0.000131232 *
m-Xylene	0.000122438	5.0124E-06	0 *	0.0218054	0.000100806 *

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Southwestern Energy	Job: V1.0
Location:	RidgetopWellpad	
Flowsheet:	Ridgeland Ventures	

Mass Fraction	Pipeline	Produced Water	Reservoir Water	Sales Oil	Test Separator Gas
Ethylbenzene	4.41424E-05	1.64617E-06	0 *	0.00662894	0 *

Mass Flow	Pipeline lb/h	Produced Water lb/h	Reservoir Water lb/h	Sales Oil lb/h	Test Separator Gas lb/h
Nitrogen	335.397	0.000117355	0 *	4.84031E-05	332.957 *
Methane	34270.9	0.110767	0 *	0.339062	34074.9 *
CO2	219.57	0.0776504	0 *	0.0555763	217.447 *
Ethane	11860.4	0.177472	0 *	22.0567	11559.5 *
Propane	6181.63	0.176538	0 *	155.369	5855.93 *
Isobutane	1065.14	0.0076803	0 *	105.223	992.355 *
n-Butane	2269.38	0.0775428	0 *	357.475	2120.32 *
Isopentane	728.464	0.0122557	0 *	321.246	693.157 *
n-Pentane	752.978	0.013429	0 *	445.851	724.844 *
n-Hexane	272.52	0.00113719	0 *	538.838	286.222 *
Methylcyclopentane	22.2085	0.00258507	0 *	44.473	20.7912 *
Benzene	4.15501	0.044754	0 *	8.29056	4.28826 *
Cyclohexane	29.7181	0.00765745	0 *	74.6193	27.7216 *
n-Heptane	132.731	0.000416474	0 *	763.24	159.529 *
n-Octane	79.1896	0.000170568	0 *	1396.41	122.285 *
n-Nonane	14.9692	0.000241779	0 *	794.679	28.1643 *
n-Decane	4.6107	4.17647E-05	0 *	692.042	7.81113 *
n-Undecane	2.01362	3.60419E-05	0 *	970.924	0 *
Dodecane	0	0	0 *	0	0 *
Water	100.246	12295	12401.6 *	6.2832	0 *
Triethylene Glycol	0	0	0 *	0	0 *
Oxygen	0	0	0 *	0	0 *
Argon	0	0	0 *	0	0 *
Carbon Monoxide	0	0	0 *	0	0 *
Cyclopentane	2.06759	0.000484493	0 *	1.78175	3.85023 *
Isohexane	0	0	0 *	0	0 *
3-Methylpentane	317.614	0.00857019	0 *	510.392	342.993 *
Neohexane	300.918	0.000772629	0 *	288.906	113.543 *
2,3-Dimethylbutane	59.6134	0.000663807	0 *	77.6676	61.5023 *
Methylcyclohexane	53.1293	0.00426238	0 *	298.254	53.9032 *
Isooctane	0	0	0 *	0	0 *
Decane, 2-Methyl-	0	0	0 *	0	0 *
Toluene	8.24096	0.0768582	0 *	58.8626	7.58747 *
m-Xylene	7.23582	0.061632	0 *	178.051	5.82836 *
Ethylbenzene	2.60871	0.0202412	0 *	54.1284	0 *

Volumetric Flow	Pipeline ft^3/h	Produced Water gpm	Reservoir Water gpm	Sales Oil gpm	Test Separator Gas ft^3/h
Nitrogen	305.848	3.13436E-07	0	1.59609E-07	169.993
Methane	52141.6	0.000541363	0	0.00201435	27768.7
CO2	117.049	0.000121462	0	7.03589E-05	59.4613
Ethane	8745	0.00059325	0	0.0908938	4098.31
Propane	2858.1	0.000504924	0	0.571296	1158.79
Isobutane	349.474	2.00876E-05	0	0.365623	124.42
n-Butane	723.467	0.000200267	0	1.2057	242.953
Isopentane	172.502	2.94693E-05	0	1.02577	48.6153
n-Pentane	175.594	3.23536E-05	0	1.41271	47.6604
n-Hexane	47.5206	2.60412E-06	0	1.62868	9.56416
Methylcyclopentane	4.14451	5.36809E-06	0	0.118495	0.82802
Benzene	0.863534	8.34634E-05	0	0.018475	0.202681
Cyclohexane	5.50239	1.54703E-05	0	0.190861	1.036
n-Heptane	17.5306	9.2269E-07	0	2.2358	2.71427
n-Octane	8.06332	3.6598E-07	0	3.95758	1.74018
n-Nonane	1.1377	5.06496E-07	0	2.19576	0.456441

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Southwestern Energy	Job: V1.0
Location:	RidgetopWellpad	
Flowsheet:	Ridgeland Ventures	

Volumetric Flow	Pipeline ft^3/h	Produced Water gpm	Reservoir Water gpm	Sales Oil gpm	Test Separator Gas ft^3/h
n-Decane	0.258724	8.6106E-08	0	1.88055	0.141913
n-Undecane	0.0783293	7.32931E-08	0	2.59627	0
Dodecane	0	0	0	0	0
Water	131.793	24.6144	24.8117	0.0106625	0
Triethylene Glycol	0	0	0	0	0
Oxygen	0	0	0	0	0
Argon	0	0	0	0	0
Carbon Monoxide	0	0	0	0	0
Cyclopentane	0.497488	1.03207E-06	0	0.00472827	0.253047
Isohexane	0	0	0	0	0
3-Methylpentane	56.6991	1.94518E-05	0	1.53648	12.7937
Neohexane	55.787	1.76408E-06	0	0.889974	5.10727
2,3-Dimethylbutane	10.8159	1.50243E-06	0	0.234776	2.49014
Methylcyclohexane	7.62767	8.51928E-06	0	0.773048	1.12458
Isooctane	0	0	0	0	0
Decane, 2-Methyl-	0	0	0	0	0
Toluene	1.28691	0.00014189	0	0.133216	0.16548
m-Xylene	0.869411	0.000112859	0	0.405058	0.0859432
Ethylbenzene	0.319084	3.68681E-05	0	0.122911	0

Std. Liquid Volumetric Fraction	Pipeline	Produced Water	Reservoir Water	Sales Oil	Test Separator Gas
Nitrogen	0.00243623	1.18278E-08	0 *	5.06357E-09	0.0024595 *
Methane	0.669842	3.00399E-05	0 *	9.54443E-05	0.677299 *
CO2	0.00157481	7.72751E-06	0 *	5.74076E-06	0.00158602 *
Ethane	0.195106	4.05082E-05	0 *	0.00522562	0.193379 *
Propane	0.0714337	2.8306E-05	0 *	0.0258577	0.068817 *
Isobutane	0.0110914	1.10969E-06	0 *	0.0157805	0.0105087 *
n-Butane	0.0227673	1.07941E-05	0 *	0.0516506	0.0216324 *
Isopentane	0.00682952	1.59426E-06	0 *	0.0433755	0.00660866 *
n-Pentane	0.00699706	1.73149E-06	0 *	0.0596688	0.00684978 *
n-Hexane	0.00240524	1.39262E-07	0 *	0.0684924	0.00256898 *
Methylcyclopentane	0.000172738	2.78985E-07	0 *	0.00498183	0.000164455 *
Benzene	2.75298E-05	4.11437E-06	0 *	0.000791114	2.88942E-05 *
Cyclohexane	0.000222308	7.94803E-07	0 *	0.00803914	0.000210888 *
n-Heptane	0.00113033	4.9211E-08	0 *	0.0936094	0.00138157 *
n-Octane	0.000656883	1.96318E-08	0 *	0.166823	0.00103156 *
n-Nonane	0.000121473	2.72234E-08	0 *	0.0928749	0.000232424 *
n-Decane	3.67867E-05	4.62353E-09	0 *	0.0795207	6.33776E-05 *
n-Undecane	1.58647E-05	3.94007E-09	0 *	0.11017	0 *
Dodecane	0	0	0 *	0	0 *
Water	0.000587536	0.999856	1 *	0.000530362	0 *
Triethylene Glycol	0	0	0 *	0	0 *
Oxygen	0	0	0 *	0	0 *
Argon	0	0	0 *	0	0 *
Carbon Monoxide	0	0	0 *	0	0 *
Cyclopentane	1.61607E-05	5.25441E-08	0 *	0.00020057	3.06042E-05 *
Isohexane	0	0	0 *	0	0 *
3-Methylpentane	0.00278247	1.04175E-06	0 *	0.0643962	0.00305574 *
Neohexane	0.00269748	9.60999E-08	0 *	0.0372986	0.00103507 *
2,3-Dimethylbutane	0.000524588	8.10508E-08	0 *	0.00984327	0.000550383 *
Methylcyclohexane	0.00040234	4.4787E-07	0 *	0.032529	0.000415119 *
Isooctane	0	0	0 *	0	0 *
Decane, 2-Methyl-	0	0	0 *	0	0 *
Toluene	5.54005E-05	7.16915E-06	0 *	0.00569902	5.18718E-05 *
m-Xylene	4.8812E-05	5.76881E-06	0 *	0.0172985	3.99837E-05 *
Ethylbenzene	1.75402E-05	1.88836E-06	0 *	0.00524152	0 *

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Southwestern Energy	Job: V1.0
Location:	RidgetopWellpad	
Flowsheet:	Ridgeland Ventures	

Std. Vapor Volumetric Flow	Pipeline MMSCFD	Produced Water MMSCFD	Reservoir Water MMSCFD	Sales Oil MMSCFD	Test Separator Gas MMSCFD
Nitrogen	0.109043	3.81541E-08	0 *	1.57367E-08	0.10825 *
Methane	19.4563	6.28847E-05	0 *	0.000192492	19.345 *
CO2	0.0454393	1.60695E-05	0 *	1.15013E-05	0.045 *
Ethane	3.5924	5.37546E-05	0 *	0.00668078	3.50125 *
Propane	1.27677	3.64626E-05	0 *	0.0320904	1.2095 *
Isobutane	0.166905	1.20349E-06	0 *	0.0164883	0.1555 *
n-Butane	0.355608	1.21508E-05	0 *	0.0560157	0.33225 *
Isopentane	0.0919569	1.54708E-06	0 *	0.0405522	0.0875 *
n-Pentane	0.0950514	1.6952E-06	0 *	0.0562815	0.0915 *
n-Hexane	0.0288019	1.20187E-07	0 *	0.0569483	0.03025 *
Methylcyclopentane	0.00240337	2.79752E-07	0 *	0.00481281	0.00225 *
Benzene	0.000484463	5.21819E-06	0 *	0.000966657	0.0005 *
Cyclohexane	0.00321606	8.28679E-07	0 *	0.0080752	0.003 *
n-Heptane	0.0120643	3.78544E-08	0 *	0.0693729	0.0145 *
n-Octane	0.00631392	1.35997E-08	0 *	0.111338	0.00975 *
n-Nonane	0.00106299	1.71692E-08	0 *	0.0564316	0.002 *
n-Decane	0.000295137	2.67341E-09	0 *	0.0442985	0.0005 *
n-Undecane	0.000117328	2.10006E-09	0 *	0.0565729	0 *
Dodecane	0	0	0 *	0	0 *
Water	0.0506795	6.21576	6.26962 *	0.00317647	0 *
Triethylene Glycol	0	0	0 *	0	0 *
Oxygen	0	0	0 *	0	0 *
Argon	0	0	0 *	0	0 *
Carbon Monoxide	0	0	0 *	0	0 *
Cyclopentane	0.000268502	6.29174E-08	0 *	0.000231382	0.0005 *
Isohexane	0	0	0 *	0	0 *
3-Methylpentane	0.0335677	9.05759E-07	0 *	0.0539419	0.03625 *
Neohexane	0.0318032	8.1657E-08	0 *	0.0305337	0.012 *
2,3-Dimethylbutane	0.00630037	7.01558E-08	0 *	0.00820847	0.0065 *
Methylcyclohexane	0.00492821	3.95374E-07	0 *	0.0276657	0.005 *
Isooctane	0	0	0 *	0	0 *
Decane, 2-Methyl-	0	0	0 *	0	0 *
Toluene	0.000814596	7.59722E-06	0 *	0.00581841	0.00075 *
m-Xylene	0.000620743	5.28726E-06	0 *	0.0152746	0.0005 *
Ethylbenzene	0.000223795	1.73644E-06	0 *	0.00464354	0 *

Stream Properties

Property	Units	Pipeline	Produced Water	Reservoir Water	Sales Oil	Test Separator Gas
Temperature	°F	74.9621	70	68 *	70 *	68 *
Pressure	psig	215	0.5	400 *	0.5	400 *
Mole Fraction Vapor		0.999986	0	0	0	0.996002
Mole Fraction Light Liquid		1.35197E-05	1	1	0.99625	0.00399849
Mole Fraction Heavy Liquid		0	0	0	0.00375039	0
Molecular Weight	lb/lbmol	21.2127	18.016	18.0153	97.0071	21.0632
Mass Density	lb/ft^3	0.896242	62.2744	62.3163	43.1234	1.71272
Molar Flow	lbmol/h	2785.95	682.501	688.393	84.1738	2744.95
Mass Flow	lb/h	59097.7	12295.9	12401.6	8165.46	57817.4
Vapor Volumetric Flow	ft^3/h	65939.4	197.447	199.01	189.351	33757.6
Liquid Volumetric Flow	gpm	8221.02	24.6168	24.8117	23.6074	4208.74
Std Vapor Volumetric Flow	MMSCFD	25.3734	6.21597	6.26962	0.766624	25 *
Std Liquid Volumetric Flow	sgpm	341.084	24.5822	24.7917 *	23.683	335.4
Compressibility		0.947557	0.000773405	0.0211711	0.0060138	0.900618
Specific Gravity			0.998483	0.999155	0.691423	
API Gravity			10.0157	9.9633	71.6974	
Enthalpy	Btu/h	-9.66507E+07	-8.39366E+07	-8.46715E+07	-7.67986E+06	-9.53701E+07
Mass Enthalpy	Btu/lb	-1635.44	-6826.38	-6827.47	-940.531	-1649.51
Mass Cp	Btu/(lb*°F)	0.507971	0.974673	0.974206	0.509201	0.54127
Ideal Gas CpCv Ratio		1.24449	1.32583	1.32594	1.05671	1.24777

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Southwestern Energy	Job: V1.0
Location:	RidgetopWellpad	
Flowsheet:	Ridgeland Ventures	

Stream Properties

Property	Units	Pipeline	Produced Water	Reservoir Water	Sales Oil	Test Separator Gas
Dynamic Viscosity	cP		0.995637	1.02705	0.416329	
Kinematic Viscosity	cSt		0.998093	1.02889	0.602618	
Thermal Conductivity	Btu/(h*ft*°F)		0.347033	0.346162	0.0704622	
Surface Tension	lbf/ft		0.00504239 ?	0.0050581	0.00135141 ?	
Net Ideal Gas Heating Value	Btu/ft^3	1156.2	0.0610126	0	4913.24	1150.68
Net Liquid Heating Value	Btu/lb	20618.5	-1058.41	-1059.76	19061.4	20668.8
Gross Ideal Gas Heating Value	Btu/ft^3	1274.19	50.3743	50.31	5295.66	1268.24
Gross Liquid Heating Value	Btu/lb	22729.1	1.38086	0	20557.4	22786.8
Mass Fraction Vapor		0.999989	0	0	0	0.987662
Mass Fraction Light Liquid		1.14828E-05	1	1	0.999303	0.0123382
Mass Fraction Heavy Liquid		0	0	0	0.000696525	0
Volume Fraction Vapor		1	0	0	0	0.99945
Volume Fraction Light Liquid		1.65421E-07	1	1	0.999518	0.000550129
Volume Fraction Heavy Liquid		0	0	0	0.000482325	0

Remarks

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Southwestern Energy	Job: V1.0
Location:	RidgetopWellpad	
Flowsheet:	Ridgeland Ventures	

Connections

	Test Separator Oil	Vapor to Flare	Vapor to VRU		
From Block	--	SPLT-100	SPLT-100		
To Block	MIX-102	MIX-105	CMPR-100		

Stream Composition

Mole Fraction	Test Separator Oil		Vapor to Flare	Vapor to VRU		
Nitrogen	0.000730015	*	2.7735E-05	2.7735E-05		
Methane	0.102662	*	0.0577951	0.0577951		
CO2	0.000430009	*	0.0011194	0.0011194		
Ethane	0.0901618	*	0.256857	0.256857		
Propane	0.0915818	*	0.32003	0.32003		
Isobutane	0.0256905	*	0.0618717	0.0618717		
n-Butane	0.0731015	*	0.143661	0.143661		
Isopentane	0.0414308	*	0.0395038	0.0395038		
n-Pentane	0.0550711	*	0.0408294	0.0408294		
n-Hexane	0.051071	*	0.011807	0.011807		
Methylcyclopentane	0.00457009	*	0.00101379	0.00101379		
Benzene	0.000880018	*	0.000207059	0.000207059		
Cyclohexane	0.00763015	*	0.00134291	0.00134291		
n-Heptane	0.0615912	*	0.00448226	0.00448226		
n-Octane	0.099282	*	0.00214852	0.00214852		
n-Nonane	0.051061	*	0.000337952	0.000337952		
n-Decane	0.0405708	*	8.42178E-05	8.42178E-05		
n-Undecane	0.052161	*	3.04509E-05	3.04509E-05		
Dodecane	0	*	0	0		
Water	0	*	0.0238369	0.0238369		
Triethylene Glycol	0	*	0	0		
Oxygen	0	*	0	0		
Argon	0	*	0	0		
Carbon Monoxide	0	*	0	0		
Cyclopentane	0	*	0.000118389	0.000118389		
Isohexane	0	*	0	0		
3-Methylpentane	0.0471709	*	0.0141094	0.0141094		
Neohexane	0.0463209	*	0.0135832	0.0135832		
2,3-Dimethylbutane	0.00737015	*	0.00266684	0.00266684		
Methylcyclohexane	0.0253905	*	0.00191852	0.00191852		
Isooctane	0	*	0	0		
Decane, 2-Methyl-	0	*	0	0		
Toluene	0.00542011	*	0.000317224	0.000317224		
m-Xylene	0.0141703	*	0.000219457	0.000219457		
Ethylbenzene	0.00448009	*	8.01212E-05	8.01212E-05		

Molar Flow	Test Separator Oil lbmol/h		Vapor to Flare lbmol/h	Vapor to VRU lbmol/h		
Nitrogen	0.0871141	*	1.26788E-06	2.40898E-05		
Methane	12.2509	*	0.00264205	0.0501989		
CO2	0.0513138	*	5.11722E-05	0.000972272		
Ethane	10.7592	*	0.011742	0.223098		
Propane	10.9286	*	0.0146299	0.277968		
Isobutane	3.0657	*	0.00282841	0.0537398		
n-Butane	8.72335	*	0.00656735	0.12478		
Isopentane	4.94402	*	0.00180588	0.0343117		
n-Pentane	6.57175	*	0.00186648	0.035463		
n-Hexane	6.09441	*	0.000539746	0.0102552		
Methylcyclopentane	0.545358	*	4.63446E-05	0.000880548		
Benzene	0.105014	*	9.4655E-06	0.000179845		
Cyclohexane	0.910522	*	6.13901E-05	0.00116641		

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Southwestern Energy	Job: V1.0
Location:	RidgetopWellpad	
Flowsheet:	Ridgeland Ventures	

Molar Flow	Test Separator Oil lbmol/h	Vapor to Flare lbmol/h	Vapor to VRU lbmol/h		
n-Heptane	7.34981 *	0.000204903	0.00389315		
n-Octane	11.8475 *	9.82177E-05	0.00186614		
n-Nonane	6.09321 *	1.54492E-05	0.000293534		
n-Decane	4.8414 *	3.84994E-06	7.31489E-05		
n-Undecane	6.22448 *	1.39203E-06	2.64486E-05		
Dodecane	0 *	0	0		
Water	0 *	0.00108968	0.020704		
Triethylene Glycol	0 *	0	0		
Oxygen	0 *	0	0		
Argon	0 *	0	0		
Carbon Monoxide	0 *	0	0		
Cyclopentane	0 *	5.41202E-06	0.000102828		
Isohexane	0 *	0	0		
3-Methylpentane	5.629 *	0.000645	0.012255		
Neohexane	5.52757 *	0.000620945	0.011798		
2,3-Dimethylbutane	0.879495 *	0.000121912	0.00231633		
Methylcyclohexane	3.0299 *	8.77035E-05	0.00166637		
Isooctane	0 *	0	0		
Decane, 2-Methyl-	0 *	0	0		
Toluene	0.646792 *	1.45016E-05	0.000275531		
m-Xylene	1.69097 *	1.00323E-05	0.000190613		
Ethylbenzene	0.534618 *	3.66267E-06	6.95907E-05		

Mass Fraction	Test Separator Oil	Vapor to Flare	Vapor to VRU		
Nitrogen	0.000261217 *	1.69475E-05	1.69475E-05		
Methane	0.0210371 *	0.0202243	0.0202243		
CO2	0.000241729 *	0.00107459	0.00107459		
Ethane	0.0346296 *	0.16847	0.16847		
Propane	0.0515834 *	0.307821	0.307821		
Isobutane	0.019073 *	0.0784416	0.0784416		
n-Butane	0.0542716 *	0.182135	0.182135		
Isopentane	0.0381819 *	0.0621698	0.0621698		
n-Pentane	0.0507525 *	0.064256	0.064256		
n-Hexane	0.0562163 *	0.0221939	0.0221939		
Methylcyclopentane	0.00491284 *	0.00186108	0.00186108		
Benzene	0.000878038 *	0.000352795	0.000352795		
Cyclohexane	0.0082024 *	0.00246526	0.00246526		
n-Heptane	0.0788315 *	0.00979683	0.00979683		
n-Octane	0.14486 *	0.00535336	0.00535336		
n-Nonane	0.0836506 *	0.000945458	0.000945458		
n-Decane	0.073734 *	0.000261376	0.000261376		
n-Undecane	0.104144 *	0.000103823	0.000103823		
Dodecane	0 *	0	0		
Water	0 *	0.00936706	0.00936706		
Triethylene Glycol	0 *	0	0		
Oxygen	0 *	0	0		
Argon	0 *	0	0		
Carbon Monoxide	0 *	0	0		
Cyclopentane	0 *	0.000181111	0.000181111		
Isohexane	0 *	0	0		
3-Methylpentane	0.0519233 *	0.0265219	0.0265219		
Neohexane	0.0509877 *	0.0255328	0.0255328		
2,3-Dimethylbutane	0.00811268 *	0.00501293	0.00501293		
Methylcyclohexane	0.0318439 *	0.00410893	0.00410893		
Isooctane	0 *	0	0		
Decane, 2-Methyl-	0 *	0	0		
Toluene	0.00637901 *	0.000637557	0.000637557		
m-Xylene	0.0192161 *	0.00050821	0.00050821		

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Southwestern Energy	Job: V1.0
Location:	RidgetopWellpad	
Flowsheet:	Ridgeland Ventures	

Mass Fraction	Test Separator Oil	Vapor to Flare	Vapor to VRU		
Ethylbenzene	0.00607537 *	0.000185541	0.000185541		

Mass Flow	Test Separator Oil lb/h	Vapor to Flare lb/h	Vapor to VRU lb/h		
Nitrogen	2.44036 *	3.55177E-05	0.000674836		
Methane	196.534 *	0.0423849	0.805314		
CO2	2.25829 *	0.00225206	0.0427892		
Ethane	323.519 *	0.35307	6.70834		
Propane	481.905 *	0.645113	12.2571		
Isobutane	178.185 *	0.164393	3.12347		
n-Butane	507.02 *	0.381709	7.25247		
Isopentane	356.705 *	0.130292	2.47555		
n-Pentane	474.143 *	0.134664	2.55862		
n-Hexane	525.188 *	0.0465128	0.883743		
Methylcyclopentane	45.8971 *	0.00390034	0.0741065		
Benzene	8.20286 *	0.000739368	0.014048		
Cyclohexane	76.629 *	0.00516656	0.0981646		
n-Heptane	736.465 *	0.0205316	0.390101		
n-Octane	1353.32 *	0.0112193	0.213166		
n-Nonane	781.486 *	0.00198144	0.0376473		
n-Decane	688.842 *	0.000547776	0.0104077		
n-Undecane	972.938 *	0.000217586	0.00413414		
Dodecane	0 *	0	0		
Water	0 *	0.0196309	0.372988		
Triethylene Glycol	0 *	0	0		
Oxygen	0 *	0	0		
Argon	0 *	0	0		
Carbon Monoxide	0 *	0	0		
Cyclopentane	0 *	0.000379561	0.00721166		
Isohexane	0 *	0	0		
3-Methylpentane	485.081 *	0.0555831	1.05608		
Neohexane	476.34 *	0.0535102	1.01669		
2,3-Dimethylbutane	75.7908 *	0.0105058	0.19961		
Methylcyclohexane	297.494 *	0.00861126	0.163614		
Isooctane	0 *	0	0		
Decane, 2-Methyl-	0 *	0	0		
Toluene	59.5944 *	0.00133616	0.025387		
m-Xylene	179.522 *	0.00106508	0.0202364		
Ethylbenzene	56.7577 *	0.000388847	0.00738809		

Volumetric Flow	Test Separator Oil gpm	Vapor to Flare ft^3/h	Vapor to VRU ft^3/h		
Nitrogen	0.00933538	0.000480218	0.00912415		
Methane	1.31314	0.994353	18.8927		
CO2	0.00354343	0.0191701	0.364232		
Ethane	1.42052	4.36429	82.9215		
Propane	1.82635	5.38075	102.234		
Isobutane	0.625957	1.03106	19.5902		
n-Butane	1.7276	2.38913	45.3935		
Isopentane	1.13658	0.651268	12.3741		
n-Pentane	1.49941	0.67184	12.765		
n-Hexane	1.57222	0.191944	3.64693		
Methylcyclopentane	0.120665	0.0165608	0.314655		
Benzene	0.0180876	0.00339937	0.064588		
Cyclohexane	0.192698	0.0219441	0.416939		
n-Heptane	2.12518	0.0721292	1.37045		
n-Octane	3.76489	0.0341675	0.649182		
n-Nonane	2.11417	0.00530462	0.100788		

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Southwestern Energy	Job: V1.0
Location:	RidgetopWellpad	
Flowsheet:	Ridgeland Ventures	

Volumetric Flow	Test Separator Oil gpm	Vapor to Flare ft^3/h	Vapor to VRU ft^3/h		
n-Decane	1.82924	0.00130734	0.0248395		
n-Undecane	2.53987	0.000466485	0.00886321		
Dodecane	0	0	0		
Water	0	0.409117	7.77323		
Triethylene Glycol	0	0	0		
Oxygen	0	0	0		
Argon	0	0	0		
Carbon Monoxide	0	0	0		
Cyclopentane	0	0.00195184	0.0370849		
Isohexane	0	0	0		
3-Methylpentane	1.44499	0.229877	4.36767		
Neohexane	1.45134	0.222039	4.21873		
2,3-Dimethylbutane	0.2265	0.0435078	0.826649		
Methylcyclohexane	0.753509	0.0310439	0.589834		
Isooctane	0	0	0		
Decane, 2-Methyl-	0	0	0		
Toluene	0.132277	0.0051448	0.0977512		
m-Xylene	0.398727	0.00351767	0.0668357		
Ethylbenzene	0.125666	0.00128623	0.0244383		

Std. Liquid Volumetric Fraction	Test Separator Oil		Vapor to Flare	Vapor to VRU		
Nitrogen	0.000207295	*	1.06795E-05	1.06795E-05		
Methane	0.0449221	*	0.0342931	0.0342931		
CO2	0.000189413	*	0.000668627	0.000668627		
Ethane	0.0622366	*	0.240426	0.240426		
Propane	0.0651234	*	0.308592	0.308592		
Isobutane	0.0216985	*	0.0708623	0.0708623		
n-Butane	0.0594846	*	0.15852	0.15852		
Isopentane	0.0391081	*	0.0505648	0.0505648		
n-Pentane	0.051525	*	0.0518004	0.0518004		
n-Hexane	0.0542062	*	0.0169934	0.0169934		
Methylcyclopentane	0.00417473	*	0.0012558	0.0012558		
Benzene	0.000635581	*	0.000202787	0.000202787		
Cyclohexane	0.00670351	*	0.00159987	0.00159987		
n-Heptane	0.0733434	*	0.00723778	0.00723778		
n-Octane	0.13128	*	0.00385241	0.00385241		
n-Nonane	0.0741615	*	0.000665595	0.000665595		
n-Decane	0.0642714	*	0.000180915	0.000180915		
n-Undecane	0.0896428	*	7.09635E-05	7.09635E-05		
Dodecane	0	*	0	0		
Water	0	*	0.00476273	0.00476273		
Triethylene Glycol	0	*	0	0		
Oxygen	0	*	0	0		
Argon	0	*	0	0		
Carbon Monoxide	0	*	0	0		
Cyclopentane	0	*	0.000122808	0.000122808		
Isohexane	0	*	0	0		
3-Methylpentane	0.049696	*	0.0201568	0.0201568		
Neohexane	0.0499348	*	0.0198562	0.0198562		
2,3-Dimethylbutane	0.00779949	*	0.00382695	0.00382695		
Methylcyclohexane	0.0263458	*	0.00269944	0.00269944		
Isooctane	0	*	0	0		
Decane, 2-Methyl-	0	*	0	0		
Toluene	0.00468508	*	0.000371827	0.000371827		
m-Xylene	0.0141622	*	0.000297418	0.000297418		
Ethylbenzene	0.00446281	*	0.000108227	0.000108227		

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Southwestern Energy	Job: V1.0
Location:	RidgetopWellpad	
Flowsheet:	Ridgeland Ventures	

Std. Vapor Volumetric Flow	Test Separator Oil MMSCFD		Vapor to Flare MMSCFD	Vapor to VRU MMSCFD		
Nitrogen	0.000793403	*	1.15474E-08	2.194E-07		
Methane	0.111576	*	2.40628E-05	0.000457193		
CO2	0.000467347	*	4.66058E-07	8.8551E-06		
Ethane	0.0979907	*	0.000106942	0.00203189		
Propane	0.099534	*	0.000133243	0.00253162		
Isobutane	0.0279213	*	2.57601E-05	0.000489442		
n-Butane	0.079449	*	5.9813E-05	0.00113645		
Isopentane	0.0450283	*	1.64473E-05	0.000312498		
n-Pentane	0.059853	*	1.69992E-05	0.000322984		
n-Hexane	0.0555056	*	4.9158E-06	9.34003E-05		
Methylcyclopentane	0.00496692	*	4.2209E-07	8.0197E-06		
Benzene	0.000956431	*	8.62083E-08	1.63796E-06		
Cyclohexane	0.00829269	*	5.59118E-07	1.06232E-05		
n-Heptane	0.0669393	*	1.86618E-06	3.54574E-05		
n-Octane	0.107903	*	8.9453E-07	1.69961E-05		
n-Nonane	0.0554947	*	1.40705E-07	2.6734E-06		
n-Decane	0.0440936	*	3.50638E-08	6.66213E-07		
n-Undecane	0.0566903	*	1.26781E-08	2.40884E-07		
Dodecane	0	*	0	0		
Water	0	*	9.92443E-06	0.000188564		
Triethylene Glycol	0	*	0	0		
Oxygen	0	*	0	0		
Argon	0	*	0	0		
Carbon Monoxide	0	*	0	0		
Cyclopentane	0	*	4.92907E-08	9.36523E-07		
Isohexane	0	*	0	0		
3-Methylpentane	0.0512669	*	5.87442E-06	0.000111614		
Neohexane	0.0503431	*	5.65534E-06	0.000107451		
2,3-Dimethylbutane	0.00801011	*	1.11033E-06	2.10962E-05		
Methylcyclohexane	0.0275952	*	7.98771E-07	1.51766E-05		
Isooctane	0	*	0	0		
Decane, 2-Methyl-	0	*	0	0		
Toluene	0.00589075	*	1.32075E-07	2.50943E-06		
m-Xylene	0.0154007	*	9.13702E-08	1.73603E-06		
Ethylbenzene	0.0048691	*	3.33582E-08	6.33806E-07		

Stream Properties

Property	Units	Test Separator Oil		Vapor to Flare	Vapor to VRU		
Temperature	°F	68	*	69.9943	69.9943		
Pressure	psig	400	*	0.5	0.5		
Mole Fraction Vapor		0		0.999997	0.999997		
Mole Fraction Light Liquid		1		3.22996E-06	3.22996E-06		
Mole Fraction Heavy Liquid		0		0	0		
Molecular Weight	lb/lbmol	78.288		45.8446	45.8446		
Mass Density	lb/ft^3	41.0521		0.124768	0.124768		
Molar Flow	lbmol/h	119.332		0.0457141	0.868567		
Mass Flow	lb/h	9342.26		2.09574	39.8191		
Vapor Volumetric Flow	ft^3/h	227.571		16.797	319.144		
Liquid Volumetric Flow	gpm	28.3725		2.09418	39.7894		
Std Vapor Volumetric Flow	MMSCFD	1.08683		0.000416347	0.00791059		
Std Liquid Volumetric Flow	sgpm	29.1667	*	0.00823974	0.156555		
Compressibility		0.139657		0.982305	0.982305		
Specific Gravity		0.658213					
API Gravity		82.0221					
Enthalpy	Btu/h	-9.25119E+06		-2235.94	-42482.8		
Mass Enthalpy	Btu/lb	-990.251		-1066.9	-1066.9		
Mass Cp	Btu/(lb*°F)	0.527544		0.403142	0.403142		
Ideal Gas CpCv Ratio		1.0705		1.12152	1.12152		

* User Specified Values
? Extrapolated or Approximate Values

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Southwestern Energy	Job: V1.0
Location:	RidgetopWellpad	
Flowsheet:	Ridgeland Ventures	

Stream Properties

Property	Units	Test Separator Oil	Vapor to Flare	Vapor to VRU		
Dynamic Viscosity	cP	0.28852				
Kinematic Viscosity	cSt	0.438753				
Thermal Conductivity	Btu/(h*ft*°F)	0.0675712				
Surface Tension	lbf/ft	0.00099246 ?				
Net Ideal Gas Heating Value	Btu/ft^3	3991.26	2371.81	2371.81		
Net Liquid Heating Value	Btu/lb	19192.5	19470	19470		
Gross Ideal Gas Heating Value	Btu/ft^3	4308.95	2577.26	2577.26		
Gross Liquid Heating Value	Btu/lb	20732.4	21170.8	21170.8		
Mass Fraction Vapor		0	0.999999	0.999999		
Mass Fraction Light Liquid		1	1.26933E-06	1.26933E-06		
Mass Fraction Heavy Liquid		0	0	0		
Volume Fraction Vapor		0	1	1		
Volume Fraction Light Liquid		1	2.54312E-09	2.54312E-09		
Volume Fraction Heavy Liquid		0	0	0		

Remarks

Flowsheet Environment
SRK Environment

Client Name:	Southwestern Energy	Job: V1.0
Location:	RidgetopWellpad	
Flowsheet:	Ridgeland Ventures	

Environment Settings

Number of Poynting Intervals	0	Freeze Out Temperature Threshold Difference	10 °F
Gibbs Excess Model Evaluation Temperature	77 °F	Phase Tolerance	0.01

Components

Component Name	Henry`s Law Component	Phase Initiator	Component Name	Henry`s Law Component	Phase Initiator
Nitrogen	False	False	Dodecane	False	False
Methane	False	False	Water	False	True
CO2	False	False	Triethylene Glycol	False	True
Ethane	False	False	Oxygen	False	False
Propane	False	False	Argon	False	False
Isobutane	False	False	Carbon Monoxide	False	False
n-Butane	False	False	Cyclopentane	False	False
Isopentane	False	False	Isohexane	False	False
n-Pentane	False	False	3-Methylpentane	False	False
n-Hexane	False	False	Neohexane	False	False
Methylcyclopentane	False	False	2,3-Dimethylbutane	False	False
Benzene	False	False	Methylcyclohexane	False	False
Cyclohexane	False	False	Isooctane	False	False
n-Heptane	False	False	Decane, 2-Methyl-	False	False
n-Octane	False	False	Toluene	False	False
n-Nonane	False	False	m-Xylene	False	False
n-Decane	False	False	Ethylbenzene	False	False
n-Undecane	False	False			

Physical Property Method Sets

Liquid Molar Volume	COSTALD	Overall Package	SRK
Stability Calculation	SRK	Vapor Package	SRK
Light Liquid Package	SRK	Heavy Liquid Package	SRK

Remarks

Environments Report

Client Name:	Southwestern Energy	Job: V1.0
Location:	RidgetopWellpad	

Project-Wide Constants

Atmospheric Pressure	14.6959 psia	IG Ref Pressure	14.6959 psia
IG Ref Temperature	60 °F	IG Ref Volume	379.485 ft^3/lbmol
Liq Ref Temperature	60 °F		

Environment [SRK Environment]

Environment Settings

Number of Poynting Intervals	0	Freeze Out Temperature Threshold Difference	10 °F
Gibbs Excess Model Evaluation Temperature	77 °F	Phase Tolerance	0.01

Components

Component Name	Henry`s Law Component	Phase Initiator	Component Name	Henry`s Law Component	Phase Initiator
Nitrogen	False	False	Dodecane	False	False
Methane	False	False	Water	False	True
CO2	False	False	Triethylene Glycol	False	True
Ethane	False	False	Oxygen	False	False
Propane	False	False	Argon	False	False
Isobutane	False	False	Carbon Monoxide	False	False
n-Butane	False	False	Cyclopentane	False	False
Isopentane	False	False	Isohexane	False	False
n-Pentane	False	False	3-Methylpentane	False	False
n-Hexane	False	False	Neohexane	False	False
Methylcyclopentane	False	False	2,3-Dimethylbutane	False	False
Benzene	False	False	Methylcyclohexane	False	False
Cyclohexane	False	False	Isooctane	False	False
n-Heptane	False	False	Decane, 2-Methyl-	False	False
n-Octane	False	False	Toluene	False	False
n-Nonane	False	False	m-Xylene	False	False
n-Decane	False	False	Ethylbenzene	False	False
n-Undecane	False	False			

Physical Property Method Sets

Liquid Molar Volume	COSTALD	Overall Package	SRK
Stability Calculation	SRK	Vapor Package	SRK
Light Liquid Package	SRK	Heavy Liquid Package	SRK

Remarks

20150528_SWN_Ridgetop Ventures_Promax_v1.1.pmx
Project Warnings Report

Client Name:	Southwestern Energy	Job: V1.0
Location:	RidgetopWellpad	

ProMax:ProMax!Project!Flowsheets!Ridgeland Ventures !Blocks!Scrubber Dump 2!Properties!PDrop
Warning: A negative pressure drop of -40 psi was encountered in block Scrubber Dump 2.
ProMax:ProMax!Project!Flowsheets!Ridgeland Ventures !Blocks!Choke!Properties!PDrop
Warning: A negative pressure drop of -25391.9 psi was encountered in block Choke.
ProMax:ProMax!Project!Flowsheets!Ridgeland Ventures !PStreams!2
Warning: The temperature of 70 °F is below hydrate formation.
ProMax:ProMax!Project!Flowsheets!Ridgeland Ventures !Blocks!Compressor Stage 1
Warning: The change in entropy is negative.
ProMax:ProMax!Project!Flowsheets!Ridgeland Ventures !Blocks!Compressor Stage 2
Warning: The change in entropy is negative.
ProMax:ProMax!Project!Flowsheets!Ridgeland Ventures !Blocks!Compressor Stage 3
Warning: The change in entropy is negative.
ProMax:ProMax!Project!Flowsheets!Ridgeland Ventures !Blocks!CMPR-100
Warning: The change in entropy is negative.

User Value Sets Report

Client Name:	Southwestern Energy	Job: V1.0
Location:	RidgetopWellpad	

Tank Losses.53

User Value [ShellLength]

* Parameter	20	ft	Upper Bound		ft
* Lower Bound	0	ft	* Enforce Bounds	False	

User Value [ShellDiam]

* Parameter	12	ft	Upper Bound		ft
* Lower Bound	0	ft	* Enforce Bounds	False	

User Value [BreatherVP]

* Parameter	0.03	psig	Upper Bound		psig
Lower Bound		psig	* Enforce Bounds	False	

User Value [BreatherVacP]

* Parameter	-0.03	psig	Upper Bound		psig
Lower Bound		psig	* Enforce Bounds	False	

User Value [DomeRadius]

Parameter		ft	Upper Bound		ft
Lower Bound		ft	* Enforce Bounds	False	

User Value [OpPress]

* Parameter	0	psig	Upper Bound		psig
Lower Bound		psig	* Enforce Bounds	False	

User Value [AvgPercentLiq]

* Parameter	50	%	Upper Bound		%
Lower Bound		%	* Enforce Bounds	False	

User Value [MaxPercentLiq]

* Parameter	90	%	Upper Bound		%
Lower Bound		%	* Enforce Bounds	False	

User Value Sets Report

Client Name:	Southwestern Energy	Job: V1.0
Location:	RidgetopWellpad	

User Value [AnnNetTP]

* Parameter	849.476	bbl/day	Upper Bound	bbl/day
* Lower Bound	0	bbl/day	* Enforce Bounds	False

User Value [OREff]

* Parameter	66.5	%	Upper Bound	%
Lower Bound		%	* Enforce Bounds	False

User Value [AtmPressure]

* Parameter	14.2535	psia	Upper Bound	psia
Lower Bound		psia	* Enforce Bounds	False

User Value [MaxLiqSurfaceT]

* Parameter	61.4758	°F	Upper Bound	°F
Lower Bound		°F	* Enforce Bounds	False

User Value [TotalLosses]

* Parameter	4.17586	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [WorkingLosses]

* Parameter	1.04396	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [StandingLosses]

* Parameter	0	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [RimSealLosses]

* Parameter	0	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [WithdrawalLoss]

* Parameter	0	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [LoadingLosses]

* Parameter	2.68809	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [DeckFittingLosses]

* Parameter	0	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [DeckSeamLosses]

* Parameter	0	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [FlashingLosses]

* Parameter	1.88744	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [GasMoleWeight]

* Parameter	0.0455266	kg/mol	Upper Bound	kg/mol
Lower Bound		kg/mol	* Enforce Bounds	False

User Value Sets Report

Client Name:	Southwestern Energy	Job: V1.0
Location:	RidgetopWellpad	

Remarks
This User Value Set was programmatically generated. GUID={5524AB8C-40B1-4354-9DD7-EED65770BF87}

Tank Losses.331

User Value [ShellLength]

* Parameter	20	ft	Upper Bound	ft
* Lower Bound	0	ft	* Enforce Bounds	False

User Value [ShellDiam]

* Parameter	12	ft	Upper Bound	ft
* Lower Bound	0	ft	* Enforce Bounds	False

User Value [BreatherVP]

* Parameter	0.03	psig	Upper Bound	psig
Lower Bound		psig	* Enforce Bounds	False

User Value [BreatherVacP]

* Parameter	-0.03	psig	Upper Bound	psig
Lower Bound		psig	* Enforce Bounds	False

User Value [DomeRadius]

Parameter		ft	Upper Bound	ft
Lower Bound		ft	* Enforce Bounds	False

User Value [OpPress]

* Parameter	0	psig	Upper Bound	psig
Lower Bound		psig	* Enforce Bounds	False

User Value [AvgPercentLiq]

* Parameter	50	%	Upper Bound	%
Lower Bound		%	* Enforce Bounds	False

User Value [MaxPercentLiq]

* Parameter	90	%	Upper Bound	%
Lower Bound		%	* Enforce Bounds	False

User Value [AnnNetTP]

* Parameter	820.265	bbl/day	Upper Bound	bbl/day
* Lower Bound	0	bbl/day	* Enforce Bounds	False

User Value [OREff]

* Parameter	66.5	%	Upper Bound	%
Lower Bound		%	* Enforce Bounds	False

User Value [AtmPressure]

* Parameter	14.2535	psia	Upper Bound	psia
Lower Bound		psia	* Enforce Bounds	False

User Value [MaxLiqSurfaceT]

* Parameter	61.4758	°F	Upper Bound	°F
Lower Bound		°F	* Enforce Bounds	False

User Value Sets Report

Client Name:	Southwestern Energy	Job: V1.0
Location:	RidgetopWellpad	

User Value [TotalLosses]

* Parameter	25.3369	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [WorkingLosses]

* Parameter	5.35963	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [StandingLosses]

* Parameter	0.974583	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [RimSealLosses]

* Parameter	0	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [WithdrawalLoss]

* Parameter	0	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [LoadingLosses]

* Parameter	47.7324	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [DeckFittingLosses]

* Parameter	0	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [DeckSeamLosses]

* Parameter	0	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [FlashingLosses]

* Parameter	77.9664	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [GasMoleWeight]

* Parameter	0.0543644	kg/mol	Upper Bound	kg/mol
Lower Bound		kg/mol	* Enforce Bounds	False

Remarks
This User Value Set was programmatically generated. GUID={23417019-6BCF-4B6A-8C2C-C51E3F9510A8}

Cn+ Flow/Frac.55

User Value [CnPlusSum]

* Parameter	139.674	ton/yr	Upper Bound	
Lower Bound			* Enforce Bounds	False

Remarks
This User Value Set was programmatically generated. GUID={CEA3CA5D-E2E3-46DB-A7C5-D92F1E3E3C8A}

User Value Sets Report

Client Name:	Southwestern Energy	Job: V1.0
Location:	RidgetopWellpad	

Cn+ Flow/Frac.525

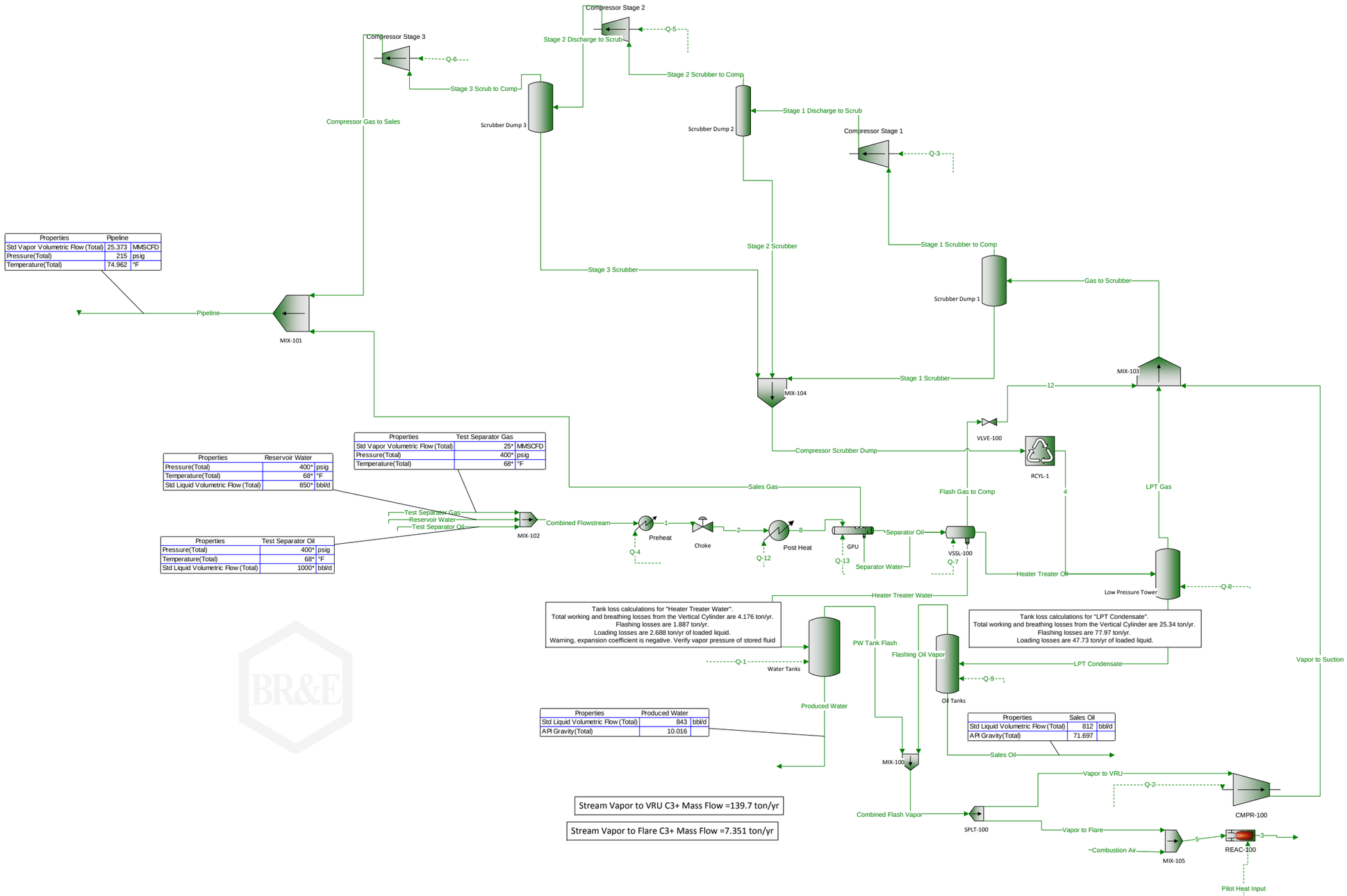
User Value [CnPlusSum]

* Parameter	7.35125	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

Remarks

This User Value Set was programmatically generated. GUID={B1B5784C-81D6-46F0-8CA3-A09758308B44}

Ridgetop Land Ventures
SWN



Properties	Pipeline	
Std Vapor Volumetric Flow (Total)	25.373	MMSCFD
Pressure(Total)	215	psig
Temperature(Total)	74.962	°F

Properties	Test Separator Gas	
Std Vapor Volumetric Flow (Total)	25*	MMSCFD
Pressure(Total)	400*	psig
Temperature(Total)	68*	°F

Properties	Reservoir Water	
Pressure(Total)	400*	psig
Temperature(Total)	68*	°F
Std Liquid Volumetric Flow (Total)	850*	bbl/d

Properties	Test Separator Oil	
Pressure(Total)	400*	psig
Temperature(Total)	68*	°F
Std Liquid Volumetric Flow (Total)	1000*	bbl/d

Properties	Produced Water	
Std Liquid Volumetric Flow (Total)	843	bbl/d
API Gravity(Total)	10.016	

Properties	Sales Oil	
Std Liquid Volumetric Flow (Total)	812	bbl/d
API Gravity(Total)	71.697	

ATTACHMENT J

Class I Legal Advertisement

AIR QUALITY PERMIT NOTICE
Notice of Application

Notice is given that Southwestern Production Company, LLC has applied to the West Virginia Department of Environmental Protection, Division of Air Quality, for a Class II General Permit (G70-A) for a new natural gas production wellpad (Ridgetop Land Ventures Wellpad). The facility will be located 0.7 miles off Harlan Ridge Road (at 39.665780, -80.673410) near New Martinsville, West Virginia in Wetzel County

The applicant estimates that the potential to discharge the following Regulated Air Pollutants will be:

Pollutant	Emissions (tons per year)
NO_X	12.02
CO	16.73
VOC	63.08
SO_2	0.05
PM	5.09
Total HAPs	2.60
Carbon Dioxide Equivalents (CO_2e)	13,966

Written comments will be received by the West Virginia Department of Environmental Protection, Division of Air Quality, 601 57th Street, SE, Charleston, WV 25304, for at least 30 calendar days from the date of publication of this notice.

Any questions regarding this permit application should be directed to the DAQ at (304) 926-0499, extension 1250, during normal business hours.

Dated this the XX day of June, 2015.

By: SWN Production Company, LLC
Paul Geiger – Sr. Vice President Ops Management
10000 Energy Drive
Spring TX 77389

ATTACHMENT L

General Permit Registration Application Fee

ATTACHMENT O

Emission Summary Sheet

G70-A EMISSIONS SUMMARY SHEET

Emission Point ID No.	Emission Point Type[1]	Emission Unit Vented Through This Point		Air Pollution Control Device		All Regulated Pollutants - Chemical Name/CAS[2]	Maximum Potential Uncontrolled Emissions [3]		Maximum Potential Controlled Emissions [4]		Emission Form or Phase	Est. Method Used [5]
		ID No.	Source	ID No.	Device Type	*(Speciate VOCs & HAPS)*	lb/hr	ton/yr	lb/hr	ton/yr	*(At exit conditions, Solid, Liquid or Gas/Vapor)*	
EP-TANKS- PW (Total All Tanks)	Upward vertical stack	EU-TANKS-PW	Four (4) Produced Water Tanks	APC-VRU1 & APC-VRU2& APC-COMB-TKLD	VRUs, Combustor	VOC HAPS	1.38 0.01	6.06 0.05	0.07 <0.01	0.30 <0.01	Gas/Vapor	ProMax
EP-TANKS-COND (Total All Tanks)	Upward vertical stack	EU-TANKS - COND	Four (4) Condensate Tanks	APC-VRU1 & APC-VRU2& APC-COMB-TKLD	VRUs, Combustor	VOC HAPS	23.59 0.63	103.30 2.76	1.18 0.03	5.17 0.14	Gas/Vapor	ProMax
EP-ENGINE1	Upward vertical stack	EU-ENGINE1	Caterpillar G3306NA Engine	Catalyst	NSCR	NO_X CO $PM/PM_{10}/PM_{2.5}$ SO_2 VOC CO_{2e}	4.31 4.31 0.02 <0.01 0.16 170	18.86 18.86 0.11 <0.01 1.05 745	0.32 0.64 0.02 <0.01 0.16 170	1.40 2.80 0.11 0.01 1.05 745	Gas/Vapor	AP-42 Vendor Data
EP-ENGINE2	Upward vertical stack	EU-ENGINE2	Caterpillar G3306NA Engine	Catalyst	NSCR	NO_X CO $PM/PM_{10}/PM_{2.5}$ SO_2 VOC CO_{2e}	4.31 4.31 0.02 <0.01 0.16 170	18.86 18.86 0.11 <0.01 1.05 745	0.32 0.64 0.02 <0.01 0.16 170	1.40 2.80 0.11 0.01 1.05 745	Gas/Vapor	AP-42 Vendor Data
VRU-1	Upward vertical stack	VRU-1	VRU Engine	Catalyst	NSCR	NO_X CO $PM/PM_{10}/PM_{2.5}$ SO_2 VOC CO_{2e}	2.84 2.23 0.02 <0.01 0.16 93	12.44 9.77 0.07 <0.01 0.74 406	0.20 0.41 0.02 <0.01 0.16 93	0.89 1.78 0.07 <0.01 0.74 406	Gas/Vapor	AP-42 Vendor Data
VRU-2	Upward vertical stack	VRU-2	VRU Engine	Catalyst	NSCR	NO_X CO $PM/PM_{10}/PM_{2.5}$ SO_2 VOC CO_{2e}	0.27 0.76 0.02 <0.01 0.29 140	1.16 3.33 0.10 <0.01 1.27 613	0.27 0.76 0.02 <0.01 0.29 140	1.16 3.33 0.10 <0.01 1.27 613	Gas/Vapor	AP-42 Vendor Data

EP-HT1 to EP-HT2 (Total – All units)	Upward vertical stack	EU-HT1 to EU-HT2	Heater Treaters	None	---	NO_X CO $PM/PM_{10}/PM_{2.5}$ SO_2 VOC HAPs CO_{2e}	0.08 0.07 <0.01 <0.01 <0.01 <0.01 117	0.34 0.29 0.03 <0.01 0.02 <0.01 513	0.08 0.07 <0.01 <0.01 <0.01 <0.01 117	0.34 0.29 0.03 <0.01 0.02 <0.01 513	Gas/Vapor	AP-42
EP-GPU1 to EP-GPU5 (Total – All units)	Upward vertical stack	EU-GPU1 to EU-GPU5	GPU Burners	None	---	NO_X CO $PM/PM_{10}/PM_{2.5}$ SO_2 VOC HAPs CO_{2e}	0.39 0.33 0.03 <0.01 0.02 <0.01 586	1.70 1.43 0.13 0.01 0.09 0.03 2,565	0.39 0.33 0.03 <0.01 0.02 <0.01 586	1.70 1.43 0.13 0.01 0.09 0.03 2,565	Gas/Vapor	AP-42
EP-LOAD-COND	Upward vertical stack	EU-LOAD-COND	Condensate Liquid Loading	APC-VRU1 & APC-VRU2& APC-COMB-TKLD	VRUs, Combustor	VOC HAPs Benzene	32.53 0.80 0.01	142.48 3.50 0.03	10.90 0.27 0.002	47.73 1.17 0.01	Gas/Vapor	AP-42
EP-LOAD-PW	Upward vertical stack	EU-LOAD-PW	Produced Water Liquid Loading	APC-VRU1 & APC-VRU2& APC-COMB-TKLD	VRUs, Combustor	VOC HAPs Benzene	1.14 0.001 0.004	4.98 0.01 0.02	0.61 0.002 0.001	2.69 0.01 0.006	Gas/Vapor	AP-42
EP-FUG	Fugitive	EU-FUG	Fugitive Components	None	---	VOC HAPs CO_2e	0.64 0.02 116	2.80 0.07 507	0.64 0.02 116	2.80 0.07 507	Gas/Vapor	AP-42
EP-PILOT	Upward vertical stack	EU-PILOT	Vapor Combustor Pilot	None	---	NO_X CO $PM/PM_{10}/PM_{2.5}$ SO_2 CO_{2e}	0.01 <0.01 <0.01 <0.01 8	0.02 0.02 0.002 <0.01 33	0.01 <0.01 <0.01 <0.01 8	0.02 0.02 0.002 <0.01 33	Gas/Vapor	AP-42
APC-COMB-TKLD	Upward vertical stack	APC-COMB-TKLD	Vapor Combustor	None	---	NO_X CO $PM/PM_{10}/PM_{2.5}$ SO_2 CO_{2e}	1.17 0.98 0.09 0.01 1,764	5.13 4.31 0.39 0.03 7,728	1.17 0.98 0.09 0.01 1,764	5.13 4.31 0.39 0.03 7,728	Gas/Vapor	AP-42

The EMISSION SUMMARY SHEET provides a summation of emissions by emission unit. Note that uncaptured process emission unit emissions are not typically considered to be fugitive and must be accounted for on the appropriate EMISSIONS UNIT DATA SHEET and on the EMISSIONS SUMMARY SHEET. Please note that total emissions from the source are equal to all vented emissions, all fugitive emissions, plus all other emissions (e.g. uncaptured emissions). Please complete the FUGITIVE EMISSIONS DATA SUMMARY SHEET for fugitive emission activities.

[1] Please add descriptors such as upward vertical stack, downward vertical stack, horizontal stack, relief vent, rain cap, etc.

[2] List all regulated air pollutants. Speciate VOCs, including all HAPs. Follow chemical name with Chemical Abstracts Service (CAS) number. **LIST** Acids, CO, CS_2, VOCs, H_2S, Inorganics, Lead, Organics, O_3, NO, NO_2, SO_2, SO_3, all applicable Greenhouse Gases (including CO_2 and methane), etc. **DO NOT LIST** H_2, H_2O, N_2, O_2, and Noble Gases

[3] Give maximum potential emission rate with no control equipment operating. If emissions occur for less than 1 hr, then record emissions per batch in minutes (e.g. 5 lb VOC/20 minute batch).

[4] Give maximum potential emission rate with proposed control equipment operating. If emissions occur for less than 1 hr, then record emissions per batch in minutes (e.g. 5 lb VOC/20 minute batch).

[5] Indicate method used to determine emission rate as follows: MB = material balance; ST = stack test (give date of test); EE = engineering estimate; M = modeling; O = other (specify).