SWN PRODUCTION COMPANY, LLC

FORK RIDGE PAD

GENERAL PERMIT G-70A
CLASS II UPDATE

SUBMITTED TO WVDEP DIVISION OF AIR QUALITY
DECEMBER 2015

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INTRODUCTION

SWN Production Company, LLC (SWN), submits this G70-A General Permit Class II Update application for the Fork Ridge Pad (Fork Ridge), a natural gas production facility in Marshall County currently authorized under Permit No. G70-A091. SWN requests authorization with this submittal to construct additional emission sources. Included with this application are changes in the emission estimates for the emission sources at the facility. The changes are summarized below.

Emission Unit ID	Description of Emission Source	Description of Revision
EU-ENG1	1,380-hp Caterpillar G3516B Engine w/ Oxidation Catalyst	The reciprocating internal combustion engine is replacing a 145-hp Caterpillar G3306 NA engine.
EU-ENG2	1,380-hp Caterpillar G3516B Engine w/ Oxidation Catalyst	The reciprocating internal combustion engine is replacing a 215-hp Caterpillar G3406 NA engine.
EU-ENG3	215-hp Caterpillar G3406 NA Engine w/ Catalytic Converter	No revision to emission source.
EU-ENG4	1,380-hp Caterpillar G3516B Engine w/ Oxidation Catalyst	The reciprocating internal combustion engine will be installed as a new engine.
EU-DEHY1	35.0-MMSCFD TEG Dehydration Unit	Flash tank off-gases were represented as being routed to the produced water tanks, which were captured with 98% efficiency to be routed to the combustor. Per WVDEP guidance, the capture efficiency has been revised to 100%. No other changes have been made to the emission estimates for this emission source.
EU-RB1	0.75-mmBtu/hr TEG Reboiler	No revision to emission source.
EU-GPU1 - EU-GPU8	Eight (8) 1.0-mmBtu/hr GPU Burners	No revision to emission source.
EU-HT1 - EU-HT2	Two (2) 0.5-mmBtu/hr Heater Treaters	No revision to emission source.
EU-TANKS-COND	Five (5) 400-bbl Condensate Tanks Routed to Vapor Combustor	Storage tank emissions have been revised based on a new process simulation.
EU-TANKS-PW	Five (5) 400-bbl Produced Water Tanks Routed to Vapor Combustor	Storage tank emissions have been revised based on a new process simulation.
EU-LOAD-COND	Condensate Truck Loading w/ Vapor Return Routed to Combustor	Loading emissions have been revised based on a new process simulation.
EU-LOAD-PW	Produced Water Truck Loading w/ Vapor Return Routed to Combustor	Loading emissions have been revised based on a new process simulation.
APC-COMB-TKLD	One (1) 30.0-mmBtu/hr Vapor Combustor - Tank/Loading Stream	The capture efficiency for gases routed to the combustor from the glycol dehydrator and storage tanks has been increased to 100%.

Emission Unit ID	Description of Emission Source	Description of Revision
EU-PILOT	Vapor Combustor Pilots	No revision to emission source.
EU-FUG	Fugitive Emissions	Fugitive component counts have been updated based on the change in the number of engines.
EU-HR	Fugitive Haul Road Emissions	No revision to emission source.

Note that other small storage tanks may be present on site (i.e., methanol) but are considered de minimis sources per Table 45-13B and are not addressed further in this application.

Proposed Emissions

Emissions calculations for the facility are presented in Attachment S. A fuel heating value of 905 Btu/scf was used to calculate emissions from natural gas-fired equipment. Actual heating value may vary (generally 905 - 1,300) but using a lower heating value in the emissions calculations provides a more conservative (higher) estimate of fuel use. Emissions from the Caterpillar engines were calculated with manufacturer data when available and AP-42/EPA emissions factors for the remaining pollutants. Emissions from the heaters were estimated using AP-42/EPA emission factors.

Triethylene glycol (TEG) dehydration unit emissions have been estimated using an extended analysis generated by process simulation and GRI-GLYCalc 4.0 software. Still vent emissions are reduced by condenser and non-condensable gases are routed to the reboiler as fuel with an estimated 50% destruction efficiency. Flash tank off-gases are routed to the produced water storage tanks to then be routed to the combustor for 98% destruction efficiency. Control of the produced water storage tanks is discussed below.

Condensate tank emissions were calculated by creating a profile in the EPA TANKS 4.0.9d model using properties obtained in a representative liquids analysis as the tank contents. Although produced water storage tanks contain primarily water, a profile was created in EPA TANKS 4.0.9d assuming 1% of the total throughput as condensate and 99% as water to provide a conservative emissions estimate of the trace hydrocarbons that may be entrained in the water. Flashing emissions were calculated using ProMax process simulation software. Condensate loading has been calculated using the properties from EPA TANKS 4.0.9d and process simulation.

Fugitive emissions were calculated with a component count by equipment type from a similar facility, and representative extended gas and liquids analyses. Fugitive haul road emissions were calculated using EPA/AP-42 methodologies.

Greenhouse gas emissions were calculated with the latest EPA factors and manufacture data when available. Documents used as references for the emissions calculations, including engine specification sheets, AP-42 and EPA emission factor references, gas and liquids analyses, and process simulation results are included.

Aggregation Analysis

The aggregation of facilities is appropriate only if separate emissions sources meet the following three-prong test:

1. The sources belong to a single major industrial grouping (same two-digit major SIC code);
2. The sources are under common control of the same person (or persons under common control); and
3. The sources are located on one or more "contiguous or adjacent" properties.

Under the third prong, SWN determined that there were no other facilities contiguous with or adjacent to the proposed Fork Ridge Pad to be permitted. Neither the WV DEP nor EPA have established a distance under which source aggregations are required, but the terms "contiguous" or "adjacent" require analyzing distances between operations. To be considered contiguous, two operations must share a common fence line. As for adjacent, operations located more than a quarter of a mile apart are clearly not adjacent, but operations within a quarter of a mile require an analysis to determine if they meet the common sense notion of a plant. No other SWN locations are located within a quarter mile of the proposed Fork Ridge Pad to be permitted; therefore, no additional facilities are contiguous or adjacent.

Regulatory Discussion

STATE

45 CSR 13 - PERMITS FOR CONSTRUCTION, MODIFICATION, RELOCATION AND OPERATION OF STATIONARY SOURCES OF AIR POLLUTANTS, NOTIFICATION REQUIREMENTS, ADMINISTRATIVE UPDATES, TEMPORARY PERMITS, GENERAL PERMITS, AND PROCEDURES FOR EVALUATION:

Potential emissions associated with the proposed project are greater than the minor source construction permit thresholds of 6 pounds per hour (pph) AND 10 tons per year (tpy) of any regulated air pollutant OR 144 pounds per day (ppd) of any regulated air pollutant OR 2 pph OR 5 tpy of aggregated hazardous air pollutants (HAP) OR 45 CSR 27 toxic air pollutant (TAP) (10%

increase if above BAT triggers or increase to Best Available Technology (BAT) triggers) OR subject to applicable Standard or Rule. The facility is not within 300 feet of any occupied dwelling, business, public building, school, church, community, institutional building or public park, and meets all other requirements for registration under a G70-A General Permit.

45 CSR 22 - AIR QUALITY MANAGEMENT FEE PROGRAM:

The facility will be required to maintain a valid Certificate to Operate on the premises.

45 CSR 30 - REQUIREMENTS FOR OPERATING PERMITS:

Emissions from the facility do not exceed major source thresholds; therefore, this rule does not apply.

FEDERAL

40 CFR PART 60 SUBPART KB—STANDARDS OF PERFORMANCE FOR VOLATILE ORGANIC LIQUID STORAGE VESSELS (INCLUDING PETROLEUM LIQUID STORAGE VESSELS) FOR WHICH CONSTRUCTION, RECONSTRUCTION, OR MODIFICATION COMMENCED AFTER JULY 23, 1984

The affected facility to which this subpart applies is each storage vessel with a capacity greater than or equal to 75 cubic meters (m^3) that is used to store volatile organic liquids (VOL) for which construction, reconstruction, or modification is commenced after July 23, 1984. The tanks at this facility were constructed after the effective date of this subpart but are less than 75 m^3 (which equals approximately 471 bbl); therefore, this subpart does not apply.

40 CFR PART 60 SUBPART KKK - STANDARDS OF PERFORMANCE FOR STATIONARY FOR EQUIPMENT LEAKS OF VOC FROM ONSHORE NATURAL GAS PROCESSING PLANTS:

The facility is not considered an affected source (natural gas processing plant) and is therefore not subject to this Subpart.

40 CFR PART 60 SUBPART IIII - STANDARDS OF PERFORMANCE FOR STATIONARY COMPRESSION IGNITION INTERNAL COMBUSTION ENGINES:

The facility does not contain the affected source (diesel-fired engine) and is therefore not subject to this Subpart.

40 CFR PART 60 SUBPART JJJJ - STANDARDS OF PERFORMANCE FOR STATIONARY SPARK IGNITION INTERNAL COMBUSTION ENGINES:

The engines were manufactured after June 12, 2006 and are subject to the requirements of this subpart. The manufacture dates of the three Caterpillar G3516B engines are not yet known but they are presumed to be subject to NSPS Subpart JJJJ as new engines. EU-ENG3 was manufactured in 2014 and is subject to the requirements of this subpart.

40 CFR PART 60 SUBPART OOOO - STANDARDS OF PERFORMANCE FOR CRUDE OIL AND NATURAL GAS PRODUCTION, TRANSMISSION, AND DISTRIBUTION:

The emission sources affected by this Subpart include well completions, pneumatic controllers, equipment leaks from natural gas processing plants, sweetening units at natural gas processing plants, reciprocating compressors, centrifugal compressors and storage vessels which are constructed, modified or reconstructed after August 23, 2011.

SWN will ensure compliance of all subject wells and equipment located at this facility with all applicable requirements in accordance with the respective compliance dates. Wells located at this production facility are not drilled principally to produce natural gas, therefore they are not affected sources subject to gas well completion requirements.

Pneumatic controllers affected by this Subpart include continuous bleed, natural gas-driven pneumatic controllers with a natural gas bleed rate greater than 6 SCFH. No pneumatic devices with a continuous bleed greater than 6 SCFH will be installed at this facility.

Storage vessels affected by this Subpart include those with VOC emissions greater than 6 TPY. Emissions from the storage vessels at this facility are greater than 6 TPY each and they are subject to this subpart.

40 CFR PART 63 SUBPART HH - NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS FOR SOURCE CATEGORIES FROM OIL AND NATURAL GAS PRODUCTION FACILITIES:

The site is a minor (area) source of hazardous air pollutants. This subpart applies to affected emission points that are located at facilities that are major and area sources of HAP, and either process, upgrade, or store hydrocarbon liquids prior to custody transfer or that process, upgrade, or store natural gas prior to entering the natural gas transmission and storage source category. For purposes of this subpart natural gas enters the natural gas transmission and storage source category after the natural gas processing plant, if present. Even though the TEG dehydration unit at this facility is considered an affected area source, it is exempt from the

requirements of § 63.764(d)(2) since the actual average emissions of benzene from the glycol dehydration unit process vent to the atmosphere are less than 0.90 Mg (1.0 TPY), as determined by the procedures specified in § 63.772(b)(2). However, the facility must maintain records of the de minimis determination as required in § 63.774(d)(1).

40 CFR PART 63 SUBPART HHH - NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS FOR SOURCE CATEGORIES FROM NATURAL TRANSMISSION AND STORAGE FACILITIES:

The facility is not a natural gas transmission and storage facility and is therefore not subject to this Subpart.

40 CFR PART 63 SUBPART ZZZZ - NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS FOR SOURCE CATEGORIES FROM STATIONARY RECIPROCATING INTERNAL COMBUSTION ENGINES - AREA SOURCE:

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 located at a major source of 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.

Owners and operators of new or reconstructed engines at area sources must meet the requirements of Subpart ZZZZ by complying with either 40 CFR Part 60 Subpart IIII (for CI engines) or 40 CFR Part 60 Subpart JJJJ (for SI engines). Based on emission calculations, this facility is a minor source of HAP. The engines are new engines as defined by this subpart and comply with MACT Subpart ZZZZ by complying with the requirements of NSPS Subpart JJJJ.

APPLICATION FOR GENERAL PERMIT REGISTRATION

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:
10000 Energy Drive
Spring, TX 77389

5. If applicant is a subsidiary corporation, please provide the name of parent corporation:
Southwestern Energy 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 and natural gas production well pad

8a. Standard Industrial Classification (SIC) code: **1311**

AND

8b. North American Industry System (NAICS) code: **211111**

9. DAQ Plant ID No. (for existing facilities only):
051-00205

10. List all current 45CSR13 and other General Permit numbers associated with this process (for existing facilities only):
G70-A091

A: PRIMARY OPERATING SITE INFORMATION

11A. Facility name of primary operating site:	12A. Address of primary operating site:
Fork Ridge Pad	**Not applicable. Facility is located at 39.87151, -80.638514**

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: **SWN owns the mineral rights and has control of the site.**

– 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 intersection of SR 250 and CR 2 in Moundsville, WV, travel south on SR 250 14.17 miles to intersection of SR 250 and CR 17(Fork Ridge Road). Turn right onto CR 17 and travel 3.64 miles to well pad entrance on the right.

15A. Nearest city or town:	16A. County:	17A. UTM Coordinates:
Moundsville, WV	**Marshall**	Northing (KM): **4,413.58884** Easting (KM): **530.91413** Zone: **17S**

18A. Briefly describe the proposed new operation or change (s) to the facility:	19A. Latitude & Longitude Coordinates (NAD83, Decimal Degrees to 5 digits):
This application proposes installation of three (3) 1,380-hp Caterpillar G3516B compressor engines, revision of storage tank emissions and update of combustor emissions.	Latitude: **39.87151** Longitude: **-80.638514**

B: 1ST ALTERNATE OPERATING SITE INFORMATION (only available for G20, G40, & G50 General Permits) – NOT APPLICABLE

11B. Name of 1st alternate operating site:	12B. Address of 1st alternate operating site:
_____	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): - NOT APPLICABLE

11C. Name of 2nd alternate operating site: _____ _____	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: **On or about January 4, 2016 but contingent upon approval.** ☐ 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: **On or about January 4, 2016 but contingent upon approval.**

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
- ☒ ATTACHMENT N: MATERIAL SAFETY DATA SHEETS (MSDS)
- ☒ ATTACHMENT O: EMISSIONS SUMMARY SHEETS
- ☒ OTHER SUPPORTING DOCUMENTATION NOT DESCRIBED ABOVE (Equipment Drawings, Aggregation Discussion, etc.)

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) _____

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 _____ 12/4/15
(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 **SWN Production Company, LLC**

Phone & Fax **304-884-1652**
Phone Fax

Email **Kristi.Evans@swn.com**

ATTACHMENT A: BUSINESS REGISTRATION 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.

atL006 v.4
L1160094016

ATTACHMENT B: PROCESS DESCRIPTION

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 also occurs on-site. A description of the facility process is as follows: Condensate, gas and water come from the wellhead(s) to the production unit(s), where the first stage of separation occurs. Fluids (condensate and produced water) will be sent to the heater treater(s). Flash gases from the heater treater are captured via natural gas-fired engine-driven flash gas compressor(s). Produced water from the heater treater(s) flows into the produced water storage tanks. Condensate flows into the low-pressure tower(s). Flash gases from the low-pressure tower(s) are routed via hard-piping (with 100% capture efficiency) to the inlet of the flash gas compressor(s) to be compressed.

Working, breathing and flashing vapors from the condensate and produced water storage tanks will be routed to the vapor combustor with a 100% capture efficiency to be burned with at least 98% combustion efficiency. The vapor combustor has three (3) natural gas-fired pilots to ensure a constant flame for combustion.

The natural gas stream from the gas production units is sent to the compressors and then will be routed to the dehydration unit before exiting the facility. In the dehydration process, gas passes through a contactor vessel where water is absorbed by the glycol. The “rich” glycol containing water goes to the glycol dehydrator reboiler where heat is used to boil off the water. Still vent vapors from the dehydration unit will be controlled by an air-cooled condenser. Non-condensables from the still column overheads are routed to the reboiler for combustion. It was conservatively assumed that the reboiler provides 50% destruction efficiency, as the burner on the reboiler is necessary to maintain the temperature and is inherent in the process; therefore, it is appropriate to use 50% efficiency with no monitoring required. The manufacturer guarantees a higher control efficiency. Flash tank off gas will be routed to the vapor combustor with a 100% capture efficiency to be burned with a 98% combustion efficiency.

A process flow diagram reflecting facility operations is shown in Attachment D.

ATTACHMENT C: DESCRIPTION OF FUGITIVE EMISSIONS

Fugitive emissions at this site will consist of haul road emissions, condensate and produced water loading operations, and equipment leaks.

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						
Unpaved Haul Roads	PM Total PM_{10} $PM_{2.5}$	0.59 0.14 0.01	1.95 0.48 0.05	N/A	N/A	O – AP-42 13.2.2
Loading/Unloading Operations - Condensate	VOC n-Hexane Benzene Toluene Ethylbenzene Xylenes Carbon Dioxide Methane	Does not apply	37.65 2.07 0.04 0.25 0.25 0.66 <0.01 0.24	Does not apply	11.30 0.62 0.01 0.07 0.08 0.20 <0.01 0.07	O – AP-42 5.2-4 / API 5-12
Loading/Unloading Operations – Produced Water	VOC n-Hexane Benzene Toluene Ethylbenzene Xylenes Carbon Dioxide Methane	Does not apply	0.61 0.03 <0.01 <0.01 <0.01 0.01 0.22 6.38	Does not apply	0.18 0.01 <0.01 <0.01 <0.01 <0.01 0.07 1.91	O – AP-42 5.2-4 / API 5-12

Equipment Leaks	VOC n-Hexane Benzene Toluene Ethylbenzene Xylenes Carbon Dioxide Methane	Does not apply	6.38 0.26 <0.01 0.03 0.02 0.06 0.05 9.36	Does not apply	N/A	O – EPA-453/R-95-017
Blowdown Emissions						
Other						

[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).

Note: Greenhouse Gas (GHG) emissions were calculated using EPA Mandatory Reporting Rule and 2009 API Compendium guidance. With the exception of fugitive emissions (which are calculated by mass balance), emissions calculation methodologies are intended to calculate metric tons (tonnes) for the purposes of emissions reporting to EPA. These values were converted to tons for consistency with other pollutants.

LEAK SOURCE DATA SHEET

Source Category	Pollutant	Number of Source Components[1]	Number of Components Monitored by Frequency[2]	Average Time to Repair (days)[3]	Estimated Annual Emission Rate (lb/yr)[4]
Pumps[5]	light liquid VOC[6,7]	0	N/A	N/A	0
	heavy liquid VOC[8]				
	Non-VOC[9]				
Valves[10]	Gas VOC	178	N/A	N/A	2,940
	Light Liquid VOC	127	N/A	N/A	5,840
	Heavy Liquid VOC				
	Non-VOC				
Safety Relief Valves[11]	Gas VOC	48	N/A	N/A	1,540
	Non VOC				
Open-ended Lines[12]	VOC	2	N/A	N/A	20
	Non-VOC				
Sampling Connections[13]	VOC				
	Non-VOC				
Compressors	VOC	12	N/A	N/A	380
	Non-VOC				
Flanges	VOC	721 (Gas), 502 (LL)	N/A	N/A	1,020 (Gas), 1,020 (LL)
	Non-VOC				
Other	VOC	0	N/A	N/A	0
	Non-VOC				

[1 - 13] See notes on the following page.

Note: Component counts taken by equipment type at representative facility and made site-specific according to the number of each equipment type at this site.

Notes for Leak Source Data Sheet

1. For VOC sources include components on streams and equipment that contain greater than 10% w/w VOC, including feed streams, reaction/separation facilities, and product/by-product delivery lines. Do not include certain leakless equipment as defined below by category.

2. By monitoring frequency, give the number of sources routinely monitored for leaks, using a portable detection device that measures concentration in ppm. Do not include monitoring by visual or soap-bubble leak detection methods. "M/Q(M)/Q/SA/A/O" means the time period between inspections as follows:

   Monthly/Quarterly, with Monthly follow-up of repaired leakers/Quarterly/Semi-annual/Annually/Other (specify time period)

   If source category is not monitored, a single zero in the space will suffice. For example, if 50 gas-service valves are monitored quarterly, with monthly follow-up of those repaired, 75 are monitored semi-annually, and 50 are checked bimonthly (alternate months), with non checked at any other frequency, you would put in the category “valves, gas service:” 0/50/0/75/0/50 (bimonthly).

3. Give the average number of days, after a leak is discovered, that an attempt will be made to repair the leak.

4. Note the method used: MB - material balance; EE - engineering estimate; EPA - emission factors established by EPA (cite document used); O - other method, such as in-house emission factor (specify).

5. Do not include in the equipment count sealless pumps (canned motor or diaphragm) or those with enclosed venting to a control device. (Emissions from vented equipment should be included in the estimates given in the Emission Points Data Sheet.)

6. Volatile organic compounds (VOC) means the term as defined in 40 CFR □51.100 (s).

7. A light liquid is defined as a fluid with vapor pressure equal to or greater than 0.04 psi (0.3 Kpa) at 20°C. For mixtures, if 20% w/w or more of the stream is composed of fluids with vapor pressures greater than 0.04 psi (0.3 Kpa) at 20 °C, then the fluid is defined as a light liquid.

8. A heavy liquid is defined as a fluid with a vapor pressure less than 0.04 psi (0.3 Kpa) at 20°C. For mixtures, if less than 20% w/w of the stream is composed of fluids with vapor pressures greater than 0.04 psi (0.3 Kpa) at 20 °C, then the fluid is defined as a heavy liquid.

9. LIST CO, H_2S, mineral acids, NO, NO_2, SO_3, etc. DO NOT LIST CO_2, H_2, H_2O, N_2, O_2, and Noble Gases.

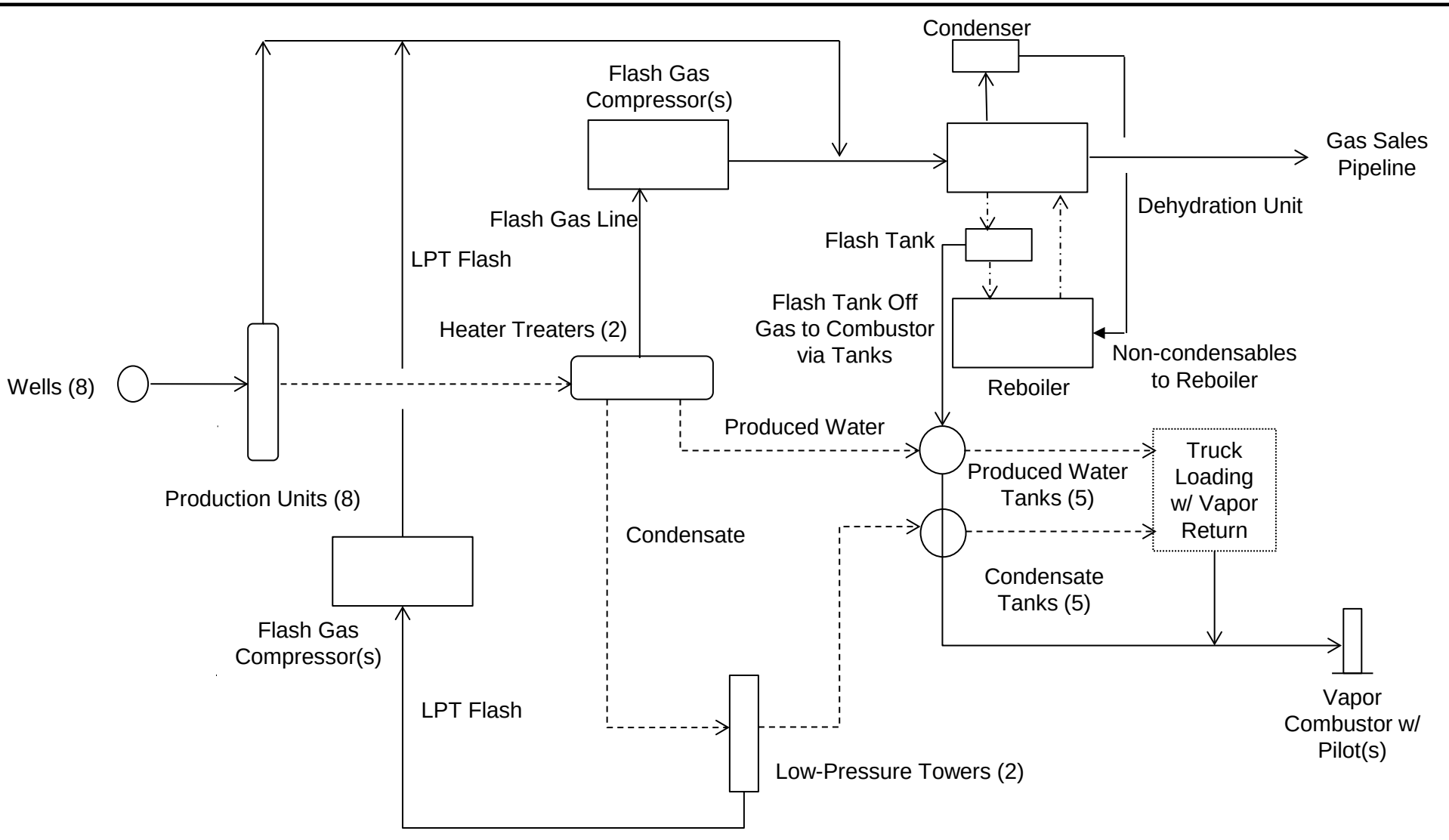
10. Include all process valves whether in-line or on an open-ended line such as sample, drain and purge valves. Do not include safety-relief valves, or leakless valves such as check, diaphragm, and bellows seal valves.

11. Do not include a safety-relief valve if there is a rupture disk in place upstream of the valve, or if the valve vents to a control device.

12 Open-ended lines include purge, drain and vent lines. Do not include sampling connections, or lines sealed by plugs, caps, blinds or second valves.

13. Do not include closed-purge sampling connections.

ATTACHMENT D: PROCESS FLOW DIAGRAM



Gas/Vapor

Liquids (Condensate and Produced Water)

Glycol

Note: Drawing is a depiction of general facility process and is not intended to represent facility and/or equipment layout.

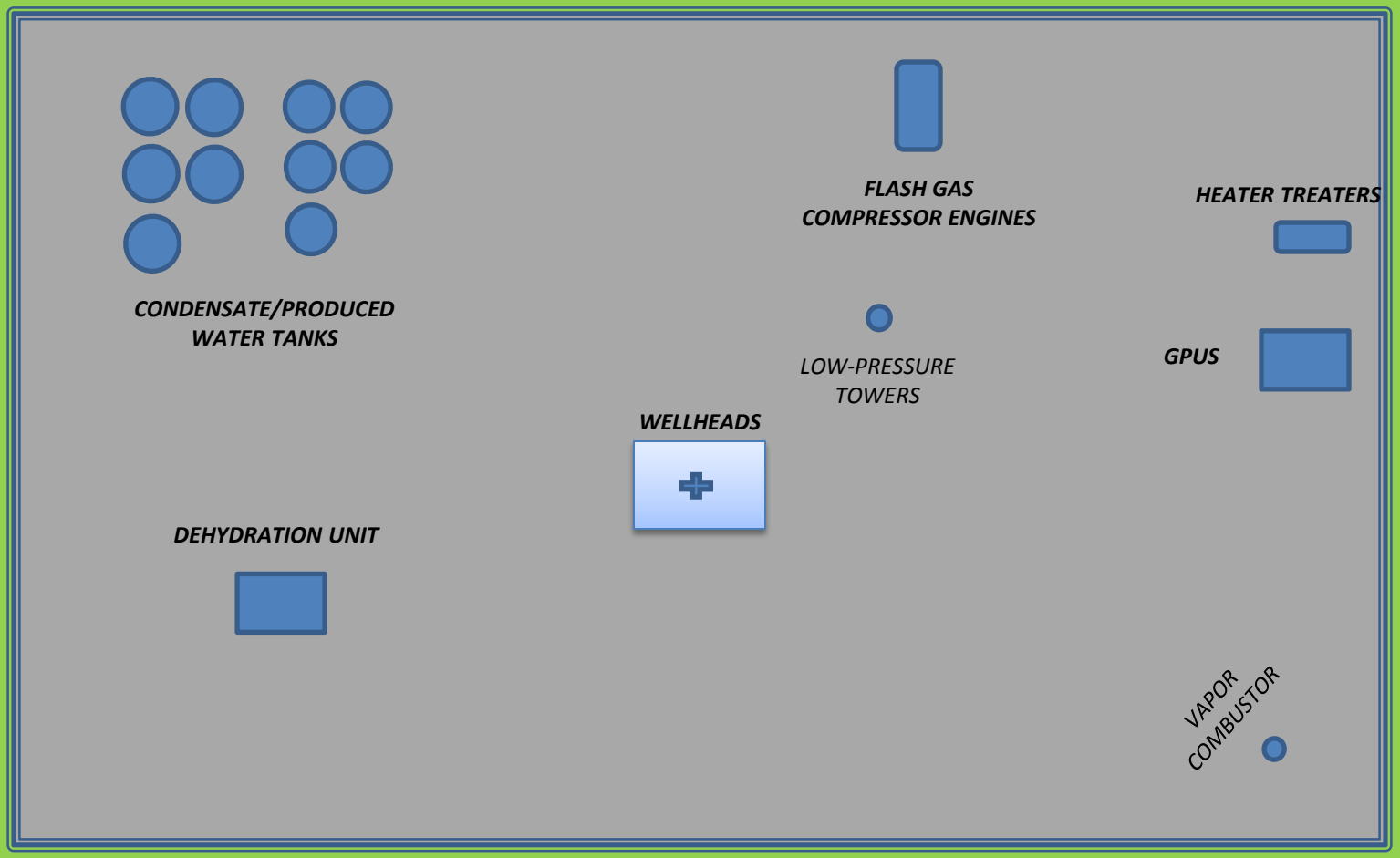
SWN Production Company, LLC

Fork Ridge Pad

Attachment D: Process Flow Diagram

November 2015

ATTACHMENT E: PLOT PLAN



***NOTE**: Image is only a representation of production/emissions equipment. Actual location specifications and equipment placement are not to scale.*

SWN Production Company, LLC
Fork Ridge Pad
Simple Plot Plan
November 2015

STC-908294-B-2

K:\EandP\WVD\Team Data\Production\Production Facilities\Bid Layouts 03/13/15 MRM

DISCHARGE CHANNEL #2
SEE DETAIL ON SHEET #6

1.87:1 CUT

2.07:1 CUT

2:1 FILL

FORK RIDGE PAD
(NAD27)
LAT: 39° 52' 17.06"
LONG: 80° 38' 18.35"
PAD ELEVATION:
1393'

AIR SHA
PAD AR

2.23:1 FILL

WELL HEAD COMPRESSORS

STONE PAD
AREA

BERM (TYP.)

LIMITS OF WELL PAD

CAMERA PAD

WELL PAD ACCESS ROAD

34'

ESD PULL STATION

201H 1H 3H 5H

206H 6H 8H 10H

BID ITEM #4 – WELL HEAD (SEE NOTE 9)

BID ITEM #16 – JERSEY BARRIER (TYP.)

92'

3-INCH PIPE FROM WELL TO SAND TRAP DUMP LINE (TYP.)

3-INCH FROM WELL TO SAND TRAP (TYP.)

6-INCH SALES HEADER

2-INCH COMMON FLUID LINE

WATER DUMP LINE

OIL DUMP LINE

2-INCH BLOW DOWN LINE (TYP.)

BID ITEM #6 – DOUBLE GPU'S & SALES HEADER

DOUBLE GPU

3-INCH PIPE FROM SAND TRAP TO GPU

ESD

TEG

54'

34'

FLASH GAS METER SKID

HEATER TREATER

BID ITEM #9 – HEATER TREATERS

BID ITEM #8 – DEHY EQUPMENT

159'

SAND TRAP (TYP.)

BID ITEM #5 – SAND TRAPS

88'

117'

BTEX

DEHY SKID

REBOILER

METER

BID ITEM #7 – METER SKID

BID ITEM #10 – ABOVE & BELOW GRADE PIPING

3406 COMPRESSOR

BID ITEM #11 – COMPRESSORS

3306 COMPRESSORS

COMPRESSOR BOXES (SEE NOTE 10)

206'

BID ITEM #13/14 – STORAGE TANKS

TANK CONTAINMENT AREA

DRAIN LOAD OUT

VAPOR RECOVERY

OIL LOAD OUT

ESD

WATER LOAD OUT

WATER TANK (TYP.)

BID ITEM #15 – COMBUSTOR

30 MMBTU/HR COMBUSTOR (10' X 10' PAD)

36'

O5 W3 W2 W1

O4 O3 O2 O1

VAPOR TOWER (5' X 5' PAD)

BID ITEM #12 – LOW PRESSURE TOWER

FLASH GAS (FROM VAPOR TOWER)

FLARE DRUM & BLOWCASE

76'

72'

70'

OIL TANK (TYP.)

1.47:1 CUT

FORK RIDGE

1380 1390 1370 1380 1400 1410

#	Revision Description	DATE	DWN	CHK
A	INITIAL RELEASE	3/13/15	MRM	ZT

LEGEND

- ABOVE GROUND WELL HEAD DISCHARGE PIPING
- BELOW GROUND WELL HEAD DISCHARGE PIPING
- ABOVE GROUND GAS PIPING
- BELOW GROUND GAS PIPING
- ABOVE GROUND PRODUCED WATER PIPING
- BELOW GROUND WATER PIPING
- ABOVE GROUND OIL/CONDENSATE PIPING
- BELOW GROUND OIL/CONDENSATE PIPING
- ABOVE GROUND DISCHARGE PIPING
- BELOW GROUND DISCHARGE PIPING
- ABOVE GROUND 6-INCH SALES LINE
- 1280 EXISTING GROUND CONTOUR (2-FOOT INTERVAL)
- WELL PAD LIMITS

BID ITEM #17 – ELECTRICAL WIRING SUPPORT

WIRING

1. 12 PAIR WIRE FROM EACH WELLHEAD TO METERS NEAR THE HEADER
2. 2 PAIR WIRE FROM HEADER/ METER AREA TO EDGE OF LOCATION/ LEASE ROAD FOR ESD
3. 4 PAIR WIRE FROM HEADER/METER AREA TO COMPRESSOR
4. 24 PAIR WIRE FROM HEADER/METER AREA TO TANK BATTERY FOR JUNCTION BOX
5. 4 PAIR WIRE (SPARE) FROM HEADER/METER AREA TO TANK BATTERY FOR JUNCTION BOX
6. 12 PAIR WIRE FROM TANK BATTERY JUNCTION BOX TO COMBUSTOR
7. 4 PAIR WIRE FROM HEADER/METER AREA TO TEG UNIT

TEG UNIT

1. UNIT MUST BE 25 FT FROM ANY FIRED VESSEL

NOTES

1. ALL WIRING USED IS 18 GAUGE CLX EXCEPT THE 4 PAIR WIRE USED FOR THE TEG WHICH IS 12 GAUGE CLX
2. APPROXIMATELY 10 – 15 FT OF EXTRA WIRE SHOULD BE LEFT AT ALL JUNCTIONS, AND APPROXIMATELY 20 FT OF EXTRA WIRE AT THE COMPRESSOR
3. LINES COMING FROM EACH SPECIFIC WELLHEAD MUST BE MARKED/IDENTIFIED WITH ITS RESPECTIVE WELL OF ORIGIN AT THE OTHER END/JUNCTION NEAR THE HEADER

*FOLLOW CONSTRAINED FACILITY SPACING STANDARD

NOTES:

1. THE CONTRACTOR IS RESPONSIBLE FOR PROTECTING ALL EXISTING STRUCTURES, UTILITIES, FACILITIES, AND ALL PROPOSED WORK ON THE SITE DURING CONSTRUCTION. MANY EXISTING FEATURES ARE SENSITIVE TO VIBRATIONS AND HEAVY EQUIPMENT LOADING. THE CONTRACTOR MUST EXERCISE CAUTION AND DILIGENCE TO AVOID CAUSING DAMAGE. ANY EXISTING FEATURES DAMAGED BY THE CONTRACTOR THAT NEED TO BE REPAIRED BY THE OWNER WILL BE AT THE CONTRACTOR'S EXPENSE.
2. CONTRACTOR SHALL ADHERE TO ALL SPACING REQUIREMENTS SHOWN ON DRAWING.
3. CONTRACTOR IS RESPONSIBLE FOR PROVIDING A DAILY OPERATION SUMMARY OF WORK PERFORMED TO SWN PERSONNEL.
4. CONTRACTOR IS RESPONSIBLE FOR DAILY HOUSEKEEPING WHILE ONSITE. RESPONSIBILITIES INCLUDE KEEPING ALL MATERIAL LEFT ONSITE ORGANIZED AND NEATLY PUT AWAY, LOCATION IS WALKED AND CLEANED UP DAILY, AND GATE IS LOCKED AFTER DAILY OPERATIONS CEASE.
5. FINAL CLEANUP AT THE END OF THE PROJECT INCLUDES CLEANING EQUIPMENT WITH CLEANING MATERIALS APPROPRIATE TO SURFACE AND MATERIAL BEING CLEANED, CLEAN DEBRIS FROM STORMWATER DRAINAGE SYSTEMS AND ROADWAYS, AND REMOVE WASTE AND SURPLUS MATERIALS, RUBBISH, AND CONSTRUCTION FACILITIES FROM SITE. ANY LEFTOVER MATERIAL NEEDS TO BE TAKEN OFFSITE AND COMMUNICATED WITH SWN CONSTRUCTION FOREMAN.
6. CONTRACTOR WILL NEED TO SUPPLY SWN PERSONNEL WITH ALL UNDERGROUND PIPING PHOTOS AND SKETCHES OF SEGMENT LENGTHS AT PROJECT COMPLETION. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO DOCUMENT BELOW GRADE PIPING WITH PHOTOS DURING CONSTRUCTION AND TO SKETCH PIPING BETWEEN ABOVE/BELOW GRADE PIPING TRANSITIONS. THESE ITEMS WILL BE USED TO COMPLETE THE AS-BUILT DRAWING OF THE PAD BY OTHERS.
7. CONTRACTOR IS RESPONSIBLE FOR COMPLETING COMMISSION SHEETS AND PRE-PAD TANK BATTERY INSPECTION SHEETS ONCE FULL INSTALLATION OF PAD IS COMPLETE.
8. ALL PROCESS PIPING SHALL BE INSTALLED IN ACCORDANCE WITH ASME B31.3 CODES AND STANDARDS.
9. CONTRACTOR SHALL EXCAVATE ALL PIPE TRENCHES TO A MINIMUM OF 3 FEET DEEP. THE CONTRACTOR SHALL INSTALL 6 TO 8 INCHES OF SWN SUPPLIED AGGREGATE IN TRENCH FOR PIPE BEDDING PRIOR TO PIPE INSTALLATION. PIPES IN TRENCH SHALL BE SPACED 10-INCHES ON CENTER. AFTER PIPING IS INSTALLED CONTRACTOR SHALL PLACE 6 TO 8 INCHES OF SWN SUPPLIED AGGREGATE ABOVE PIPING. THE CONTRACTOR SHALL BACKFILL THE REMAINDER OF THE TRENCH WITH SUITABLE EXCAVATED MATERIAL (I.E. MAXIMUM PARTICLE SIZE OF 3 INCHES, CONTRACTOR SHALL SCREEN EXCAVATED MATERIAL TO REMOVE OVERSIZED MATERIAL). BACKFILL SHALL BE COMPACTED IN 6-INCH LOOSE LIFTS UNTIL SUBGRADE IS ACHIEVED. THE CONTRACTOR SHALL USE THE +3-INCH STONE, FROM SCREENING, TO RETURN SITE TO ORIGINAL GRADE ONLY AFTER SUBGRADE HAS BEEN ACHIEVED. #4 STONE (SUPPLIED BY SWN) MAY NEED TO BE USED TO SUPPLEMENT THE +3-INCH STONE TO RETURN SITE TO ORIGINAL GRADE.
10. CONTRACTOR SHALL CONSTRUCT AND FILL COMPRESSOR PAD BOXES. COMPRESSOR PAD BOXES SHALL BE CONSTRUCTED OF TREATED 2" X 6" LUMBER TO THE DIMENSIONS 12' X 24' X 6". AFTER BOX CONSTRUCTION AND INSTALLATION, 3" LIMESTONE SAND SHALL BE INSTALLED AND COMPACTED. AN ADDITIONAL 2" SCREED SHALL THEN BE INSTALLED TO FILL THE COMPRESSOR BOX. COMPRESSORS SHALL BE SET ON THE CONSTRUCTED PADS USING REQUIRED LIFTING AND HANDLING EQUIPMENT. COMPRESSOR PAD FILL MATERIALS WILL BE SUPPLIED BY SWN. CONTRACTOR SHALL SUPPLY LUMBER, LABOR AND EQUIPMENT TO CONSTRUCT THE BOXES, LABOR AND EQUIPMENT TO FILL AND COMPACT THE BOX MATERIAL, EQUIPMENT TO SET COMPRESSORS, AND LABOR TO INSTALL COMPRESSORS.

PROPERTY INFORMATION		
WELL	PROPERTY #	AFE #
2011H		
1H		
3H		
5H		
205H		
6H		
8H		
10H		

FACILITY BID LAYOUT

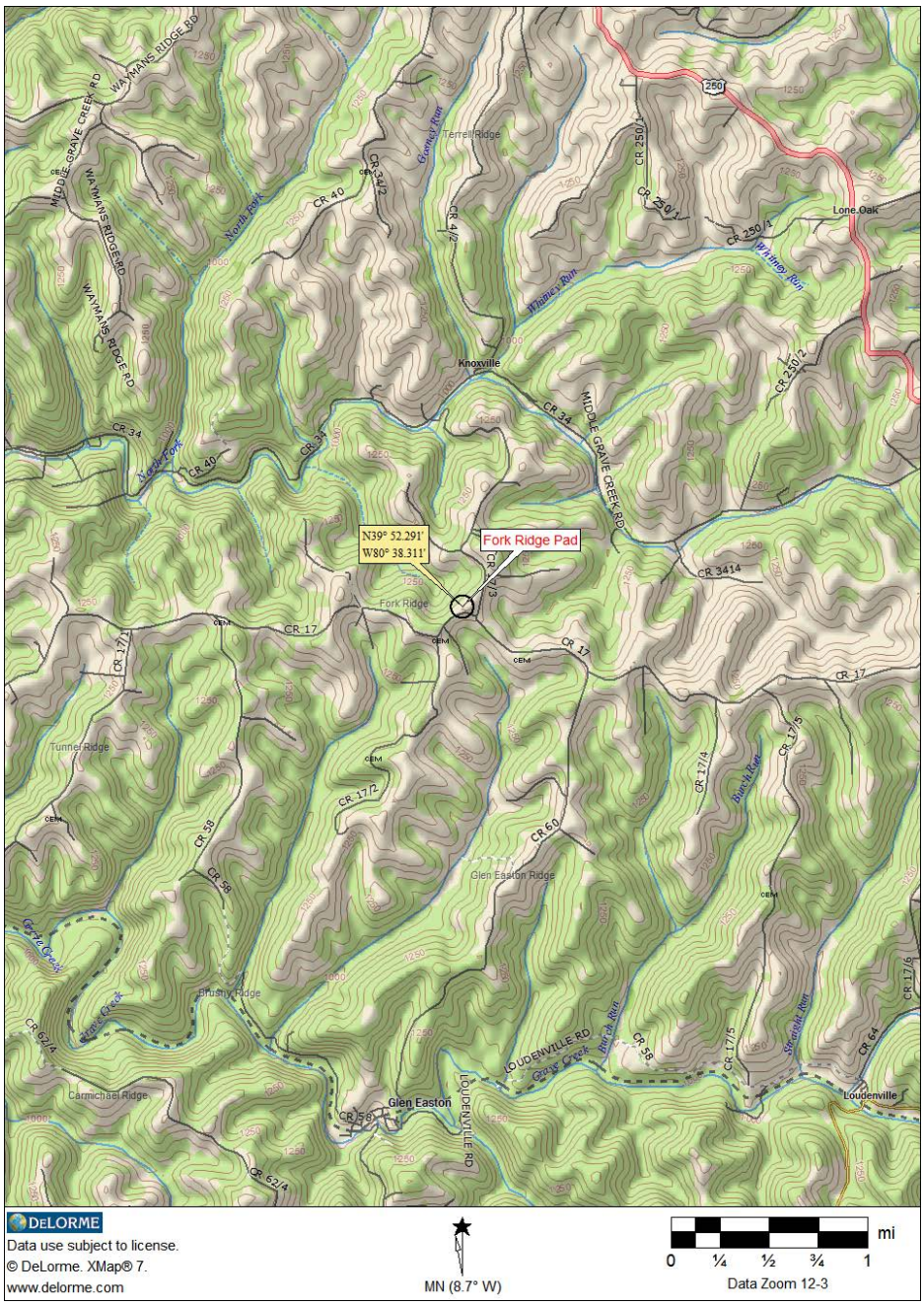
FORK RIDGE PAD

MARCELLUS SOUTH DISTRICT

COUNTY: MARSHALL	PAD #: 908294
DRAWN BY: MRM	DATE: 02/20/15
CHECKED BY: ZT	DATE: 03/13/15
DRAWING #: STC-908294-B-2	
REVISION: A	SHEET #: 1 OF 1
SCALE: 1"=25'	SHEET SIZE: ANSI-D

DO NOT SCALE DRAWING

ATTACHMENT F: AREA MAP



Fork Ridge Pad
Figure 1: Area Map
Marshall County, West Virginia
December 2015

ATTACHMENT G: EMISSION UNIT DATA SHEETS AND G70-A SECTION APPLICABILITY FORM

Emission Units Table

Storage Vessel Emission Unit Data Sheet

Natural Gas Fired Compressor Engine (RICE) Emission Data Sheet

Glycol Dehydration Emission Unit Data Sheet

Tank Truck Loading Emission Unit Data Sheet

G70-A Section Applicability Form

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-MC1706	EP-MC1706	Caterpillar G3306 NA Engine	2014	145-hp	Removal	NSCR
EU-MC4907	EP-MC4907	Caterpillar G3406 NA Engine	2014	215-hp	Removal	NSCR
EU-MC4908	EP-MC4908	Caterpillar G3406 NA Engine	2014	215-hp	Removal	NSCR
EU-ENG1	EP-ENG1	Caterpillar G3516B Engine	TBD	1,380-hp	New	Oxidation Catalyst
EU-ENG2	EP-ENG2	Caterpillar G3516B Engine	TBD	1,380-hp	New	Oxidation Catalyst
EU-ENG3	EP-ENG3	Caterpillar G3406 NA Engine	TBD	215-hp	New	NSCR
EU-ENG4	EP-ENG4	Caterpillar G3516B Engine	TBD	1,380-hp	New	Oxidation Catalyst
EU-GPU1	EP-GPU1	GPU Burner	2014	1.0-mmBtu/hr	N/A	N/A
EU-GPU2	EP-GPU2	GPU Burner	2014	1.0-mmBtu/hr	N/A	N/A
EU-GPU3	EP-GPU3	GPU Burner	2014	1.0-mmBtu/hr	N/A	N/A
EU-GPU4	EP-GPU4	GPU Burner	2014	1.0-mmBtu/hr	N/A	N/A
EU-GPU5	EP-GPU5	GPU Burner	2014	1.0-mmBtu/hr	N/A	N/A
EU-GPU6	EP-GPU6	GPU Burner	2014	1.0-mmBtu/hr	N/A	N/A
EU-GPU7	EP-GPU7	GPU Burner	2014	1.0-mmBtu/hr	N/A	N/A
EU-GPU8	EP-GPU8	GPU Burner	2014	1.0-mmBtu/hr	N/A	N/A
EU-HT1	EP-HT1	Heater Treater	2014	0.5-mmBtu/hr	N/A	N/A
EU-HT2	EP-HT2	Heater Treater	2014	0.5-mmBtu/hr	N/A	N/A

Emission Units Table (Continued)

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

EU-DEHY1	EP-DEHY1	TEG Dehydration Unit	2014	35.0-MMSCFD	N/A	APC-COND and APC-COMB-TKLD
EU-RB1	EP-RB1	TEG Reboiler	2014	0.75-mmBtu/hr	N/A	N/A
EU-TANKS-COND	APC-COMB-TKLD	Five (5) Condensate Tanks	2014	400-bbl each	Modification	APC-COMB-TKLD
EU-TANKS-PW	APC-COMB-TKLD	Five (5) Produced Water Tanks	2014	400-bbl each	N/A	APC-COMB-TKLD
EU-LOAD-COND	APC-COMB-TKLD	Condensate Truck Loading	2014	12,264,000 gallons	Modification	APC-COMB-TKLD
EU-LOAD-PW	APC-COMB-TKLD	Produced Water Truck Loading	2014	15,330,000 gallons	N/A	APC-COMB-TKLD
APC-COMB-TKLD	APC-COMB-TKLD	Vapor Combustor	2014	30.0-mmBtu/hr	Modification	N/A
EU-Pilot	APC-COMB-TKLD	Vapor Combustor Pilots	2014	150 scfh	N/A	N/A
EU-FUG	EP-FUG	Fugitive Emissions	2014	N/A	Modification	N/A
EU-HR	EP-HR	Fugitive Haul Road Emissions	2014	N/A	N/A	N/A

[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.

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	2. Tank Name Five (5) 400-bbl Condensate Storage Tanks
3. Emission Unit ID number EU-TANKS-COND	4. Emission Point ID number APC-COMB-TKLD
5. Date Installed or Modified *(for existing tanks)* 2014	6. Type of change: ☐ New construction ☐ New stored material ☒ Other
7A. Description of Tank Modification *(if applicable)* Revision to process simulation based on proposed operations.	
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.) Not applicable	

II. TANK INFORMATION (required)

8. Design Capacity *(specify barrels or gallons).* Use the internal cross-sectional area multiplied by internal height. 400 barrels (per tank)	
9A. Tank Internal Diameter (ft.) 12	9B. Tank Internal Height (ft.) 20
10A. Maximum Liquid Height (ft.) 19	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. 16,074.56 gallons (per EPA TANKS 4.0.9d)	
13A. Maximum annual throughput (gal/yr) 12,264,000 (Total for all tanks)	13B. Maximum daily throughput (gal/day) 33,600 (Total for all tanks)
14. Number of tank turnovers per year 762.94 (Total for all tanks, per EPA TANKS 4.0.9d)	15. Maximum tank fill rate (gal/min) Unknown
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 combustors, flares, thermal oxidizers)
☐ Condenser[1]
☐ Other[1] (describe)

☐ Rupture Disc (psig)
☐ Inert Gas Blanket of _____
☐ Conservation Vent (psig
Vacuum Setting Pressure Setting
☐ 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	
Refer to Attachment I Emissions Calculations and enclosed TANKS Summary Sheet.									

[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 **Refer to enclosed TANKS Summary Sheet.**		
19. Tank Shell Construction: ☐ Riveted ☐ Gunite lined ☐ Epoxy-coated rivets ☐ Other (describe)		
20A. Shell Color:	20B. Roof Color:	20C. Year Last Painted:
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):		
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):
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:			
28. Daily Avg. Ambient Temperature (°F):		29. Annual Avg. Maximum Temperature (°F):	
30. Annual Avg. Minimum Temperature (°F):		31. Avg. Wind Speed (mph):	
32. Annual Avg. Solar Insulation Factor (BTU/ft^2-day):		33. Atmospheric Pressure (psia):	
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):	35B. Maximum (psig):	
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):		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:			
39B. CAS number:			
39C. Liquid density (lb/gal):			
39D. Liquid molecular weight (lb/lb-mole):			
39E. Vapor molecular weight (lb/lb-mole):			
39F. Maximum true vapor pressure (psia):			
39G. Maxim Reid vapor pressure (psia):			
39H. Months Storage per year. From: To:			

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 Storage	2. Tank Name Five (5) 400-bbl Produced Water Storage Tanks
3. Emission Unit ID number EU-TANKS-PW	4. Emission Point ID number APC-COMB-TKLD
5. Date Installed or Modified *(for existing tanks)* 2014	6. Type of change: ☐ New construction ☐ New stored material ☒ Other
7A. Description of Tank Modification *(if applicable)* Revision to tank emissions based on 100% capture rate to combustor.	
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.) Not applicable	

II. TANK INFORMATION (required)

8. Design Capacity *(specify barrels or gallons).* Use the internal cross-sectional area multiplied by internal height. 400 barrels (per tank)	
9A. Tank Internal Diameter (ft.) 12	9B. Tank Internal Height (ft.) 20
10A. Maximum Liquid Height (ft.) 19	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. 16,074.56 gallons (per EPA TANKS 4.0.9d)	
13A. Maximum annual throughput (gal/yr) 15,330,000 (Total for all tanks)	13B. Maximum daily throughput (gal/day) 42,000 (Total for all tanks)
14. Number of tank turnovers per year 953.68 (Total for all tanks, per EPA TANKS 4.0.9d)	15. Maximum tank fill rate (gal/min) Unknown
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 combustors, flares, thermal oxidizers)
☐ Condenser[1]
☐ Other[1] (describe)

☐ Rupture Disc (psig)
☐ Inert Gas Blanket of _____
☐ Conservation Vent (psig
Vacuum Setting Pressure Setting
☐ 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	
Refer to Attachment I Emissions Calculations and enclosed TANKS Summary Sheet.									

[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 **Refer to enclosed TANKS Summary Sheet.**		
19. Tank Shell Construction: ☐ Riveted ☐ Gunite lined ☐ Epoxy-coated rivets ☐ Other (describe)		
20A. Shell Color:	20B. Roof Color:	20C. Year Last Painted:
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):		
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):
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:			
28. Daily Avg. Ambient Temperature (°F):		29. Annual Avg. Maximum Temperature (°F):	
30. Annual Avg. Minimum Temperature (°F):		31. Avg. Wind Speed (mph):	
32. Annual Avg. Solar Insulation Factor (BTU/ft^2-day):		33. Atmospheric Pressure (psia):	
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):	35B. Maximum (psig):	
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):		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:			
39B. CAS number:			
39C. Liquid density (lb/gal):			
39D. Liquid molecular weight (lb/lb-mole):			
39E. Vapor molecular weight (lb/lb-mole):			
39F. Maximum true vapor pressure (psia):			
39G. Maxim Reid vapor pressure (psia):			
39H. Months Storage per year. From: To:			

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-ENG1		EU-ENG2		EU-ENG3	
Emission Point ID No. [2]		EP-ENG1		EP-ENG2		EP-ENG3	
Engine Manufacturer and Model		Caterpillar G3516B		Caterpillar G3516B		Caterpillar G3406 NA	
Manufacturer's Rated bhp/rpm		1,380-hp/1,400-rpm		1,380-hp/1,400-rpm		215-hp/1,800 rpm	
Source Status[3]		NS		NS		NS	
Date Installed/Modified/Removed[4]		TBD		TBD		TBD	
Engine Manufactured/Reconstruction Date[5]		TBD		TBD		TBD	
Is this engine subject to 40CFR60, Subpart JJJJ?		Yes		Yes		Yes	
Is this a Certified Stationary Spark Ignition Engine according to 40CFR60, Subpart JJJJ? (Yes or No)[6]		No		No		No	
Is this engine subject to 40CFR63, Subpart ZZZZ? (yes or no)		Yes		Yes		Yes	
Engine, Fuel and Combustion Data	Engine Type[7]	LB4S		LB4S		RB4S	
	APCD Type[8]	CAT		CAT		NSCR	
	Fuel Type[9]	RG		RG		RG	
	H_2S (gr/100 scf)	Negligible		Negligible		Negligible	
	Operating bhp/rpm	1,380-hp/1,400-rpm		1,380-hp/1,400-rpm		215-hp/1,800 rpm	
	BSFC (Btu/bhp-hr)	7,433		7,433		8,756	
	Fuel throughput (ft^3/hr)	11,334		11,334		2,080	
	Fuel throughput ($MMft^3$/yr)	99.29		99.29		18.22	
	Operation (hrs/yr)	8,760		8,760		8,760	
Reference[10]	Potential Emissions[11]	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr
MD	NO_X	3.04	13.32	3.04	13.32	0.47	2.06
MD	CO	2.68	11.74	2.68	11.74	0.95	4.16
MD	VOC	2.08	9.11	2.08	9.11	0.36	1.58
AP	SO_2	0.01	0.03	0.01	0.03	<0.01	<0.01
AP	PM_{10}	0.10	0.44	0.10	0.44	0.02	0.08
MD	Formaldehyde	0.37	1.60	0.37	1.60	0.03	0.13
MRR[12]	Proposed Monitoring:	In accordance with NSPS Subpart JJJJ		In accordance with NSPS Subpart JJJJ		In accordance with NSPS Subpart JJJJ	
	Proposed Recordkeeping:	In accordance with NSPS Subpart JJJJ		In accordance with NSPS Subpart JJJJ		In accordance with NSPS Subpart JJJJ	
	Proposed Reporting:	In accordance with NSPS Subpart JJJJ		In accordance with NSPS Subpart JJJJ		In accordance with NSPS Subpart JJJJ	

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^{TM} , 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.

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-ENG4					
Emission Point ID No. [2]		EP-ENG4					
Engine Manufacturer and Model		Caterpillar G3516B					
Manufacturer's Rated bhp/rpm		1,380-hp/1,400-rpm					
Source Status[3]		NS					
Date Installed/Modified/Removed[4]		TBD					
Engine Manufactured/Reconstruction Date[5]		TBD					
Is this engine subject to 40CFR60, Subpart JJJJ?		Yes					
Is this a Certified Stationary Spark Ignition Engine according to 40CFR60, Subpart JJJJ? (Yes or No)[6]		No					
Is this engine subject to 40CFR63, Subpart ZZZZ? (yes or no)		Yes					
Engine, Fuel and Combustion Data	Engine Type[7]	LB4S					
	APCD Type[8]	CAT					
	Fuel Type[9]	RG					
	H_2S (gr/100 scf)	Negligible					
	Operating bhp/rpm	1,380-hp/1,400-rpm					
	BSFC (Btu/bhp-hr)	7,433					
	Fuel throughput (ft^3/hr)	11,334					
	Fuel throughput ($MMft^3$/yr)	99.29					
	Operation (hrs/yr)	8,760					
Reference[10]	Potential Emissions[11]	lbs/hr	tons/yr				
MD	NO_X	3.04	13.32				
MD	CO	2.68	11.74				
MD	VOC	2.08	9.11				
AP	SO_2	0.01	0.03				
AP	PM_{10}	0.10	0.44				
MD	Formaldehyde	0.37	1.60				
MRR[12]	Proposed Monitoring:	In accordance with NSPS Subpart JJJJ					
	Proposed Recordkeeping:	In accordance with NSPS Subpart JJJJ					
	Proposed Reporting:	In accordance with NSPS Subpart JJJJ					

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^{TM} , 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.

GLYCOL DEHYDRATION EMISSION UNIT DATA SHEET

General Glycol Dehydration Unit Data		Manufacturer and Model		To be determined	
		Max Dry Gas Flow Rate (mmscf/day)		35.0	
		Design Heat Input (mmBtu/hr)		0.75	
		Design Type (DEG or TEG)		TEG	
		Source Status[2]		MS	
		Date Installed/Modified/Removed[3]		2014	
		Regenerator Still Vent APCD[4]		CC	
		Control Device ID[4]		APC-COND	
		Fuel HV (Btu/scf)		905	
		H_2S Content (gr/100 scf)		Negligible	
		Operation (hrs/yr)		8,760	
Emission Unit ID/ Emission Point ID[1]	Vent	Reference[5]	Potential Emissions[6]	lbs/hr	tons/yr
	Reboiler Vent	AP	NO_X	0.08	0.36
		AP	CO	0.07	0.30
		AP	VOC	<0.01	0.02
		AP	SO_2	<0.01	<0.01
		AP	PM_{10}	<0.01	0.02
	Glycol Regenerator Still Vent	GRI-GLYCalc™	VOC	2.09	9.15
		GRI-GLYCalc™	Benzene	0.10	0.45
		GRI-GLYCalc™	Ethylbenzene	0.03	0.11
		GRI-GLYCalc™	Toluene	0.12	0.51
		GRI-GLYCalc™	Xylenes	0.06	0.28
		GRI-GLYCalc™	n-Hexane	0.05	0.24

1. Enter the appropriate Emission Unit ID Numbers and Emission Point ID Numbers for the glycol dehydration unit reboiler vent and glycol regenerator still vent. The glycol dehydration unit reboiler vent and glycol regenerator still vent should be designated RBV-1 and RSV-1, respectively. If the compressor station incorporates multiple glycol dehydration units, a *Glycol Dehydration Emission Unit Data Sheet* shall be completed for each, using Source Identification #s RBV-2 and RSV-2, RBV-3 and RSV-3, etc.

2. Enter the Source Status using the following codes:

NS	Construction of New Source	ES	Existing Source
MS	Modification of Existing Source	RS	Removal of Source

3. Enter the date (or anticipated date) of the glycol dehydration unit's installation (construction of source), modification or removal.

4. Enter the Air Pollution Control Device (APCD) type designation using the following codes and the control device ID number:

NA	None	CD	Condenser
FL	Flare	CC	Condenser/Combustion Combination
TO	Thermal Oxidizer		

5. Enter the Potential Emissions Data Reference designation using the following codes:

MD	Manufacturer's Data	AP	AP-42	
GR	GRI-GLYCalc™	OT	Other _____	(please list)

6. Enter the Reboiler Vent and Glycol Regenerator Still Vent Potential to Emit (PTE) for the listed regulated pollutants in lbs per hour and tons per year. The Glycol Regenerator Still Vent potential emissions may be determined using the most recent version of the thermodynamic software model GRI-GLYCalc™ (Radian International LLC & Gas Research Institute). Attach all referenced Potential Emissions Data (or calculations) and the GRI-GLYCalc *Aggregate Calculations Report* to this *Glycol Dehydration Emission Unit Data Sheet(s)*. This PTE data shall be incorporated in the *Emissions Summary Sheet.*

Include a copy of the GRI-GLYCalc™ analysis. This includes a printout of the aggregate calculations report, which shall include emissions reports, equipment reports, and stream reports.

Note: Controlled emissions for DEHY1 include still vent emissions only. Flash tank emissions are routed to the combustor via the produced water tanks. Uncombusted emissions are reported at the combustor.

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: APC-COMB-TKLD	3. Year Installed/ Modified: 2014
4. Emission Unit Description: Condensate Truck Loading		
5. Loading Area Data:		
5A. Number of pumps: One (1)	5B. Number of liquids loaded: One (1)	5C. Maximum number of tank trucks loading at one time: One (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 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)	~33.6		
Max. annual throughput (1000 gal/yr)	12,264.00		
Loading Method [1]	SUB		
Max. Fill Rate (gal/min)	125		
Average Fill Time (min/loading)	~60		
Max. Bulk Liquid Temperature (^{o}F)	50.33		
True Vapor Pressure [2]	12.3835		
Cargo Vessel Condition[3]	U		
Control Equipment or Method [4]	Vapor Return w/ Combustion Controls		
Minimum collection efficiency (%)	70%		
Minimum control efficiency (%)	98%		

** Continued on next page*

Maximum Emission Rate	Loading (lb/hr)	13.82		
	Annual (ton/yr)	11.30		
Estimation Method [5] EPA				

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 Captured loading emissions shall be routed to the vapor combustor(s).	RECORDKEEPING None proposed
REPORTING None proposed	TESTING None proposed

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

Not applicable

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: APC-COMB-TKLD	3. Year Installed/ Modified: 2014
4. Emission Unit Description: Produced Water Truck Loading		
5. Loading Area Data:		
5A. Number of pumps: One (1)	5B. Number of liquids loaded: One (1)	5C. Maximum number of tank trucks loading at one time: One (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 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	Produced Water		
Max. daily throughput (1000 gal/day)	~42.0		
Max. annual throughput (1000 gal/yr)	15,330.00		
Loading Method [1]	SUB		
Max. Fill Rate (gal/min)	125		
Average Fill Time (min/loading)	~60		
Max. Bulk Liquid Temperature (^{o}F)	50.33		
True Vapor Pressure [2]	0.2507		
Cargo Vessel Condition[3]	U		
Control Equipment or Method [4]	Vapor Return w/ Combustion Controls		
Minimum collection efficiency (%)	70%		
Minimum control efficiency (%)	98%		

** Continued on next page*

Maximum Emission Rate	Loading (lb/hr)	0.18		
	Annual (ton/yr)	0.18		
Estimation Method [5] EPA				

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 Captured loading emissions shall be routed to the vapor combustor(s).	RECORDKEEPING None proposed
REPORTING None proposed	TESTING None proposed

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

Not applicable

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.*

ATTACHMENT H: AIR POLLUTION CONTROL DEVICE SHEETS

APCDS – Condenser

GRI-GLYCalc ™ Condenser Control Efficiency Curves Report

GRI-GLYCalc ™ Annual Air-Cooled Condenser Performance Report

BTEX Unit Data Sheet

APCDS – Combustor

Vapor Combustor Specification Sheet

Air Pollution Control Device Sheet
(CONDENSER SYSTEM)

Control Device ID No. :APC-COND Installation Date: 2014 or New ☐

Equipment Information and Filter Characteristics

1. Manufacturer: Jatco Model No. TBD	2. Method: ☐ Pressure condensation ☒ Temperature condensation ☐ Surface ☐ Contact ☐ Other, specify
3. Control Device Name: Still Column Condenser (BTEX Unit)	
4. Provide diagram of condenser:	
5. Provide diagram(s) of unit describing capture system with duct arrangement and size of duct, air volume, capacity, horsepower of movers. If applicable, state hood face velocity and hood collection efficiency.	
6. Heat exchanger area: ft^3	7. Reported removal efficiency: See attached GLYCalc condenser control curve efficiency report
8. Coolant Used:	9. Refrigeration capacity: Ref. tons
10. Composition of coolant:	11. Internal operating temperature: °F
12. Specific heat of coolant: BTU/lb.°F, at 77°F	13. Temperature of condensation: 100 °F
Average Operation:	**Maximum Operation:**
14. Coolant Temperature: Inlet: Varies °F Outlet: <100 °F	15. Coolant Temperature: Inlet: Varies °F Outlet: <100 °F
16. Gas Temperature: Inlet: 212 °F Outlet: <100 °F	17. Gas Temperature: Inlet: 212 °F Outlet: <100 °F
18. Gas flow rate: 13.97 ft^3/min	19. Gas flow rate: 13.97 ft^3/min
20. Coolant flow rate per condenser: Type: Water: gal/min Air: N/A ft^3/min Other: lb/hour	21. Coolant flow rate per condenser: Type: Water: gal/min Air: N/A ft^3/min Other: lb/hour
22. Efficiency of condenser: See attached GLYCalc condenser control efficiency reports	23. Efficiency of condenser: See attached GLYCalc condenser control efficiency reports
24. Condenser surface area: ft^2	25. Condenser surface area: ft^2

26. Pollutant		Guaranteed Minimum Control Efficiency %	Concentration ppmv	Specific Heat BTU/lb-mol °F	Heat of Vaporation BTU/lb-mol
A	VOC	N/A*	-	N/A	N/A
B	Benzene	N/A*	-	0.24295	N/A
C	Toluene	N/A*	-	0.26005	N/A
D	Ethylbenzene	N/A*	-	0.27768	N/A
E	Xylenes	N/A*	-	0.27954	N/A
F	n-Hexane	N/A*	-	0.38628	N/A
G					
Total Concentration in ppmv					

Emission Gas (Vapor) Stream

27. **Before Condenser**		28. **After Condenser**	
Inlet vapor flow rate:	ft^3/min	Inlet vapor flow rate:	ft^3/min
Influent vapor temperature:	°F	Influent vapor temperature:	°F
Effluent vapor temperature:	°F	Effluent vapor temperature:	°F

29. Pollutant		INLET Vapor Pressure	INLET Condensation Temperature	INLET Rate lb/hr	OUTLET Rate lb/hr	OUTLET Vapor Pressure	OUTLET Condensation Temperature
A	VOC	N/A	N/A	15.27	3.48	N/A	N/A
B	Benzene	N/A	N/A	0.73	0.17	N/A	N/A
C	Toluene	N/A	N/A	2.33	0.20	N/A	N/A
D	Ethylbenzene	N/A	N/A	1.31	0.04	N/A	N/A
E	Xylenes	N/A	N/A	4.02	0.11	N/A	N/A
F	n-Hexane	N/A	N/A	0.26	0.09	N/A	N/A
G							
Total of the POLLUTANT lb/hr							

30. Moisture content: %

31. Describe any air pollution control device inlet and outlet gas conditioning processes (e.g., gas cooling, gas reheating, gas humidification):
N/A

32. Describe the collection material disposal system:
N/A

33. Have you included *Condenser Control Device* in the Emissions Summary Sheet? Yes

34. Manufacturer's Guaranteed Capture Efficiency for each air pollutant. N/A
35. Manufacturer's Guaranteed Control Efficiency for each air pollutant. *Manufacturer does not guarantee control efficiency of condenser alone; refer to condenser control curve efficiency report for control efficiency at various operating temperatures. Manufacturer guarantees 95% control efficiency of the combined condenser/reboiler burner controls.
36. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty. N/A

GRI-GLYCalc VERSION 4.0 - CONDENSER CONTROL CURVE EFFICIENCY REPORT

Case Name: Fork Ridge 35 MMscfd TEG Dehydrator
File Name: P:\Flatrock Tulsa Projects\Chesapeake Operating, Inc\COI WV\CHK APP Fork Ridge\2014Aug G70 General Permit\Fork Ridge_GLYCalc.ddf
Date: August 25, 2014

CONDENSER CONTROL EFFICIENCY CURVES

Note: Condenser curves computed for the range 40.0 F <= T <= 170.0 F. DO NOT EXTRAPOLATE BEYOND THIS RANGE!

Temp(F)	BTEX	Total HAP	VOC
40.0	99.21	99.03	87.58
45.0	99.04	98.83	86.92
50.0	98.85	98.60	86.23
55.0	98.62	98.33	85.50
60.0	98.35	98.02	84.76
65.0	98.04	97.66	83.99
70.0	97.68	97.24	83.19
75.0	97.26	96.76	82.34
80.0	96.77	96.20	81.45
85.0	96.20	95.57	80.50
90.0	95.55	94.84	79.49
95.0	94.79	94.00	78.41
100.0	93.91	93.05	77.24
105.0	92.89	91.95	75.98
110.0	91.71	90.68	74.60
115.0	90.34	89.23	73.10
120.0	88.74	87.56	71.44
125.0	86.87	85.61	69.60
130.0	84.70	83.37	67.58
135.0	81.91	80.52	65.10
140.0	78.78	77.36	62.47
145.0	75.05	73.61	59.47
150.0	70.55	69.12	56.02
155.0	65.10	63.70	52.01
160.0	58.43	57.11	47.28
165.0	50.24	49.06	41.64
170.0	40.55	39.56	35.04

GRI-GLYCalc VERSION 4.0 - ANNUAL AIR-COOLED CONDENSER PERFORMANCE

Case Name: Fork Ridge 35 MMscfd TEG Dehydrator
File Name: P:\Flatrock Tulsa Projects\Chesapeake Operating, Inc\COI WV\CHK APP Fork Ridge\2014Aug G70 General Permit\Fork Ridge_GLYCalc.ddf
Date: August 25, 2014

ANNUAL AIR-COOLED CONDENSER PERFORMANCE

Nearest Site for Air Temperature Data: Charleston, WV

Ambient Air Dry Bulb Temperature (deg. F)	Frequency (%)	Condenser Outlet Temperature (deg. F)
<=50	39.66	<=70
51-55	8.12	71-75
56-60	8.65	76-80
61-65	9.55	81-85
66-70	11.00	86-90
71-75	9.30	91-95
76-80	6.39	96-100
81-85	4.50	101-105
86-90	2.27	106-110
91-95	0.49	111-115
96-100	0.06	116-120
>100	0.01	>120

Condenser outlet temperature approach to ambient: 20.00 deg. F

Annual air-cooled condenser emissions and control efficiency:

	Uncontrolled emissions tons/year	Controlled emissions tons/year	% Control
Benzene	3.210	0.490	84.72
BTEX	36.770	1.366	96.29
Total HAP	37.903	1.636	95.68
VOC	66.887	12.774	80.90

JATCO Vertical Panel
Air Cooled Heat Exchangers

Full stainless steel condenser with stainless steel skid base, using stainless steel aluminum wound 1" 1.0 fin tubes. A multi-pass tube construction with each pass draining to the lower liquid line, that is connected to a JATCO automatic blowcase. Units can be configured in series to increase cooling capacity.

Specifications:

Test pressure:	20 psi
Operating pressure:	1 psi
Max operating temp:	225° F
Max Condenser Vapor Outlet Temp:	10° F Approach to Ambient Temp.
Headers:	304 Stainless Steel
Fin Tube Description:	1" x 16 ga x SA249 TP316 Aluminum L-Foot
Fin Tube Length:	6' 0"
Fin Dimension:	.015" x 2.5"

Model #	No. of Passes	Max H_20 Removed	# of Tubes	Maximum Regen Compatibility
System I	3	834 *lbs* ./D	8	125,000 BTU/HR
System II	5	2,500 *lbs.* /D	16	375,000 BTU/HR
System III	7	3,334 *lbs.* /D	24	500,000 BTU/HR

JATCO BTEX Eliminator Guarantee

The system operation of the JATCO BTEX "Eliminator" is able to achieve stack test results in excess of 95% destruction efficiency by routing the pre-condensed still column vapors to the main burner and inducing the low pressure V.O.C.s into the primary air inlet of the original burner using our patented JATCO compound injector burner assembly. When re-boiler temperature is reached, a valve stops the V.O.C. flow to the main burner and opens to route the V.O.C.s to the exhaust stack, through the igniter (to be installed with unit). The igniter consists of a stainless steel nipple with a nickel alloy wire coil. As the main burner is on its firing cycle, the exhaust gases keep this coil red hot by cumulating heat in the fire tube. After the main burner shuts off, and V.O.C.s are routed to the exhaust stack, the coil will ignite or flash the vapor for a period until there is free air oxygen dilution. The actual stack testing will show burner/on burner/off cycles and concentrations. It is also a note that general operation of standard glycol re-boiler dehydration, when the burner is on is when you achieve the flash/flux around the fire tube and when it shuts off the V.O.C output from the still column diminishes rapidly.

JATCO Environmental Inc. stands behind all of the testing performed on our BTEX Systems Units and will purchase any unit back that does not perform to these standards.

BTEX Eliminator Shell & Tube System

The Shell and Tube Eliminator System is a counter flow stainless steel tube and bundle heat exchanger condensing system used to capture and recycle BTEX and VOC vapors from the dehydrator still column. (more)

Recent blog entries

Dec 10, 2010, posted by Admin

Guess who got in on the blogging game???

Nov 30, 1999, posted by

WE WILL BE AT THE DUG SHOW

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: ☒ New	
3. Maximum Rated Total Flow Capacity: **11,188** scfh **268,500** scfd	4. Maximum Design Heat Input: **30.0** MMBtu/hr	5. Design Heat Content: **2,682** 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-6.5-34-268500**	8. Hours of operation per year: **8,760**

9. List the emission units whose emissions are controlled by this vapor combustion control device: (Emission Point ID#: **APC-COMB-TKLD**)*

10. Emission Unit ID#	Emission Source Description:	Emission Unit ID#	Emission Source Description:
EU-TANKS-COND	**Condensate Tanks**	**EU-LOAD-PW**	**Produced Water Truck Loading**
EU-TANKS-PW	**Produced Water Tanks**	**EU-DEHY1**	**TEG Dehydration Unit Flash Tank Only**
EU-LOAD-COND	**Condensate Truck Loading**		

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 -	**34** ft	**N/A** ft	☐Yes ☒No

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 (ft/s)
186.46	**2,682**	**1,000**	

19. Provide an attachment with the characteristics of the waste gas stream to be burned.

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?
Natural Gas	**3**	**150**	**135,750**	☒ 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:

Pilot monitored via flame rod.

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

29. Pollutant(s) Controlled	30. % Capture Efficiency	31. Manufacturer's Guaranteed Control Efficiency (%)
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:

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-6.5-34-268500

Expected Destruction Removal Efficiency (DRE):	98% or Greater of Non-Methane Hydrocarbons
Unit Size:	6.5-foot Diameter 34-Foot Overall Height
Design Heat Input:	30 MMBTU/HR
Design Flow Rates:	268,500 SCFD
Design Heat Content:	2682 BTU/SCF
Waste Gas Flame Arrestor:	Enardo
Pilot Type:	MRW Electric Ignition
Pilot Operation (Continuous/Intermittent):	Three (3) Continuous
Pilot Fuel Consumption:	150 SCFH or Less Total (50 SCFH per Pilot)
Pilot Monitoring Device:	Flame Rod
Automatic Re-Ignition:	Included
Remote Alarm Indication:	Included

Description of Control Scheme:

The Combustor pilots are monitored via flame rod. If one of the pilot flames are 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: EMISSIONS CALCULATIONS

SWN Production Company, LLC
Fork Ridge Pad
Summary of Criteria Air Pollutant Emissions

Equipment	Unit ID	Emission Point ID	NOx		CO		Total VOC[1]		SO_2		PM Total	
			lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY
1,380-hp Caterpillar G3516B Engine w/ Oxidation Catalyst	EU-ENG1	EP-ENG1	3.04	13.32	2.68	11.74	2.08	9.11	0.01	0.03	0.10	0.44
1,380-hp Caterpillar G3516B Engine w/ Oxidation Catalyst	EU-ENG2	EP-ENG2	3.04	13.32	2.68	11.74	2.08	9.11	0.01	0.03	0.10	0.44
215-hp Caterpillar G3406 NA Engine w/ Catalytic Converter	EU-ENG3	EP-ENG3	0.47	2.06	0.95	4.16	0.36	1.58	<0.01	<0.01	0.04	0.16
1,380-hp Caterpillar G3516B Engine w/ Oxidation Catalyst	EU-ENG4	EP-ENG4	3.04	13.32	2.68	11.74	2.08	9.11	0.01	0.03	0.10	0.45
35.0-MMSCFD TEG Dehydration Unit	EU-DEHY1	EP-RB1	-	-	-	-	2.09	9.15	-	-	-	-
0.75-mmBtu/hr TEG Reboiler	EU-RB1	EP-RB1	0.08	0.36	0.07	0.30	<0.01	0.02	<0.01	<0.01	0.01	0.03
Eight (8) 1.0-mmBtu/hr GPU Burners	EU-GPU1 - EU-GPU8	EP-GPU1 - EP-GPU8	0.88	3.84	0.72	3.12	0.05	0.24	0.01	0.02	0.07	0.29
Two (2) 0.5-mmBtu/hr Heater Treaters	EU-HT1 - EU-HT2	EP-HT1 - EP-HT2	0.12	0.52	0.10	0.44	0.01	0.02	<0.01	<0.01	0.01	0.04
Five (5) 400-bbl Condensate Tanks Routed to Vapor Combustor	EU-TANKS-COND	APC-COMB-TKLD	-	-	-	-	-	-	-	-	-	-
Five (5) 400-bbl Produced Water Tanks Routed to Vapor Combustor	EU-TANKS-PW	APC-COMB-TKLD	-	-	-	-	-	-	-	-	-	-
Condensate Truck Loading w/ Vapor Return Routed to Combustor	EU-LOAD-COND	APC-COMB-TKLD	-	-	-	-	2.58	11.30	-	-	-	-
Produced Water Truck Loading w/ Vapor Return Routed to Combustor	EU-LOAD-PW	APC-COMB-TKLD	-	-	-	-	0.04	0.18	-	-	-	-
One (1) 30.0-mmBtu/hr Vapor Combustor - Tank/Loading Stream	APC-COMB-TKLD	APC-COMB-TKLD	4.14	18.13	8.27	36.22	6.78	29.70	-	-	0.09	0.39
Vapor Combustor Pilots	EU-PILOT	APC-COMB-TKLD	0.02	0.09	0.01	0.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fugitive Emissions	EU-FUG	EP-FUG	-	-	-	-	1.46	6.38	-	-	-	-
Fugitive Haul Road Emissions	EU-HR	EP-HR	-	-	-	-	-	-	-	-	0.59	1.95
		Total =	**14.83**	**64.95**	**18.16**	**79.52**	**19.61**	**85.90**	**0.03**	**0.11**	**1.10**	**4.19**

Notes:

[1] Total VOC includes all constituents heavier than Propane (C3+), including hazardous air pollutants (HAP). Speciated HAP presented in following table. Also note that Caterpillar engine manufacturer data for VOC does not include formaldehyde; therefore, total VOC emissions presented here are different than VOC emissions as defined and calculated in the engine calculations.

SWN Production Company, LLC
Fork Ridge Pad
Summary of Hazardous Air Pollutants

Equipment	Unit ID	Estimated Emissions (lb/hr)									
		Acetalde-hyde	Acrolein	Benzene	Ethyl-benzene	Formalde-hyde	Methanol	n-Hexane	Toluene	Xylenes	Total HAP
1,380-hp Caterpillar G3516B Engine w/ Oxidation Catalyst	EU-ENG1	0.09	0.05	<0.01	<0.01	0.37	0.03	-	<0.01	<0.01	0.54
1,380-hp Caterpillar G3516B Engine w/ Oxidation Catalyst	EU-ENG2	0.09	0.05	<0.01	<0.01	0.37	0.03	-	<0.01	<0.01	0.54
215-hp Caterpillar G3406 NA Engine w/ Catalytic Converter	EU-ENG3	0.01	<0.01	<0.01	<0.01	0.03	0.01	-	<0.01	<0.01	0.05
1,380-hp Caterpillar G3516B Engine w/ Oxidation Catalyst	EU-ENG4	0.09	0.05	<0.01	<0.01	0.37	0.03	-	<0.01	<0.01	0.54
35.0-MMSCFD TEG Dehydration Unit	EU-DEHY1	-	-	0.10	0.03	-	-	0.05	0.12	0.06	0.36
0.75-mmBtu/hr TEG Reboiler	EU-RB1	-	-	<0.01	-	<0.01	-	<0.01	<0.01	-	-
Eight (8) 1.0-mmBtu/hr GPU Burners	EU-GPU1 - EU-GPU8	-	-	<0.01	-	<0.01	-	0.02	<0.01	-	0.02
Two (2) 0.5-mmBtu/hr Heater Treaters	EU-HT1 - EU-HT2	-	-	<0.01	-	<0.01	-	<0.01	<0.01	-	<0.01
Five (5) 400-bbl Condensate Tanks Routed to Vapor Combustor	EU-TANKS-COND	-	-	-	-	-	-	-	-	-	-
Five (5) 400-bbl Produced Water Tanks Routed to Vapor Combustor	EU-TANKS-PW	-	-	-	-	-	-	-	-	-	-
Condensate Truck Loading w/ Vapor Return Routed to Combustor	EU-LOAD-COND	-	-	<0.01	0.02	-	-	0.14	0.02	0.05	0.22
Produced Water Truck Loading w/ Vapor Return Routed to Combustor	EU-LOAD-PW	-	-	<0.01	<0.01	-	-	<0.01	<0.01	<0.01	<0.01
One (1) 30.0-mmBtu/hr Vapor Combustor - Tank/Loading Stream	APC-COMB-TKLD	-	-	0.01	0.04	-	-	0.33	0.04	0.10	0.52
Vapor Combustor Pilots	EU-PILOT	-	-	<0.01	-	<0.01	-	<0.01	<0.01	-	<0.01
Fugitive Emissions	EU-FUG	-	-	<0.01	0.01	-	-	0.06	0.01	0.01	0.08
Fugitive Haul Road Emissions	EU-HR	-	-	-	-	-	-	-	-	-	-
	Total =	**0.26**	**0.16**	**0.13**	**0.09**	**1.13**	**0.08**	**0.60**	**0.20**	**0.23**	**2.88**

Continued on Next Page

SWN Production Company, LLC
Fork Ridge Pad
Summary of Hazardous Air Pollutants (Continued)

Equipment	Unit ID	Estimated Emissions (TPY)									
		Acetalde-hyde	Acrolein	Benzene	Ethyl-benzene	Formalde-hyde	Methanol	n-Hexane	Toluene	Xylenes	Total HAP
1,380-hp Caterpillar G3516B Engine w/ Oxidation Catalyst	EU-ENG1	0.38	0.23	0.02	<0.01	1.60	0.11	-	0.02	0.01	2.37
1,380-hp Caterpillar G3516B Engine w/ Oxidation Catalyst	EU-ENG2	0.38	0.23	0.02	<0.01	1.60	0.11	-	0.02	0.01	2.37
215-hp Caterpillar G3406 NA Engine w/ Catalytic Converter	EU-ENG3	0.02	0.02	0.01	<0.01	0.13	0.03	-	<0.01	<0.01	0.22
1,380-hp Caterpillar G3516B Engine w/ Oxidation Catalyst	EU-ENG4	0.38	0.23	0.02	<0.01	1.60	0.11	-	0.02	0.01	2.37
35.0-MMSCFD TEG Dehydration Unit	EU-DEHY1	-	-	0.45	0.11	-	-	0.24	0.51	0.28	1.59
0.75-mmBtu/hr TEG Reboiler	EU-RB1	-	-	<0.01	-	<0.01	-	0.01	<0.01	-	0.01
Eight (8) 1.0-mmBtu/hr GPU Burners	EU-GPU1 - EU-GPU8	-	-	<0.01	-	<0.01	-	0.07	<0.01	-	0.07
Two (2) 0.5-mmBtu/hr Heater Treaters	EU-HT1 - EU-HT2	-	-	<0.01	-	<0.01	-	0.01	<0.01	-	0.01
Five (5) 400-bbl Condensate Tanks Routed to Vapor Combustor	EU-TANKS-COND	-	-	-	-	-	-	-	-	-	-
Five (5) 400-bbl Produced Water Tanks Routed to Vapor Combustor	EU-TANKS-PW	-	-	-	-	-	-	-	-	-	-
Condensate Truck Loading w/ Vapor Return Routed to Combustor	EU-LOAD-COND	-	-	0.01	0.08	-	-	0.62	0.07	0.20	0.98
Produced Water Truck Loading w/ Vapor Return Routed to Combustor	EU-LOAD-PW	-	-	<0.01	<0.01	-	-	0.01	<0.01	<0.01	0.02
One (1) 30.0-mmBtu/hr Vapor Combustor - Tank/Loading Stream	APC-COMB-TKLD	-	-	0.04	0.17	-	-	1.45	0.19	0.44	2.29
Vapor Combustor Pilots	EU-PILOT	-	-	<0.01	-	<0.01	-	<0.01	<0.01	-	<0.01
Fugitive Emissions	EU-FUG	-	-	<0.01	0.02	-	-	0.26	0.03	0.06	0.37
Fugitive Haul Road Emissions	EU-HR	-	-	-	-	-	-	-	-	-	-
	Total =	**1.15**	**0.71**	**0.58**	**0.39**	**4.94**	**0.36**	**2.66**	**0.86**	**1.01**	**12.66**

SWN Production Company, LLC
Fork Ridge Pad
Summary of Greenhouse Gas Emissions - Metric Tons per Year (Tonnes)

Equipment	Unit ID	Carbon Dioxide (CO_2)		Methane (CH_4)		Methane (CH_4) as $CO_{2\ Eq.}$		Nitrous Oxide (N_2O)		Nitrous Oxide (N_2O) as $CO_{2\ Eq.}$		Total CO_2 + $CO_{2\ Eq.}$[1]	
		lb/hr	tonnes/yr	lb/hr	tonnes/yr	lb/hr	tonnes/yr	lb/hr	tonnes/yr	lb/hr	tonnes/yr	lb/hr	tonnes/yr
1,380-hp Caterpillar G3516B Engine w/ Oxidation Catalyst	EU-ENG1	1,493.78	5,935.50	0.02	0.09	0.57	2.25	<0.01	0.01	0.67	2.68	1,495.02	5,940.42
1,380-hp Caterpillar G3516B Engine w/ Oxidation Catalyst	EU-ENG2	1,493.78	5,935.50	0.02	0.09	0.57	2.25	<0.01	0.01	0.67	2.68	1,495.02	5,940.42
215-hp Caterpillar G3406 NA Engine w/ Catalytic Converter	EU-ENG3	283.44	1,126.25	<0.01	0.02	0.10	0.41	<0.01	<0.01	0.12	0.49	283.67	1,127.16
1,380-hp Caterpillar G3516B Engine w/ Oxidation Catalyst	EU-ENG4	1,493.78	5,935.50	0.02	0.09	0.57	2.25	<0.01	0.01	0.67	2.68	1,495.02	5,940.42
35.0-MMSCFD TEG Dehydration Unit	EU-DEHY1	<0.01	0.01	0.44	1.74	10.97	43.60	-	-	-	-	10.98	43.61
0.75-mmBtu/hr TEG Reboiler	EU-RB1	87.73	348.60	<0.01	0.01	0.04	0.16	<0.01	<0.01	0.05	0.20	87.82	348.96
Eight (8) 1.0-mmBtu/hr GPU Burners	EU-GPU1 - EU-GPU8	935.82	3,718.44	0.02	0.07	0.44	1.75	<0.01	0.01	0.53	2.09	936.78	3,722.28
Two (2) 0.5-mmBtu/hr Heater Treaters	EU-HT1 - EU-HT2	116.98	464.80	<0.01	0.01	0.06	0.22	<0.01	<0.01	0.07	0.26	117.10	465.28
Five (5) 400-bbl Condensate Tanks Routed to Vapor Combustor	EU-TANKS-COND	-	-	-	-	-	-	-	-	-	-	-	-
Five (5) 400-bbl Produced Water Tanks Routed to Vapor Combustor	EU-TANKS-PW	-	-	-	-	-	-	-	-	-	-	-	-
Condensate Truck Loading w/ Vapor Return Routed to Combustor	EU-LOAD-COND	<0.01	<0.01	0.02	0.07	0.41	1.65	-	-	-	-	0.41	1.65
Produced Water Truck Loading w/ Vapor Return Routed to Combustor	EU-LOAD-PW	0.02	0.06	0.44	1.74	10.93	43.42	-	-	-	-	10.94	43.48
One (1) 30.0-mmBtu/hr Vapor Combustor - Tank/Loading Stream	APC-COMB-TKLD	3,509.31	13,944.14	0.07	0.26	1.65	6.57	0.01	0.03	1.97	7.83	3,512.94	13,958.54
Vapor Combustor Pilots	EU-PILOT	15.88	63.10	<0.01	<0.01	0.01	0.03	<0.01	<0.01	0.01	0.04	15.90	63.17
Fugitive Emissions	EU-FUG	0.01	0.05	2.14	8.49	53.50	212.28	-	-	-	-	53.51	212.33
Fugitive Haul Road Emissions	EU-HR	-	-	-	-	-	-	-	-	-	-	-	-
	Total =	**9,430.54**	**37,471.94**	**3.19**	**12.67**	**79.81**	**316.84**	**0.02**	**0.06**	**4.77**	**18.94**	**9,515.11**	**37,807.72**

Notes:

[1] CO_2 Equivalent = Pollutant times GWP multiplier. 40 CFR 98 Table A-1, Global Warming Potential (GWP) multiplier (100-Year Time Horizon): CO_2 = 1, CH_4 = 25, N_2O = 298

[2] Per API Compendium (2009) Chapter 5: Because most of the CH_4 and CO_2 emissions from storage tanks occur as a result of flashing (which is controlled by the vapor combustor in this case), working and breathing loss emissions of these gases are very small in production and virtually non-existent in the downstream segments. Vapors from the tanks are routed to the vapor combustor at this site. Therefore, GHG emissions from the condensate and produced water tanks are assumed to be negligible.

SWN Production Company, LLC
Fork Ridge Pad
Summary of Greenhouse Gas Emissions - Short Tons per Year (Tons)

Equipment	Unit ID	Carbon Dioxide (CO_2)		Methane (CH_4)		Methane (CH_4) as $CO_{2\ Eq.}$		Nitrous Oxide (N_2O)		Nitrous Oxide (N_2O) as $CO_{2\ Eq.}$		Total CO_2 + $CO_{2\ Eq.}$[1]	
		lb/hr	tons/yr[2]	lb/hr	tons/yr[2]	lb/hr	tons/yr	lb/hr	tons/yr[2]	lb/hr	tons/yr	lb/hr	tons/yr
1,380-hp Caterpillar G3516B Engine w/ Oxidation Catalyst	EU-ENG1	1,493.78	6,542.76	0.02	0.10	0.57	2.48	<0.01	0.01	0.67	2.95	1,495.02	6,548.19
1,380-hp Caterpillar G3516B Engine w/ Oxidation Catalyst	EU-ENG2	1,493.78	6,542.76	0.02	0.10	0.57	2.48	<0.01	0.01	0.67	2.95	1,495.02	6,548.19
215-hp Caterpillar G3406 NA Engine w/ Catalytic Converter	EU-ENG3	283.44	1,241.48	<0.01	0.02	0.10	0.45	<0.01	<0.01	0.12	0.54	283.67	1,242.48
1,380-hp Caterpillar G3516B Engine w/ Oxidation Catalyst	EU-ENG4	1,493.78	6,542.76	0.02	0.10	0.57	2.48	<0.01	0.01	0.67	2.95	1,495.02	6,548.19
35.0-MMSCFD TEG Dehydration Unit	EU-DEHY1	<0.01	0.01	0.44	1.92	10.97	48.07	-	-	-	-	10.98	48.08
0.75-mmBtu/hr TEG Reboiler	EU-RB1	87.73	384.27	<0.01	0.01	0.04	0.18	<0.01	<0.01	0.05	0.22	87.82	384.67
Eight (8) 1.0-mmBtu/hr GPU Burners	EU-GPU1 - EU-GPU8	935.82	4,098.88	0.02	0.08	0.44	1.93	<0.01	0.01	0.53	2.30	936.78	4,103.11
Two (2) 0.5-mmBtu/hr Heater Treaters	EU-HT1 - EU-HT2	116.98	512.36	<0.01	0.01	0.06	0.24	<0.01	<0.01	0.07	0.29	117.10	512.89
Five (5) 400-bbl Condensate Tanks Routed to Vapor Combustor	EU-TANKS-COND	-	-	-	-	-	-	-	-	-	-	-	-
Five (5) 400-bbl Produced Water Tanks Routed to Vapor Combustor	EU-TANKS-PW	-	-	-	-	-	-	-	-	-	-	-	-
Condensate Truck Loading w/ Vapor Return Routed to Combustor	EU-LOAD-COND	<0.01	<0.01	0.02	0.07	0.41	1.82	-	-	-	-	0.41	1.82
Produced Water Truck Loading w/ Vapor Return Routed to Combustor	EU-LOAD-PW	0.02	0.07	0.44	1.91	10.93	47.86	-	-	-	-	10.94	47.93
One (1) 30.0-mmBtu/hr Vapor Combustor - Tank/Loading Stream	APC-COMB-TKLD	3,509.31	15,370.78	0.07	0.29	1.65	7.24	0.01	0.03	1.97	8.63	3,512.94	15,386.66
Vapor Combustor Pilots	EU-PILOT	15.88	69.56	<0.01	<0.01	0.01	0.03	<0.01	<0.01	0.01	0.04	15.90	69.63
Fugitive Emissions	EU-FUG	0.01	0.05	2.14	9.36	53.50	234.00	-	-	-	-	53.51	234.05
Fugitive Haul Road Emissions	EU-HR	-	-	-	-	-	-	-	-	-	-	-	-
	Total =	**9,430.54**	**41,305.74**	**3.19**	**13.97**	**79.81**	**349.26**	**0.02**	**0.07**	**4.77**	**20.88**	**9,515.11**	**41,675.88**

Notes:

[1] CO_2 Equivalent = Pollutant times GWP multiplier. 40 CFR 98 Table A-1, Global Warming Potential (GWP) multiplier (100-Year Time Horizon): CO_2 = 1, CH_4 = 25, N_2O = 298

[2] EPA and API GHG calculation methodologies calculate emissions in metric tons (tonnes). These values have been converted to short tons for consistency with permitting threshold units.

[3] Per API Compendium (2009) Chapter 5: Because most of the CH_4 and CO_2 emissions from storage tanks occur as a result of flashing (which is controlled by the vapor combustor in this case), working and breathing loss emissions of these gases are very small in production and virtually non-existent in the downstream segments. Vapors from the tanks are routed to the vapor combustor at this site. Therefore, GHG emissions from the condensate and produced water tanks are assumed to be negligible.

SWN Production Company, LLC
Fork Ridge Pad
Engine Emissions Calculations - Criteria Air Pollutants

Equipment Information

Unit ID:	EU-ENG1	EU-ENG2	EU-ENG3	EU-ENG4
Emission Point ID:	EP-ENG1	EP-ENG2	EP-ENG3	EP-ENG4
Make:	Caterpillar	Caterpillar	Caterpillar	Caterpillar
Model:	G3516B	G3516B	G3406 NA	G3516B
Design Class:	4S-LB	4S-LB	4S-RB	4S-LB
Controls:	Oxid. Cat.	Oxid. Cat.	NSCR	Oxid. Cat.
Horsepower (hp):	1,380	1,380	215	1,380
Fuel Use (Btu/hp-hr):	7,433	7,433	8,756	7,433
Fuel Use (scfh):	11,334	11,334	2,080	11,334
Annual Fuel Use (mmscf):	99.29	99.29	18.22	99.29
Fuel Use (mmBtu/hr):	10.26	10.26	1.88	10.26
Exhaust Flow (acfm):	9,181	9,181	1,040	9,181
Exhaust Temp (°F):	999	999	1,168	999
Operating Hours:	8,760	8,760	8,760	8,760
Fuel Heating Value (Btu/scf):	905	905	905	905
Uncontrolled Manufacturer Emission Factors [1]				
NOx (g/hp-hr):	1.00	1.00	15.91	1.00
CO (g/hp-hr):	2.94	2.94	15.91	2.94
NMNEHC/VOC (g/hp-hr):	0.94	0.94	0.41	0.94
Total VOC = NMNEHC + HCHO (g/hp-hr):	1.34	1.34	0.68	1.34
Post-Catalyst Emission Factors				
NOx Control Eff. %	0.00%	0.00%	93.71%	0.00%
CO Control Eff. %	70.00%	70.00%	87.43%	70.00%
VOC Control Eff. %	40.00%	40.00%	0.00%	40.00%
NOx (g/hp-hr):	1.00	1.00	1.00	1.00
CO (g/hp-hr):	0.88	0.88	2.00	0.88
NMNEHC/VOC (g/hp-hr):	0.56	0.56	0.70	0.56
Total VOC = NMNEHC + HCHO (g/hp-hr):	0.68	0.68	0.76	0.68

Uncontrolled Criteria Air Pollutant Emissions

Unit ID:	EU-ENG1		EU-ENG2		EU-ENG3		EU-ENG4	
Pollutant	**lb/hr**	**TPY**	**lb/hr**	**TPY**	**lb/hr**	**TPY**	**lb/hr**	**TPY**
NOx	3.04	13.32	3.04	13.32	7.54	33.03	3.04	13.33
CO	8.94	39.16	8.94	39.16	7.54	33.03	8.94	39.18
NMNEHC/VOC (does not include HCHO)	2.86	12.53	2.86	12.53	0.19	0.83	2.86	12.53
Total VOC (includes HCHO)	4.08	17.87	4.08	17.87	0.19	0.83	4.08	17.86

SWN Production Company, LLC
Fork Ridge Pad
Engine Emissions Calculations - Criteria Air Pollutants (Continued)

Proposed Criteria Air Pollutant Emissions[2]

Unit ID:	EU-ENG1		EU-ENG2		EU-ENG3		EU-ENG4	
Pollutant	**lb/hr**	**TPY**	**lb/hr**	**TPY**	**lb/hr**	**TPY**	**lb/hr**	**TPY**
NOx	3.04	13.32	3.04	13.32	0.47	2.06	3.04	13.32
CO	2.68	11.74	2.68	11.74	0.95	4.16	2.68	11.74
NMNEHC/VOC (does not include HCHO)	1.72	7.53	1.72	7.53	0.33	1.45	1.72	7.53
Total VOC (includes HCHO)	2.08	9.11	2.08	9.11	0.36	1.58	2.08	9.11
SO_2	0.01	0.03	0.01	0.03	<0.01	<0.01	<0.01	0.03
$PM_{10/2.5}$	<0.01	<0.01	<0.01	<0.01	0.02	0.08	<0.01	<0.01
PM_{COND}	0.10	0.44	0.10	0.44	0.02	0.08	0.10	0.45
PM_{TOT}	0.10	0.44	0.10	0.44	0.04	0.16	0.10	0.45

AP-42 Emission Factors (lb/mmBtu)[3]

	4S-LB	4S-RB
Pollutant	**3.2-2 (7/00)**	**3.2-3 (7/00)**
SO_2	5.88E-04	5.88E-04
$PM_{10/2.5}$	7.71E-05	9.50E-03
PM_{COND}	9.91E-03	9.91E-03
PM_{TOT}	9.99E-03	1.94E-02

Notes:

[1] Uncontrolled emission factors based on engine manufacturer data. Per Caterpillar, NMNEHC emission factor does not include formaldehyde (HCHO); therefore, NMNEHC and HCHO factors have been added to demonstrate total uncontrolled VOC.

[2] Post-catalyst emission factors based on catalyst manufacturer data and/or NSPS Subpart JJJJ limits, if applicable. Per NSPS Subpart JJJJ, VOC limit does not include HCHO; therefore, HCHO emissions have been added to the NSPS JJJJ VOC emission rates for demonstration purposes only.

[3] Per AP-42, all particulate matter (PM) from combustion of natural gas (total, condensable and filterable PM) is presumed <1 micrometer in diameter.

SWN Production Company, LLC
Fork Ridge Pad
Engine Emissions Calculations - Hazardous Air Pollutants

Equipment Information

Unit ID:	**EU-ENG1**	**EU-ENG2**	**EU-ENG3**	**EU-ENG4**
Emission Point ID:	EP-ENG1	EP-ENG2	EP-ENG3	EP-ENG4
Make:	Caterpillar	Caterpillar	Caterpillar	Caterpillar
Model:	G3516B	G3516B	G3406 NA	G3516B
Design Class:	4S-LB	4S-LB	4S-RB	4S-LB
Controls:	Oxid. Cat.	Oxid. Cat.	NSCR	Oxid. Cat.
Horsepower (hp):	1,380	1,380	215	1,380
Fuel Use (Btu/hp-hr):	7,433	7,433	8,756	7,433
Fuel Use (scfh):	11,334	11,334	2,080	11,334
Annual Fuel Use (mmscf):	99.29	99.29	18.22	99.29
Fuel Use (mmBtu/hr):	10.26	10.26	1.88	10.26
Exhaust Flow (acfm):	9,181	9,181	1,040	9,181
Exhaust Temp (°F):	999	999	1,168	999
Operating Hours:	8,760	8,760	8,760	8,760

Manufacturer Formaldehyde Factor

Pre-Control (g/hp-hr):	0.40	0.40	0.27	0.40
Control Efficiency[1]:	70.00%	70.00%	76.00%	70.00%
Permit Factor (g/hp-hr):	0.12	0.12	0.06	0.12

Uncontrolled HAP Emissions

Unit ID:	**EU-ENG1**		**EU-ENG2**		**EU-ENG3**		**EU-ENG4**	
Pollutant	**lb/hr**	**TPY**	**lb/hr**	**TPY**	**lb/hr**	**TPY**	**lb/hr**	**TPY**
Acetaldehyde	0.09	0.38	0.09	0.38	0.01	0.02	0.09	0.38
Acrolein	0.05	0.23	0.05	0.23	<0.01	0.02	0.05	0.23
Benzene	<0.01	0.02	<0.01	0.02	<0.01	0.01	<0.01	0.02
Ethylbenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Formaldehyde	1.22	5.33	1.22	5.33	0.13	0.56	1.22	5.33
Methanol	0.03	0.11	0.03	0.11	0.01	0.03	0.03	0.11
Toluene	<0.01	0.02	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Xylenes	<0.01	0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Total HAPs =	**1.39**	**6.10**	**1.39**	**6.10**	**0.15**	**0.66**	**1.39**	**6.10**

SWN Production Company, LLC
Fork Ridge Pad
Engine Emissions Calculations - Hazardous Air Pollutants

Proposed HAP Emissions

Unit ID:	EU-ENG1		EU-ENG2		EU-ENG3		EU-ENG4	
Pollutant	**lb/hr**	**TPY**	**lb/hr**	**TPY**	**lb/hr**	**TPY**	**lb/hr**	**TPY**
Acetaldehyde	0.09	0.38	0.09	0.38	0.01	0.02	0.09	0.38
Acrolein	0.05	0.23	0.05	0.23	<0.01	0.02	0.05	0.23
Benzene	<0.01	0.02	<0.01	0.02	<0.01	0.01	<0.01	0.02
Ethylbenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Formaldehyde	0.37	1.60	0.37	1.60	0.03	0.13	0.37	1.60
Methanol	0.03	0.11	0.03	0.11	0.01	0.03	0.03	0.11
Toluene	<0.01	0.02	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Xylenes	<0.01	0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Total HAPs =	**0.54**	**2.37**	**0.54**	**2.37**	**0.05**	**0.22**	**0.54**	**2.37**

AP-42 Emission Factors (lb/mmBtu)

	4S-RB	4S-RB
Pollutant	**3.2-3 (7/00)**	**3.2-3 (7/00)**
Acetaldehyde	2.79E-03	2.79E-03
Acrolein	2.63E-03	2.63E-03
Benzene	1.58E-03	1.58E-03
Ethylbenzene	2.18E-05	2.18E-05
Methanol	3.06E-03	3.06E-03
Toluene	5.58E-04	5.58E-04
Xylenes	1.95E-04	1.95E-04

Notes:
[1] For conservative estimate, no reduction taken for any HAP other than formaldehyde.

SWN Production Company, LLC
Fork Ridge Pad
Engine Emissions Calculations - Greenhouse Gases

Equipment Information

Unit ID:	EU-ENG1	EU-ENG2	EU-ENG3	EU-ENG4
Emission Point ID:	EP-ENG1	EP-ENG2	EP-ENG3	EP-ENG4
Make:	Caterpillar	Caterpillar	Caterpillar	Caterpillar
Model:	G3516B	G3516B	G3406 NA	G3516B
Design Class:	4S-LB	4S-LB	4S-RB	4S-LB
Controls:	Oxid. Cat.	Oxid. Cat.	NSCR	Oxid. Cat.
Horsepower (hp):	1,380	1,380	215	1,380
Fuel Use (Btu/hp-hr):	7,433	7,433	8,756	7,433
Fuel Use (scfh):	11,334	11,334	2,080	11,334
Fuel Use (mmBtu/hr):	10.26	10.26	1.88	10.26
Exhaust Flow (acfm):	9,181	9,181	1,040	9,181
Exhaust Temp (°F):	999	999	1,168	999
Operating Hours:	8,760	8,760	8,760	8,760
Manufacturer data used to calculate CO_2 emissions (g/hp-hr):	491	491	598	491

Greenhouse Gas (GHG) Emissions[1]

Unit ID:	EU-ENG1		EU-ENG2		EU-ENG3		EU-ENG4	
Pollutant	**lb/hr**	**tonnes/yr**	**lb/hr**	**tonnes/yr**	**lb/hr**	**tonnes/yr**	**lb/hr**	**tonnes/yr**
CO_2	1,493.78	5,935.50	1,493.78	5,935.50	283.44	1,126.25	1,493.78	5,935.50
CH_4	0.02	0.09	0.02	0.09	<0.01	0.02	0.02	0.09
N_2O	<0.01	0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
CH_4 as CO_2e	0.57	2.25	0.57	2.25	0.10	0.41	0.57	2.25
N_2O as CO_2e	0.67	2.68	0.67	2.68	0.12	0.49	0.67	2.68
Total CO_2 + CO_2e =	**1,495.02**	**5,940.42**	**1,495.02**	**5,940.42**	**283.67**	**1,127.16**	**1,495.02**	**5,940.42**

40 CFR 98 Tables C-1 and C-2 Emission Factors (kg/mmBtu)[2]

Methane (CH_4)	1.00E-03	1.00E-04
Nitrous Oxide (N_2O)	1.00E-04	1.00E-04

Notes:
[1] Conversion to short tons (tons) found in site-wide Summary of Greenhouse Gases - Short Tons per Year (tons) table.
[2] CO_2e = CO_2 equivalent (Pollutant times GWP multiplier):
40 CFR 98 Table A-1, Global Warming Potential (GWP) multiplier: CO_2 = 1, CH_4 = 25, N_2O = 298

SWN Production Company, LLC
Fork Ridge Pad
Gas Production Unit Burner Emissions Calculations - Criteria Air Pollutants

Equipment Information

Unit ID:	**EU-GPU1 - EU-GPU8 (EACH)**
Emission Point ID:	EP-GPU1 - EP-GPU8
Description:	Gas Production Unit Burner
Number of Units:	8
Burner Design (mmBtu/hr):	1.0
Fuel HHV (Btu/scf):	905
Annual Fuel Use (mmscf):	9.68
Annual Operating Hours:	8,760

Criteria Air Pollutant Emissions

Unit ID:	**EU-GPU1 - EU-GPU8 (EACH)**		**EU-GPU1 - EU-GPU8 (TOTAL)**	
Pollutant	**lb/hr**	**TPY**	**lb/hr**	**TPY**
NOx	0.11	0.48	0.88	3.84
CO	0.09	0.39	0.72	3.12
VOC	0.01	0.03	0.05	0.24
SO_2	<0.01	<0.01	<0.01	<0.02
$PM_{10/2.5}$	0.01	0.03	0.05	0.22
PM_{COND}	<0.01	0.01	<0.02	<0.07
PM_{TOT}	0.01	0.04	0.07	0.29

AP-42 Emission Factors for Units <100 mmBtu/hr (lb/mmscf)[1]

Pollutant	1.4-1, -2 (7/98)
NOx	100.0
CO	84.0
VOC	5.5
SO_2	0.6
$PM_{10/2.5}$	5.7
PM_{COND}	1.9
PM_{TOT}	7.6

Notes:
[1] All PM (total, condensable and filterable) is assumed to be <1 micrometer in diameter. Total PM is the sum of filterable PM and condensable PM.

SWN Production Company, LLC
Fork Ridge Pad
Gas Production Unit Burner Emissions Calculations - Hazardous Air Pollutants

Equipment Information

Unit ID:	**EU-GPU1 - EU-GPU8 (EACH)**
Emission Point ID:	EP-GPU1 - EP-GPU8
Description:	Gas Production Unit Burner
Number of Units:	8
Burner Design (mmBtu/hr):	1.0
Fuel HHV (Btu/scf):	905
Annual Fuel Use (mmscf):	9.68
Annual Operating Hours:	8,760

Hazardous Air Pollutant Emissions

Unit ID:	**EU-GPU1 - EU-GPU8 (EACH)**		**EU-GPU1 - EU-GPU8 (TOTAL)**	
Pollutant	**lb/hr**	**TPY**	**lb/hr**	**TPY**
n-Hexane	<0.01	0.01	<0.02	<0.07
Formaldehyde	<0.01	<0.01	<0.01	<0.01
Benzene	<0.01	<0.01	<0.01	<0.01
Toluene	<0.01	<0.01	<0.01	<0.01
Total HAPs =	**<0.01**	**0.01**	**0.02**	**0.07**

AP-42 Emission Factors (lb/mmscf)

Pollutant	1.4-3 (7/98)
n-Hexane	1.80E+00
Formaldehyde	7.50E-02
Benzene	2.10E-03
Toluene	3.40E-03

SWN Production Company, LLC
Fork Ridge Pad
Gas Production Unit Burner Emissions Calculations - Greenhouse Gases

Equipment Information

Unit ID:	**EU-GPU1 - EU-GPU8 (EACH)**
Emission Point ID:	EP-GPU1 - EP-GPU8
Description:	Gas Production Unit Burner
Number of Units:	8
Burner Design (mmBtu/hr):	1.0
Fuel HHV (Btu/scf):	905
Annual Fuel Use (mmscf):	9.68
Annual Operating Hours:	8,760

Greenhouse Gas (GHG) Emissions[1]

Unit ID:	**EU-GPU1 - EU-GPU8 (EACH)**		**EU-GPU1 - EU-GPU8 (TOTAL)**	
Pollutant	**lb/hr**	**tonnes/yr**	**lb/hr**	**tonnes/yr**
CO_2	116.98	464.80	935.82	3,718.44
CH_4	<0.01	0.01	<0.02	<0.07
N_2O	<0.01	<0.01	<0.01	<0.01
CH_4 as CO_2e	0.06	0.22	0.44	1.75
N_2O as CO_2e	0.07	0.26	0.53	2.09
Total CO_2 + CO_2e =	**117.10**	**465.28**	**936.78**	**3,722.28**

40 CFR 98 Tables C-1 and C-2 Emission Factors (kg/mmBtu)[2]

Carbon Dioxide (CO_2)	53.06
Methane (CH_4)	1.00E-03
Nitrous Oxide (N_2O)	1.00E-04

Notes:
[1] Conversion to short tons (tons) found in site-wide Summary of Greenhouse Gases - Short Tons per Year (tons) table.
[2] CO_2e = CO_2 equivalent (Pollutant times GWP multiplier):
40 CFR 98 Table A-1, Global Warming Potential (GWP) multiplier: CO_2 = 1, CH_4 = 25, N_2O = 298

SWN Production Company, LLC
Fork Ridge Pad
Heater Treater Emissions Calculations - Criteria Air Pollutants

Equipment Information

Unit ID:	**EU-HT1 - EU-HT2 (EACH)**
Emission Point ID:	EP-HT1 - EP-HT2
Description:	Heater Treater
Number of Units:	2
Burner Design (mmBtu/hr):	0.5
Fuel HHV (Btu/scf):	905
Annual Fuel Use (mmscf):	4.84
Annual Operating Hours:	8,760

Criteria Air Pollutant Emissions

Unit ID:	**EU-HT1 - EU-HT2 (EACH)**		**EU-HT1 and EU-HT2 (TOTAL)**	
Pollutant	**lb/hr**	**TPY**	**lb/hr**	**TPY**
NOx	0.06	0.26	0.12	0.52
CO	0.05	0.22	0.10	0.44
VOC	<0.01	0.01	0.01	0.02
SO_2	<0.01	<0.01	<0.01	<0.01
$PM_{10/2.5}$	<0.01	0.01	0.01	0.03
PM_{COND}	<0.01	<0.01	<0.01	0.01
PM_{TOT}	<0.01	0.02	0.01	0.04

AP-42 Emission Factors for Units <100 mmBtu/hr (lb/mmscf)[1]

Pollutant	1.4-1, -2 (7/98)
NOx	100.0
CO	84.0
VOC	5.5
SO_2	0.6
$PM_{10/2.5}$	5.7
PM_{COND}	1.9
PM_{TOT}	7.6

Notes:
[1] All PM (total, condensable and filterable) is assumed to be <1 micrometer in diameter. Total PM is the sum of filterable PM and condensable PM.

SWN Production Company, LLC
Fork Ridge Pad
Heater Treater Emissions Calculations - Hazardous Air Pollutants

Equipment Information

Unit ID:	**EU-HT1 - EU-HT2 (EACH)**
Emission Point ID:	EP-HT1 - EP-HT2
Description:	Heater Treater
Number of Units:	2
Burner Design (mmBtu/hr):	0.5
Fuel HHV (Btu/scf):	905
Annual Fuel Use (mmscf):	4.84
Annual Operating Hours:	8,760

Hazardous Air Pollutant Emissions

Unit ID:	**EU-HT1 - EU-HT2 (EACH)**		**EU-HT1 and EU-HT2 (TOTAL)**	
Pollutant	**lb/hr**	**TPY**	**lb/hr**	**TPY**
n-Hexane	<0.01	<0.01	<0.01	0.01
Formaldehyde	<0.01	<0.01	<0.01	<0.01
Benzene	<0.01	<0.01	<0.01	<0.01
Toluene	<0.01	<0.01	<0.01	<0.01
Total HAPs =	**<0.01**	**<0.01**	**<0.01**	**0.01**

AP-42 Emission Factors (lb/mmscf)

Pollutant	1.4-3 (7/98)
n-Hexane	1.80E+00
Formaldehyde	7.50E-02
Benzene	2.10E-03
Toluene	3.40E-03

SWN Production Company, LLC
Fork Ridge Pad
Heater Treater Emissions Calculations - Greenhouse Gases

Equipment Information

Unit ID:	**EU-HT1 - EU-HT2 (EACH)**
Emission Point ID:	EP-HT1 - EP-HT2
Description:	Heater Treater
Number of Units:	2
Burner Design (mmBtu/hr):	0.5
Fuel HHV (Btu/scf):	905
Annual Fuel Use (mmscf):	4.84
Annual Operating Hours:	8,760

Greenhouse Gas (GHG) Emissions[1]

Unit ID:	**EU-HT1 - EU-HT2 (EACH)**		**EU-HT1 and EU-HT2 (TOTAL)**	
Pollutant	**lb/hr**	**tonnes/yr**	**lb/hr**	**tonnes/yr**
CO_2	58.49	232.40	116.98	464.80
CH_4	<0.01	<0.01	<0.01	<0.01
N_2O	<0.01	<0.01	<0.01	<0.01
CH_4 as CO_2e	0.03	0.11	0.06	0.22
N_2O as CO_2e	0.03	0.13	0.07	0.26
Total CO_2 + CO_2e =	**58.55**	**232.64**	**117.10**	**465.28**

40 CFR 98 Tables C-1 and C-2 Emission Factors (kg/mmBtu)[2]

Carbon Dioxide (CO_2)	53.06
Methane (CH_4)	1.00E-03
Nitrous Oxide (N_2O)	1.00E-04

Notes:
[1] Conversion to short tons (tons) found in site-wide Summary of Greenhouse Gases - Short Tons per Year (tons) table.
[2] CO_2e = CO_2 equivalent (Pollutant times GWP multiplier):
40 CFR 98 Table A-1, Global Warming Potential (GWP) multiplier: CO_2 = 1, CH_4 = 25, N_2O = 298

SWN Production Company, LLC
Fork Ridge Pad
Glycol Dehydration Unit Emissions - Criteria and Hazardous Air Pollutants

Equipment Information

Parameter	Units	Value
Unit ID	-	EU-DEHY1
Emisison Point ID	-	EP-RB1
Maximum Throughput	MMSCFD	35.00
Operating Hours	Hours/Year	8,760
Wet Gas Temperature	°F	70
Wet Gas Pressure	psig	900
Pump Make	-	Kimray
Pump Model	-	45015 PV
Pump Type	Electric/Gas	Gas
Lean Glycol Flow Rate	gpm	7.50
Flash Tank Temperature	°F	150
Flash Tank Pressure	psig	50
Flash Tank Controls	Yes/No	Reboiler Combustion
Stripping Gas Flow Rate	scfm	N/A
Regenerator Still Vent Controls	Yes/No	Condenser/ Combustion
Flash Tank Control Efficiency	%	98%
Condenser Temperature	°F	100
Condenser Pressure	psia	14.00

Proposed Emissions

Unit ID: **EU-DEHY1**

Pollutant	lb/hr	TPY
n-Hexane	0.05	0.24
Benzene	0.10	0.45
Toluene	0.12	0.51
Ethylbenzene	0.03	0.11
Xylenes	0.06	0.28
Total HAPs =	**0.36**	**1.59**
Total VOCs =	**2.09**	**9.15**

GRI-GLYCalc Results - Uncontrolled (For Reference Only)

	STILL VENT		FLASH TANK		TOTAL (EU-DEHY1)	
Pollutant	**lb/hr**	**TPY**	**lb/hr**	**TPY**	**lb/hr**	**TPY**
n-Hexane	0.2586	1.1327	1.2206	5.3463	1.4792	6.4790
Benzene	0.7329	3.2103	0.1378	0.6034	0.8707	3.8137
Toluene	2.3298	10.2046	0.2925	1.2811	2.6223	11.4857
Ethylbenzene	1.3142	5.7562	0.0988	0.4327	1.4130	6.1889
Xylenes	4.0180	17.5988	0.2154	0.9432	4.2334	18.5420
Total HAPs =	**8.6535**	**37.9026**	**1.9651**	**8.6067**	**10.6186**	**46.5093**
Total VOCs =	**15.2710**	**66.8870**	**50.6085**	**221.6654**	**65.8795**	**288.5524**

SWN Production Company, LLC
Fork Ridge Pad

GRI-GLYCalc Results - Controlled (For Reference Only)

	STILL VENT		FLASH TANK		TOTAL (EU-DEHY1)	
Pollutant	**lb/hr**	**TPY**	**lb/hr**	**TPY**	**lb/hr**	**TPY**
n-Hexane	0.0453	0.1986	0.0244	0.1069	0.0697	0.3055
Benzene	0.0855	0.3747	0.0028	0.0121	0.0883	0.3868
Toluene	0.0974	0.4266	0.0058	0.0250	0.1032	0.4516
Ethylbenzene	0.0211	0.0923	0.0020	0.0087	0.0231	0.1010
Xylenes	0.0529	0.2316	0.0043	0.0189	0.0572	0.2505
Total HAPs =	**0.3022**	**1.3238**	**0.0393**	**0.1721**	**0.3415**	**1.4959**
Total VOCs =	**1.7409**	**7.6250**	**1.0122**	**4.4333**	**2.7531**	**12.0583**

Notes:

[1]Dehydration unit is equipped with two (2) 7.5 gpm Kimray 45015 gas injection pumps. One is a backup; only one pump will be in use at one time.
[2]Flash tank off gas is routed to the combustor via the tanks. 100% capture efficiency and 98% control efficiency assumed; therefore, 98% control efficiency was taken in GRI-GLYCalc™.
[3]Regenerator still vent emissions are controlled by condenser, with non-condensables routed to the reboiler for destruction. 50% combustion control efficiency taken in GRI-GLYCalc™.

[4]20% safety factor added to controlled GRI-GLYCalc™ results to account for potential fluctuations in gas composition. Note that proposed emissions include still vent emissions only. Flash tank emissions are routed to the combustor via the produced water tanks. Uncombusted emissions are reported at the combustor.

[5]GRI-GLYCalc™ report attached.

SWN Production Company, LLC
Fork Ridge Pad
Glycol Dehydration Unit Emissions - Greenhouse Gas Emissions

Proposed Emissions [1]

Unit ID: **EU-DEHY1**

Pollutant	lb/hr	tons/yr
CO_2 =	<0.01	0.01
CH_4 =	0.44	1.92
CH_4 as CO_2e =	10.97	48.07
Total CO_2 + CO_2e =	**10.98**	**48.08**

GRI-GLYCalc Results - Uncontrolled (For Reference Only) [2]

Unit ID: **STILL VENT** **FLASH TANK** **TOTAL (EU-DEHY1)**

Pollutant	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr
CO_2 =	0.0042	0.0182	0.5742	2.5152	0.5784	2.5334
CH_4 =	0.7335	3.2129	101.3636	443.9726	102.0971	447.1855
CH_4 as CO_2e =	18.3375	80.3225	2,534.0900	11,099.3150	2,552.4275	11,179.6375
Total CO_2 + CO_2e =	**18.3417**	**80.3407**	**2,534.6642**	**11,101.8302**	**2,553.0059**	**11,182.1709**

GRI-GLYCalc Results - Controlled (For Reference Only) [2]

Unit ID: **STILL VENT** **FLASH TANK** **TOTAL (EU-DEHY1)**

Pollutant	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr
CO_2 =	0.0021	0.0091	0.0115	0.0503	0.0136	0.0594
Input CH_4 from GLYCalc =	0.3658	1.6022	2.0273	8.8795	2.3931	10.4817
CH_4 as CO_2e =	9.1450	40.0550	50.6825	221.9875	59.8275	262.0425
Total CO_2 + CO_2e =	**9.1471**	**40.0641**	**50.6940**	**222.0378**	**59.8411**	**262.1019**

Glycol Dehydration Unit Emissions - Greenhouse Gas Emissions (Continued)

Notes:

[1] Proposed CH_4 emissions based on GRI-GLYCalc™ results with 20% safety factor added for potential fluctuations in gas composition. Proposed CO_2 emissions calculated using mass balance based on CH_4 and CO_2 mol% in the gas sample. Note that proposed emissions include still vent emissions only. Flash tank emissions are controlled by the combustor and are represented there.

[2] Example CO_2 Calculation (Exhibit 5.1: API Compendium of Greenhouse Gas Emissions Methodologies for the Oil and Gas Industry, August 2009):
CO_2 = tonnes CH_4 * tonne mole CH_4/16 tonne CH_4 * tonne mole gas/tonne mole CH_4 * tonne mole CO_2/tonne mole gas * 44 tonne CO_2/tonne mole CO_2

Input CH_4 mol% from gas analysis =	77.183
Input CO_2 mol% from gas analysis =	0.159

SWN Production Company, LLC
Fork Ridge Pad
Glycol Reboiler Emissions Calculations - Criteria Air Pollutants

Equipment Information

Unit ID:	**EU-RB1**
Emission Point ID:	EP-RB1
Description:	TEG Reboiler
Combustor Type:	Uncontrolled
Burner Design (mmBtu/hr):	0.75
Fuel HHV (Btu/scf):	905
Annual Fuel Use (mmscf):	7.26
Annual Operating Hours:	8,760

Proposed Emissions

Unit ID: **EU-RB1**

Pollutant	lb/hr	TPY
NOx	0.08	0.36
CO	0.07	0.30
VOC	<0.01	0.02
SO_2	<0.01	<0.01
$PM_{10/2.5}$	<0.01	0.02
PM_{COND}	<0.01	0.01
PM_{TOT}	0.01	0.03

AP-42 Emission Factors for Units <100 mmBtu/hr (lb/mmscf)

Pollutant	1.4-1, -2 (7/98)
NOx	100.0
CO	84.0
VOC	5.5
SO_2	0.6
$PM_{10/2.5}$	5.7
PM_{COND}	1.9
PM_{TOT}	7.6

SWN Production Company, LLC
Fork Ridge Pad
Glycol Reboiler Emissions Calculations - Hazardous Air Pollutants

Equipment Information

Unit ID:	**EU-RB1**
Description:	TEG Reboiler
Burner Design (mmBtu/hr):	0.75
Fuel HHV (Btu/scf):	905
Annual Fuel Use (mmscf):	7.26
Annual Operating Hours:	8,760

Proposed Emissions

Unit ID: **EU-RB1**

Pollutant	lb/hr	TPY
n-Hexane	<0.01	0.01
Formaldehyde	<0.01	<0.01
Benzene	<0.01	<0.01
Toluene	<0.01	<0.01
Total HAPs =	**<0.01**	**0.01**

AP-42 Emission Factors (lb/mmscf)

Pollutant	1.4-3 (7/98)
n-Hexane	1.80E+00
Formaldehyde	7.50E-02
Benzene	2.10E-03
Toluene	3.40E-03

SWN Production Company, LLC
Fork Ridge Pad
Glycol Reboiler Emissions Calculations - Greenhouse Gases

Equipment Information

Unit ID:	**EU-RB1**
Description:	TEG Reboiler
Burner Design (mmBtu/hr):	0.75
Fuel HHV (Btu/scf):	905
Annual Fuel Use (mmscf):	7.26
Annual Operating Hours:	8,760

Greenhouse Gas (GHG) Emissions[1]

Unit ID: **EU-RB1**

Pollutant	lb/hr	tonnes/yr
CO_2	87.73	348.60
CH_4	<0.01	<0.01
N_2O	<0.01	<0.01
CH_4 as CO_2e	0.04	0.16
N_2O as CO_2e	0.05	0.20
Total CO_2 + CO_2e	**87.82**	**348.96**

CO_2e = CO_2 equivalent (Pollutant times GWP multiplier)

40 CFR 98 Table A-1, Global Warming Potential (GWP) multiplier (100-Year Time Horizon): CO_2 = 1, CH_4 = 25, N_2O = 298

40 CFR 98 Tables C-1 and C-2 Emission Factors (kg/mmBtu)

Carbon Dioxide (CO_2)	53.06
Methane (CH_4)	1.00E-03
Nitrous Oxide (N_2O)	1.00E-04

Notes:

[1] Conversion to short tons (tons) found in site-wide Summary of Greenhouse Gases - Short Tons per Year (tons) table.

SWN Production Company, LLC
Fork Ridge Pad
Storage Tank Emissions - Criteria Air Pollutants

Tank Information

Unit ID:	**EU-TANKS-COND**	**EU-TANKS-PW**
Emission Point ID:	APC-COMB-TKLD	APC-COMB-TKLD
Contents: [1]	Condensate	Produced Water
Number of Tanks: [2]	5	5
Capacity (bbl) - Per Tank:	400	400
Capacity (gal) - Per Tank:	16,800	16,800
Total Throughput (bbl/yr):	292,000	365,000
Total Throughput (gal/yr):	12,264,000	15,330,000
Total Throughput (bbl/d):	800	1,000
Tank Flashing Emission Factor (lb/bbl):	7.00	0.87
Total Working Losses (lb/yr): [3]	17,456.38	222.91
Breathing Losses per Tank (lb/yr): [3]	1,271.49	10.98
Tank Vapor Capture Efficiency:	100%	100%
Captured Vapors Routed to:	Vapor Combustor	Vapor Combustor

Uncontrolled Storage Tank Emissions

Unit ID:	**EU-TANKS-COND**		**EU-TANKS-PW**	
Emissions	**lb/hr**	**TPY**	**lb/hr**	**TPY**
Working Losses	1.99	8.73	0.03	0.11
Breathing Losses	0.73	3.20	0.01	0.05
Flashing Losses	233.33	1,022.00	36.08	158.05
Total VOC =	**236.06**	**1,033.93**	**36.12**	**158.21**

Notes:

[1] Produced water tanks assumed to contain 99% produced water and 1% condensate.

[2] SWN requests to combine working, breathing and flashing emissions from each tank type to be combined into one emissions point with a total throughput limit rather than an individual tank limit.

[3] Tank working and breathing emissions were calculated using maximum throughput in EPA TANKS 4.0.9d for working losses and multiplying results for breathing losses by the number of tanks for total potential evaporative losses from all tanks. Flashing calculated using Promax process simulation. Reports located in Attachment L. Uncontrolled tank working/breathing/flashing emissions are routed to a vapor combustor with 100% capture efficiency per WVDEP guidance.

Total Annual Emissions (TPY) = Tank Working + Breathing + Flashing Emissions (TPY) * (1 - Capture Efficiency (%))

SWN Production Company, LLC
Fork Ridge Pad
Storage Tank Emissions - Hazardous Air Pollutants

Uncontrolled Storage Tank Emissions

Unit ID:	EU-TANKS-COND		EU-TANKS-PW	
Pollutant	**lb/hr**	**TPY**	**lb/hr**	**TPY**
Total VOC = [1]	**236.06**	**1,033.93**	**36.12**	**158.21**
n-Hexane	12.96	56.77	1.98	8.69
Benzene	0.24	1.04	0.04	0.16
Toluene	1.55	6.77	0.24	1.04
Ethylbenzene	1.59	6.98	0.24	1.07
Xylenes	4.16	18.22	0.64	2.79
Total HAP =	**20.50**	**89.78**	**3.14**	**13.74**

Estimated HAP Composition (% by Weight)[3]

Pollutant	Wt%
n-Hexane	5.491%
Benzene	0.101%
Toluene	0.655%
Ethylbenzene	0.675%
Xylenes	1.762%
Total HAP =	**8.684%**

Notes:

[1] VOC emissions calculated in Criteria Air Pollutant calculations.

[2] Uncontrolled tank working/breathing/flashing emissions are routed to a vapor combustor with 100% capture efficiency.

[3] Speciated liquids analysis located in Fugitive Emissions Calculations. HAP weight % calculated as % of total hydrocarbons in the sample. All HAP assumed to volatilize from liquids for most conservative emissions estimate.

SWN Production Company, LLC
Fork Ridge Pad
Condensate Truck Loading Emissions - Criteria and Hazardous Air Pollutants

Loading Information

Unit ID:	**EU-LOAD-COND**
Emission Point ID:	APC-COMB-TKLD
Fill Method:	Submerged
Type of Service:	Dedicated
Mode of Operation:	Normal
Saturation Factor:	0.6
Em. Factor (lb/1000 gal): [1]	6.14
Throughput (1000 gal):	12,264
Control Type:	Vapor Return/Combustion
Vapor Capture Efficiency: [2]	70%
Average Fill Rate (gal/hr):	7,500
Captured Vapors Routed to:	Vapor Combustor

8.3102	= P, True vapor pressure of liquid loaded (max. psia)[3]
50.43	= M, Molecular weight of vapor (lb/lb-mol)
50.33	= T, Temperature of bulk liquid loaded (average °F)
510.33	= T, Temperature of bulk liquid loaded (°F + 460 = °R)

Uncontrolled Loading Emissions[4]

Pollutant	Max. lb/hr	Avg. lb/hr	TPY
VOC =	**46.05**	**8.60**	**37.65**
n-Hexane	2.53	0.47	2.07
Benzene	0.05	0.01	0.04
Toluene	0.30	0.06	0.25
Ethylbenzene	0.31	0.06	0.25
Xylenes	0.81	0.15	0.66
Total HAP [5] =	**4.00**	**0.75**	**3.27**

SWN Production Company, LLC
Fork Ridge Pad
Condensate Truck Loading Emissions - Criteria and Hazardous Air Pollutants (Continued)

Uncaptured Loading Emissions[4]

Pollutant	Max. lb/hr	Avg. lb/hr	TPY
VOC =	**13.82**	**2.58**	**11.30**
n-Hexane	0.76	0.14	0.62
Benzene	0.01	<0.01	0.01
Toluene	0.09	0.02	0.07
Ethylbenzene	0.09	0.02	0.08
Xylenes	0.24	0.05	0.20
Total HAP [5] =	**1.20**	**0.22**	**0.98**

Notes:

[1] AP-42 5.2-4 Eq.1: Loading Loss (lb/1000 gal) = 12.46 *S*P*M/T.

[2] Uncontrolled emissions that are captured by the collection system are routed to a vapor combustor. Per AP-42 5.2-6, 70% capture efficiency can be assumed for trucks not subject to NSPS. Uncaptured emissions shown represent those not captured by the collection system or controlled by the vapor combustor.

[3] AP-42 Section 7.1 - Properties of Selected Petroleum Liquids correlation with RVP estimated from process simulation.

[4] Maximum lb/hr based on average hourly truck loading rate. Average lb/hr based on TPY conversion assuming continuous operation.

[5] Speciated liquids analysis located in Fugitive Emissions Calculations. HAP weight % calculated as % of total hydrocarbons in the sample. All HAP assumed to volatilize from liquids for most conservative emissions estimate.

Pollutant	Wt%
n-Hexane	5.491%
Benzene	0.101%
Toluene	0.655%
Ethylbenzene	0.675%
Xylenes	1.762%
Total HAPs =	**8.684%**

SWN Production Company, LLC
Fork Ridge Pad
Condensate Truck Loading Emissions - Greenhouse Gases

Loading Information

Unit ID:	**EU-LOAD-COND**
Fill Method:	APC-COMB-TKLD
Fill Method:	Submerged
Type of Service:	Dedicated
Mode of Operation:	Normal
TOC Em. Factor (tonne/10^6 gal): [1]	0.91
Throughput (10^6 gal):	12.264
Control Type:	Vapor Return/Combustion
Vapor Capture Efficiency: [2]	70.00%
Average Fill Rate (gal/hr):	7,500
Captured Vapors Routed to:	Vapor Combustor

Input CH_4 from Promax =	1.9684%
Input CO_2 from Promax =	0.0255%

Uncontrolled Loading Emissions[3, 4]

Pollutant	Max. lb/hr	Avg. lb/hr	tonnes/yr	tons/yr
CH_4	0.30	0.06	0.22	0.24
CH_4 as CO_2e	7.40	1.38	5.49	6.05
CO_2	<0.01	<0.01	<0.01	<0.01
Total CO_2 + CO_2e =	**7.41**	**1.38**	**5.49**	**6.06**

SWN Production Company, LLC
Fork Ridge Pad
Condensate Truck Loading Emissions - Greenhouse Gases (Continued)

Uncaptured Loading Emissions[3, 4]

Pollutant	Max. lb/hr	Avg. lb/hr	tonnes/yr	tons/yr
CH_4	0.09	0.02	0.07	0.07
CH_4 as CO_2e	2.22	0.41	1.65	1.82
CO_2	<0.01	<0.01	<0.01	<0.01
Total CO_2 + CO_2e =	**2.22**	**0.41**	**1.65**	**1.82**

API Compendium Table 5-12

Loading Type	Emission Factor (tonne TOC/10^6 gal)
Rail/Truck - Submerged Loading - Dedicated Normal Service	0.91
Rail/Truck - Submerged Loading - Vapor Balance Service	1.51
Rail/Truck - Splash Loading - Dedicated Normal Service	2.20
Rail/Truck - Splash Loading - Vapor Balance Service	1.51
Marine Loading - Ships/Ocean Barges	0.28
Marine Loading - Barges	0.45

Notes:

[1] API Compendium of Greenhouse Gas Emissions Methodologies for the Oil and Gas Industry, Table 5-12.

[2] Uncontrolled emissions that are captured by the collection system are routed to a vapor combustor. Per AP-42 5.2-6, 70% capture efficiency can be assumed for trucks not subject to NSPS. Uncaptured emissions shown represent those not captured by the collection system or controlled by the vapor combustor.

[3] Maximum lb/hr based on average hourly truck loading rate. Average lb/hr based on TPY conversion assuming continuous operation.

[4] CO_2e = CO_2 equivalent (Pollutant times GWP multiplier):

40 CFR 98 Table A-1, Global Warming Potential (GWP) multiplier: CO_2 = 1, CH_4 = 25

SWN Production Company, LLC
Fork Ridge Pad
Produced Water Truck Loading Emissions - Criteria and Hazardous Air Pollutants

Loading Information

Unit ID:	**EU-LOAD-PW**
Emission Point ID:	APC-COMB-TKLD
Fill Method:	Submerged
Type of Service:	Dedicated
Mode of Operation:	Normal
Saturation Factor:	0.6
Em. Factor (lb/1000 gal): [1]	0.08
Throughput (1000 gal):	15,330
Control Type:	Vapor Return/Combustion
Vapor Capture Efficiency: [2]	70%
Average Fill Rate (gal/hr):	7,500
Captured Vapors Routed to:	Vapor Combustor

0.2425	= P, True vapor pressure of liquid loaded (max. psia)
23.417	= M, Molecular weight of vapor (lb/lb-mol)
50.33	= T, Temperature of bulk liquid loaded (average °F)
510.33	= T, Temperature of bulk liquid loaded (°F + 460 = °R)

Uncontrolled Loading Emissions[3]

Pollutant	Max. lb/hr	Avg. lb/hr	TPY
VOC =	**0.60**	**0.14**	**0.61**
n-Hexane	0.03	0.01	0.03
Benzene	<0.01	<0.01	<0.01
Toluene	<0.01	<0.01	<0.01
Ethylbenzene	<0.01	<0.01	<0.01
Xylenes	0.01	<0.01	0.01
Total HAP[4] =	**0.05**	**0.01**	**0.05**

SWN Production Company, LLC
Fork Ridge Pad
Produced Water Truck Loading Emissions - Criteria and Hazardous Air Pollutants (Continued)

Uncaptured Loading Emissions[3]

Pollutant	Max. lb/hr	Avg. lb/hr	TPY
VOC =	**0.18**	**0.04**	**0.18**
n-Hexane	0.01	<0.01	0.01
Benzene	<0.01	<0.01	<0.01
Toluene	<0.01	<0.01	<0.01
Ethylbenzene	<0.01	<0.01	<0.01
Xylenes	<0.01	<0.01	<0.01
Total HAP[4] =	**0.02**	**<0.01**	**0.02**

Notes:

[1] AP-42 5.2-4 Eq.1: Loading Loss (lb/1000 gal) = 12.46 *S*P*M/T. Properties based on mixture of 99% water and 1% condensate.

[2] Uncontrolled emissions that are captured by the collection system are routed to a vapor combustor. Per AP-42 5.2-6, 70% capture efficiency can be assumed for trucks not subject to NSPS. Uncaptured emissions shown represent those not captured by the collection system or controlled by the vapor combustor.

[3] Maximum lb/hr based on average hourly truck loading rate. Average lb/hr based on TPY conversion assuming continuous operation.

[4] Speciated liquids analysis located in Fugitive Emissions Calculations. HAP weight % calculated as % of total hydrocarbons in the sample. All HAP assumed to volatilize from liquids for most conservative emissions estimate.

Pollutant	Wt%
n-Hexane	5.491%
Benzene	0.101%
Toluene	0.655%
Ethylbenzene	0.675%
Xylenes	1.762%
Total HAPs =	**8.684%**

SWN Production Company, LLC
Fork Ridge Pad
Produced Water Truck Loading Emissions - Greenhouse Gases

Loading Information

Unit ID:	**EU-LOAD-PW**
Fill Method:	APC-COMB-TKLD
Fill Method:	Submerged
Type of Service:	Dedicated
Mode of Operation:	Normal
TOC Em. Factor (tonne/10^6 gal): [1]	0.91
Throughput (10^6 gal):	15.330
Control Type:	Vapor Return/Combustion
Vapor Capture Efficiency: [2]	70.00%
Average Fill Rate (gal/hr):	7,500
Captured Vapors Routed to:	Vapor Combustor

Input CH_4 from Promax =	41.5010%
Input CO_2 from Promax =	1.4348%

Uncontrolled Loading Emissions[3, 4]

Pollutant	Max. lb/hr	Avg. lb/hr	tonnes/yr	tons/yr
CH_4	6.24	1.46	5.79	6.38
CH_4 as CO_2e	156.11	36.43	144.74	159.55
CO_2	0.22	0.05	0.20	0.22
Total CO_2 + CO_2e =	**156.33**	**36.48**	**144.94**	**159.77**

SWN Production Company, LLC
Fork Ridge Pad
Produced Water Truck Loading Emissions - Greenhouse Gases (Continued)

Uncaptured Loading Emissions[3, 4]

Pollutant	Max. lb/hr	Avg. lb/hr	tonnes/yr	tons/yr
CH_4	1.87	0.44	1.74	1.91
CH_4 as CO_2e	46.83	10.93	43.42	47.86
CO_2	0.06	0.02	0.06	0.07
Total CO_2 + CO_2e =	**46.90**	**10.94**	**43.48**	**47.93**

API Compendium Table 5-12

Loading Type	Emission Factor (tonne TOC/10^6 gal)
Rail/Truck - Submerged Loading - Dedicated Normal Service	0.91
Rail/Truck - Submerged Loading - Vapor Balance Service	1.51
Rail/Truck - Splash Loading - Dedicated Normal Service	2.20
Rail/Truck - Splash Loading - Vapor Balance Service	1.51
Marine Loading - Ships/Ocean Barges	0.28
Marine Loading - Barges	0.45

Notes:

[1] API Compendium of Greenhouse Gas Emissions Methodologies for the Oil and Gas Industry, Table 5-12.

[2] Uncontrolled emissions that are captured by the collection system are routed to a vapor combustor. Per AP-42 5.2-6, 70% capture efficiency can be assumed for trucks not subject to NSPS. Uncaptured emissions shown represent those not captured by the collection system or controlled by the vapor combustor.

[3] Maximum lb/hr based on average hourly truck loading rate. Average lb/hr based on TPY conversion assuming continuous operation.

[4] CO_2e = CO_2 equivalent (Pollutant times GWP multiplier):
40 CFR 98 Table A-1, Global Warming Potential (GWP) multiplier: CO_2 = 1, CH_4 = 25

SWN Production Company, LLC
Fork Ridge Pad
Tanks/Loading Vapor Combustor Emissions Calculations - Criteria and Hazardous Air Pollutants

Criteria and Hazardous Air Pollutant Emissions

Unit ID	Pollutant	Emission Factors[1]	Total Captured Emissions[2]		Combustor Destruction Efficiency	Total Controlled Emissions (Post-Capture and Combustion)	
			lb/hr	TPY	%	lb/hr	TPY
APC-COMB-TKLD	NOx	0.138	-	-	-	4.14	18.13
	CO	0.2755	-		-	8.27	36.22
	PM	7.6	-		-	0.09	0.39
	VOC	Mass Balance	339.03	1,484.93	98.00%	6.78	29.70
	n-Hexane	Mass Balance	16.74	73.35	98.00%	0.33	1.45
	Benzene	Mass Balance	0.45	1.95	98.00%	0.01	0.04
	Toluene	Mass Balance	2.18	9.52	98.00%	0.04	0.19
	Ethylbenzene	Mass Balance	1.99	8.75	98.00%	0.04	0.17
	Xylenes	Mass Balance	5.16	22.61	98.00%	0.10	0.44

Notes:

[1] Although a vapor combustor is not considered a flare by design, the function is consistent in that it combusts a waste stream for the purpose of reducing emissions; therefore, flare emission factors for NOx and CO were used to provide the most accurate emissions estimates. Although the combustor is designed to be smokeless, PM emissions have been estimated using AP-42 Table 1.4-1 factor (lb/mmscf) for a conservative estimate.

Hours per Year: 8,760
Number of Combustors: 1

NOx and CO emission factors (lb/mmBtu): *TCEQ Air Permit Technical Guidance for Chemical Sources: Flares and Vapor Oxidizers:* High Btu waste streams (>1,000 Btu/scf) based on heat input to the combustor = 30.00 mmBtu/hr Total Heat Input

[2] Total captured emissions are based on 100% capture efficiency from storage tanks and 70% capture efficiency from truck loading with 98% destruction efficiency from the vapor combustor based on 8,760 hours of operation per year. Uncaptured vapors reported at loading emission units. Captured emissions from sources controlled by VOC combustor shown in following tables.

SWN Production Company, LLC
Fork Ridge Pad
Tanks/Loading Vapor Combustor Emissions Calculations - Criteria and Hazardous Air Pollutants (Continued)

Source	Captured VOC Emissions	
	lb/hr	TPY
Dehydration Unit Flash Tank Vapors	60.73	266.00
Condensate Storage Tanks	236.06	1,033.93
Produced Water Storage Tanks	36.12	158.21
Condensate Truck Loading	6.02	26.36
Produced Water Truck Loading	0.10	0.43
Total VOC =	**339.03**	**1,484.93**

Source	Captured HAP Emissions (lb/hr)				
	n-Hexane	Benzene	Toluene	Ethylbenzene	Xylenes
Dehydration Unit Flash Tank Vapors	1.46	0.17	0.35	0.12	0.26
Condensate Storage Tanks	12.96	0.24	1.55	1.59	4.16
Produced Water Storage Tanks	1.98	0.04	0.24	0.24	0.64
Condensate Truck Loading	0.33	0.01	0.04	0.04	0.11
Produced Water Truck Loading	0.01	<0.01	<0.01	<0.01	<0.01
Total HAP =	**16.74**	**0.45**	**2.18**	**1.99**	**5.16**

Source	Captured HAP Emissions (TPY)				
	n-Hexane	Benzene	Toluene	Ethylbenzene	Xylenes
Dehydration Unit Flash Tank Vapors	6.42	0.72	1.54	0.52	1.13
Condensate Storage Tanks	56.77	1.04	6.77	6.98	18.22
Produced Water Storage Tanks	8.69	0.16	1.04	1.07	2.79
Condensate Truck Loading	1.45	0.03	0.17	0.18	0.46
Produced Water Truck Loading	0.02	<0.01	<0.01	<0.01	0.01
Total HAP =	**73.35**	**1.95**	**9.52**	**8.75**	**22.61**

SWN Production Company, LLC
Fork Ridge Pad
Tanks/Loading Vapor Combustor Emissions Calculations - Greenhouse Gases

Equipment Information

Unit ID:	**APC-COMB-TKLD**
Description:	Vapor Combustor
Number of Combustors:	1
Burner Design Capacity (mmBtu/hr):	30.00
Stream HHV (Btu/scf):	2,682
Annual Throughput (mmscf):	97.99
Annual Operating Hours:	8,760

Greenhouse Gas (GHG) Emissions

Pollutant	lb/hr	tonnes/yr	tons/yr
CO_2	3,509.31	13,944.14	15,370.78
CH_4	0.07	0.26	0.29
N_2O	0.01	0.03	0.03
CH_4 as CO_2e	1.65	6.57	7.24
N_2O as CO_2e	1.97	7.83	8.63
Total CO_2 + CO_2e =	**3,512.94**	**13,958.54**	**15,386.66**

40 CFR 98 Tables C-1 and C-2 Emission Factors (kg/mmBtu)[1]

Carbon Dioxide (CO_2)	53.06
Methane (CH_4)	1.00E-03
Nitrous Oxide (N_2O)	1.00E-04

Notes:
[1] CO_2e = CO_2 equivalent (Pollutant times GWP multiplier):
40 CFR 98 Table A-1, Global Warming Potential (GWP) multiplier: CO_2 = 1, CH_4 = 25, N_2O = 298

SWN Production Company, LLC
Fork Ridge Pad
Vapor Combustor Pilot Emissions Calculations - Criteria Air Pollutants

Criteria Air Pollutant Emissions

Unit ID	Pollutant	Emission Factors [1] (lb/mmscf)	Emissions lb/hr	Emissions TPY
EU-PILOT APC-COMB-TKLD	NOx	100	0.02	0.09
	CO	84	0.01	0.06
	VOC	5.5	<0.01	<0.01
	SO_2	0.6	<0.01	<0.01
	PM	7.6	<0.01	<0.01

905	Pilot Stream Heat Content (Btu/SCF)
8,760	Pilot Hours/Yr
150	Pilot Gas Flow Rate (SCFH)[2]
135,750	Total Pilot Gas Fuel Use (Btu/hr)
1.31	Total Annual Fuel Use (MMSCF)

Notes:

[1] AP-42 Table 1.4-1, -2 (7/98)

[2] Combustor is equipped with three (3) pilots with a pilot fuel consumption of 50 SCFH per pilot.

SWN Production Company, LLC
Fork Ridge Pad
Vapor Combustor Pilot Emissions Calculations - Hazardous Air Pollutants

Hazardous Air Pollutant Emissions

Unit ID	Pollutant	Emission Factors [1] (lb/mmscf)	Emissions lb/hr	Emissions TPY
EU-PILOT APC-COMB-TKLD	n-Hexane	1.8	<0.01	<0.01
	Formaldehyde	0.075	<0.01	<0.01
	Benzene	0.0021	<0.01	<0.01
	Toluene	0.0034	<0.01	<0.01
		Total HAPs =	**<0.01**	**<0.01**

905	Pilot Stream Heat Content (Btu/SCF)
8,760	Pilot Hours/Yr
150	Pilot Gas Flow Rate (SCFH)2
135,750	Total Pilot Gas Fuel Use (Btu/hr)
1.31	Total Annual Fuel Use (MMSCF)

Notes:
[1] AP-42 Table 1.4-3 (7/98)

SWN Production Company, LLC
Fork Ridge Pad
Vapor Combustor Pilot Emissions Calculations - Greenhouse Gases

Greenhouse Gas (GHG) Emissions

Unit ID	Pollutant	Emissions		
		lb/hr	tonnes/yr	tons/yr
EU-PILOT APC-COMB-TKLD	CO_2	15.88	63.10	69.56
	CH_4	<0.01	<0.01	<0.01
	N_2O	<0.01	<0.01	<0.01
	CH_4 as CO_2e	0.01	0.03	0.03
	N_2O as CO_2e	0.01	0.04	0.04
Total CO_2 + CO_2e =		**15.90**	**63.17**	**69.63**

905	Pilot Stream Heat Content (Btu/SCF)
8,760	Pilot Hours/Yr
150	Pilot Gas Flow Rate (SCFH)2
135,750	Total Pilot Gas Fuel Use (Btu/hr)
1.31	Total Annual Fuel Use (MMSCF)

40 CFR 98 Tables C-1 and C-2 Emission Factors (kg/mmBtu)[1]

Carbon Dioxide (CO_2)	53.06
Methane (CH_4)	1.00E-03
Nitrous Oxide (N_2O)	1.00E-04

Notes:
[1] CO_2e = CO_2 equivalent (Pollutant times GWP multiplier):
40 CFR 98 Table A-1, Global Warming Potential (GWP) multiplier: CO_2 = 1, CH_4 = 25, N_2O = 298

SWN Production Company, LLC
Fork Ridge Pad
Fugitive Emissions Calculations - Criteria and Hazardous Air Pollutants and Greenhouse Gases

Equipment Information

Source Type/Service	Number of Sources[1]	Em. Factor (lb/hr/source)[2]	Control Efficiency	TOC lb/hr	TOC TPY	VOC Wt %
Valves - Gas	178	9.92E-03	0.00%	1.77	7.75	18.96%
Flanges - Gas	721	8.60E-04	0.00%	0.62	2.72	18.96%
Compressor Seals - Gas	12	1.94E-02	0.00%	0.23	1.01	18.96%
Relief Valves - Gas	48	1.94E-02	0.00%	0.93	4.07	18.96%
Open-Ended Lines - Gas	2	4.41E-03	0.00%	0.01	0.04	18.96%
Total TOC (Gas Components) =				**3.56**	**15.59**	-
Valves - Light Oil	127	5.51E-03	0.00%	0.70	3.07	95.21%
Flanges - Light Oil	502	2.43E-04	0.00%	0.12	0.53	95.21%
Pump Seals - Light Oil	0	2.87E-02	0.00%	0.00	0.00	95.21%
Other - Light Oil	0	1.65E-02	0.00%	0.00	0.00	95.21%
Total TOC (Liquid Components) =				**0.82**	**3.60**	-

VOC and Greenhouse Gas Emissions

Source Type/Service	VOC			CH_4		CO_2	
	lb/hr	TPY	lb/yr	lb/hr	TPY	lb/hr	TPY
Valves - Gas	0.33	1.47	2,932.29	1.06	4.63	0.01	0.03
Flanges - Gas	0.12	0.51	1,029.38	0.37	1.62	<0.01	0.01
Compressor Seals - Gas	0.04	0.19	386.58	0.14	0.60	<0.01	<0.01
Relief Valves - Gas	0.18	0.77	1,546.32	0.56	2.43	<0.01	0.01
Open-Ended Lines - Gas	<0.01	0.01	14.64	0.01	0.02	<0.01	<0.01
Components in Gas Service =	**0.67**	**2.95**	**5,909.20**	**2.13**	**9.31**	**0.01**	**0.05**
Valves - Light Oil	0.67	2.92	5,838.00	0.01	0.05	<0.01	<0.01
Flanges - Light Oil	0.12	0.51	1,015.35	<0.01	0.01	<0.01	<0.01
Pump Seals - Light Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other - Light Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Components in Liquid Service =	**0.78**	**3.43**	**6,832.80**	**0.01**	**0.05**	**<0.01**	**<0.01**
Total (Gas + Liquid Components) =	**1.46**	**6.38**	**12,742.00**	**2.14**	**9.36**	**0.01**	**0.05**

SWN Production Company, LLC
Fork Ridge Pad
Fugitive Emissions Calculations (Continued)

Hazardous Air Pollutant (HAP) Emissions (lb/hr)

Source Type/Service	n-Hexane	Benzene	Toluene	Ethylbenzene	Xylenes	2,2,4-Tri.	Total
Valves - Gas	0.01	<0.01	<0.01	0.00	<0.01	0.00	0.01
Flanges - Gas	<0.01	<0.01	<0.01	0.00	<0.01	0.00	<0.01
Compressor Seals - Gas	<0.01	<0.01	<0.01	0.00	<0.01	0.00	<0.01
Relief Valves - Gas	<0.01	<0.01	<0.01	0.00	<0.01	0.00	<0.01
Open-Ended Lines - Gas	<0.01	<0.01	<0.01	0.00	<0.01	0.00	<0.01
Components in Gas Service =	**0.01**	**<0.01**	**<0.01**	**0.00**	**<0.01**	**0.00**	**0.01**
Valves - Light Oil	0.04	<0.01	<0.01	<0.01	0.01	0.00	0.06
Flanges - Light Oil	0.01	<0.01	<0.01	<0.01	<0.01	0.00	0.01
Pump Seals - Light Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other - Light Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Components in Liquid Service =	**0.05**	**<0.01**	**0.01**	**0.01**	**0.01**	**0.00**	**0.07**
Total (Gas + Liquid Components) =	**0.06**	**<0.01**	**0.01**	**0.01**	**0.01**	**0.00**	**0.08**

Hazardous Air Pollutant (HAP) Emissions (TPY)

Source Type/Service	n-Hexane	Benzene	Toluene	Ethylbenzene	Xylenes	2,2,4-Tri.	Total
Valves - Gas	0.03	<0.01	<0.01	0.00	<0.01	0.00	0.03
Flanges - Gas	0.01	<0.01	<0.01	0.00	<0.01	0.00	0.01
Compressor Seals - Gas	<0.01	<0.01	<0.01	0.00	<0.01	0.00	<0.01
Relief Valves - Gas	0.01	<0.01	<0.01	0.00	<0.01	0.00	0.01
Open-Ended Lines - Gas	<0.01	<0.01	<0.01	0.00	<0.01	0.00	<0.01
Components in Gas Service =	**0.06**	**<0.01**	**<0.01**	**0.00**	**<0.01**	**0.00**	**0.06**
Valves - Light Oil	0.17	<0.01	0.02	0.02	0.05	0.00	0.27
Flanges - Light Oil	0.03	<0.01	<0.01	<0.01	0.01	0.00	0.05
Pump Seals - Light Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other - Light Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Components in Liquid Service =	**0.20**	**<0.01**	**0.02**	**0.02**	**0.06**	**0.00**	**0.31**
Total (Gas + Liquid Components) =	**0.26**	**<0.01**	**0.03**	**0.02**	**0.06**	**0.00**	**0.37**

SWN Production Company, LLC
Fork Ridge Pad
Fugitive Emissions Calculations (Continued)

Typical Component Count per Equipment Type based on Representative Facility[3]

Source Type/Service	WH	GPU	HT	LPT	FGC	OT	TT-O	DEHY
Valves - Gas	12	3	2	5	5	0	0	24
Flanges - Gas	37	15	9	24	33	3	2	90
Compressor Seals - Gas	0	0	0	0	3	0	0	0
Relief Valves - Gas	1	3	1	1	1	1	1	2
Open-Ended Lines - Gas	0	0	0	0	0	0	0	2
Valves - Light Oil	0	5	6	12	3	6	9	0
Connectors - Light Oil	0	20	24	48	12	24	30	0
Pump Seals - Light Oil	0	0	0	0	0	0	0	0
Other - Light Oil	0	0	0	0	0	0	0	0

Equipment Type	WH	GPU	HT	LPT	FGC	OT	TT-O	DEHY
Number of Each Type On Pad =	8	8	2	2	4	5	1	1

SWN Production Company, LLC
Fork Ridge Pad
Fugitive Emissions Calculations (Continued)

Speciated Gas Analysis[4]

Component	Molecular Weight	Mole %	Equiv. Wt. Basis	Weight %	HC Weight %	lb/hr	TPY
Hydrogen Sulfide	34.082	0.000%	0.000	0.000%	-	0.00	0.00
Carbon Dioxide	44.010	0.159%	0.070	0.335%	-	0.01	0.05
Nitrogen	28.013	0.364%	0.102	0.488%	-	0.02	0.08
Methane	16.042	77.183%	12.382	59.215%	59.706%	2.13	9.31
Ethane	30.069	14.716%	4.425	21.162%	21.338%	0.76	3.33
Propane	44.096	4.782%	2.109	10.085%	10.168%	0.36	1.59
i-Butane	58.122	0.647%	0.376	1.798%	1.813%	0.06	0.28
n-Butane	58.122	1.210%	0.703	3.363%	3.391%	0.12	0.53
i-Pentane	72.149	0.327%	0.236	1.128%	1.138%	0.04	0.18
n-Pentane	72.149	0.271%	0.196	0.935%	0.943%	0.03	0.15
n-Hexane	86.175	0.079%	0.068	0.326%	0.328%	0.01	0.05
Other Hexanes	86.175	0.142%	0.122	0.585%	0.590%	0.02	0.09
Heptanes (as n-Heptane)	100.202	0.084%	0.084	0.403%	0.406%	0.01	0.06
Benzene	78.114	0.002%	0.002	0.007%	0.008%	<0.01	<0.01
Toluene	92.141	0.003%	0.003	0.013%	0.013%	<0.01	<0.01
Ethylbenzene	106.167	0.000%	0.000	0.000%	0.000%	0.00	0.00
Xylenes	106.167	0.001%	0.001	0.005%	0.005%	<0.01	<0.01
2,2,4-Trimethylpentane	114.230	0.000%	0.000	0.000%	0.000%	0.00	0.00
Octanes (as n-Octane)	114.229	0.022%	0.025	0.120%	0.121%	<0.01	0.02
Nonanes (as n-Nonane)	128.255	0.005%	0.006	0.031%	0.031%	<0.01	<0.01
Decanes (as n-Decane)	142.282	0.000%	0.000	0.000%	0.000%	0.00	0.00
TOTAL =		**100.00%**	**20.91**	**100.00%**	**100.00%**	**3.59**	**15.72**
		TOTAL HC =	**20.74**	**TOTAL VOC =**	**18.96%**	**0.67**	**2.96**
				TOTAL HAP =	**0.35%**	**0.01**	**0.06**

SWN Production Company, LLC
Fork Ridge Pad
Fugitive Emissions Calculations (Continued)

Speciated Liquids Analysis[4]

Component	Molecular Weight	Mole %	Equiv. Wt. Basis	Weight %	HC Weight %	lb/hr	TPY
Hydrogen Sulfide	34.082	0.000%	0.000	0.000%	-	0.00	0.00
Carbon Dioxide	44.010	0.018%	0.008	0.010%	-	<0.01	<0.01
Nitrogen	28.013	0.026%	0.007	0.009%	-	<0.01	<0.01
Methane	16.042	7.419%	1.190	1.489%	1.490%	0.01	0.05
Ethane	30.069	8.764%	2.635	3.298%	3.299%	0.03	0.12
Propane	44.096	9.825%	4.332	5.422%	5.423%	0.04	0.20
i-Butane	58.122	3.048%	1.772	2.217%	2.218%	0.02	0.08
n-Butane	58.122	8.045%	4.676	5.852%	5.853%	0.05	0.21
i-Pentane	72.149	5.183%	3.739	4.680%	4.681%	0.04	0.17
n-Pentane	72.149	5.869%	4.234	5.299%	5.300%	0.04	0.19
n-Hexane	86.175	5.090%	4.386	5.490%	5.491%	0.05	0.20
Other Hexanes	86.175	7.647%	6.589	8.247%	8.248%	0.07	0.30
Heptanes (as n-Heptane)	100.202	12.459%	12.484	15.624%	15.627%	0.13	0.56
Benzene	78.114	0.103%	0.080	0.101%	0.101%	<0.01	<0.01
Toluene	92.141	0.568%	0.523	0.655%	0.655%	0.01	0.02
Ethylbenzene	106.167	0.508%	0.539	0.675%	0.675%	0.01	0.02
Xylenes	106.167	1.326%	1.408	1.762%	1.762%	0.01	0.06
2,2,4-Trimethylpentane	114.230	0.000%	0.000	0.000%	0.000%	0.00	0.00
Octanes (as n-Octane)	114.229	8.562%	9.780	12.240%	12.242%	0.10	0.44
Nonanes (as n-Nonane)	128.255	4.206%	5.394	6.751%	6.752%	0.06	0.24
Decanes (as n-Decane)	142.282	11.332%	16.123	20.179%	20.182%	0.17	0.73
TOTAL =		**100.00%**	**79.90**	**100.00%**	**100.00%**	**0.82**	**3.60**
		TOTAL HC =	**79.89**	**TOTAL VOC =**	**95.21%**	**0.78**	**3.43**
				TOTAL HAP =	**8.68%**	**0.07**	**0.31**

Notes:

[1] Component counts taken by equipment type at representative facility and made site-specific according to the number of each equipment type at this site.

[2] Emission Factor Source: EPA-453/R-95-017. TOC multiplied by pollutant content of streams (weight %) to obtain pollutant emissions.

[3] Equipment Type Key: WH = Well Head, GPU = Gas Production Unit, HT = Heater Treater, LPT = Low-Pressure Tower, FGC = Flash Gas Compressor, OT = Oil Tank, TT-O = Tank Truck - Oil, DEHY = Dehydration Unit

[4] Analyses located in Attachment L.

SWN Production Company, LLC
Fork Ridge Pad
Fugitive Unpaved Haul Road Emissions Calculations

Facility Data [1]

Vehicle Type	Light Vehicles (Pick-ups and Cars)	Medium Trucks (Service Trucks)	Heavy Trucks (Tanker Trucks)[2]
Average vehicle weight ((empty + full)/2) (tons)	2	15	23.5
Number of wheels per vehicle type (w)	4	10	18
Average number of round trips/day/vehicle type	5	3	9
Distance per round trip (miles/trip)	0.22	0.22	0.22
Vehicle miles travelled (miles/day)	1.10	0.66	2.08
Number of days operational (days/yr)	365	365	365
Vehicle miles travelled VMT (miles/yr)	400.95	240.57	759.69
Average vehicle speed S (mph)	10	10	10
Average number of round trips/hour/vehicle type	0.28	0.17	0.53
Average number of round trips/year/vehicle type	1,825	1,095	3,458
Estimated maximum number of round trips/hour/vehicle type	3	3	2
Estimated maximum number of round trips/day/vehicle type	7	4	12
Estimated maximum number of round trips/year/vehicle type	2,683	1,533	4,599

190	Average Tanker Volume (bbl)
7,980	Gallons Tanker Volume
1,000	bwpd
800	bopd
9.47	Tanker Trucks per Day
140	Length Leased Access Road (ft)
440	Longest Pad Side (ft)
1,160	Total Round Trip Feet

Formula & Calculation Inputs

$E=k(s/12)^a * (W/3)^b * ((365-P) / 365)$ *Reference : AP-42, Section 13.2.2 (11/06), Equation 1a and 2*

where:

	Rate	Units	Comment
Days per year	365		
Annual average hours per day of road operations	18		
k = PM Particle Size Multiplier	4.90	lb/VMT	AP-42 Section 13.2.2 (11/06), Table 13.2.2-2 (PM)
k = PM10 Particle Size Multiplier	1.50	lb/VMT	AP-42 Section 13.2.2 (11/06), Table 13.2.2-2 (PM_{10})
k = PM2.5 Particle Size Multiplier	0.15	lb/VMT	AP-42 Section 13.2.2 (11/06), Table 13.2.2-2 ($PM_{2.5}$)
s = Surface Material Silt Content	3.9	%	State Default Data from AP-42 Data (1999 NEI Data)
P = Number of days > 0.01 inch of rain	150	days/year	AP-42 Section 13.2.2 (11/06), Figure 13.2.2-1
a = PM Constant	0.70	unitless	AP-42 Section 13.2.2 (11/06), Table 13.2.2-2 (PM)
a = PM10 & PM2.5 Constant	0.90	unitless	AP-42 Section 13.2.2 (11/06), Table 13.2.2-2 (PM_{10} & $PM_{2.5}$)
b = PM, PM10, & PM2.5 Constant	0.45	unitless	AP-42 Section 13.2.2 (11/06), Table 13.2.2-2
Total hourly fleet vehicle miles travelled (miles/hr)	0.21	VMT/hr	
Total annual fleet vehicle miles travelled (miles/yr)[3]	1,401.20	VMT/yr	
Average wheels[4]	13		
Average vehicle weight of the fleet (W)[5]	15.9	tons	
Moisture Ratio	1.00		Estimated based on 0.2% uncontrolled surface water content assuming no watering
Control Efficiency (CF)	0.00	%	Based on Moisture Ratio and Figure 13.2.2-2 Control

EPA - BID Document 13.2.2 - 1998

Continued on Next Page

SWN Production Company, LLC
Fork Ridge Pad
Fugitive Unpaved Haul Road Emissions Calculations

Emission Calculations

	Emission Factors			Control Efficiency	Total Vehicle Miles Travelled		Uncontrolled Emission Rates			Uncontrolled Emission Rates		
	PM	PM_{10}	$PM_{2.5}$				Total PM	Total PM_{10}	$PM_{2.5}$	Total PM	Total PM_{10}	$PM_{2.5}$
Vehicle Type	**(lbs/VMT)**	**(lbs/VMT)**	**(lbs/VMT)**	**(%)**	**(VMT/hr)**	**(VMT/yr)**	**(lb/hr)**	**(lb/hr)**	**(lb/hr)**	**(tons/yr)**	**(tons/yr)**	**(tons/yr)**
Light Vehicles	2.78	0.68	0.07	0.00	0.06	400.95	0.17	0.04	0.00	0.56	0.14	0.01
Medium Trucks	2.78	0.68	0.07	0.00	0.04	240.57	0.10	0.02	0.00	0.33	0.08	0.01
Heavy Trucks	2.78	0.68	0.07	0.00	0.12	759.69	0.32	0.08	0.01	1.06	0.26	0.03
			Total =	**0.00**	**0.22**	**1,401.21**	**0.59**	**0.14**	**0.01**	**1.95**	**0.48**	**0.05**

Notes:

1) Facility vehicle data based on estimates, GP5.1 and AP-42 13.2.2-2 defaults for industrial unpaved roads

2) Tank trucker average vehicle weight as $(W_{(empty)}+W_{(full)})/2 = (7 + 40)/2 = 23.7$ tons

3) Average vehicle miles travelled (VMT/yr) as (No. of round trip/vehicle * No. of vehicles/type * Roundtrip miles/trip)* 365 days/yr * No. of vehicle type)

4) Average wheels calculated as average of (No. of wheels per vehicle type * No. of vehicle/type)

5) Average vehicle fleet calculated as (Average weight of vehicle type * Percentage of each vehicle type on unpaved surface). Percentage of each vehicle type= $VMT_{vehicle\ type}$/VMT

6) Minimum one-per-day average pick-up trucks and service trucks even if tanker not required every day.

7) Per EPA BID calculations, all emissions based on average trips. Estimated maximum hourly, daily and yearly trips provided for information only.

Calculation of Emission Factors (AP-42, 13.2.2)

Equation 1a: $EF = k(s/12)^a (W/3)^b$ *where k, a, and b are empirical constants and*

EF = size-specific emission factor (lb/VMT)

s = surface material silt content %

W = mean vehicle weight (tons)

Equation 2: $EF_{ext} = EF*((365-P)/365)$ *where:*

EF_{ext} *= annual size-specific emission factor extrapolated for natural mitigation, lb/VMT*

EF = emission factor from Equation 1a

P = number of days in a year with at least 0.01 inches of precipitation

Calculation of Emissions

$E = EF_{ext} * VMT/yr * ((1-CF)/100) * 1\ ton/2000\ lbs$ *where:*

E = annual emissions (tons/yr)

EF_{ext} *= annual size-specific emission factor extrapolated for natural mitigation, lb/VMT*

CF = control efficiency (%)

ATTACHMENT J: CLASS I LEGAL ADVERTISEMENT

Note: Affidavit of Publication will be submitted upon receipt by SWN from the publisher.

AIR QUALITY PERMIT NOTICE
Notice of Application

Notice is given that SWN Production Company, LLC has applied to the West Virginia Department of Environmental Protection, Division of Air Quality, for a G70-A General Permit Registration for a natural gas production facility (Fork Ridge Pad) located near Moundsville in Marshall County, West Virginia. From the intersection of SR 250 and CR 2 in Moundsville, travel south on SR 250 14.17 miles to the intersection of SR 250 and CR 17 (Fork Ridge Road). Turn right onto CR 17 and travel 3.64 miles to the well pad entrance on the right. Latitude and longitude coordinates are: 39.87151, -80.638514.

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

Nitrogen Oxides (NOx)	64.95 tons/yr
Carbon Monoxide (CO)	79.52 tons/yr
Volatile Organic Compounds (VOC)	85.90 tons/yr
Sulfur Dioxide (SO_2)	0.11 tons/yr
Particulate Matter (PM)	4.19 tons/yr
Acetaldehyde	1.15 tons/yr
Acrolein	0.71 tons/yr
Benzene	0.58 tons/yr
Ethylbenzene	0.39 tons/yr
Formaldehyde	4.94 tons/yr
Methanol	0.36 tons/yr
n-Hexane	2.66 tons/yr
Toluene	0.86 tons/yr
Xylenes	1.01 tons/yr
Carbon Dioxide	41,305.74 tons/yr
Methane	13.97 tons/yr
Nitrous Oxide	0.07 tons/yr
CO_2 Equivalent	41,675.88 tons/yr

The change in equipment and operations is planned to begin on or about January 4, 2016. 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 3rd of December, 2015

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

ATTACHMENT L: APPLICATION FEE

ATTACHMENT N: MATERIAL SAFETY DATA SHEETS (MSDS)

Material Safety Data Sheet

Health	1
Flammability	4
Reactivity	0
PPE	

Material Name: Natural Gas

*** Section 1 - Chemical Product and Company Identification ***

Product name: Natural Gas
Synonyms: Wellhead Gas; Petroleum Gas; Fuel Gas; Methane; Marsh Gas
Chemical Family: Petroleum Hydrocarbon
Formula: Gas mixture, primarily methane

Supplier: Chesapeake Energy Corporation and its subsidiaries
6100 N. Western Avenue
Oklahoma City, OK 73118

Other Information: Phone: 405-848-8000 Fax: 405-753-5468
Emergency Phone Number: Chemtrec – 800-424-9300

*** Section 2 - Hazards Identification ***

Emergency Overview

Flammable gas, simple asphyxiant, freeze burns can occur from liquid natural gas. Keep away from heat, sparks, flames, static electricity, or other sources of ignition.

Potential Health Effects: Eyes

Natural gas is generally non-irritating to the eyes. Liquid or expanding gas can cause severe freeze burns to the eye and surrounding tissue. Pressurized gas can cause mechanical injury to the eye.

Potential Health Effects: Skin

None for gas; liquid or expanding gas can cause severe freeze burns on the skin.

Potential Health Effects: Ingestion

This material is a gas under normal atmospheric conditions and ingestion is unlikely.

Potential Health Effects: Inhalation

Drowsiness, excitation, or mild narcosis is produced at elevated concentrations and is an asphyxiant when the oxygen concentration falls below 18% at sea level.

HMIS Ratings: Health: 1 **Fire:** 4 **HMIS Reactivity** 0
Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe * = Chronic hazard

*** Section 3 - Composition / Information on Ingredients ***

CAS #	Component	Percent Ranges
8006-14-2	Natural Gas	100
74-82-8	Methane	>90
74-84-0	Ethane	<5
74-98-6	Propane	<1
Mixture	C4-C6 Aliphatic Hydrocarbons	Trace amounts

This product may contain small amounts of heavier hydrocarbons. Components of this product are normally within the ranges listed above; however, depending on the geographical source, gas composition may vary.

*** Section 4 - First Aid Measures ***

First Aid: Eyes

Move away from exposure to vapors and into fresh air. If liquefied gas contacts the eye, flush with large amounts of tepid water for at least 15 minutes. Seek medical attention.

First Aid: Skin

Treat burned or frostbitten skin by immersing the affected area in tepid water. When sensation has returned to the frostbitten skin, keep the skin warm, dry, and clean. For burns, lay bulky, dry sterile bandages over affected area and seek prompt medical attention.

First Aid: Ingestion

Not considered likely since the product is a gas under normal conditions.

First Aid: Inhalation

If conditions are safe to do so, remove affected person to fresh air. If breathing is difficult, administer oxygen. If breathing has stopped, give artificial respiration or cardiopulmonary resuscitation (CPR). Seek immediate medical attention.

* * * Section 5 - Fire Fighting Measures * * *

General Fire Hazards

See Section 9 for Flammability Properties.

This gas is extremely flammable and forms flammable mixtures with air. It will burn in the open or be explosive in confined spaces. Its vapors are lighter than air and will disperse. A hazard of re-ignition or explosion exists if flame is extinguished without stopping the flow of gas.

Hazardous Combustion Products

Combustion may yield carbon monoxide and/or carbon dioxide.

Extinguishing Media

Stop the gas flow if it can be done without risk. Dry chemical, carbon dioxide, or halon. Water can be used to cool the fire but may not extinguish the fire.

Fire Fighting Equipment/Instructions

Evacuate the area upwind of the source. If a leak or spill has not ignited, water spray can be used to disperse gas and to protect persons attempting to stop the leak. In the case of a fire, control the fire until the gas supply can be shut off. If the gas source cannot be shut off immediately, equipment and surfaces exposed to the fire should be cooled with water to prevent overheating and explosions. Firefighters should wear self-contained breathing apparatus and full protective clothing.

NFPA Ratings: Health: 1 **Fire:** 4 **Reactivity:** 0

Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe

* * * Section 6 - Accidental Release Measures * * *

Containment Procedures

Flammable Gas – Eliminate All Sources of Ignition. Stop release/spill if it can be done with minimal risk. Keep all sources of ignition and hot metal surfaces away from release/spill. The use of explosion-proof equipment is recommended.

Evacuation Procedures

Notify persons down wind of the release/spill, isolate the immediate hazard area and keep unauthorized personnel out. Contact fire authorities and appropriate state/local agencies.

Special Procedures

Eliminate sources of heat or ignition including internal combustion engines and power tools. Stay up wind and away from the release/spill. Wear appropriate protective equipment including respiratory protection as conditions warrant.

* * * Section 7 - Handling and Storage * * *

Store and use natural gas cylinders and tanks in well ventilated areas, away from direct sunlight and sources of ignition. Keep away from heat, sparks, open flames, and other sources of ignition. Rapid escape of gas may generate static charge. Electrically ground and bond all lines and equipment used with natural gas. Use only explosion-proof or intrinsically safe electrical equipment where product is stored or handled. Keep away from incompatible agents and from cylinders of oxygen.

* * * Section 8 - Exposure Controls / Personal Protection * * *

A: Component Exposure Limits

Natural Gas (8006-14-2)

ACGIH: 1000 ppm TWA (listed under Aliphatic hydrocarbon gases alkane C1-C4)

Methane (74-82-8)

ACGIH: 1000 ppm TWA (listed under Aliphatic hydrocarbon gases alkane C1-C4)

Ethane (74-84-0)
ACGIH: 1000 ppm TWA (listed under Aliphatic hydrocarbon gases alkane C1-C4)

Propane (74-98-6)
ACGIH: 1000 ppm TWA (listed under Aliphatic hydrocarbon gases alkane C1-C4)
OSHA: 1000 ppm TWA; 1800 mg/m^3 TWA
NIOSH: 1000 ppm TWA; 1800 mg/m^3 TWA

Engineering Controls
Local or general exhaust is required if used in an enclosed area in order to keep concentrations below the lower explosive limit.

PERSONAL PROTECTIVE EQUIPMENT

Personal Protective Equipment: Eyes/Face
Eye protection should be worn to safeguard against potential eye contact, irritation, or injury.

Personal Protective Equipment: Skin
Protect skin from contact. Impervious clothing should be worn as needed.

Personal Protective Equipment: Respiratory
Use approved respiratory protective equipment in the event of oxygen deficiency, when the product produces vapors that exceed permissible limits or when excessive vapors are generated. Self-contained breathing apparatus should be used for fire fighting.

Personal Protective Equipment: General
Do not smoke in areas where this product is stored or handled. A source of clean water should be available in the work area for flushing eyes and skin. Use explosion-proof equipment suitable for hazardous locations.

* * * Section 9 - Physical & Chemical Properties * * *

Appearance:	Colorless
Physical State:	Gas
Vapor Pressure:	>760 @ 25°C
Boiling Point:	-258 to -43°F
Solubility (H2O):	Slight
Evaporation Rate:	Gas under normal conditions
Octanol/H2O Coeff.:	NA
Flash Point Method:	NA

Odor:	Odorless to slight hydrocarbon
pH:	Neutral
Vapor Density:	0.6 (estimate)
Melting Point:	NA
Specific Gravity:	0.55 (estimate)
VOC:	100%
Flash Point:	Flammable gas
Upper Flammability Limit (UFL):	15.0
Lower Flammability Limit (LFL):	4.0
Burning Rate:	Flammable gas
Auto Ignition:	900 – 1170 °F

Properties of this material will vary with actual composition.

* * * Section 10 - Chemical Stability & Reactivity Information * * *

Chemical Stability
This material is stable under normal conditions of use.

Chemical Stability: Conditions to Avoid
Sources of heat or ignition.

Incompatibility
Strong oxidizers such as nitrates, chlorates, peroxides.

Hazardous Decomposition
Combustion produces carbon monoxide and carbon dioxide.

Possibility of Hazardous Reactions
Will not occur.

*** Section 11 - Toxicological Information ***

Acute Dose Effects

Component Analysis - LD50/LC50

Natural gas (8006-14-2)
Inhalation LC50 Rat: 658 mg/L/4H

Methane (74-82-8)
Inhalation LC50 Mouse: 326 g/m3/2H

Ethane (74-84-0)
Inhalation LC50 Rat: 658 mg/L/4H

Propane (74-98-6)
Inhalation LC50 Rat: 658 mg/L/4H

The major components of natural gas act as simple asphyxiant gases without significant potential for systemic toxicity. At high concentrations this material acts as an asphyxiant by diluting and displacing oxygen. Extremely high concentrations of this material can produce unconsciousness followed by death. Symptoms of persons exposed to oxygen deficient atmospheres include headache, dizziness, incoordination, cyanosis and narcosis.

*** Section 12 - Ecological Information ***

There is no information available on the ecotoxicological effects of petroleum gases. Because of their high volatility, these gases are unlikely to cause ground or water pollution. Petroleum gases released into the environment will rapidly disperse into the atmosphere and undergo photochemical degradation.

*** Section 13 - Disposal Considerations ***

This product as produced is not specifically listed as an EPA RCRA hazardous waste according to federal regulations (40 CFR 261). However, when discarded or disposed of in containers, it may meet the criteria of an "ignitable" waste. It is the responsibility of the user to determine if disposal material is hazardous according to federal, state and local regulations.

*** Section 14 - Transportation Information ***

US DOT Information

Shipping Name: Natural Gas, Compressed
UN/NA #: 1271 **Hazard Class:** 2.1 **Packing Group:** Not applicable

Depending on the product's properties the shipper may elect to classify the material differently. Refer to 49 CFR 172 for further information and descriptions.

*** Section 15 - Regulatory Information ***

US Federal Regulations

Component Analysis

None of this products components are listed under SARA Section 302 (40 CFR 355 Appendix A), SARA Section 313 (40 CFR 372.65), or CERCLA (40 CFR 302.4).

State Regulations

Component Analysis - State

The following components appear on one or more of the following state hazardous substances lists:

Component	CAS	CA	MA	MN	NJ	PA	RI
Natural gas	8006-14-2	No	Yes	No	No	Yes	No
Methane	74-82-8	No	Yes	Yes	Yes	Yes	Yes
Ethane	74-84-0	No	Yes	Yes	Yes	Yes	Yes
Propane	74-98-6	No	Yes	Yes	Yes	Yes	Yes

Component Analysis - WHMIS IDL

No components are listed in the WHMIS IDL.

Additional Regulatory Information

Component Analysis - Inventory

Component	CAS #	TSCA	CAN	EEC
Natural gas	8006-14-2	Yes	DSL	EINECS
Methane	74-82-8	Yes	DSL	EINECS
Ethane	74-84-0	Yes	DSL	EINECS
Propane	74-98-6	Yes	DSL	EINECS

* * * Section 16 - Other Information * * *

Other Information

The information presented herein has been compiled from sources considered to be dependable and is accurate and reliable to the best of our knowledge and belief, but is not guaranteed to be so. Since conditions of use are beyond our control, we make no warranties, expressed or implied, except those that may be contained in our written contract of sale or acknowledgement.

Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material, even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in their use of the material.

Key/Legend

NA - Not Applicable
ND - Not Determined
ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
TLV - Threshold Limit Value
PEL - Permissible Exposure Limit
RQ - Reportable Quantity
TWA - Time Weighted Average
STEL - Short Term Exposure Limit
NTP - National Toxicology Program
IARC - International Agency for Research on Cancer

Health	1
Flammability	4
Reactivity	0
PPE	

Material Safety Data Sheet

Material Name: Natural Gas Condensate

*** Section 1 - Chemical Product and Company Identification ***

Product name: Natural Gas Condensate
Synonyms: Drips; Condensate; Field Condensate; Gas Well Condensate; High Pressure Inlet Liquids; Lease Condensate; Natural Gas Liquids (NGL or NGLs); Pipeline Liquids
Chemical Family: Petroleum Hydrocarbon
Formula: Complex mixture

Supplier: Chesapeake Energy Corporation and its subsidiaries
6100 N. Western Avenue
Oklahoma City, OK 73118

Other Information: Phone: 405-848-8000 Fax: 405-753-5468
Emergency Phone Number: Chemtrec – 800-424-9300

*** Section 2 - Hazards Identification ***

Emergency Overview

High fire hazard. Keep away from heat, spark, open flame, and other ignition sources. Contact may cause eye, skin and mucous membrane irritation. Inhalation may cause irritation, anesthetic effects (dizziness, nausea, headaches, intoxication), and respiratory system effects. If ingested, do NOT induce vomiting as this may cause chemical pneumonia (fluid in the lungs).May contain benzene which can cause blood disease including anemia and leukemia.

Potential Health Effects: Eyes

May cause moderate irritation.

Potential Health Effects: Skin

Practically non-toxic if absorbed following acute (single) exposure. May cause skin irritation with prolonged or repeated contact. Liquid may be absorbed through the skin in toxic amounts if large areas of skin are exposed repeatedly.

Potential Health Effects: Ingestion

The major health threat of ingestion occurs from the danger of aspiration (breathing) of liquid drops into the lungs, particularly from vomiting. Aspiration may result in chemical pneumonia (fluid in the lungs), severe lung damage, respiratory failure and even death. Ingestion may cause gastrointestinal disturbances, including irritation, nausea, vomiting and diarrhea, and central nervous system (brain) effects similar to alcohol intoxication. In severe cases, tremors, convulsions, loss of consciousness, coma, respiratory arrest, and death may occur.

Potential Health Effects: Inhalation

Excessive exposure may cause irritation to the nose, throat, lungs and respiratory tract. Central nervous system (brain) effects may include headache, dizziness, loss of balance and coordination, unconsciousness, coma, respiratory failure, and death. Contains carbon dioxide, which can produce rapid breathing, fatigue, muscular incoordination, nausea, and asphyxiation depending on the concentration and duration of exposure.

Medical Conditions Aggravated by Exposure

Irritation from skin exposure may aggravate existing open wounds, skin disorders, and dermatitis (rash). Chronic respiratory disease, liver or kidney dysfunction, or pre-existing central nervous system disorders may be aggravated by exposure.

HMIS Ratings: Health: 1 **Fire:** 4 **HMIS Reactivity** 0
Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe * = Chronic hazard

*** Section 3 - Composition / Information on Ingredients ***

CAS #	Component	Percent Ranges
68919-39-1	Natural gas condensate	100
71-43-2	Benzene	0.1-2

* * * Section 4 - First Aid Measures * * *

First Aid: Eyes

In case of contact with eyes, immediately flush with clean, low-pressure water for at least 15 min. Hold eyelids open to ensure adequate flushing. Seek medical attention.

First Aid: Skin

Remove contaminated clothing. Wash contaminated areas thoroughly with soap and water or waterless hand cleanser. Obtain medical attention if irritation or redness develops.

First Aid: Ingestion

DO NOT INDUCE VOMITING. Do not give liquids. Obtain immediate medical attention. If spontaneous vomiting occurs, lean victim forward to reduce the risk of aspiration. Small amounts of material which enter the mouth should be rinsed out until the taste is dissipated. If spontaneous vomiting occurs, lean victim forward to reduce the risk of aspiration. Seek medical attention. Monitor for breathing difficulty.

First Aid: Inhalation

Remove person to fresh air. If person is not breathing, ensure an open airway and provide artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so. Seek medical attention immediately.

* * * Section 5 - Fire Fighting Measures * * *

General Fire Hazards

See Section 9 for Flammability Properties.

Vapors may be ignited rapidly when exposed to heat, spark, open flame or other source of ignition. Flowing product may be ignited by self-generated static electricity. When mixed with air and exposed to an ignition source, flammable vapors can burn in the open or explode in confined spaces. Being heavier than air, vapors may travel long distances to an ignition source and flash back. Runoff to sewer may cause fire or explosion hazard.

Hazardous Combustion Products

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke).

Extinguishing Media

SMALL FIRES: Any extinguisher suitable for Class B fires, dry chemical, CO2, water spray, fire fighting foam, or Halon.

LARGE FIRES: Water spray, fog or fire fighting foam. Water may be ineffective for fighting the fire, but may be used to cool fire-exposed containers.

Fire Fighting Equipment/Instructions

Small fires in the incipient (beginning) stage may typically be extinguished using handheld portable fire extinguishers and other fire fighting equipment.

Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH/MSHA- approved pressure-demand self-contained breathing apparatus with full facepiece and full protective clothing.

Isolate area around container involved in fire. Cool tanks, shells, and containers exposed to fire and excessive heat with water. For massive fires the use of unmanned hose holders or monitor nozzles may be advantageous to further minimize personnel exposure. Major fires may require withdrawal, allowing the tank to burn. Large storage tank fires typically require specially trained personnel and equipment to extinguish the fire, often including the need for properly applied fire fighting foam.

NFPA Ratings: Health: 1 **Fire:** 4 **Reactivity:** 0

Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe

* * * Section 6 - Accidental Release Measures * * *

Containment Procedures

Evaluate the direction of product travel, diking, sewers, etc. to confirm spill areas. Product may release substantial amounts of flammable vapors and gases (e.g., methane, ethane, and propane), at or below ambient temperature depending on source and process conditions and pressure.

Carefully contain and stop the source of the spill, if safe to do so. Protect bodies of water by diking, absorbents, or absorbent boom, if possible. Do not flush down sewer or drainage systems, unless system is designed and permitted to handle such material. The use of fire fighting foam may be useful in certain situations to reduce vapors. The proper use of water spray may effectively disperse product vapors or the liquid itself, preventing contact with ignition sources or areas/equipment that require protection - do not discharge solid water stream patterns into the liquid resulting in splashing.

Clean-Up Procedures

Take up with sand or other oil absorbing materials. Carefully shovel, scoop or sweep up into a waste container for reclamation or disposal. Response and clean-up crews must be properly trained and must utilize proper protective equipment.

Evacuation Procedures

Evacuate nonessential personnel and remove or secure all ignition sources. Consider wind direction; stay upwind and uphill, if possible.

Special Procedures

Avoid excessive skin contact with the spilled material.

* * * Section 7 - Handling and Storage * * *

Handling Procedures

Handle as a flammable liquid. Keep away from heat, sparks, and open flame! Electrical equipment should be approved for classified area. Bond and ground containers during product transfer to reduce the possibility of static-initiated fire or explosion.

Storage Procedures

Keep away from flame, sparks, excessive temperatures and open flame. Use approved vented containers. Keep containers closed and clearly labeled. Empty product containers or vessels may contain explosive vapors. Do not pressurize, cut, heat, weld or expose such containers to sources of ignition.

Store in a well-ventilated area. This storage area should comply with NFPA 30 "Flammable and Combustible Liquid Code". Avoid storage near incompatible materials. The cleaning of tanks previously containing this product should follow API Recommended Practice (RP) 2013 "Cleaning Mobile Tanks In Flammable and Combustible Liquid Service" and API RP 2015 "Cleaning Petroleum Storage Tanks".

* * * Section 8 - Exposure Controls / Personal Protection * * *

A: Component Exposure Limits

Benzene (71-43-2)

ACGIH:	0.5 ppm TWA
	2.5 ppm STEL
	Skin - potential significant contribution to overall exposure by the cutaneous route
OSHA:	10 ppm TWA; 25 ppm ceiling; 50 ppm (10 min.)
NIOSH:	0.1 ppm TWA
	1 ppm STEL

Engineering Controls

Use adequate ventilation to keep vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces.

PERSONAL PROTECTIVE EQUIPMENT

Personal Protective Equipment: Eyes/Face

Safety glasses or goggles are recommended where there is a possibility of splashing or spraying.

Personal Protective Equipment: Skin

Gloves constructed of nitrile or neoprene are recommended. Chemical protective clothing such as of E.I. DuPont Tyvek-Saranex 23 ®, Tychem®, Barricade® or equivalent recommended based on degree of exposure. Note: The resistance of specific material may vary from product to product as well as with degree of exposure. Consult manufacturer specifications for further information.

Personal Protective Equipment: Respiratory

A NIOSH -approved air-purifying respirator with organic vapor cartridges or canister may be permissible under certain circumstances where airborne concentrations are or may be expected to exceed exposure limits or for odor or irritation. Protection provided by air-purifying respirators is limited. Refer to OSHA 29 CFR 1910.134, ANSI Z88.2-1992, NIOSH Respirator Decision Logic, and the manufacturer for additional guidance on respiratory protection selection. Use a positive pressure, air-supplied respirator if there is a potential for uncontrolled release, exposure levels are not known, in oxygen-deficient atmospheres, or any other circumstance where an air-purifying respirator may not provide adequate protection.

Personal Protective Equipment: General

Eye wash and quick-drench shower facilities should be available in the work area. Thoroughly clean shoes and wash contaminated clothing before reuse.

* * * Section 9 - Physical & Chemical Properties * * *

Appearance:	A colorless to straw-yellow, water-like	**Odor:**	Petroleum
Physical State:	Liquid	**pH:**	ND
Vapor Pressure:	~110 psia @ 100°F	**Vapor Density:**	>1
Boiling Point:	85 to 437°F (39 to 200°C)	**Melting Point:**	ND
Solubility (H2O):	Negligible	**Specific Gravity:**	AP 0.62 - 0.76
Evaporation Rate:	High	**VOC:**	ND
Percent Volatile:	100	**Octanol/H2O Coeff.:**	ND
Flash Point:	AP -40°F / <-40°C	**Flash Point Method:**	TCC
		Lower Flammability Limit (LFL):	ND
		Upper Flammability Limit (UFL):	ND
		Burning Rate:	ND
		Auto Ignition:	480°F / 250°C

* * * Section 10 - Chemical Stability & Reactivity Information * * *

Chemical Stability

Stable under normal ambient and anticipated conditions of storage and handling. Extremely flammable liquid and vapor. Vapor can cause flash fire.

Chemical Stability: Conditions to Avoid

Avoid high temperatures and all sources of ignition. Prevent vapor accumulation.

Incompatibility

Keep away from strong oxidizers

Hazardous Decomposition

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke).

Possibility of Hazardous Reactions

Will not occur.

* * * Section 11 - Toxicological Information * * *

Acute Dose Effects

Component Analysis - LD50/LC50

Natural gas condensate (68919-39-1)

Inhalation LC50 Rat: >5.2 mg/L/4H; Oral LD50 Rat: 14000 mg/kg; Dermal LD50 Rabbit: >2000 mg/kg

Benzene (71-43-2)

Inhalation LC50 Rat: 13050-14380 ppm/4H; Oral LD50 Rat:1800 mg/kg

Carcinogenicity

Component Carcinogenicity

Benzene (71-43-2)

ACGIH: A1 - Confirmed Human Carcinogen
OSHA: 10 ppm TWA; 25 ppm ceiling; 50 ppm (10 min.)
NIOSH: potential occupational carcinogen
NTP: Known Human Carcinogen (Select Carcinogen)
IARC: Supplement 7 [1987], Monograph 29 [1982] (Group 1 (carcinogenic to humans))

* * * Section 12 - Ecological Information * * *

Ecotoxicity

Component Analysis - Ecotoxicity - Aquatic Toxicity

Natural gas condensate (68919-39-1)

Test & Species		Conditions
96 Hr LC50 Alburnus alburnus	119 mg/L [static]	
96 Hr LC50 Cyprinodon variegatus	82 mg/L [static]	
72 Hr EC50 Selenastrum capricornutum	56 mg/L	
24 Hr EC50 Daphnia magna	170 mg/L	

Benzene (71-43-2)

Test & Species		Conditions
96 Hr LC50 Pimephales promelas	12.6 mg/L [flow-through]	
96 Hr LC50 Oncorhynchus mykiss	5.3 mg/L [flow-through]	
96 Hr LC50 Lepomis macrochirus	22 mg/L [static]	
96 Hr LC50 Poecilia reticulata	28.6 mg/L [static]	
72 Hr EC50 Selenastrum capricornutum	29 mg/L	
48 Hr EC50 water flea	356 mg/L [Static]	
48 Hr EC50 Daphnia magna	10 mg/L	

* * * Section 13 - Disposal Considerations * * *

US EPA Waste Number & Descriptions

A: General Product Information

Wastes must be tested using methods described in 40 CFR Part 261 to determine if it meets applicable definitions of hazardous wastes.

B: Component Waste Numbers

Benzene (71-43-2)

RCRA: waste number U019 (Ignitable waste, Toxic waste)
0.5 mg/L regulatory level

Disposal Instructions

All wastes must be handled in accordance with local, state and federal regulations.
See Section 7 for Handling Procedures. See Section 8 for Personal Protective Equipment recommendations.

* * * Section 14 - Transportation Information * * *

US DOT Information

Shipping Name: Petroleum distillates, n.o.s or Petroleum products, n.o.s. (condensate)
UN/NA #: 1268 **Hazard Class:** 3 **Packing Group:** II

* * * Section 15 - Regulatory Information * * *

US Federal Regulations

Component Analysis

This material may contain one of the following chemicals required to be identified under SARA Section 302 (40 CFR 355 Appendix A), SARA Section 313 (40 CFR 372.65) and/or CERCLA (40 CFR 302.4).

Benzene (71-43-2)

SARA 313: 0.1 % de minimis concentration

CERCLA: 10 lb final RQ (received an adjusted RQ of 10 lbs based on potential carcinogenicity in an August 14, 1989 final rule); 4.54 kg final RQ (received an adjusted RQ of 10 lbs based on potential carcinogenicity in an August 14, 1989 final rule)

State Regulations

Component Analysis - State

The following components appear on one or more of the following state hazardous substances lists:

Component	CAS	CA	MA	MN	NJ	PA	RI
Benzene	71-43-2	Yes	Yes	Yes	Yes	Yes	Yes

The following statement(s) are provided under the California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65):

WARNING! This product contains a chemical known to the state of California to cause cancer.
WARNING! This product contains a chemical known to the state of California to cause reproductive/developmental effects.

Component Analysis - WHMIS IDL

The following components are identified under the Canadian Hazardous Products Act Ingredient Disclosure List:

Component	CAS #	Minimum Concentration
Benzene	71-43-2	0.1 %

Additional Regulatory Information

Component Analysis - Inventory

Component	CAS #	TSCA	CAN	EEC
Natural gas condensate	68919-39-1	Yes	DSL	EINECS
Benzene	71-43-2	Yes	DSL	EINECS

* * * Section 16 - Other Information * * *

Other Information

The information presented herein has been compiled from sources considered to be dependable and is accurate and reliable to the best of our knowledge and belief, but is not guaranteed to be so. Since conditions of use are beyond our control, we make no warranties, expressed or implied, except those that may be contained in our written contract of sale or acknowledgement.

Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material, even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in their use of the material.

Key/Legend

NA - Not Applicable
ND - Not Determined
ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
TLV - Threshold Limit Value
PEL - Permissible Exposure Limit
RQ - Reportable Quantity
TWA - Time Weighted Average
STEL - Short Term Exposure Limit
NTP - National Toxicology Program
IARC - International Agency for Research on Cancer

Material Safety Data Sheet

Health	1
Flammability	4
Reactivity	0
PPE	

Material Name: Produced Water

* * * Section 1 - Chemical Product and Company Identification * * *

Product name: Produced Water - Sweet
Synonyms: Salt Water, H_2O, Oily Water, Formation Water
Chemical Family: Water
Formula: Complex mixture

Supplier: Chesapeake Energy Corporation and its subsidiaries
6100 N. Western Avenue
Oklahoma City, OK 73118

Other Information: Phone: 405-848-8000 Fax: 405-753-5468
Emergency Phone Number: Chemtrec – 800-424-9300

* * * Section 2 - Hazards Identification * * *

Emergency Overview

May cause eye, skin, respiratory and gastrointestinal tract irritation.

Potential Health Effects: Eyes

May cause eye irritation.

Potential Health Effects: Skin

Contact may cause skin irritation.

Potential Health Effects: Ingestion

Ingestion may cause irritation of the digestive tract that may result in nausea, vomiting and diarrhea.

Potential Health Effects: Inhalation

Breathing the mist and vapors may be irritating to the respiratory tract.

HMIS Ratings: Health: 1 **Fire:** 4 **HMIS Reactivity** 0
Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe * = Chronic hazard

* * * Section 3 - Composition / Information on Ingredients * * *

Produced water is a mixture of varying amounts of water and oil produced from various exploration and production processes. Produced water may contain an upper layer of flammable liquid and vapor hydrocarbons. Produced water may include small amounts of natural gas condensate, and benzene may be present.

CAS #	Component	Percent
7732-18-5	Water	>68
Not Available	Dissolved Minerals	<32
71-43-2	Benzene	<1
8002-05-9	Petroleum distillates (naphtha)	<1

Normal composition ranges are shown. Exceptions may occur depending on the source of the produced water.

* * * Section 4 - First Aid Measures * * *

First Aid: Eyes

Flush eyes with clean, low-pressure water for at least 15 minutes, occasionally lifting the eyelids. If pain or redness persists after flushing, obtain medical attention. If eye is exposed to hot liquid, cover eyes with cloth and seek medical attention immediately.

First Aid: Skin

In case of hot liquid exposure, do not remove clothing or treat-wash only unburned area and seek medical attention immediately.

First Aid: Ingestion

Do not induce vomiting. Seek medical attention.

First Aid: Inhalation

Immediately remove person to area of fresh air. For respiratory distress, give oxygen, rescue breathing, or administer CPR if necessary. Obtain prompt medical attention.

*** Section 5 - Fire Fighting Measures ***

General Fire Hazards

See Section 9 for Flammability Properties.

May react with strong oxidizing materials and a wide variety of chemicals. Forms explosive mixtures with air.

Hazardous Combustion Products

Not Determined.

Extinguishing Media

Dry chemical, foam, carbon dioxide, or water spray.

Fire Fighting Equipment/Instructions

Any fire would be associated with any natural gas condensate floating on the surface of the produced water. Water may be ineffective on flames but should be used to keep fire exposed containers cool. Keep the surrounding areas cool by using water mists. Firefighters should wear self-contained breathing apparatus and full protective clothing.

NFPA Ratings: Health: 1 **Fire:** 4 **Reactivity:** 0

Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe

*** Section 6 - Accidental Release Measures ***

Containment Procedures

Stop the source of the leak or release. Clean up releases as soon as possible, observing precautions in Personal Protection Equipment section. Contain liquid to prevent further contamination of soil and surface water.

Clean-Up Procedures

Take up with sand or other oil absorbing materials. Carefully shovel, scoop or sweep up into a waste container for reclamation or disposal. Response and clean-up crews must be properly trained and must utilize proper protective equipment. Where feasible and appropriate, remove contaminated soil or flush with fresh water. Follow prescribed procedures for reporting and responding to larger releases. Advise authorities and the National Response Center (800-424-8802) if the release is to a watercourse.

Evacuation Procedures

Evacuate nonessential personnel and remove or secure all ignition sources. Consider wind direction; stay upwind and uphill, if possible.

Special Procedures

Avoid excessive skin contact with the spilled material.

*** Section 7 - Handling and Storage ***

Handling Procedures

Handle as a flammable liquid. Keep away from heat, sparks, and open flame! Electrical equipment should be approved for classified area. Bond and ground containers during product transfer to reduce the possibility of static-initiated fire or explosion.

Storage Procedures

Keep away from flame, sparks, excessive temperatures and open flame. Use approved vented containers. Keep containers closed and clearly labeled. Empty product containers or vessels may contain explosive vapors. Do not pressurize, cut, heat, weld or expose such containers to sources of ignition. Do not enter storage areas and confined spaces without adequate ventilation. Use appropriate respiratory protection if there is a potential to exceed component exposure limit(s).

*** Section 8 - Exposure Controls / Personal Protection ***

A: Component Exposure Limits

Petroleum distillates (naphtha) (8002-05-9)

OSHA: 500 ppm TWA; 2000 mg/m^3 TWA

NIOSH: 350 mg/m^3 TWA

1800 mg/m^3 Ceiling (15 min)

Benzene (71-43-2)

ACGIH: 0.5 ppm TWA
2.5 ppm STEL
Skin - potential significant contribution to overall exposure by the cutaneous route
OSHA: 10 ppm TWA; 25 ppm ceiling; 50 ppm (10 min.)
NIOSH: 0.1 ppm TWA
1 ppm STEL

Engineering Controls

Use adequate ventilation to keep vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces.

PERSONAL PROTECTIVE EQUIPMENT

Personal Protective Equipment: Eyes/Face

Chemical goggles or face shield should be worn when handling product if the possibility of spray exists.

Personal Protective Equipment: Skin

Normal working clothes should be worn. Wash contaminated clothing prior to reuse.

Personal Protective Equipment: Respiratory

Respiratory protection is not required for normal use. At excessive concentrations, wear a NIOSH approved air purifying respirator with organic vapor cartridges.

Personal Protective Equipment: General

A source of clean water should be in the work area for flushing eyes and skin.

* * * Section 9 - Physical & Chemical Properties * * *

Appearance:	Clear or opaque	**Odor:**	Salty with a slight hydrocarbon odor.
Physical State:	Liquid	**pH:**	4.9-8.5
Vapor Pressure:	NA	**Vapor Density:**	1.2
Boiling Point:	212°F	**Melting Point:**	ND
Solubility (H2O):	Soluble	**Specific Gravity:**	>1 @ 0°C
Freezing Point:	<32°F	**Evaporation Rate:**	ND
VOC:	ND	**Octanol/H2O Coeff.:**	ND
Flash Point:	ND	**Flash Point Method:**	ND
		Lower Flammability Limit (LFL):	4.0
		Upper Flammability Limit (UFL):	46.0
		Burning Rate:	ND
		Auto Ignition:	NA

* * * Section 10 - Chemical Stability & Reactivity Information * * *

Chemical Stability

Stable under normal ambient and anticipated conditions of storage and handling.

Chemical Stability: Conditions to Avoid

Keep material away from heat, sparks, and open flames.

Incompatibility

Keep away from strong oxidizers.

Hazardous Decomposition

Not Determined.

Possibility of Hazardous Reactions

Will not occur.

*** Section 11 - Toxicological Information ***

Acute Dose Effects

Component Analysis - LD50/LC50

Water (7732-18-5)
Oral LD50 Rat: >90 mL/kg

Petroleum distillates (naphtha) (8002-05-9)
Oral LD50 Rat: >4300 mg/kg; Dermal LD50 Rabbit: >2000 mg/kg

Benzene (71-43-2)
Inhalation LC50 Rat: 13050-14380 ppm/4H; Oral LD50 Rat:1800 mg/kg

Carcinogenicity

Component Carcinogenicity

Petroleum distillates (naphtha) (8002-05-9)
IARC: Monograph 45 [1989] (Group 3 (not classifiable))

Benzene (71-43-2)
ACGIH: A1 - Confirmed Human Carcinogen
OSHA: 10 ppm TWA; 25 ppm ceiling; 50 ppm (10 min.)
NIOSH: potential occupational carcinogen
NTP: Known Human Carcinogen (Select Carcinogen)
IARC: Supplement 7 [1987], Monograph 29 [1982] (Group 1 (carcinogenic to humans))

*** Section 12 - Ecological Information ***

Ecotoxicity

Component Analysis - Ecotoxicity - Aquatic Toxicity

Petroleum distillates (naphtha) (8002-05-9)

Test & Species		Conditions
96 Hr LC50 Salmo gairdneri	258 mg/L [static]	
24 Hr EC50 Daphnia magna	36 mg/L	

Benzene (71-43-2)

Test & Species		Conditions
96 Hr LC50 Pimephales promelas	12.6 mg/L [flow-through]	
96 Hr LC50 Oncorhynchus mykiss	5.3 mg/L [flow-through]	
96 Hr LC50 Lepomis macrochirus	22 mg/L [static]	
96 Hr LC50 Poecilia reticulata	28.6 mg/L [static]	
72 Hr EC50 Selenastrum capricornutum	29 mg/L	
48 Hr EC50 water flea	356 mg/L [Static]	
48 Hr EC50 Daphnia magna	10 mg/L	

* * * Section 13 - Disposal Considerations * * *

This product as produced is not specifically listed as an EPA RCRA hazardous waste according to federal regulations (40 CFR 261). However, when discarded or disposed of, it may meet the criteria of a "characteristic" hazardous waste. This product could also contain benzene at low concentrations and may exhibit the characteristic of "toxicity" (D018) as determined by the toxicity characteristic leaching procedure (TCLP). This material could become a hazardous waste if mixed with or contaminated with a hazardous waste or other substance(s). It is the responsibility of the user to determine if disposal material is hazardous according to federal, state and local regulations.

* * * Section 14 - Transportation Information * * *

US DOT Information

Shipping Name: Not Regulated

Additional Info.: This may not apply to all shipping situations. Consult 49CFR 172 for additional information.

* * * Section 15 - Regulatory Information * * *

US Federal Regulations

Component Analysis

This material may contain one or more of the following chemicals identified under SARA Section 302 (40 CFR 355 Appendix A), SARA Section 313 (40 CFR 372.65) and/or CERCLA (40 CFR 302.4).

Benzene (71-43-2)

SARA 313: 0.1 % de minimis concentration

CERCLA: 10 lb final RQ (received an adjusted RQ of 10 lbs based on potential carcinogenicity in an August 14, 1989 final rule); 4.54 kg final RQ (received an adjusted RQ of 10 lbs based on potential carcinogenicity in an August 14, 1989 final rule)

State Regulations

Component Analysis - State

The following components appear on one or more of the following state hazardous substances lists:

Component	CAS	CA	MA	MN	NJ	PA	RI
Petroleum distillates (naphtha)	8002-05-9	No	Yes	Yes	Yes	Yes	Yes
Benzene	71-43-2	Yes	Yes	Yes	Yes	Yes	Yes

The following statement(s) are provided under the California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65):

WARNING! This product contains a chemical known to the state of California to cause cancer.
WARNING! This product contains a chemical known to the state of California to cause reproductive/developmental effects.

Component Analysis - WHMIS IDL

The following components are identified under the Canadian Hazardous Products Act Ingredient Disclosure List:

Component	CAS #	Minimum Concentration
Benzene	71-43-2	0.1 %

Additional Regulatory Information

Material Safety Data Sheet

Material Name: Produced Water

Component Analysis - Inventory

Component	CAS #	TSCA	CAN	EEC
Water	7732-18-5	Yes	DSL	EINECS
Petroleum distillates (naphtha)	8002-05-9	Yes	DSL	EINECS
Benzene	71-43-2	Yes	DSL	EINECS

* * * Section 16 - Other Information * * *

Other Information

The information presented herein has been compiled from sources considered to be dependable and is accurate and reliable to the best of our knowledge and belief, but is not guaranteed to be so. Since conditions of use are beyond our control, we make no warranties, expressed or implied, except those that may be contained in our written contract of sale or acknowledgement.

Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material, even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in their use of the material.

Key/Legend

NA - Not Applicable
ND - Not Determined
ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
TLV - Threshold Limit Value
PEL - Permissible Exposure Limit
RQ - Reportable Quantity
TWA - Time Weighted Average
STEL - Short Term Exposure Limit
NTP - National Toxicology Program
IARC - International Agency for Research on Cancer

Material Safety Data Sheet

Health	1
Flammability	4
Reactivity	0
PPE	

Material Name: Petroleum Crude Oil

* * * Section 1 - Chemical Product and Company Identification * * *

Product name: Petroleum Crude Oil
Synonyms: Crude Oil, Non-hydrogen sulfide crude oil, sweet crude oil, petroleum distillates (naphtha)
Chemical Family: Petroleum Hydrocarbon
Formula: Complex mixture

Supplier: Chesapeake Energy Corporation and its subsidiaries
6100 N. Western Avenue
Oklahoma City, OK 73118

Other Information: Phone: 405-848-8000 Fax: 405-753-5468
Emergency Phone Number: Chemtrec – 800-424-9300

* * * Section 2 - Hazards Identification * * *

Emergency Overview

FLAMMABLE LIQUID - HIGH FIRE HAZARD - Keep away from heat and ignition sources. High concentrations may cause immediate unconsciousness - death may result unless promptly and successfully resuscitated. Petroleum Crude Oil is a liquid that ranges in color from amber to black depending on the source.

Potential Health Effects: Eyes

Contact with eyes may cause moderate to severe irritation.

Potential Health Effects: Skin

Practically non-toxic if absorbed following a single exposure. May cause skin irritation with prolonged or repeated contact. Liquid may be absorbed through the skin in toxic amounts if large areas of skin are exposed repeatedly. Rare, pre-cancerous warts on the forearms, hands and scrotum have been reported from prolonged or repeated skin contact.

Potential Health Effects: Ingestion

The health threat of ingestion occurs from the danger of aspiration of the liquids into the lungs. Aspiration may result in chemical pneumonia, severe lung damage, respiratory failure or even death. Ingestion may cause gastrointestinal problems, or central nervous system effects similar to alcohol intoxication. In severe cases, tremors, convulsions, loss of consciousness, coma, respiratory arrest, and death may occur.

Potential Health Effects: Inhalation

Excessive exposure may cause irritations to the nose, throat, lungs, and respiratory tract. Central nervous system (brain) effects may include headache, dizziness, loss of balance and coordination, unconsciousness, coma respiratory failure, and death may occur.

HMIS Ratings: Health: 1 **Fire:** 4 **HMIS Reactivity** 0
Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe * = Chronic hazard

* * * Section 3 - Composition / Information on Ingredients * * *

Petroleum Crude Oil is a complex mixture of paraffinic, cycloparaffinic and aromatic hydrocarbons with a range of carbon numbers between C1 to C60+. Petroleum Crude Oil can contain minor amounts of sulfur, nitrogen and oxygen compounds as well as trace amounts of heavy metals such as nickel, vanadium and lead. Composition varies depending on source of crude.

CAS #	Component	Percent Ranges
8002-05-9	Petroleum distillates (naphtha)	98-100
1330-20-7	Xylenes (o-, m-, p- isomers)	0-5
108-88-3	Toluene	0-5
100-41-4	Ethyl benzene	0-5
71-43-2	Benzene	0-5

*** Section 4 - First Aid Measures ***

First Aid: Eyes

Flush immediately with fresh water for at least 15 minutes while holding eyelids open. Remove contact lenses if worn. Seek medical attention if irritation persists.

First Aid: Skin

Remove contaminated clothing. Wash skin thoroughly with soap and water. Wash contaminated clothing. Discard contaminated non-waterproof shoes or boots. See a doctor if any signs or symptoms described in this document occur. DO NOT use solvents for washing.

First Aid: Ingestion

DO NOT INDUCE VOMITING. Do not give liquids. Obtain immediate medical treatment. If spontaneous vomiting occurs, lean the victim forward to reduce the risk of aspiration and monitor for breathing difficulties.

First Aid: Inhalation

If signs and symptoms described in this document occur, move person to fresh air. If these effects continue, seek medical attention. If breathing is difficult, give oxygen. If breathing has stopped, begin artificial respiration (CPR) and activate 911.

*** Section 5 - Fire Fighting Measures ***

General Fire Hazards

See Section 9 for Flammability Properties.

Flash point and explosive limits are highly dependent on the crude oil source. Treat as an OSHA/NFPA flammable liquid unless otherwise indicated. Vapors may be ignited rapidly when exposed to heat, spark, open flame or other source of ignition. When mixed with air and exposed to an ignition source, flammable vapors can burn in the open or explode in confined spaces. Being heavier than air, vapors may travel long distances to an ignition source and flash back. Runoff to sewer may cause fire or explosion hazard.

Hazardous Combustion Products

Carbon Monoxide, Carbon Dioxide and Reactive Hydrocarbon Compounds.

Extinguishing Media

Dry Chemical, Carbon Dioxide (CO2), Foam (Foam and water fog can cause frothing.)

Fire Fighting Equipment/Instructions

Small fires in the incipient (beginning) stage may typically be extinguished using handheld portable fire extinguishers and other fire fighting equipment. Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH/MSHA- approved pressure-demand self-contained breathing apparatus with full facepiece and full protective clothing. Isolate area around container involved in fire. Cool tanks, shells, and containers exposed to fire and excessive heat with water. For massive fires the use of unmanned hose holders or monitor nozzles may be advantageous to further minimize personnel exposure. Major fires may require withdrawal, allowing the tank to burn. Large storage tank fires typically require specially trained personnel and equipment to extinguish the fire, often including the need for properly applied fire fighting foam.

NFPA Ratings: Health: 1 **Fire:** 4 **Reactivity:** 0
Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe

*** Section 6 - Accidental Release Measures ***

Containment Procedures

Carefully contain and stop the source of the spill, if safe to do so. Protect bodies of water by diking, absorbents, or absorbent boom, if possible. Do not flush down sewer or drainage systems, unless system is designed and permitted to handle such material. The use of fire fighting foam may be useful in certain situations to reduce vapors. The proper use of water spray may effectively disperse product vapors or the liquid itself, preventing contact with ignition sources or areas/equipment that require protection - do not discharge solid water stream patterns into the liquid resulting in splashing.

Clean-Up Procedures

Take up with sand or other oil absorbing materials. Carefully shovel, scoop or sweep up into a waste container for reclamation or disposal. Response and clean-up crews must be properly trained and must utilize proper protective equipment (see Section 8).

Evacuation Procedures

Evacuate nonessential personnel and remove or secure all ignition sources. Consider wind direction; stay upwind and uphill, if possible. Evaluate the direction of product travel, diking, sewers, etc. to confirm spill areas. Product may release substantial amounts of flammable vapors and gases (e.g., methane, ethane, and propane), at or below ambient temperature depending on source and process conditions and pressure.

Special Procedures

Avoid excessive skin contact with the spilled material.

* * * Section 7 - Handling and Storage * * *

Handling Procedures

Handle as a flammable liquid. Keep away from heat, sparks, and open flame! Electrical equipment should be approved for classified area. Bond and ground containers during product transfer to reduce the possibility of static-initiated fire or explosion.

Storage Procedures

Keep away from flame, sparks, excessive temperatures and open flame. Use approved vented containers. Keep containers closed and clearly labeled. Empty product containers or vessels may contain explosive vapors. Do not pressurize, cut, heat, weld or expose such containers to sources of ignition. Store in a well-ventilated area. This storage area should comply with NFPA 30 "Flammable and Combustible Liquids Code". Avoid storage near incompatible materials. The cleaning of tanks previously containing this product should follow API STD 2015 "Safe Entry and Cleaning of Petroleum Storage Tanks". Avoid vapors when opening hatches and dome covers. Confined spaces should be ventilated prior to entry.

* * * Section 8 - Exposure Controls / Personal Protection * * *

A: Component Exposure Limits

Petroleum distillates (naphtha) (8002-05-9)

OSHA: 500 ppm TWA; 2000 mg/m^3 TWA
NIOSH: 350 mg/m^3 TWA
1800 mg/m^3 Ceiling (15 min)

Toluene (108-88-3)

ACGIH: 20 ppm TWA
OSHA: 200 ppm TWA; 300 ppm Ceiling; 500 ppm (10 min.)
NIOSH: 100 ppm TWA; 375 mg/m^3 TWA
150 ppm STEL; 560 mg/m^3 STEL

Xylenes (o-, m-, p- isomers) (1330-20-7)

ACGIH: 100 ppm TWA
150 ppm STEL
OSHA: 100 ppm TWA; 435 mg/m^3 TWA
150 ppm STEL; 655 mg/m^3 STEL

Benzene (71-43-2)

ACGIH: 0.5 ppm TWA
2.5 ppm STEL
Skin - potential significant contribution to overall exposure by the cutaneous route
OSHA: 10 ppm TWA; 25 ppm ceiling; 50 ppm (10 min.)
NIOSH: 0.1 ppm TWA
1 ppm STEL

Ethyl benzene (100-41-4)

ACGIH:	100 ppm TWA
	125 ppm STEL
OSHA:	100 ppm TWA; 435 mg/m^3 TWA
	125 ppm STEL; 545 mg/m^3 STEL
NIOSH:	100 ppm TWA; 435 mg/m^3 TWA
	125 ppm STEL; 545 mg/m^3 STEL

Engineering Controls

Use adequate ventilation to keep vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces.

PERSONAL PROTECTIVE EQUIPMENT

Personal Protective Equipment: Eyes/Face

Chemical splash goggles or safety glasses are recommended.

Personal Protective Equipment: Skin

Neoprene, impervious gloves should be worn to avoid prolonged or frequently repeated skin contact with this material. Normal work clothes should be laundered to decontaminate before reuse. Leather goods contaminated with this product should be discarded. Impervious clothing and boots may be required for prolonged contact.

Personal Protective Equipment: Respiratory

Respiratory protection is not required during normal use in well-ventilated areas. Use a positive-pressure air supplied respirator if there is a (1) potential for uncontrolled release, (2) where exposure levels are not known, (3) oxygen deficient atmospheres, or (4) any condition where ventilation or an air-purifying type of respirator may not be adequate.

Personal Protective Equipment: General

Avoid repeated and prolonged skin exposure. Wash hands before eating, drinking, smoking, or using toilet facilities. Do not gasoline or solvents for washing. Discard leather shoes and gloves contaminated with this product. Launder contaminated clothing before reuse.

* * * Section 9 - Physical & Chemical Properties * * *

Appearance:	Depending on its source, the typical color ranges from amber to brown to greenish black.	**Odor:**	Petroleum/asphalt type
Physical State:	Liquid	**pH:**	ND
Vapor Pressure:	Variable	**Vapor Density:**	3 - 5 typical
Boiling Point:	AP 100° - 1000+°F	**Melting Point:**	ND
Solubility (H2O):	Negligible	**Specific Gravity:**	AP 0.7 - 1.04 - (Varies)
Evaporation Rate:	ND	**VOC:**	ND
Octanol/H2O Coeff.:			
Flash Point:	< 40 to 200°F	**Upper Flammability Limit (UFL):**	15
Flash Point Method:	ND	**Lower Flammability Limit (LFL):**	0.4
		Burning Rate:	ND
		Auto Ignition:	500°F

* * * Section 10 - Chemical Stability & Reactivity Information * * *

Chemical Stability

This is a stable material.

Chemical Stability: Conditions to Avoid

Heat, sparks, open flame, static electricity or ignition sources should be avoided.

Incompatibility

Keep away from strong oxidizing agents (such as Peroxide, Dichromate, Permanganate, Chlorine), strong acids, caustics and halogens.

Hazardous Decomposition

Carbon Monoxide, Carbon Dioxide and Reactive Hydrocarbon Compounds.

Possibility of Hazardous Reactions

Will not occur.

* * * Section 11 - Toxicological Information * * *

Acute Dose Effects

Component Analysis - LD50/LC50

Petroleum distillates (naphtha) (8002-05-9)
Oral LD50 Rat: >4300 mg/kg; Dermal LD50 Rabbit: >2000 mg/kg

Toluene (108-88-3)
Inhalation LC50 Rat: 12.5 mg/L/4H; Inhalation LC50 Rat:>26700 ppm/1H; Oral LD50 Rat:636 mg/kg; Dermal LD50 Rabbit:8390 mg/kg; Dermal LD50 Rat:12124 mg/kg

Xylenes (o-, m-, p- isomers) (1330-20-7)
Inhalation LC50 Rat: 5000 ppm/4H; Oral LD50 Rat: 4300 mg/kg; Dermal LD50 Rabbit: >1700 mg/kg

Benzene (71-43-2)
Inhalation LC50 Rat: 13050-14380 ppm/4H; Oral LD50 Rat:1800 mg/kg

Ethyl benzene (100-41-4)
Inhalation LC50 Rat: 17.2 mg/L/4H; Oral LD50 Rat:3500 mg/kg; Dermal LD50 Rabbit:15354 mg/kg

Carcinogenicity

Component Carcinogenicity

Petroleum distillates (naphtha) (8002-05-9)
IARC: Monograph 45 [1989] (Group 3 (not classifiable))

Toluene (108-88-3)
ACGIH: A4 - Not Classifiable as a Human Carcinogen
IARC: Monograph 71 [1999], Monograph 47 [1989] (Group 3 (not classifiable))

Xylenes (o-, m-, p- isomers) (1330-20-7)
ACGIH: A4 - Not Classifiable as a Human Carcinogen
IARC: Monograph 71 [1999], Monograph 47 [1989] (Group 3 (not classifiable))

Benzene (71-43-2)
ACGIH: A1 - Confirmed Human Carcinogen
OSHA: 10 ppm TWA; 25 ppm ceiling; 50 ppm (10 min.)
NIOSH: potential occupational carcinogen
NTP: Known Carcinogen (Select Carcinogen)
IARC: Supplement 7 [1987], Monograph 29 [1982] (Group 1 (carcinogenic to humans))

Ethyl benzene (100-41-4)
ACGIH: A3 - Confirmed animal carcinogen with unknown relevance to humans
IARC: Monograph 77 [2000] (Group 2B (possibly carcinogenic to humans))

*** Section 12 - Ecological Information ***

Ecotoxicity

Component Analysis - Ecotoxicity - Aquatic Toxicity

Petroleum distillates (naphtha) (8002-05-9)

Test & Species		Conditions
96 Hr LC50 Salmo gairdneri	258 mg/L [static]	
24 Hr EC50 Daphnia magna	36 mg/L	

Toluene (108-88-3)

Test & Species		Conditions
96 Hr LC50 Pimephales promelas	25 mg/L [flow-through]	1 day old
96 Hr LC50 Oncorhynchus mykiss	24.0 mg/L [flow-through]	
96 Hr LC50 Lepomis macrochirus	24.0 mg/L [static]	
96 Hr LC50 Lepomis macrochirus	13 mg/L [static]	
96 Hr EC50 Selenastrum capricornutum	>433 mg/L	
30 min EC50 Photobacterium phosphoreum	19.7 mg/L	
48 Hr EC50 water flea	11.3 mg/L	
48 Hr EC50 water flea	310 mg/L	
48 Hr EC50 Daphnia magna	11.3 mg/L	

Xylenes (o-, m-, p- isomers) (1330-20-7)

Test & Species		Conditions
96 Hr LC50 Pimephales promelas	13.4 mg/L [flow-through]	
96 Hr LC50 Oncorhynchus mykiss	8.05 mg/L [flow-through]	
96 Hr LC50 Lepomis macrochirus	16.1 mg/L [flow-through]	
96 Hr LC50 Pimephales promelas	26.7 mg/L [static	
24 hr EC50 Photobacterium phosphoreum	0.0084 mg/L	
48 Hr EC50 water flea	3.82 mg/L	
48 Hr LC50 Gammarus lacustris	0.6 mg/L	

Benzene (71-43-2)

Test & Species		Conditions
96 Hr LC50 Pimephales promelas	12.6 mg/L [flow-through]	
96 Hr LC50 Oncorhynchus mykiss	5.3 mg/L [flow-through]	
96 Hr LC50 Lepomis macrochirus	22 mg/L [static]	
96 Hr LC50 Poecilia reticulata	28.6 mg/L [static]	
72 Hr EC50 Selenastrum capricornutum	29 mg/L	
48 Hr EC50 water flea	356 mg/L [Static]	
48 Hr EC50 Daphnia magna	10 mg/L	

Ethyl benzene (100-41-4)

Test & Species	Conditions
96 Hr LC50 Oncorhynchus mykiss	14.0 mg/L [static]
96 Hr LC50 Pimephales promelas	9.09 mg/L [flow-through]
96 Hr LC50 Lepomis macrochirus	150.0 mg/L [static]
96 Hr LC50 Oncorhynchus mykiss	4.2 mg/L [static]
96 Hr LC50 Lepomis macrochirus	32 mg/L [static]
96 Hr LC50 Pimephales promelas	48.5 mg/L [static]
96 Hr LC50 Poecilia reticulata	9.6 mg/L [static]
72 Hr EC50 Selenastrum capricornutum	4.6 mg/L
96 Hr EC50 Selenastrum capricornutum	>438 mg/L
30 min EC50 Photobacterium phosphoreum	9.68 mg/L
24 Hr EC50 Nitrosomonas	96 mg/L
48 Hr EC50 Daphnia magna	1.8-2.4 mg/L

* * * Section 13 - Disposal Considerations * * *

This product as produced is not specifically listed as an EPA RCRA hazardous waste according to federal regulations (40 CFR 261). However, when discarded or disposed of, it may meet the criteria of a "characteristic" hazardous waste. This product could also contain benzene at low concentrations and may exhibit the characteristic of "toxicity" (D018) as determined by the toxicity characteristic leaching procedure (TCLP). This material could become a hazardous waste if mixed with or contaminated with a hazardous waste or other substance(s).

It is the responsibility of the user to determine if disposal material is hazardous according to federal, state and local regulations.

* * * Section 14 - Transportation Information * * *

This material when transported via U.S. commerce would be regulated by DOT Regulations.

US DOT Information

Shipping Name: Petroleum Crude Oil
UN/NA #: 1267 **Hazard Class:** 3 **Packing Group:** II
DOT reportable quantity (lbs): Not Applicable
Additional Info.: This description shown may not apply to all shipping situations. Consult 49CFR 172.101 for mode or quantity-specific requirements.

* * * Section 15 - Regulatory Information * * *

US Federal Regulations

Component Analysis

This material contains one or more of the following chemicals identified under SARA Section 302 (40 CFR 355 Appendix A), SARA Section 313 (40 CFR 372.65) and/or CERCLA (40 CFR 302.4).

Toluene (108-88-3)

SARA 313: 1.0 % de minimis concentration
CERCLA: 1000 lb final RQ; 454 kg final RQ

Xylenes (o-, m-, p- isomers) (1330-20-7)

SARA 313: 1.0 % de minimis concentration
CERCLA: 100 lb final RQ; 45.4 kg final RQ

Benzene (71-43-2)
SARA 313: 0.1 % de minimis concentration
CERCLA: 10 lb final RQ (received an adjusted RQ of 10 lbs based on potential carcinogenicity in an August 14, 1989 final rule); 4.54 kg final RQ (received an adjusted RQ of 10 lbs based on potential carcinogenicity in an August 14, 1989 final rule)

Ethyl benzene (100-41-4)
SARA 313: 0.1 % de minimis concentration
CERCLA: 1000 lb final RQ; 454 kg final RQ

State Regulations

Component Analysis - State
The following components appear on one or more of the following state hazardous substances lists:

Component	CAS	CA	MA	MN	NJ	PA	RI
Petroleum distillates (naphtha)	8002-05-9	No	Yes	Yes	Yes	Yes	Yes
Toluene	108-88-3	Yes	Yes	Yes	Yes	Yes	Yes
Xylenes (o-, m-, p- isomers)	1330-20-7	Yes	Yes	Yes	Yes	Yes	Yes
Benzene	71-43-2	Yes	Yes	Yes	Yes	Yes	Yes
Ethyl benzene	100-41-4	Yes	Yes	Yes	Yes	Yes	Yes

The following statement(s) are provided under the California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65):

WARNING! This product contains a chemical known to the state of California to cause cancer.
WARNING! This product contains a chemical known to the state of California to cause reproductive/developmental effects.

Component Analysis - WHMIS IDL
The following components are identified under the Canadian Hazardous Products Act Ingredient Disclosure List:

Component	CAS #	Minimum Concentration
Toluene	108-88-3	1 %
Benzene	71-43-2	0.1 %
Ethyl benzene	100-41-4	0.1 %

Additional Regulatory Information

Component Analysis - Inventory

Component	CAS #	TSCA	CAN	EEC
Petroleum distillates (naphtha)	8002-05-9	Yes	DSL	EINECS
Toluene	108-88-3	Yes	DSL	EINECS
Xylenes (o-, m-, p- isomers)	1330-20-7	Yes	DSL	EINECS
Benzene	71-43-2	Yes	DSL	EINECS
Ethyl benzene	100-41-4	Yes	DSL	EINECS

* * * Section 16 - Other Information * * *

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PEL - Permissible Exposure Limit
RQ – Reportable Quantity
TWA - Time Weighted Average
STEL - Short Term Exposure Limit
NTP - National Toxicology Program
IARC - International Agency for Research on Cancer

ATTACHMENT O: EMISSION SUMARY 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] *(Speciate VOCs & HAPS)*	Maximum Potential Uncontrolled Emissions[3]		Maximum Potential Controlled Emissions[4]		Emission Form or Phase *(At exit conditions, Solid, Liquid or Gas/Vapor)*	Est. Method Used[5]
		ID No.	Source	ID No.	Device Type		lb/hr	ton/yr	lb/hr	ton/yr		
EP-ENG1	Upward vertical stack	EU-ENG1	Flash Gas Compressor Engine	N/A	Oxidation Catalyst	NOx	3.04	13.32	3.04	13.32	Gas/Vapor	O = Manufacturer Data, AP-42
						CO	8.94	39.16	2.68	11.74		
						VOC	4.08	17.87	2.08	7.53		
						SO_2	0.01	0.03	0.01	0.03		
						PM_{10}	<0.01	<0.01	<0.01	<0.01		
						PM Total	0.10	0.44	0.10	0.44		
						Acetaldehyde	0.09	0.38	0.09	0.38		
						Acrolein	0.05	0.23	0.05	0.23		
						Benzene	<0.01	0.02	<0.01	0.02		
						Ethylbenzene	<0.01	<0.01	<0.01	<0.01		
						Formaldehyde	1.22	5.33	0.37	1.60		
						Methanol	0.03	0.11	0.03	0.11		
						Toluene	<0.01	0.02	<0.01	0.02		
						Xylenes	<0.01	0.01	<0.01	0.01		
						Carbon Dioxide	1,493.78	6,542.76	1,493.78	6,542.76		
						Methane	0.02	0.10	0.02	0.10		
						Nitrous Oxide	<0.01	2.48	<0.01	2.48		
EP-ENG2	Upward vertical stack	EU-ENG2	Flash Gas Compressor Engine	N/A	Oxidation Catalyst	NOx	3.04	13.32	3.04	13.32	Gas/Vapor	O = Manufacturer Data, AP-42
						CO	8.94	39.16	2.68	11.74		
						VOC	4.08	17.87	2.08	7.53		
						SO_2	0.01	0.03	0.01	0.03		
						PM_{10}	<0.01	<0.01	<0.01	<0.01		
						PM Total	0.10	0.44	0.10	0.44		
						Acetaldehyde	0.09	0.38	0.09	0.38		
						Acrolein	0.05	0.23	0.05	0.23		
						Benzene	<0.01	0.02	<0.01	0.02		
						Ethylbenzene	<0.01	<0.01	<0.01	<0.01		
						Formaldehyde	1.22	5.33	0.37	1.60		
						Methanol	0.03	0.11	0.03	0.11		
						Toluene	<0.01	0.02	<0.01	0.02		
						Xylenes	<0.01	0.01	<0.01	0.01		
						Carbon Dioxide	1,493.78	6,542.76	1,493.78	6,542.76		
						Methane	0.02	0.10	0.02	0.10		
						Nitrous Oxide	<0.01	2.48	<0.01	2.48		

EP-ENG3	Upward vertical stack	EU-ENG3	Flash Gas Compressor Engine	N/A	NSCR	NOx CO VOC SO_2 PM_{10} PM Total Acetaldehyde Acrolein Benzene Ethylbenzene Formaldehyde Methanol Toluene Xylenes Carbon Dioxide Methane Nitrous Oxide	7.54 7.54 0.32 <0.01 0.02 0.04 0.01 <0.01 <0.01 <0.01 0.13 0.01 <0.01 <0.01 283.44 <0.01 <0.01	33.03 33.03 1.40 <0.01 0.09 0.18 0.02 0.02 0.01 <0.01 0.57 0.03 <0.01 <0.01 1,241.47 0.02 <0.01	0.47 0.95 0.36 <0.01 0.02 0.04 0.01 <0.01 <0.01 <0.01 0.03 0.01 <0.01 <0.01 283.44 <0.01 <0.01	2.06 4.16 1.58 <0.01 0.09 0.18 0.02 0.02 0.01 <0.01 0.13 0.03 <0.01 <0.01 1,241.47 0.02 <0.01	Gas/Vapor	O = Manufacturer Data, AP-42
EP-ENG4	Upward vertical stack	EU-ENG4	Flash Gas Compressor Engine	N/A	Oxidation Catalyst	NOx CO VOC SO_2 PM_{10} PM Total Acetaldehyde Acrolein Benzene Ethylbenzene Formaldehyde Methanol Toluene Xylenes Carbon Dioxide Methane Nitrous Oxide	3.04 8.94 4.08 0.01 <0.01 0.10 0.09 0.05 <0.01 <0.01 1.22 0.03 <0.01 <0.01 1,493.78 0.02 <0.01	13.32 39.16 17.87 0.03 <0.01 0.44 0.38 0.23 0.02 <0.01 5.33 0.11 0.02 0.01 6,542.76 0.10 2.48	3.04 2.68 2.08 0.01 <0.01 0.10 0.09 0.05 <0.01 <0.01 0.37 0.03 <0.01 <0.01 1,493.78 0.02 <0.01	13.32 11.74 7.53 0.03 <0.01 0.44 0.38 0.23 0.02 <0.01 1.60 0.11 0.02 0.01 6,542.76 0.10 2.48	Gas/Vapor	O = Manufacturer Data, AP-42

EP-GPU1	Upward vertical stack	EU-GPU1	GPU Burner	N/A	None	NOx CO VOC SO_2 PM_{10} PM Total n-Hexane Formaldehyde Benzene Toluene Carbon Dioxide Methane Nitrous Oxide	0.11 0.09 0.01 <0.01 0.01 0.01 <0.01 <0.01 <0.01 <0.01 116.98 <0.01 <0.01	0.48 0.39 0.03 <0.01 0.03 0.04 0.01 <0.01 <0.01 <0.01 512.36 0.01 <0.01	N/A	N/A	Gas/Vapor	O = AP-42
EP-GPU2	Upward vertical stack	EU-GPU2	GPU Burner	N/A	None	NOx CO VOC SO_2 PM_{10} PM Total n-Hexane Formaldehyde Benzene Toluene Carbon Dioxide Methane Nitrous Oxide	0.11 0.09 0.01 <0.01 0.01 0.01 <0.01 <0.01 <0.01 <0.01 116.98 <0.01 <0.01	0.48 0.39 0.03 <0.01 0.03 0.04 0.01 <0.01 <0.01 <0.01 512.36 0.01 <0.01	N/A	N/A	Gas/Vapor	O = AP-42
EP-GPU3	Upward vertical stack	EU-GPU3	GPU Burner	N/A	None	NOx CO VOC SO_2 PM_{10} PM Total n-Hexane Formaldehyde Benzene Toluene Carbon Dioxide Methane Nitrous Oxide	0.11 0.09 0.01 <0.01 0.01 0.01 <0.01 <0.01 <0.01 <0.01 116.98 <0.01 <0.01	0.48 0.39 0.03 <0.01 0.03 0.04 0.01 <0.01 <0.01 <0.01 512.36 0.01 <0.01	N/A	N/A	Gas/Vapor	O = AP-42

EP-GPU4	Upward vertical stack	EU-GPU4	GPU Burner	N/A	None	NOx CO VOC SO_2 PM_{10} PM Total n-Hexane Formaldehyde Benzene Toluene Carbon Dioxide Methane Nitrous Oxide	0.11 0.09 0.01 <0.01 0.01 0.01 <0.01 <0.01 <0.01 <0.01 116.98 <0.01 <0.01	0.48 0.39 0.03 <0.01 0.03 0.04 0.01 <0.01 <0.01 <0.01 512.36 0.01 <0.01	N/A	N/A	Gas/Vapor	O = AP-42
EP-GPU5	Upward vertical stack	EU-GPU5	GPU Burner	N/A	None	NOx CO VOC SO_2 PM_{10} PM Total n-Hexane Formaldehyde Benzene Toluene Carbon Dioxide Methane Nitrous Oxide	0.11 0.09 0.01 <0.01 0.01 0.01 <0.01 <0.01 <0.01 <0.01 116.98 <0.01 <0.01	0.48 0.39 0.03 <0.01 0.03 0.04 0.01 <0.01 <0.01 <0.01 512.36 0.01 <0.01	N/A	N/A	Gas/Vapor	O = AP-42
EP-GPU6	Upward vertical stack	EU-GPU6	GPU Burner	N/A	None	NOx CO VOC SO_2 PM_{10} PM Total n-Hexane Formaldehyde Benzene Toluene Carbon Dioxide Methane Nitrous Oxide	0.11 0.09 0.01 <0.01 0.01 0.01 <0.01 <0.01 <0.01 <0.01 116.98 <0.01 <0.01	0.48 0.39 0.03 <0.01 0.03 0.04 0.01 <0.01 <0.01 <0.01 512.36 0.01 <0.01	N/A	N/A	Gas/Vapor	O = AP-42

EP-GPU7	Upward vertical stack	EU-GPU7	GPU Burner	N/A	None	NOx CO VOC SO_2 PM_{10} PM Total n-Hexane Formaldehyde Benzene Toluene Carbon Dioxide Methane Nitrous Oxide	0.11 0.09 0.01 <0.01 0.01 0.01 <0.01 <0.01 <0.01 <0.01 116.98 <0.01 <0.01	0.48 0.39 0.03 <0.01 0.03 0.04 0.01 <0.01 <0.01 <0.01 512.36 0.01 <0.01	N/A	N/A	Gas/Vapor	O = AP-42
EP-GPU8	Upward vertical stack	EU-GPU8	GPU Burner	N/A	None	NOx CO VOC SO_2 PM_{10} PM Total n-Hexane Formaldehyde Benzene Toluene Carbon Dioxide Methane Nitrous Oxide	0.11 0.09 0.01 <0.01 0.01 0.01 <0.01 <0.01 <0.01 <0.01 116.98 <0.01 <0.01	0.48 0.39 0.03 <0.01 0.03 0.04 0.01 <0.01 <0.01 <0.01 512.36 0.01 <0.01	N/A	N/A	Gas/Vapor	O = AP-42
EP-HT1	Upward vertical stack	EU-HT1	Heater Treater	N/A	None	NOx CO VOC SO_2 PM_{10} PM Total n-Hexane Formaldehyde Benzene Toluene Carbon Dioxide Methane Nitrous Oxide	0.06 0.05 <0.01 <0.01 <0.01 <0.01 <0.01 <0.01 <0.01 <0.01 58.49 <0.01 <0.01	0.26 0.22 0.01 <0.01 0.01 0.02 <0.01 <0.01 <0.01 <0.01 256.18 <0.01 <0.01	N/A	N/A	Gas/Vapor	O = AP-42

EP-HT2	Upward vertical stack	EU-HT2	Heater Treater	N/A	None	NOx CO VOC SO_2 PM_{10} PM Total n-Hexane Formaldehyde Benzene Toluene Carbon Dioxide Methane Nitrous Oxide	0.06 0.05 <0.01 <0.01 <0.01 <0.01 <0.01 <0.01 <0.01 <0.01 58.49 <0.01 <0.01	0.26 0.22 0.01 <0.01 0.01 0.02 <0.01 <0.01 <0.01 <0.01 256.18 <0.01 <0.01	N/A	N/A	Gas/Vapor	O = AP-42
EP-DEHY1*	Upward vertical stack	EU-DEHY1	TEG Dehydration Unit	Condenser/ Combustion	APC-COND/APC-COMB-TKLD	VOC n-Hexane Benzene Toluene Ethylbenzene Xylenes Carbon Dioxide Methane	65.88 1.48 0.87 2.62 1.41 4.23 0.58 102.10	288.55 6.48 3.81 11.49 6.19 18.54 2.53 447.19	2.09 0.05 0.10 0.12 0.03 0.06 <0.01 0.44	9.15 0.24 0.45 0.51 0.11 0.28 0.01 1.92	Gas/Vapor	O = GLYCalc
EP-RB1	Upward vertical stack	EU-RB1	TEG REboiler	N/A	None	NOx CO VOC SO_2 PM_{10} PM Total n-Hexane Formaldehyde Benzene Toluene Carbon Dioxide Methane Nitrous Oxide	0.08 0.07 <0.01 <0.01 <0.01 0.01 <0.01 <0.01 <0.01 <0.01 87.73 <0.01 <0.01	0.36 0.30 0.02 <0.01 0.02 0.03 0.01 <0.01 <0.01 <0.01 384.27 0.01 <0.01	N/A	N/A	Gas/Vapor	O = AP-42

APC-COMB-TKLD	Upward vertical stack	EU-TANKS-COND, EU-TANKS-PW, EU-LOAD-COND, EU-LOAD-PW, EU-PILOT, APC-COMB-TKLD	Vapor Combustor	-	None	NOx CO PM VOC n-Hexane Formaldehyde Benzene Toluene Ethylbenzene Xylenes Carbon Dioxide Methane Nitrous Oxide	4.16 8.28 0.09 575.37 29.76 <0.01 0.69 3.72 3.59 9.35 3525.19 0.07 0.01	18.22 36.28 0.39 2574.96 133.26 <0.01 3.03 16.67 16.13 41.9 15440.56 6.91 0.03	4.16 8.28 0.09 6.78 0.33 <0.01 0.01 0.04 0.04 0.10 3525.19 0.07 0.01	18.22 36.28 0.39 18.13 1.45 <0.01 0.04 0.19 0.17 0.44 15440.56 6.91 0.03	Gas/Vapor	O (AP-42, Mass Balance)
EP-FUG	Fugitive	EU-FUG	Fugitive Components	-	None	VOC n-Hexane Benzene Toluene Ethylbenzene Xylenes Carbon Dioxide Methane	N/A	6.38 0.26 <0.01 0.03 0.02 0.06 0.05 9.36	N/A	N/A	Gas/Vapor	O = EPA-453/ R-95-017
EP-HR	Fugitive	EU-HR	Fugitive Haul Road Emissions	-	None	PM Total PM_{10} $PM_{2.5}$	0.59 0.14 0.01	1.95 0.48 0.05	N/A	N/A	Gas/Vapor	O = 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).

Note: Controlled emissions for DEHY1 include still vent emissions only. Flash tank emissions are routed to the combustor via the produced water tanks. Uncombusted emissions are reported at the combustor.

ATTACHMENT P: SUPPORT DOCUMENTS

ENGINE SPECIFICATION SHEETS

AP-42 AND EPA EMISSION FACTORS

GRI-GLYCALC INPUT SUMMARY AND AGGREGATE CALCULATIONS REPORTS

REPRESENTATIVE GAS AND LIQUIDS ANALYSES

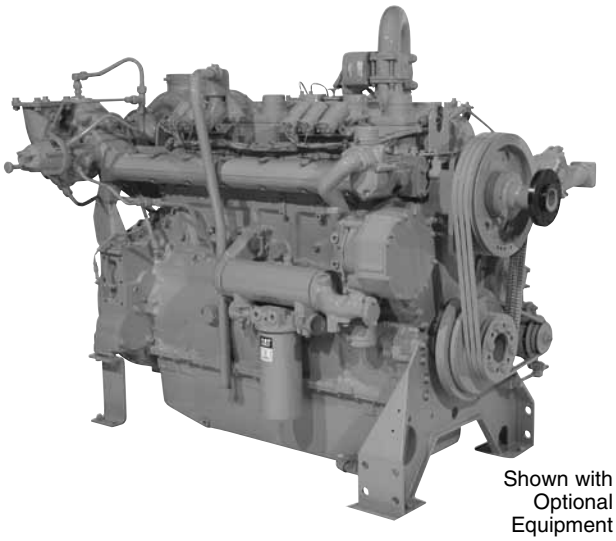
PROMAX PROCESS SIMULATION RESULTS

EPA TANKS 4.0.9d EMISSIONS REPORT(S)

G3406 Gas Petroleum Engine

160-272 bkW (215-365 bhp) 1800 rpm

0.5% O_2 and 2.0% O_2 Ratings



Shown with Optional Equipment

CAT® ENGINE SPECIFICATIONS

In-line 6, 4-Stroke-Cycle

Emissions Settings	0.5% O_2 and 2.0% O_2
Bore	137 mm (5.4 in.)
Stroke	165 mm (6.5 in.)
Displacement	14.59 L (891 cu. in.)
Aspiration	Naturally Aspirated or Turbocharged-Aftercooled
Governor and Protection	Woodward PSG
Combustion	Rich Burn
Engine Weight, net dry (approx)	1360.8 kg (3000 lb)
Power Density	6.7 kg/kW (11 lb/bhp)
Power per Displacement	18.6 bhp/L
Total Cooling System Capacity	37.9 L (10 gal)
Jacket Water	30.3 L (8 gal)
SCAC	7.6 L (2 gal)
Lube Oil System (refill)	75.7 L (20 gal)
Oil Change Interval	750 hours
Rotation (from flywheel end)	Counterclockwise
Flywheel and Flywheel Housing	SAE No. 1
Flywheel Teeth	113

FEATURES

Engine Design
- Proven reliability and durability
- Ability to burn a wide spectrum of gaseous fuels
- Robust diesel strength design prolongs life and lowers owning and operating costs
- Broad operating speed range

Emissions
- Rich burn engine design easily meets emission requirements
- 0.5% O_2 rating meets U.S. EPA Spark Ignited Stationary NSPS Emissions for 2007/8 and 2010/11 with the use of aftermarket AFRC and TWC

Full Range of Attachments

Large variety of factory-installed engine attachments reduces packaging time

Testing

Every engine is full-load tested to ensure proper engine performance.

Gas Engine Rating Pro

GERP is a PC-based program designed to provide site performance capabilities for Cat® natural gas engines for the gas compression industry. GERP provides engine data for your site's altitude, ambient temperature, fuel, engine coolant heat rejection, performance data, installation drawings, spec sheets, and pump curves.

Product Support Offered Through Global Cat Dealer Network

More than 2,200 dealer outlets

Cat factory-trained dealer technicians service every aspect of your petroleum engine

Cat parts and labor warranty

Preventive maintenance agreements available for repair-before-failure options

S•O•S℠ program matches your oil and coolant samples against Caterpillar set standards to determine:
- Internal engine component condition
- Presence of unwanted fluids
- Presence of combustion by-products
- Site-specific oil change interval

Over 80 Years of Engine Manufacturing Experience

Over 60 years of natural gas engine production

Ownership of these manufacturing processes enables Caterpillar to produce high quality, dependable products.
- Cast engine blocks, heads, cylinder liners, and flywheel housings
- Machine critical components
- Assemble complete engine

Web Site

For all your petroleum power requirements, visit www.catoilandgas.cat.com.

STANDARD EQUIPMENT

Air Inlet System
Air cleaner — heavy-duty
Air cleaner rain cap
Service indicator

Control System
Governor — Woodward PSG mechanical
Governor locking — positive control

Cooling System
Thermostats and housing
Jacket water pump
Aftercooler water pump
Aftercooler core

Exhaust System
Watercooled exhaust manifolds
Dry exhaust elbow

Flywheel & Flywheel Housing
SAE No. 1 flywheel
SAE No. 1 flywheel housing
SAE standard rotation

Fuel System
Gas pressure regulator
Natural gas carburetor

Ignition System
Altronic III ignition system

Instrumentation
Service meter

Lube System
Crankcase breather — top mounted
Oil cooler
Oil filter — RH
Auxiliary oil reservoir
Oil pan — full sump
Oil filler in valve cover, dipstick — RH

Mounting System
Engine supports

Protection System
Shutoffs

General
Paint — Cat yellow
Crankshaft vibration damper and drive pulleys
Lifting eyes

OPTIONAL EQUIPMENT

Air Inlet System
Precleaner

Charging System
Battery chargers
Charging alternators
Charging alternators f/u/w c customer supplied shutoffs
Ammeter gauge
Ammeter gauge and wiring
Control mounting

Control System
PSG Woodward governor

Cooling System
Radiators
Non-sparking blower fan
Blower fans for customer supplied radiators
Fan drives for customer supplied radiators
ATAAC conversion
Aftercooler
Expansion tank
Heat exchangers

Exhaust System
Flexible fittings
Elbow
Flange
Pipe
Rain cap
Muffler

Fuel System
Fuel filter
Natural gas valve and jet kits

Ignition System
CSA shielded ignition
Wiring harness

Instrumentation
Gauges and instrument panels

Lube System
Auxiliary oil reservoir removal
Lubricating oil

Mounting System
Vibration isolators

Power Take-Offs
Auxiliary drive pulleys
Enclosed clutch and clutch support
Front stub shaft and flywheel stub shaft

Protection System
Gas valves

Starting System
Air starting motor
Electric air start control
Air pressure regulator
Air silencer
Electric starting motor — single 12- and 24-volt
Starting aids
Battery sets, cables, and rack

General
Damper guard

TECHNICAL DATA

G3406 Gas Petroleum Engine — 1800 rpm

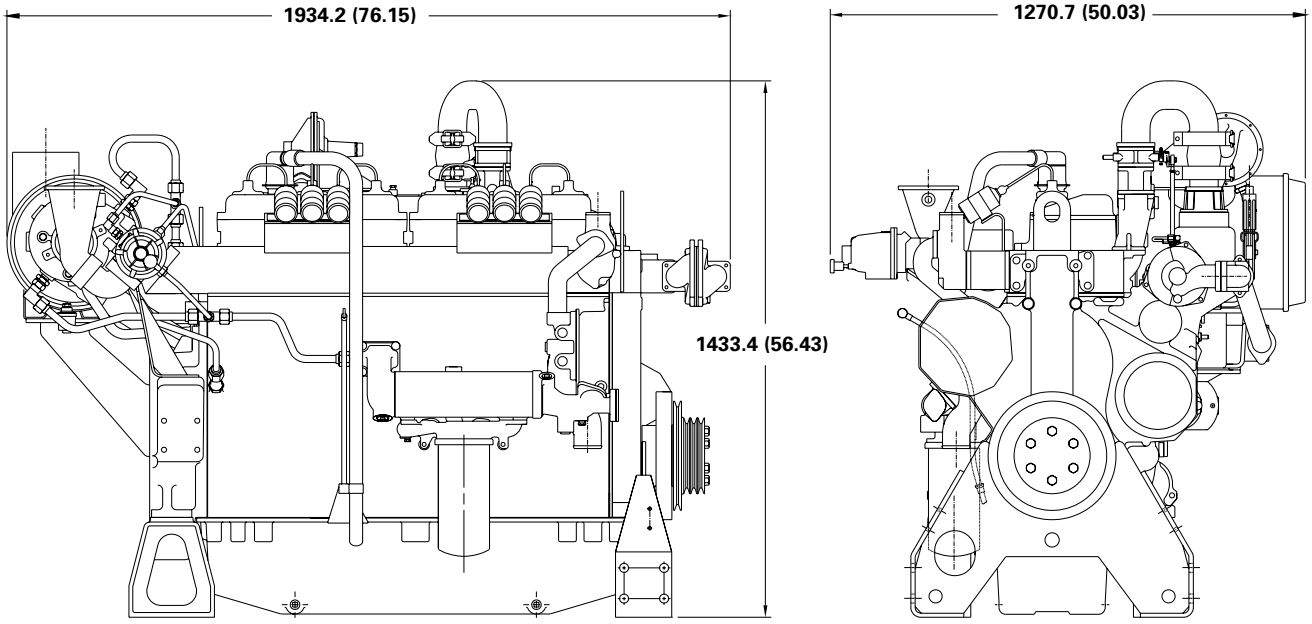
		DM5302-01	TM8513-05	DM5084-03
Engine Power				
@ 100% Load	bkW (bhp)	242 (325)	160 (215)	205 (276)
@ 75% Load	bkW (bhp)	192 (244)	120 (161)	154 (207)
Engine Speed	rpm	**1800**	**1800**	**1800**
Max Altitude @ Rated Torque and 38°C (100°F)	m (ft)	1219.2 (4000)	0	914.4 (3000)
Speed Turndown @ Max Altitude, Rated Torque, and 38°C (100°F)	%	55	45	0
SCAC Temperature	°C (°F)	54 (130)	—	—
Emissions*				
NOx	g/bkW-hr (g/bhp-hr)	35.29 (26.31)	37.47 (27.94)	20.69 (15.43)
CO	g/bkW-hr (g/bhp-hr)	2.15 (1.6)	1.9 (1.4)	20.69 (15.42)
CO_2	g/bkW-hr (g/bhp-hr)	620 (463)	685 (511)	699 (521)
VOC**	g/bkW-hr (g/bhp-hr)	0.21 (.16)	0.24 (0.18)	—
Fuel Consumption***				
@ 100% Load	MJ/bkW-hr (Btu/bhp-hr)	9.96 (7037)	10.99 (7767)	10.49 (7418)
@ 75% Load	MJ/bkW-hr (Btu/bhp-hr)	10.53 (7443)	11.75 (8304)	11.44 (8082)
Heat Balance				
Heat Rejection to Jacket Water				
@ 100% Load	bkW (Btu/min)	200 (11,401)	160 (9081)	223 (12,709)
@ 75% Load	bkW (Btu/min)	173 (9822)	138 (7868)	178 (10,156)
Heat Rejection to Aftercooler				
@ 100% Load	bkW (Btu/min)	12.6 (716)	—	6.53 (372)
@ 75% Load	bkW (Btu/min)	7.9 (450)	—	3.86 (220)
Heat Rejection to Exhaust				
@ 100% Load	bkW (Btu/min)	161 (9180)	128 (7292)	140 (7991)
@ 75% Load	bkW (Btu/min)	125 (7091)	99 (5636)	105 (6022)
Exhaust System				
Exhaust Gas Flow Rate				
@ 100% Load	m^3/min (cfm)	38.74 (1368)	30.04 (1061)	33.1 (1168)
@ 75% Load	m^3/min (cfm)	30.33 (1071)	23.84 (842)	25.4 (900)
Exhaust Stack Temperature				
@ 100% Load	°C (°F)	526 (978)	560 (1040)	540 (1004)
@ 75% Load	°C (°F)	512 (953)	535 (995)	505 (942)
Intake System				
Air Inlet Flow Rate				
@ 100% Load	m^3/min (scfm)	13 (459)	9.68 (342)	10.84 (383)
@ 75% Load	m^3/min (scfm)	10.36 (366)	7.93 (280)	8.72 (308)
Gas Pressure	kPag (psig)	137-145 (19.9-21)	10.34-34.47 (1.5-5)	10.24-34.47 (1.5-5)

*at 100% load and speed, all values are listed as not to exceed

**Volatile organic compounds as defined in U.S. EPA 40 CFR 60, subpart JJJJ

***ISO 3046/1

GAS PETROLEUM ENGINE



PACKAGE DIMENSIONS		
Length	mm (in.)	1934.2 (76.15)
Width	mm (in.)	1270.7 (50.03)
Height	mm (in.)	1433.4 (56.43)
Shipping Weight	kg (lb)	1360.8 (3000)

Note: General configuration not to be used for installation. See general dimension drawings for detail.

Dimensions are in mm (inches).

RATING DEFINITIONS AND CONDITIONS

Engine performance is obtained in accordance with SAE J1995, ISO3046/1, BS5514/1, and DIN6271/1 standards.

Transient response data is acquired from an engine/generator combination at normal operating temperature and in accordance with ISO3046/1 standard ambient conditions. Also in accordance with SAE J1995, BS5514/1, and DIN6271/1 standard reference conditions.

Conditions: Power for gas engines is based on fuel having an LHV of 33.74 kJ/L (905 Btu/cu ft) at 101 kPa (29.91 in. Hg) and 15° C (59° F). Fuel rate is based on a cubic meter at 100 kPa (29.61 in. Hg) and 15.6° C (60.1° F). Air flow is based on a cubic foot at 100 kPa (29.61 in. Hg) and 25° C (77° F). Exhaust flow is based on a cubic foot at 100 kPa (29.61 in. Hg) and stack temperature.

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dcokenour@emittechnologies.com

Prepared For:
Derek Pearce
MIDCON COMPRESSION, LP

QUOTE: QUO-13721-T4F3

Manufactured on or after 1/1/2011

INFORMATION PROVIDED BY CATERPILLAR

Engine:	G3406 NA
Horsepower:	215
RPM:	1800
Compression Ratio:	10.3
Exhaust Flow Rate:	1018 CFM
Exhaust Temperature:	1135 °F
Reference:	N/A
Fuel:	Natural Gas
Annual Operating Hours:	8760

Uncontrolled Emissions

	g/bhp-hr
NOx:	16.52
CO:	16.52
THC:	2.08
NMHC	0.31
NMNEHC:	0.21
HCHO:	0.27
O2:	0.40 %

POST CATALYST EMISSIONS

	% Reduction	g/bhp-hr
NOx:	>94 %	<1.00
CO:	>88 %	<2.00
VOC:	---	<0.70
HCHO:	>76 %	<0.06

CONTROL EQUIPMENT

Catalyst Element

Model:	RE-1450-T
Catalyst Type:	NSCR, Standard Precious Group Metals
Substrate Type:	BRAZED
Manufacturer:	EMIT Technologies, Inc
Element Quantity:	1
Element Size:	Round 14.5" x 3.5"

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WARRANTY

EMIT Technologies, Inc. warrants that the goods supplied will be free from defects in workmanship by EMIT Technologies, Inc. for a period of two (2) years from date of shipment. EMIT Technologies, Inc. will not be responsible for any defects which result from improper use, neglect, failure to properly maintain or which are attributable to defects, errors or omissions in any drawings, specifications, plans or descriptions, whether written or oral, supplied to EMIT Technologies, Inc. by Buyer.

Catalyst performance using an EMIT Air/Fuel ratio controller is dependent upon properly defined set-points, variable with engine and fuel gas composition. Air/fuel ratio controller performance is guaranteed, but not limited, to fuel gas with a HHV content of 1400 BTU/SCF.

Catalyst performance will be guaranteed for a period of 1 year from installation, or 8760 operating hours, whichever comes first. The catalyst shall be operated with an automatic air/fuel ratio controller. The performance guarantee shall not cover the effects of excessive ash masking due to operation at low load, improper engine maintenance, or inappropriate lubrication oil. The performance guarantee shall not cover the effects of continuous engine misfires (cylinder or ignition) exposing the catalyst to excessive exothermic reaction temperatures. In most cases, excluding thermal deactivation, catalyst performance is redeemable by means of proper washing (refer to EMIT Catalyst/Silencer Housing Manual for element wash information, or contact a local EMIT Sales representative).

The exhaust temperature operating range at the converter inlet is a minimum of 600°F for oxidation catalyst and 750 ˚F for NSCR catalyst, and a maximum of 1250°F.

If a properly functioning, high temperature shut down switch is not installed, thermal deactivation of catalyst at sustained temperatures above 1250˚F is not covered. If excessive exposure to over oxygenation of NSCR catalyst occurs due to improperly functioning or non-existent Air/Fuel ratio control, then deactivation of catalyst is not warranted.

The catalyst conversion efficiencies (% reduction) will be guaranteed for engine loads of 50 to 100 percent. Standard Oxidation Catalyst conversion efficiencies (% reduction) will be guaranteed for fuel gas containing less than 1.5% mole fraction of non-methane, non-ethane hydrocarbons. Applications where fuel gas exceeds this level will require a Premium Oxidation Catalyst to maintain guaranteed VOC conversion efficiencies.

Engine lubrication oil shall contain less than 0.5 wt% Sulfated Ash with a maximum allowable specific oil consumption of 0.7 g/bhp-hr. The catalyst shall be limited to a maximum ash loading of 0.022 lb/ft3. Phosphorous and zinc additives are limited to 0.03 wt%. New or Reconstructed engines must operate for a minimum of 100 hours prior to catalyst installation, otherwise the warranty is void.

The catalyst must not be exposed to the following know poisoning agents, including: antimony, arsenic, chromium, copper, iron, lead, lithium, magnesium, mercury, nickel, phosphorous, potassium, silicon, sodium, sulfur, tin, and zinc. Total poison concentrations in the fuel gas must be limited to 0.25 ppm or less for catalyst to function properly.

Shipment - Promised shipping dates are approximate lead times from the point of manufacture and are not guaranteed. EMIT Technologies, Inc. will not be liable for any loss, damage or delay in manufacture or delivery resulting from any cause beyond its control including, but not limited to a period equal to the time lost by reason of that delay. All products will be crated as per best practice to prevent any damage during shipment. Unless otherwise specified, Buyer will pay for any special packing and shipping requirements. Acceptance of goods by common carrier constitutes delivery to Buyer. EMIT Technologies, Inc. shall not be responsible for goods damaged or lost in transit.

Terms: Credit is extended to purchaser for net 30 time period. If payment is not received in the net 30 timeframe, interest on the unpaid balance will accrue at a rate of 1.5% per month from the invoice date.

Order Cancellation Terms: Upon cancellation of an order once submittal of a Purchase Order has occurred, the customer will pay a 25% restocking fee for Catalyst Housings, Catalyst Elements, and Air/Fuel Ratio Controllers; 50% restocking fee for Cooler Top Solutions Exhaust System Accessories, and other Custom Built Products; 100% of all associated shipping costs incurred by EMIT; 100% of all project expenses incurred by EMIT for Field Services.

G3516B

GAS COMPRESSION APPLICATION

GAS ENGINE SITE SPECIFIC TECHNICAL DATA

CATERPILLAR®

ENGINE SPEED (rpm):	1400	RATING STRATEGY:	STANDARD
COMPRESSION RATIO:	8:1	RATING LEVEL:	CONTINUOUS
AFTERCOOLER TYPE:	SCAC	FUEL SYSTEM:	CAT WIDE RANGE
AFTERCOOLER - STAGE 2 INLET (°F):	130		WITH AIR FUEL RATIO CONTROL
AFTERCOOLER - STAGE 1 INLET (°F):	201	**SITE CONDITIONS:**	
JACKET WATER OUTLET (°F):	210	FUEL:	SWN Van Aston1
ASPIRATION:	TA	FUEL PRESSURE RANGE(psig):	7.0-40.0
COOLING SYSTEM:	JW+OC+1AC, 2AC	FUEL METHANE NUMBER:	63.2
CONTROL SYSTEM:	ADEM3	FUEL LHV (Btu/scf):	1102
EXHAUST MANIFOLD:	DRY	ALTITUDE(ft):	1500
COMBUSTION:	LOW EMISSION	MAXIMUM INLET AIR TEMPERATURE(°F):	100
NOx EMISSION LEVEL (g/bhp-hr NOx):	0.5	STANDARD RATED POWER:	1380 bhp@1400rpm
SET POINT TIMING:	29		

				MAXIMUM RATING	SITE RATING AT MAXIMUM INLET AIR TEMPERATURE		
RATING		**NOTES**	**LOAD**	**100%**	**100%**	**75%**	**50%**
ENGINE POWER	(WITHOUT FAN)	(1)	bhp	1380	1380	1035	690
INLET AIR TEMPERATURE			°F	100	100	100	100
ENGINE DATA							
FUEL CONSUMPTION (LHV)		(2)	Btu/bhp-hr	7433	7433	7961	8551
FUEL CONSUMPTION (HHV)		(2)	Btu/bhp-hr	8206	8206	8789	9440
AIR FLOW (@inlet air temp, 14.7 psia)	(WET)	(3)(4)	ft3/min	3285	3285	2577	1802
AIR FLOW	(WET)	(3)(4)	lb/hr	13968	13968	10957	7660
FUEL FLOW (60ºF, 14.7 psia)			scfm	155	155	125	89
INLET MANIFOLD PRESSURE		(5)	in Hg(abs)	93.7	93.7	76.1	53.5
EXHAUST TEMPERATURE - ENGINE OUTLET		(6)	°F	999	999	992	1012
EXHAUST GAS FLOW (@engine outlet temp, 14.5 psia)	(WET)	(7)(4)	ft3/min	9181	9181	7180	5094
EXHAUST GAS MASS FLOW	(WET)	(7)(4)	lb/hr	14456	14456	11349	7941
EMISSIONS DATA - ENGINE OUT							
NOx (as NO2)		(8)(9)	g/bhp-hr	0.50	0.50	0.50	0.50
CO		(8)(9)	g/bhp-hr	2.83	2.83	3.04	2.98
THC (mol. wt. of 15.84)		(8)(9)	g/bhp-hr	4.74	4.74	5.08	5.16
NMHC (mol. wt. of 15.84)		(8)(9)	g/bhp-hr	1.79	1.79	1.92	1.95
NMNEHC (VOCs) (mol. wt. of 15.84)		(8)(9)(10)	g/bhp-hr	0.66	0.66	0.70	0.71
HCHO (Formaldehyde)		(8)(9)	g/bhp-hr	0.42	0.42	0.41	0.41
CO2		(8)(9)	g/bhp-hr	491	491	525	570
EXHAUST OXYGEN		(8)(11)	% DRY	9.1	9.1	8.8	8.4
HEAT REJECTION							
HEAT REJ. TO JACKET WATER (JW)		(12)	Btu/min	22700	22700	21027	19567
HEAT REJ. TO ATMOSPHERE		(12)	Btu/min	6110	6110	5092	4074
HEAT REJ. TO LUBE OIL (OC)		(12)	Btu/min	4475	4475	3978	3363
HEAT REJ. TO A/C - STAGE 1 (1AC)		(12)(13)	Btu/min	12486	12486	10391	3717
HEAT REJ. TO A/C - STAGE 2 (2AC)		(12)(13)	Btu/min	5653	5653	5312	3448
COOLING SYSTEM SIZING CRITERIA							
TOTAL JACKET WATER CIRCUIT (JW+OC+1AC)		(13)(14)	Btu/min	43450			
TOTAL AFTERCOOLER CIRCUIT (2AC)		(13)(14)	Btu/min	5935			
A cooling system safety factor of 0% has been added to the cooling system sizing criteria.							

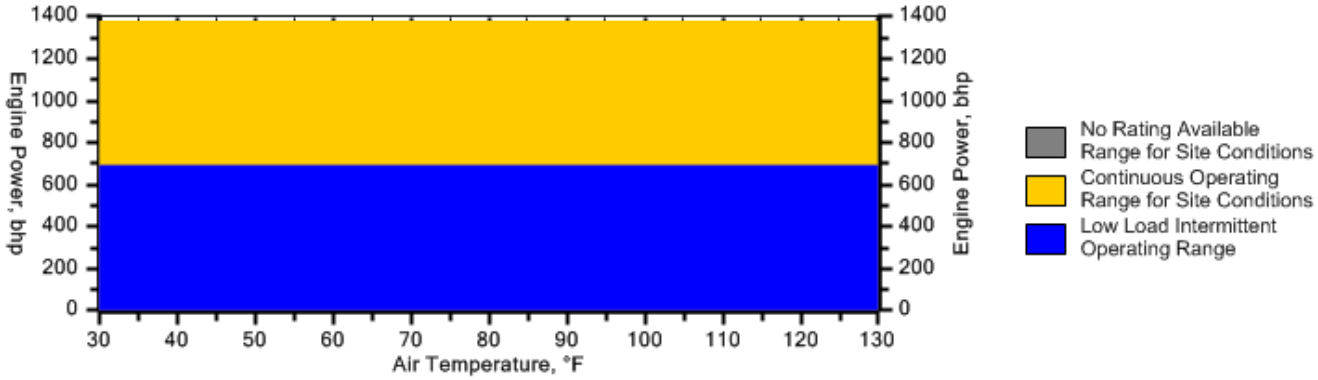
CONDITIONS AND DEFINITIONS

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. Maximum rating is the maximum capability at the specified aftercooler inlet temperature 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.

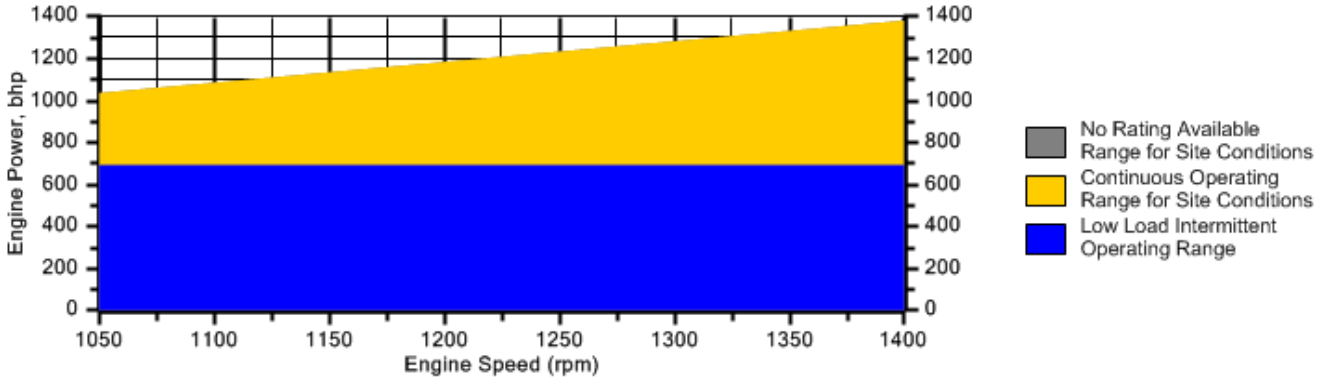
Engine Power vs. Inlet Air Temperature

Data represents temperature sweep at 1500 ft and 1400 rpm



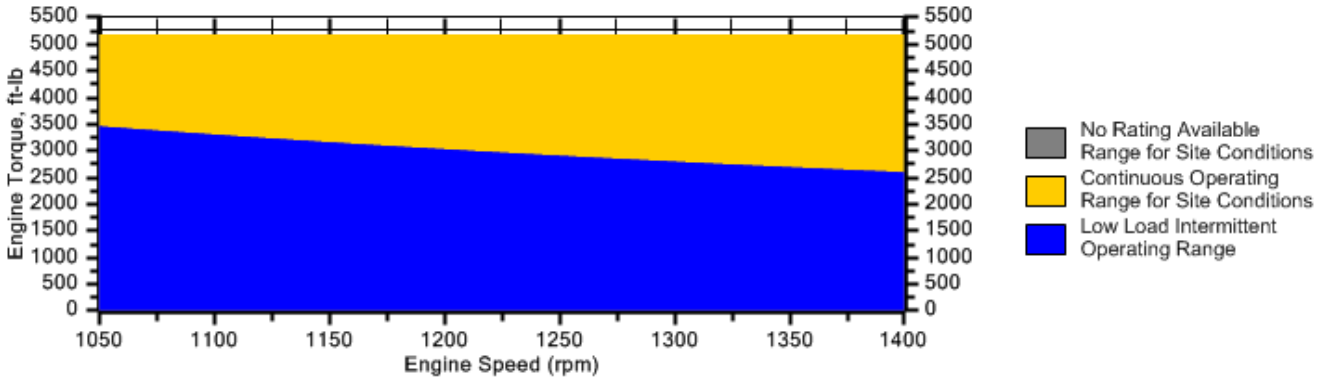
Engine Power vs. Engine Speed

Data represents speed sweep at 1500 ft and 100 °F



Engine Torque vs. Engine Speed

Data represents speed sweep at 1500 ft and 100 °F



Note: At site conditions of 1500 ft and 100°F inlet air temp., constant torque can be maintained down to 1050 rpm. The minimum speed for loading at these conditions is 1050 rpm.

NOTES

1. Engine rating is with two engine driven water pumps. Tolerance is ± 3% of full load.

2. Fuel consumption tolerance is ± 3.0% of full load data.

3. Air flow value is on a 'wet' basis. Flow is a nominal value with a tolerance of ± 5 %.

4. Inlet and Exhaust Restrictions must not exceed A&I limits based on full load flow rates from the standard technical data sheet.

5. Inlet manifold pressure is a nominal value with a tolerance of ± 5 %.

6. Exhaust temperature is a nominal value with a tolerance of (+)63°F, (-)54°F.

7. Exhaust flow value is on a "wet" basis. Flow is a nominal value with a tolerance of ± 6 %.

8. Emissions data is at engine exhaust flange prior to any after treatment.

9. Emission values are based on engine operating at steady state conditions. Fuel methane number cannot vary more than ± 3. Values listed are higher than nominal levels to allow for instrumentation, measurement, and engine-to-engine variations. They indicate "Not to Exceed" values. THC, NMHC, and NMNEHC do not include aldehydes. An oxidation catalyst may be required to meet Federal, State or local CO or HC requirements.

10. VOCs - Volatile organic compounds as defined in US EPA 40 CFR 60, subpart JJJJ

11. Exhaust Oxygen level is the result of adjusting the engine to operate at the specified NOx level. Tolerance is ± 0.5.

12. Heat rejection values are nominal. Tolerances, based on treated water, are ± 10% for jacket water circuit, ± 50% for radiation, ± 20% for lube oil circuit, and ± 5% for aftercooler circuit.

13. Aftercooler heat rejection includes an aftercooler heat rejection factor for the site elevation and inlet air temperature specified. Aftercooler heat rejection values at part load are for reference only. Do not use part load data for heat exchanger sizing.

14. Cooling system sizing criteria are maximum circuit heat rejection for the site, with applied tolerances.

Constituent	Abbrev	Mole %	Norm
Water Vapor	H2O	0.0019	0.0019
Methane	CH4	78.9440	78.9713
Ethane	C2H6	15.1730	15.1783
Propane	C3H8	4.1258	4.1272
Isobutane	iso-C4H1O	0.4192	0.4193
Norbutane	nor-C4H1O	0.6678	0.6680
Isopentane	iso-C5H12	0.0840	0.0840
Norpentane	nor-C5H12	0.0574	0.0574
Hexane	C6H14	0.0201	0.0201
Heptane	C7H16	0.0000	0.0000
Nitrogen	N2	0.3400	0.3401
Carbon Dioxide	CO2	0.1322	0.1322
Hydrogen Sulfide	H2S	0.0000	0.0000
Carbon Monoxide	CO	0.0000	0.0000
Hydrogen	H2	0.0000	0.0000
Oxygen	O2	0.0000	0.0000
Helium	HE	0.0000	0.0000
Neopentane	neo-C5H12	0.0000	0.0000
Octane	C8H18	0.0000	0.0000
Nonane	C9H20	0.0000	0.0000
Ethylene	C2H4	0.0000	0.0000
Propylene	C3H6	0.0000	0.0000
TOTAL (Volume %)		99.9654	99.9998

Fuel Makeup:	SWN Van Aston1
Unit of Measure:	English

Calculated Fuel Properties

Caterpillar Methane Number:	63.2
Lower Heating Value (Btu/scf):	1102
Higher Heating Value (Btu/scf):	1216
WOBBE Index (Btu/scf):	1327
THC: Free Inert Ratio:	210.73
Total % Inerts (% N2, CO2, He):	0.47%
RPC (%) (To 905 Btu/scf Fuel):	100%
Compressibility Factor:	0.997
Stoich A/F Ratio (Vol/Vol):	11.44
Stoich A/F Ratio (Mass/Mass):	16.60
Specific Gravity (Relative to Air):	0.689
Specific Heat Constant (K):	1.284

CONDITIONS AND DEFINITIONS

Caterpillar Methane Number represents the knock resistance of a gaseous fuel. It should be used with the Caterpillar Fuel Usage Guide for the engine and rating to determine the rating for the fuel specified. A Fuel Usage Guide for each rating is included on page 2 of its standard technical data sheet.

RPC always applies to naturally aspirated (NA) engines, and turbocharged (TA or LE) engines only when they are derated for altitude and ambient site conditions.

Project specific technical data sheets generated by the Caterpillar Gas Engine Rating Pro program take the Caterpillar Methane Number and RPC into account when generating a site rating.

Fuel properties for Btu/scf calculations are at 60F and 14.696 psia.

Caterpillar shall have no liability in law or equity, for damages, consequently or otherwise, arising from use of program and related material or any part thereof.

FUEL LIQUIDS

Field gases, well head gases, and associated gases typically contain liquid water and heavy hydrocarbons entrained in the gas. To prevent detonation and severe damage to the engine, hydrocarbon liquids must not be allowed to enter the engine fuel system. To remove liquids, a liquid separator and coalescing filter are recommended, with an automatic drain and collection tank to prevent contamination of the ground in accordance with local codes and standards.

To avoid water condensation in the engine or fuel lines, limit the relative humidity of water in the fuel to 80% at the minimum fuel operating temperature.

IAC Acoustics
10635 Brighton Lane
Stafford, Texas 77477
Phone: 832 554-0980
Fax: 832 554-0990

Emission Control Application Data Sheet

Customer:	**CDM**	Project:	**SWN -3516B-Van Aston**	Date:	**10/12/2015**
Customer Contact		IAC Contact:		Order/Quote #:	**0**

Engine Data:

Engine Model:	**CAT 3516B**		Speed:	**1400**	RPM
Fuel & Operating Type:	**Natural Gas Lean Burn**		Engine Power:	**1380**	Hp
				0	KW
Exhaust Flow Rate:	**9226**	**acfm**	Exhaust Temperature:	**1008**	°F
	15675	**m^3/hr**		**542**	°C
	14933	**lbs/hr**			

Catalyst Data:

Number of Core layers:	**1**				
Model:	**201VO-4-2-8116-1**		Inlet Size:	**16**	in
Grade:	**Extreme**		Outlet Size:	**16**	in
Body Diameter:	**42**	in	Body Length:	**234**	in
Estimated weight:	**2575**	lbs	Estimated Back Pressure:	**9.10**	in of WC
	1168	Kg		**22.7**	mbar
Core Part Number:	**3ECI-RE1O-154248-300-35-CH1000**	Qty **2**	Speed through inlet:	**6862**	ft/min

Emission:

Min. Temp. at Core Face:	**932**	°F	**500**	°C	Catalyst Type:	**Oxidation**
Max. Temp. at Core Face:	**963**	°F	**517**	°C		

	Pollutant					
	NOx	CO	NMNEHC/VOC	H_2CO	ORGANIC PM10	
Engine Out / Pre Emission:	**0.5**	**2.94**	**0.94**	**0.4**	**0**	g/bhp-hr
	127.53	**749.89**	**239.76**	**102.03**	**0.00**	mg/Nm3
Post Emission:	**0.498**	**0.088**	**0.282**	**0.060**	**0.000**	g/bhp-hr
	126.89	**22.50**	**71.93**	**15.30**	**0.00**	mg/Nm3
	0.5	***97.0***	***70.0***	***85.0***	***50.0***	% Reduction
	1.47	0.26	0.83	0.18		lb/hr
	6.44	1.14	3.65	0.78		tons/year operation **8760** hr/year
	60.9	10.8	34.5	7.3		ppmv
	36.6	6.5	20.8	4.4	0.0	ppmvd @ 15% O2

Acoustics:

Frequency Band (Hz):	31.5	63	125	250	500	1000	2000	4000	8000	
Raw Noise SPL (dB) at 3.28 ft.:	**97**	**102**	**108**	**108**	**109**	**117**	**124**	**125**	**123**	129.7 dBA
Estimated Attenuation (dB):	**21**	**47**	**53**	**57**	**57**	**54**	**50**	**49**	**47**	No Element
Plus:	**21**	**48**	**55**	**59**	**61**	**59**	**56**	**55**	**52**	One Element Layer
Silenced SPL (dB) at 10 ft.:	**54.3**	**50.3**	**48.3**	**47.3**	**42.3**	**51.3**	**61.3**	**64.3**	**64.3**	68.7 dBA

Warranty & Notes:

- **If Pre-Emission levels are not as noted above, contact IAC Acoustics for a re-quote.**
- To achieve Post Emissions levels detailed above, exhaust temperature and Pre-Emission data must be as specified.
- Maximum allowable exhaust temperature at core face is 1350°F.
- If applicable, the engine will require an air/fuel ratio controller to meet above emission levels. For Rich Burn engines λ must be 0.96 - 0.99.
- Catalyst cleaning/regeneration required, if initial backpressure increases by 2" of WC.
- Engine operation to be stable and reproducible.
- QAC is not designed to withstand a backfire, therefore measures should be taken prior to QAC unit to alleviate backfire pressure.
- Maximum lubrication oil consumption rate to be less than 0.0015 lb/bhp/hr.
- Lube oil sulfate ash contents should not exceed 0.5%.
- Phosphorus and/or Zinc should not exceed 5 ppmv in the exhaust stream.
- A high temperature alarm/shutdown to be maintained at downstream of catalyst at 1300°F.
- Fuel not to contain heavy or transition metals such as Pb, Ar, Zn, Cu, Sn, Fe, Ba, Ni, Cr etc.
- Chlorinated or Silicone containing compounds in the exhaust not to exceed 1 ppmv.
- Sulfur compounds in the exhaust gas stream not to exceed 25 ppmv.
- Performance guarantee is voided should the catalyst become masked or de-activated by any contaminant in the exhaust stream.
- Engine to be maintained and operated in accordance within manufacturer's recommended practice.
- Under no condition will IAC Acoustics assume any contingent liabilities.
- Operating manual is available online at www.maximsilencers.com or contact a Maxim sales representative.
- Nomenclature: QAC4-292-8, 4 is grade (Super Critical), 29 is catalyst block size, 2 is no. of catalyst(s) and 8 is flange diameter.
- Organic PM10 are estimate only and not a guarantee because of the variability in fuels and additives which change PM10.
- IAC's standard one year warranty applies.

Rev level: 83

Table 3.2-3. UNCONTROLLED EMISSION FACTORS FOR 4-STROKE RICH-BURN ENGINES[a]
(SCC 2-02-002-53)

Pollutant	Emission Factor (lb/MMBtu)[b] (fuel input)	Emission Factor Rating
Criteria Pollutants and Greenhouse Gases		
NO_x[c] 90 - 105% Load	2.21 E+00	A
NO_x[c] <90% Load	2.27 E+00	C
CO[c] 90 - 105% Load	3.72 E+00	A
CO[c] <90% Load	3.51 E+00	C
CO_2[d]	1.10 E+02	A
SO_2[e]	5.88 E-04	A
TOC[f]	3.58 E-01	C
Methane[g]	2.30 E-01	C
VOC[h]	2.96 E-02	C
PM10 (filterable)[i,j]	9.50 E-03	E
PM2.5 (filterable)[j]	9.50 E-03	E
PM Condensable[k]	9.91 E-03	E
Trace Organic Compounds		
1,1,2,2-Tetrachloroethane[l]	2.53 E-05	C
1,1,2-Trichloroethane[l]	<1.53 E-05	E
1,1-Dichloroethane	<1.13 E-05	E
1,2-Dichloroethane	<1.13 E-05	E
1,2-Dichloropropane	<1.30 E-05	E
1,3-Butadiene[l]	6.63 E-04	D
1,3-Dichloropropene[l]	<1.27 E-05	E
Acetaldehyde[l,m]	2.79 E-03	C
Acrolein[l,m]	2.63 E-03	C
Benzene[l]	1.58 E-03	B
Butyr/isobutyraldehyde	4.86 E-05	D
Carbon Tetrachloride[l]	<1.77 E-05	E

Table 3.2-3. UNCONTROLLED EMISSION FACTORS FOR 4-STROKE RICH-BURN ENGINES (Concluded)

Pollutant	Emission Factor (lb/MMBtu)[b] (fuel input)	Emission Factor Rating
Chlorobenzene[l]	<1.29 E-05	E
Chloroform[l]	<1.37 E-05	E
Ethane[n]	7.04 E-02	C
Ethylbenzene[l]	<2.48 E-05	E
Ethylene Dibromide[l]	<2.13 E-05	E
Formaldehyde[l,m]	2.05 E-02	A
Methanol[l]	3.06 E-03	D
Methylene Chloride[l]	4.12 E-05	C
Naphthalene[l]	<9.71 E-05	E
PAH[l]	1.41 E-04	D
Styrene[l]	<1.19 E-05	E
Toluene[l]	5.58 E-04	A
Vinyl Chloride[l]	<7.18 E-06	E
Xylene[l]	1.95 E-04	A

[a] Reference 7. Factors represent uncontrolled levels. For NO_x, CO, and PM-10, "uncontrolled" means no combustion or add-on controls; however, the factor may include turbocharged units. For all other pollutants, "uncontrolled" means no oxidation control; the data set may include units with control techniques used for NOx control, such as PCC and SCR for lean burn engines, and PSC for rich burn engines. Factors are based on large population of engines. Factors are for engines at all loads, except as indicated. SCC = Source Classification Code. TOC = Total Organic Compounds. PM10 = Particulate Matter ≤ 10 microns (μm) aerodynamic diameter. A "<" sign in front of a factor means that the corresponding emission factor is based on one-half of the method detection limit.

[b] Emission factors were calculated in units of (lb/MMBtu) based on procedures in EPA Method 19. To convert from (lb/MMBtu) to (lb/10^6 scf), multiply by the heat content of the fuel. If the heat content is not available, use 1020 Btu/scf. To convert from (lb/MMBtu) to (lb/hp-hr) use the following equation:

$$\text{lb/hp-hr} = (\text{lb/MMBtu})(\text{heat input, MMBtu/hr})(\text{1/operating HP, 1/hp})$$

[c] Emission tests with unreported load conditions were not included in the data set.

[d] Based on 99.5% conversion of the fuel carbon to CO_2. CO_2 [lb/MMBtu] = (3.67)(%CON)(C)(D)(1/h), where %CON = percent conversion of fuel carbon to CO_2,

C = carbon content of fuel by weight (0.75), D = density of fuel, 4.1 E+04 lb/10^6 scf, and h = heating value of natural gas (assume 1020 Btu/scf at 60°F).

[e] Based on 100% conversion of fuel sulfur to SO_2. Assumes sulfur content in natural gas of 2,000 gr/10^6scf.

[f] Emission factor for TOC is based on measured emission levels from 6 source tests.

[g] Emission factor for methane is determined by subtracting the VOC and ethane emission factors from the TOC emission factor.

[h] VOC emission factor is based on the sum of the emission factors for all speciated organic compounds. Methane and ethane emissions were not measured for this engine category.

[i] No data were available for uncontrolled engines. PM10 emissions are for engines equipped with a PCC.

[j] Considered ≤ 1 μm in aerodynamic diameter. Therefore, for filterable PM emissions, PM10(filterable) = PM2.5(filterable).

[k] No data were available for condensable emissions. The presented emission factor reflects emissions from 4SLB engines.

[l] Hazardous Air Pollutant as defined by Section 112(b) of the Clean Air Act.

[m] For rich-burn engines, no interference is suspected in quantifying aldehyde emissions. The presented emission factors are based on FTIR and CARB 430 emissions data measurements.

[n] Ethane emission factor is determined by subtracting the VOC emission factor from the NMHC emission factor.

Table 1.4-1. EMISSION FACTORS FOR NITROGEN OXIDES (NO_x) AND CARBON MONOXIDE (CO) FROM NATURAL GAS COMBUSTION[a]

Combustor Type (MMBtu/hr Heat Input) [SCC]	NO_x[b]		CO	
	Emission Factor ($lb/10^6$ scf)	Emission Factor Rating	Emission Factor ($lb/10^6$ scf)	Emission Factor Rating
Large Wall-Fired Boilers (>100) [1-01-006-01, 1-02-006-01, 1-03-006-01]				
Uncontrolled (Pre-NSPS)[c]	280	A	84	B
Uncontrolled (Post-NSPS)[c]	190	A	84	B
Controlled - Low NO_x burners	140	A	84	B
Controlled - Flue gas recirculation	100	D	84	B
Small Boilers (<100) [1-01-006-02, 1-02-006-02, 1-03-006-02, 1-03-006-03]				
Uncontrolled	100	B	84	B
Controlled - Low NO_x burners	50	D	84	B
Controlled - Low NO_x burners/Flue gas recirculation	32	C	84	B
Tangential-Fired Boilers (All Sizes) [1-01-006-04]				
Uncontrolled	170	A	24	C
Controlled - Flue gas recirculation	76	D	98	D
Residential Furnaces (<0.3) [No SCC]				
Uncontrolled	94	B	40	B

[a] Reference 11. Units are in pounds of pollutant per million standard cubic feet of natural gas fired. To convert from $lb/10^6$ scf to $kg/10^6$ m^3, multiply by 16. Emission factors are based on an average natural gas higher heating value of 1,020 Btu/scf. To convert from $1b/10^6$ scf to lb/MMBtu, divide by 1,020. The emission factors in this table may be converted to other natural gas heating values by multiplying the given emission factor by the ratio of the specified heating value to this average heating value. SCC = Source Classification Code. ND = no data. NA = not applicable.

[b] Expressed as NO_2. For large and small wall fired boilers with SNCR control, apply a 24 percent reduction to the appropriate NO_X emission factor. For tangential-fired boilers with SNCR control, apply a 13 percent reduction to the appropriate NO_X emission factor.

[c] NSPS=New Source Performance Standard as defined in 40 CFR 60 Subparts D and Db. Post-NSPS units are boilers with greater than 250 MMBtu/hr of heat input that commenced construction modification, or reconstruction after August 17, 1971, and units with heat input capacities between 100 and 250 MMBtu/hr that commenced construction modification, or reconstruction after June 19, 1984.

TABLE 1.4-3. EMISSION FACTORS FOR SPECIATED ORGANIC COMPOUNDS FROM NATURAL GAS COMBUSTION[a]

CAS No.	Pollutant	Emission Factor ($lb/10^6$ scf)	Emission Factor Rating
91-57-6	2-Methylnaphthalene[b, c]	2.4E-05	D
56-49-5	3-Methylchloranthrene[b, c]	<1.8E-06	E
	7,12-Dimethylbenz(a)anthracene[b,c]	<1.6E-05	E
83-32-9	Acenaphthene[b,c]	<1.8E-06	E
203-96-8	Acenaphthylene[b,c]	<1.8E-06	E
120-12-7	Anthracene[b,c]	<2.4E-06	E
56-55-3	Benz(a)anthracene[b,c]	<1.8E-06	E
71-43-2	Benzene[b]	2.1E-03	B
50-32-8	Benzo(a)pyrene[b,c]	<1.2E-06	E
205-99-2	Benzo(b)fluoranthene[b,c]	<1.8E-06	E
191-24-2	Benzo(g,h,i)perylene[b,c]	<1.2E-06	E
205-82-3	Benzo(k)fluoranthene[b,c]	<1.8E-06	E
106-97-8	Butane	2.1E+00	E
218-01-9	Chrysene[b,c]	<1.8E-06	E
53-70-3	Dibenzo(a,h)anthracene[b,c]	<1.2E-06	E
25321-22-6	Dichlorobenzene[b]	1.2E-03	E
74-84-0	Ethane	3.1E+00	E
206-44-0	Fluoranthene[b,c]	3.0E-06	E
86-73-7	Fluorene[b,c]	2.8E-06	E
50-00-0	Formaldehyde[b]	7.5E-02	B
110-54-3	Hexane[b]	1.8E+00	E
193-39-5	Indeno(1,2,3-cd)pyrene[b,c]	<1.8E-06	E
91-20-3	Naphthalene[b]	6.1E-04	E
109-66-0	Pentane	2.6E+00	E
85-01-8	Phenanathrene[b,c]	1.7E-05	D

TABLE 1.4-3. EMISSION FACTORS FOR SPECIATED ORGANIC COMPOUNDS FROM NATURAL GAS COMBUSTION (Continued)

CAS No.	Pollutant	Emission Factor ($lb/10^6$ scf)	Emission Factor Rating
74-98-6	Propane	1.6E+00	E
129-00-0	Pyrene[b, c]	5.0E-06	E
108-88-3	Toluene[b]	3.4E-03	C

[a] Reference 11. Units are in pounds of pollutant per million standard cubic feet of natural gas fired. Data are for all natural gas combustion sources. To convert from $lb/10^6$ scf to $kg/10^6$ m^3, multiply by 16. To convert from $1b/10^6$ scf to lb/MMBtu, divide by 1,020. Emission Factors preceeded with a less-than symbol are based on method detection limits.

[b] Hazardous Air Pollutant (HAP) as defined by Section 112(b) of the Clean Air Act.

[c] HAP because it is Polycyclic Organic Matter (POM). POM is a HAP as defined by Section 112(b) of the Clean Air Act.

[d] The sum of individual organic compounds may exceed the VOC and TOC emission factors due to differences in test methods and the availability of test data for each pollutant.

loading operation, resulting in high levels of vapor generation and loss. If the turbulence is great enough, liquid droplets will be entrained in the vented vapors.

A second method of loading is submerged loading. Two types are the submerged fill pipe method and the bottom loading method. In the submerged fill pipe method, the fill pipe extends almost to the bottom of the cargo tank. In the bottom loading method, a permanent fill pipe is attached to the cargo tank bottom. During most of submerged loading by both methods, the fill pipe opening is below the liquid surface level. Liquid turbulence is controlled significantly during submerged loading, resulting in much lower vapor generation than encountered during splash loading.

The recent loading history of a cargo carrier is just as important a factor in loading losses as the method of loading. If the carrier has carried a nonvolatile liquid such as fuel oil, or has just been cleaned, it will contain vapor-free air. If it has just carried gasoline and has not been vented, the air in the carrier tank will contain volatile organic vapors, which will be expelled during the loading operation along with newly generated vapors.

Cargo carriers are sometimes designated to transport only one product, and in such cases are practicing "dedicated service". Dedicated gasoline cargo tanks return to a loading terminal containing air fully or partially saturated with vapor from the previous load. Cargo tanks may also be "switch loaded" with various products, so that a nonvolatile product being loaded may expel the vapors remaining from a previous load of a volatile product such as gasoline. These circumstances vary with the type of cargo tank and with the ownership of the carrier, the petroleum liquids being transported, geographic location, and season of the year.

One control measure for vapors displaced during liquid loading is called "vapor balance service", in which the cargo tank retrieves the vapors displaced during product unloading at bulk plants or service stations and transports the vapors back to the loading terminal. Figure 5.2-5 shows a tank truck in vapor balance service filling a service station underground tank and taking on displaced gasoline vapors for return to the terminal. A cargo tank returning to a bulk terminal in vapor balance service normally is saturated with organic vapors, and the presence of these vapors at the start of submerged loading of the tanker truck results in greater loading losses than encountered during nonvapor balance, or "normal", service. Vapor balance service is usually not practiced with marine vessels, although some vessels practice emission control by means of vapor transfer within their own cargo tanks during ballasting operations, discussed below.

Emissions from loading petroleum liquid can be estimated (with a probable error of ±30 percent)[4] using the following expression:

$$L_L = 12.46 \frac{SPM}{T} \quad (1)$$

where:

L_L = loading loss, pounds per 1000 gallons ($lb/10^3$ gal) of liquid loaded

S = a saturation factor (see Table 5.2-1)
P = true vapor pressure of liquid loaded, pounds per square inch absolute (psia) (see Figure 7.1-5, Figure 7.1-6, and Table 7.1-2)
M = molecular weight of vapors, pounds per pound-mole (lb/lb-mole) (see Table 7.1-2)
T = temperature of bulk liquid loaded, °R (°F + 460)

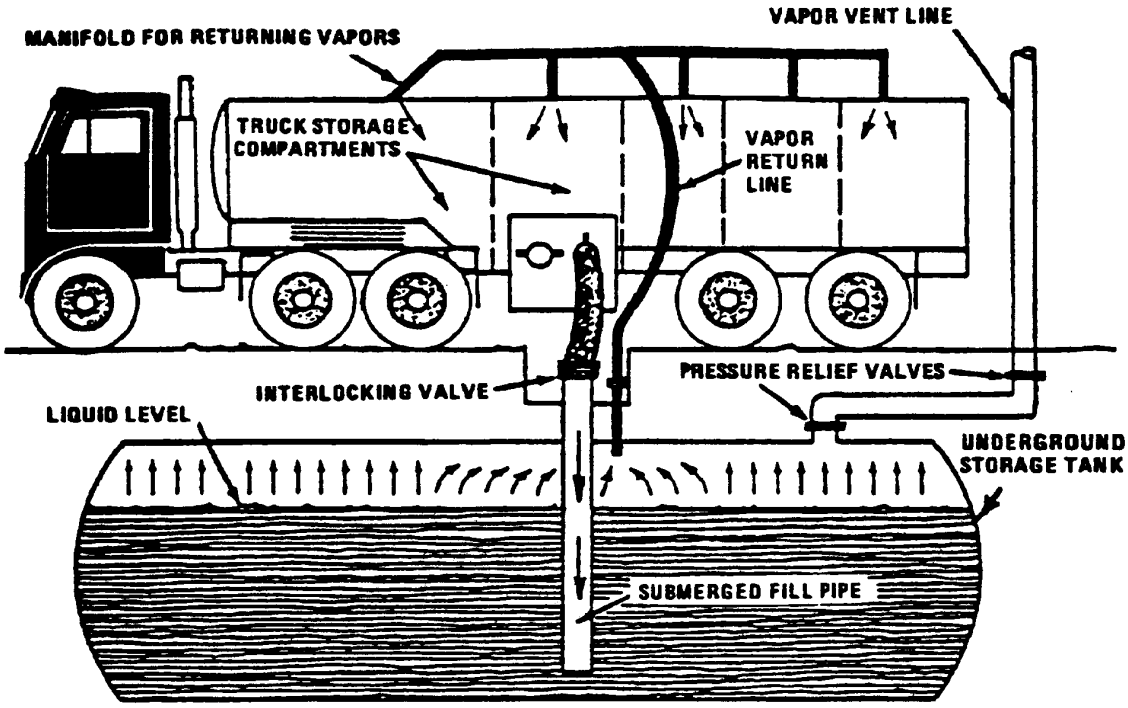


Figure 5.2-5. Tank truck unloading into a service station underground storage tank and practicing "vapor balance" form of emission control.

Table 5.2-1. SATURATION (S) FACTORS FOR CALCULATING PETROLEUM LIQUID LOADING LOSSES

Cargo Carrier	Mode Of Operation	S Factor
Tank trucks and rail tank cars	Submerged loading of a clean cargo tank	0.50
	Submerged loading: dedicated normal service	0.60
	Submerged loading: dedicated vapor balance service	1.00
	Splash loading of a clean cargo tank	1.45
	Splash loading: dedicated normal service	1.45
	Splash loading: dedicated vapor balance service	1.00
Marine vessels[a]	Submerged loading: ships	0.2
	Submerged loading: barges	0.5

[a] For products other than gasoline and crude oil. For marine loading of gasoline, use factors from Table 5.2-2. For marine loading of crude oil, use Equations 2 and 3 and Table 5.2-3.

Since flares do not lend themselves to conventional emission testing techniques, only a few attempts have been made to characterize flare emissions. Recent EPA tests using propylene as flare gas indicated that efficiencies of 98 percent can be achieved when burning an offgas with at least 11,200 kJ/m^3 (300 Btu/ft^3). The tests conducted on steam-assisted flares at velocities as low as 39.6 meters per minute (m/min) (130 ft/min) to 1140 m/min (3750 ft/min), and on air-assisted flares at velocities of 180 m/min (617 ft/min) to 3960 m/min (13,087 ft/min) indicated that variations in incoming gas flow rates have no effect on the combustion efficiency. Flare gases with less than 16,770 kJ/m^3 (450 Btu/ft^3) do not smoke.

Table 13.5-1 presents flare emission factors, and Table 13.5-2 presents emission composition data obtained from the EPA tests.[1] Crude propylene was used as flare gas during the tests. Methane was a major fraction of hydrocarbons in the flare emissions, and acetylene was the dominant intermediate hydrocarbon species. Many other reports on flares indicate that acetylene is always formed as a stable intermediate product. The acetylene formed in the combustion reactions may react further with hydrocarbon radicals to form polyacetylenes followed by polycyclic hydrocarbons.[2]

In flaring waste gases containing no nitrogen compounds, NO is formed either by the fixation of atmospheric nitrogen (N) with oxygen (O) or by the reaction between the hydrocarbon radicals present in the combustion products and atmospheric nitrogen, by way of the intermediate stages, HCN, CN, and OCN.[2] Sulfur compounds contained in a flare gas stream are converted to SO_2 when burned. The amount of SO_2 emitted depends directly on the quantity of sulfur in the flared gases.

Table 13.5-1 (English Units). EMISSION FACTORS FOR FLARE OPERATIONS[a]

EMISSION FACTOR RATING: B

Component	Emission Factor (lb/10^6 Btu)
Total hydrocarbons[b]	0.14
Carbon monoxide	0.37
Nitrogen oxides	0.068
Soot[c]	0 - 274

[a] Reference 1. Based on tests using crude propylene containing 80% propylene and 20% propane.
[b] Measured as methane equivalent.
[c] Soot in concentration values: nonsmoking flares, 0 micrograms per liter (µg/L); lightly smoking flares, 40 µg/L; average smoking flares, 177 µg/L; and heavily smoking flares, 274 µg/L.

TABLE 2-4. OIL AND GAS PRODUCTION OPERATIONS AVERAGE EMISSION FACTORS (kg/hr/source)

Equipment Type	Service[a]	Emission Factor (kg/hr/source)[b]
Valves	Gas	4.5E-03
	Heavy Oil	8.4E-06
	Light Oil	2.5E-03
	Water/Oil	9.8E-05
Pump seals	Gas	2.4E-03
	Heavy Oil	NA
	Light Oil	1.3E-02
	Water/Oil	2.4E-05
Others[c]	Gas	8.8E-03
	Heavy Oil	3.2E-05
	Light Oil	7.5E-03
	Water/Oil	1.4E-02
Connectors	Gas	2.0E-04
	Heavy Oil	7.5E-06
	Light Oil	2.1E-04
	Water/Oil	1.1E-04
Flanges	Gas	3.9E-04
	Heavy Oil	3.9E-07
	Light Oil	1.1E-04
	Water/Oil	2.9E-06
Open-ended lines	Gas	2.0E-03
	Heavy Oil	1.4E-04
	Light Oil	1.4E-03
	Water/Oil	2.5E-04

[a]Water/Oil emission factors apply to water streams in oil service with a water content greater than 50%, from the point of origin to the point where the water content reaches 99%. For water streams with a water content greater than 99%, the emission rate is considered negligible.

[b]These factors are for total organic compound emission rates (including non-VOC's such as methane and ethane) and apply to light crude, heavy crude, gas plant, gas production, and off shore facilities. "NA" indicates that not enough data were available to develop the indicated emission factor.

[c]The "other" equipment type was derived from compressors, diaphrams, drains, dump arms, hatches, instruments, meters, pressure relief valves, polished rods, relief valves, and vents. This "other" equipment type should be applied for any equipment type other than connectors, flanges, open-ended lines, pumps, or valves.

GRI-GLYCalc VERSION 4.0 - SUMMARY OF INPUT VALUES

Case Name: Fork Ridge 35 MMscfd TEG Dehydrator
File Name: Fork Ridge_GLYCalc.ddf
Date: November 18, 2015

DESCRIPTION:

Description: Ext Gas Analysis calculated by ProMax. Inlet gas temp = 70F, pressure = 900 psig. Kimray 45015 PV (7.5 gpm) glycol pump. Flash tank off gas to combustor via tanks. Still vent emissions to BTEX Skid w/ overheads to reboiler.

Annual Hours of Operation: 8760.0 hours/yr

WET GAS:

Temperature: 70.00 deg. F
Pressure: 900.00 psig
Wet Gas Water Content: Saturated

Component	Conc. (vol %)
Carbon Dioxide	0.1572
Nitrogen	0.3611
Methane	76.8093
Ethane	14.8525
Propane	4.9170
Isobutane	0.6554
n-Butane	1.2092
Isopentane	0.3167
n-Pentane	0.2663
Cyclopentane	0.0034
n-Hexane	0.0791
Cyclohexane	0.0087
Other Hexanes	0.1366
Heptanes	0.0784
Methylcyclohexane	0.0145
Benzene	0.0017
Toluene	0.0032
Ethylbenzene	0.0012
Xylenes	0.0028
C8+ Heavies	0.0370

DRY GAS:

Flow Rate: 35.0 MMSCF/day
Water Content: 7.0 lbs. H2O/MMSCF

LEAN GLYCOL:

Glycol Type: TEG
Water Content: 1.5 wt% H2O
Flow Rate: 7.5 gpm

PUMP:

Glycol Pump Type: Gas Injection
Gas Injection Pump Volume Ratio: 0.080 acfm gas/gpm glycol

FLASH TANK:

Flash Control: Combustion device
Flash Control Efficiency: 98.00 %
Temperature: 150.0 deg. F
Pressure: 50.0 psig

REGENERATOR OVERHEADS CONTROL DEVICE:

Control Device: Condenser
Temperature: 100.0 deg. F
Pressure: 14.0 psia

Control Device: Combustion Device
Destruction Efficiency: 50.0 %
Excess Oxygen: 5.0 %
Ambient Air Temperature: 50.0 deg. F

GRI-GLYCalc VERSION 4.0 - AGGREGATE CALCULATIONS REPORT

Case Name: Fork Ridge 35 MMscfd TEG Dehydrator
File Name: Fork Ridge_GLYCalc.ddf
Date: November 18, 2015

DESCRIPTION:

Description: Ext Gas Analysis calculated by ProMax. Inlet gas temp = 70F, pressure = 900 psig. Kimray 45015 PV (7.5 gpm) glycol pump. Flash tank off gas to combustor via tanks. Still vent emissions to BTEX Skid w/ overheads to reboiler.

Annual Hours of Operation: 8760.0 hours/yr

EMISSIONS REPORTS:

CONTROLLED REGENERATOR EMISSIONS

Component	lbs/hr	lbs/day	tons/yr
Methane	0.3658	8.779	1.6022
Ethane	0.5282	12.677	2.3136
Propane	0.5340	12.816	2.3389
Isobutane	0.1401	3.363	0.6137
n-Butane	0.3531	8.474	1.5466
Isopentane	0.0961	2.305	0.4207
n-Pentane	0.1003	2.407	0.4393
Cyclopentane	0.0094	0.225	0.0411
n-Hexane	0.0453	1.088	0.1986
Cyclohexane	0.0354	0.849	0.1549
Other Hexanes	0.0657	1.576	0.2876
Heptanes	0.0604	1.449	0.2645
Methylcyclohexane	0.0438	1.052	0.1919
Benzene	0.0855	2.053	0.3747
Toluene	0.0974	2.338	0.4266
Ethylbenzene	0.0211	0.506	0.0923
Xylenes	0.0529	1.269	0.2316
C8+ Heavies	0.0005	0.011	0.0021
Total Emissions	2.6349	63.238	11.5409
Total Hydrocarbon Emissions	2.6349	63.238	11.5409
Total VOC Emissions	1.7409	41.781	7.6250
Total HAP Emissions	0.3022	7.254	1.3238
Total BTEX Emissions	0.2569	6.166	1.1252

UNCONTROLLED REGENERATOR EMISSIONS

Component	lbs/hr	lbs/day	tons/yr

Component	lbs/hr	lbs/day	tons/yr
Methane	0.7335	17.605	3.2129
Ethane	1.0702	25.685	4.6875
Propane	1.1438	27.452	5.0099
Isobutane	0.3218	7.722	1.4093
n-Butane	0.8513	20.432	3.7289
Isopentane	0.2954	7.090	1.2940
n-Pentane	0.3444	8.266	1.5086
Cyclopentane	0.0380	0.913	0.1666
n-Hexane	0.2586	6.206	1.1327
Cyclohexane	0.2546	6.111	1.1153
Other Hexanes	0.2989	7.174	1.3093
Heptanes	0.7657	18.378	3.3539
Methylcyclohexane	0.5734	13.761	2.5114
Benzene	0.7329	17.591	3.2103
Toluene	2.3298	55.916	10.2047
Ethylbenzene	1.3142	31.541	5.7562
Xylenes	4.0180	96.432	17.5988
C8+ Heavies	1.7300	41.519	7.5773
Total Emissions	17.0748	409.794	74.7875
Total Hydrocarbon Emissions	17.0748	409.794	74.7875
Total VOC Emissions	15.2710	366.504	66.8871
Total HAP Emissions	8.6536	207.686	37.9026
Total BTEX Emissions	8.3950	201.479	36.7700

FLASH GAS EMISSIONS

Component	lbs/hr	lbs/day	tons/yr
Methane	2.0273	48.655	8.8795
Ethane	0.8779	21.069	3.8450
Propane	0.4723	11.336	2.0689
Isobutane	0.0914	2.194	0.4004
n-Butane	0.1890	4.536	0.8277
Isopentane	0.0598	1.434	0.2618
n-Pentane	0.0567	1.360	0.2483
Cyclopentane	0.0015	0.037	0.0067
n-Hexane	0.0244	0.586	0.1069
Cyclohexane	0.0060	0.144	0.0262
Other Hexanes	0.0371	0.890	0.1625
Heptanes	0.0365	0.875	0.1597
Methylcyclohexane	0.0109	0.260	0.0475
Benzene	0.0028	0.066	0.0121
Toluene	0.0058	0.140	0.0256
Ethylbenzene	0.0020	0.047	0.0087
Xylenes	0.0043	0.103	0.0189
C8+ Heavies	0.0118	0.282	0.0515
Total Emissions	3.9173	94.015	17.1578
Total Hydrocarbon Emissions	3.9173	94.015	17.1578
Total VOC Emissions	1.0122	24.292	4.4333
Total HAP Emissions	0.0393	0.943	0.1721
Total BTEX Emissions	0.0149	0.357	0.0652

FLASH TANK OFF GAS

Component	lbs/hr	lbs/day	tons/yr
Methane	101.3636	2432.727	443.9726
Ethane	43.8932	1053.436	192.2521
Propane	23.6172	566.812	103.4432
Isobutane	4.5709	109.701	20.0205
n-Butane	9.4490	226.776	41.3867
Isopentane	2.9883	71.719	13.0887
n-Pentane	2.8339	68.014	12.4126
Cyclopentane	0.0763	1.831	0.3342
n-Hexane	1.2206	29.295	5.3463
Cyclohexane	0.2991	7.178	1.3099
Other Hexanes	1.8546	44.509	8.1229
Heptanes	1.8234	43.761	7.9864
Methylcyclohexane	0.5427	13.024	2.3768
Benzene	0.1378	3.306	0.6034
Toluene	0.2925	7.020	1.2811
Ethylbenzene	0.0988	2.371	0.4327
Xylenes	0.2154	5.168	0.9432
C8+ Heavies	0.5884	14.121	2.5770
Total Emissions	195.8654	4700.769	857.8904
Total Hydrocarbon Emissions	195.8654	4700.769	857.8904
Total VOC Emissions	50.6086	1214.606	221.6656
Total HAP Emissions	1.9650	47.160	8.6067
Total BTEX Emissions	0.7444	17.865	3.2604

COMBINED REGENERATOR VENT/FLASH GAS EMISSIONS

Component	lbs/hr	lbs/day	tons/yr
Methane	2.3931	57.434	10.4816
Ethane	1.4061	33.746	6.1587
Propane	1.0063	24.152	4.4078
Isobutane	0.2315	5.557	1.0141
n-Butane	0.5421	13.010	2.3743
Isopentane	0.1558	3.740	0.6825
n-Pentane	0.1570	3.767	0.6875
Cyclopentane	0.0109	0.262	0.0477
n-Hexane	0.0697	1.674	0.3055
Cyclohexane	0.0414	0.992	0.1811
Other Hexanes	0.1028	2.466	0.4501
Heptanes	0.0968	2.324	0.4242
Methylcyclohexane	0.0547	1.312	0.2395
Benzene	0.0883	2.119	0.3868
Toluene	0.1033	2.478	0.4522
Ethylbenzene	0.0230	0.553	0.1010
Xylenes	0.0572	1.372	0.2505
C8+ Heavies	0.0122	0.294	0.0536
Total Emissions	6.5522	157.253	28.6987

Total Hydrocarbon Emissions	6.5522	157.253	28.6987
Total VOC Emissions	2.7530	66.073	12.0584
Total HAP Emissions	0.3415	8.197	1.4960
Total BTEX Emissions	0.2718	6.523	1.1905

COMBINED REGENERATOR VENT/FLASH GAS EMISSION CONTROL REPORT:

Component	Uncontrolled tons/yr	Controlled tons/yr	% Reduction
Methane	447.1855	10.4816	97.66
Ethane	196.9396	6.1587	96.87
Propane	108.4532	4.4078	95.94
Isobutane	21.4298	1.0141	95.27
n-Butane	45.1156	2.3743	94.74
Isopentane	14.3826	0.6825	95.25
n-Pentane	13.9211	0.6875	95.06
Cyclopentane	0.5007	0.0477	90.47
n-Hexane	6.4789	0.3055	95.28
Cyclohexane	2.4253	0.1811	92.53
Other Hexanes	9.4323	0.4501	95.23
Heptanes	11.3403	0.4242	96.26
Methylcyclohexane	4.8882	0.2395	95.10
Benzene	3.8137	0.3868	89.86
Toluene	11.4858	0.4522	96.06
Ethylbenzene	6.1889	0.1010	98.37
Xylenes	18.5420	0.2505	98.65
C8+ Heavies	10.1543	0.0536	99.47
Total Emissions	932.6779	28.6987	96.92
Total Hydrocarbon Emissions	932.6779	28.6987	96.92
Total VOC Emissions	288.5527	12.0584	95.82
Total HAP Emissions	46.5093	1.4960	96.78
Total BTEX Emissions	40.0304	1.1905	97.03

EQUIPMENT REPORTS:

CONDENSER AND COMBUSTION DEVICE

Condenser Outlet Temperature:	100.00 deg. F
Condenser Pressure:	14.00 psia
Condenser Duty:	1.34e-002 MM BTU/hr
Hydrocarbon Recovery:	0.95 bbls/day
Produced Water:	2.40 bbls/day
Ambient Temperature:	50.00 deg. F
Excess Oxygen:	5.00 %
Combustion Efficiency:	50.00 %
Supplemental Fuel Requirement:	1.34e-002 MM BTU/hr

Component	Emitted	Destroyed
Methane	49.87%	50.13%
Ethane	49.36%	50.64%
Propane	46.69%	53.31%
Isobutane	43.54%	56.46%
n-Butane	41.48%	58.52%
Isopentane	32.52%	67.48%
n-Pentane	29.12%	70.88%
Cyclopentane	24.65%	75.35%
n-Hexane	17.53%	82.47%
Cyclohexane	13.89%	86.11%
Other Hexanes	21.97%	78.03%
Heptanes	7.89%	92.11%
Methylcyclohexane	7.64%	92.36%
Benzene	11.67%	88.33%
Toluene	4.18%	95.82%
Ethylbenzene	1.60%	98.40%
Xylenes	1.32%	98.68%
C8+ Heavies	0.03%	99.97%

ABSORBER

NOTE: Because the Calculated Absorber Stages was below the minimum allowed, GRI-GLYCalc has set the number of Absorber Stages to 1.25 and has calculated a revised Dry Gas Dew Point.

Calculated Absorber Stages:	1.25	
Calculated Dry Gas Dew Point:	0.93	lbs. H2O/MMSCF
Temperature:	70.0	deg. F
Pressure:	900.0	psig
Dry Gas Flow Rate:	35.0000	MMSCF/day
Glycol Losses with Dry Gas:	0.2254	lb/hr
Wet Gas Water Content:	Saturated	
Calculated Wet Gas Water Content:	25.32	lbs. H2O/MMSCF
Calculated Lean Glycol Recirc. Ratio:	12.65	gal/lb H2O

Component	Remaining in Dry Gas	Absorbed in Glycol
Water	3.67%	96.33%
Carbon Dioxide	99.65%	0.35%
Nitrogen	99.97%	0.03%
Methane	99.98%	0.02%
Ethane	99.93%	0.07%
Propane	99.90%	0.10%
Isobutane	99.86%	0.14%
n-Butane	99.81%	0.19%
Isopentane	99.82%	0.18%
n-Pentane	99.76%	0.24%
Cyclopentane	98.93%	1.07%
n-Hexane	99.63%	0.37%
Cyclohexane	98.22%	1.78%

Other Hexanes	99.72%	0.28%
Heptanes	99.34%	0.66%
Methylcyclohexane	98.15%	1.85%
Benzene	82.83%	17.17%
Toluene	76.97%	23.03%
Ethylbenzene	72.19%	27.81%
Xylenes	63.47%	36.53%
C8+ Heavies	99.24%	0.76%

FLASH TANK

Flash Control: Combustion device
Flash Control Efficiency: 98.00 %
Flash Temperature: 150.0 deg. F
Flash Pressure: 50.0 psig

Component	Left in Glycol	Removed in Flash Gas
Water	99.48%	0.52%
Carbon Dioxide	6.76%	93.24%
Nitrogen	0.71%	99.29%
Methane	0.72%	99.28%
Ethane	2.38%	97.62%
Propane	4.62%	95.38%
Isobutane	6.58%	93.42%
n-Butane	8.27%	91.73%
Isopentane	9.22%	90.78%
n-Pentane	11.08%	88.92%
Cyclopentane	33.55%	66.45%
n-Hexane	17.75%	82.25%
Cyclohexane	47.55%	52.45%
Other Hexanes	14.40%	85.60%
Heptanes	29.85%	70.15%
Methylcyclohexane	53.14%	46.86%
Benzene	84.96%	15.04%
Toluene	89.72%	10.28%
Ethylbenzene	93.73%	6.27%
Xylenes	95.57%	4.43%
C8+ Heavies	77.12%	22.88%

REGENERATOR

No Stripping Gas used in regenerator.

Component	Remaining in Glycol	Distilled Overhead
Water	64.30%	35.70%
Carbon Dioxide	0.00%	100.00%
Nitrogen	0.00%	100.00%
Methane	0.00%	100.00%

Ethane	0.00%	100.00%
Propane	0.00%	100.00%
Isobutane	0.00%	100.00%
n-Butane	0.00%	100.00%
Isopentane	2.63%	97.37%
n-Pentane	2.49%	97.51%
Cyclopentane	1.26%	98.74%
n-Hexane	1.86%	98.14%
Cyclohexane	6.09%	93.91%
Other Hexanes	4.14%	95.86%
Heptanes	1.30%	98.70%
Methylcyclohexane	6.84%	93.16%
Benzene	5.82%	94.18%
Toluene	8.74%	91.26%
Ethylbenzene	11.03%	88.97%
Xylenes	13.45%	86.55%
C8+ Heavies	12.75%	87.25%

STREAM REPORTS:

WET GAS STREAM

Temperature: 70.00 deg. F
Pressure: 914.70 psia
Flow Rate: 1.46e+006 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	5.33e-002	3.70e+001
Carbon Dioxide	1.57e-001	2.66e+002
Nitrogen	3.61e-001	3.89e+002
Methane	7.68e+001	4.74e+004
Ethane	1.49e+001	1.72e+004
Propane	4.92e+000	8.34e+003
Isobutane	6.56e-001	1.47e+003
n-Butane	1.21e+000	2.70e+003
Isopentane	3.17e-001	8.79e+002
n-Pentane	2.66e-001	7.40e+002
Cyclopentane	3.36e-003	9.07e+000
n-Hexane	7.91e-002	2.62e+002
Cyclohexane	8.67e-003	2.81e+001
Other Hexanes	1.37e-001	4.53e+002
Heptanes	7.84e-002	3.02e+002
Methylcyclohexane	1.45e-002	5.46e+001
Benzene	1.67e-003	5.01e+000
Toluene	3.19e-003	1.13e+001
Ethylbenzene	1.24e-003	5.05e+000
Xylenes	2.82e-003	1.15e+001
C8+ Heavies	3.70e-002	2.42e+002

Total Components	100.00	8.08e+004

DRY GAS STREAM

Temperature: 70.00 deg. F
Pressure: 914.70 psia
Flow Rate: 1.46e+006 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	1.96e-003	1.36e+000
Carbon Dioxide	1.57e-001	2.65e+002
Nitrogen	3.61e-001	3.89e+002
Methane	7.69e+001	4.74e+004
Ethane	1.49e+001	1.72e+004
Propane	4.92e+000	8.34e+003
Isobutane	6.55e-001	1.46e+003
n-Butane	1.21e+000	2.70e+003
Isopentane	3.16e-001	8.78e+002
n-Pentane	2.66e-001	7.38e+002
Cyclopentane	3.33e-003	8.98e+000
n-Hexane	7.89e-002	2.61e+002
Cyclohexane	8.53e-003	2.76e+001
Other Hexanes	1.36e-001	4.52e+002
Heptanes	7.80e-002	3.00e+002
Methylcyclohexane	1.42e-002	5.36e+001
Benzene	1.38e-003	4.15e+000
Toluene	2.45e-003	8.69e+000
Ethylbenzene	8.93e-004	3.64e+000
Xylenes	1.79e-003	7.32e+000
C8+ Heavies	3.67e-002	2.40e+002
Total Components	100.00	8.07e+004

LEAN GLYCOL STREAM

Temperature: 70.00 deg. F
Flow Rate: 7.50e+000 gpm

Component	Conc. (wt%)	Loading (lb/hr)
TEG	9.85e+001	4.16e+003
Water	1.50e+000	6.33e+001
Carbon Dioxide	2.21e-012	9.33e-011
Nitrogen	2.49e-013	1.05e-011
Methane	8.51e-018	3.59e-016
Ethane	1.32e-007	5.58e-006
Propane	8.36e-009	3.53e-007
Isobutane	1.47e-009	6.20e-008
n-Butane	2.99e-009	1.26e-007
Isopentane	1.89e-004	7.98e-003

n-Pentane	2.09e-004	8.81e-003
Cyclopentane	1.15e-005	4.86e-004
n-Hexane	1.16e-004	4.89e-003
Cyclohexane	3.91e-004	1.65e-002
Other Hexanes	3.06e-004	1.29e-002
Heptanes	2.39e-004	1.01e-002
Methylcyclohexane	9.98e-004	4.21e-002
Benzene	1.07e-003	4.53e-002
Toluene	5.29e-003	2.23e-001
Ethylbenzene	3.86e-003	1.63e-001
Xylenes	1.48e-002	6.24e-001
C8+ Heavies	5.99e-003	2.53e-001
Total Components	100.00	4.22e+003

RICH GLYCOL AND PUMP GAS STREAM

Temperature: 70.00 deg. F
Pressure: 914.70 psia
Flow Rate: 8.04e+000 gpm
NOTE: Stream has more than one phase.

Component	Conc. (wt%)	Loading (lb/hr)
TEG	9.29e+001	4.16e+003
Water	2.21e+000	9.90e+001
Carbon Dioxide	3.23e-002	1.45e+000
Nitrogen	1.91e-002	8.56e-001
Methane	2.28e+000	1.02e+002
Ethane	1.01e+000	4.50e+001
Propane	5.54e-001	2.48e+001
Isobutane	1.09e-001	4.89e+000
n-Butane	2.30e-001	1.03e+001
Isopentane	7.36e-002	3.29e+000
n-Pentane	7.13e-002	3.19e+000
Cyclopentane	2.57e-003	1.15e-001
n-Hexane	3.32e-002	1.48e+000
Cyclohexane	1.28e-002	5.70e-001
Other Hexanes	4.84e-002	2.17e+000
Heptanes	5.81e-002	2.60e+000
Methylcyclohexane	2.59e-002	1.16e+000
Benzene	2.05e-002	9.16e-001
Toluene	6.36e-002	2.85e+000
Ethylbenzene	3.52e-002	1.58e+000
Xylenes	1.09e-001	4.86e+000
C8+ Heavies	5.75e-002	2.57e+000
Total Components	100.00	4.47e+003

FLASH TANK OFF GAS STREAM

Temperature: 150.00 deg. F
Pressure: 64.70 psia

Flow Rate: 3.34e+003 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	3.26e-001	5.17e-001
Carbon Dioxide	3.48e-001	1.35e+000
Nitrogen	3.45e-001	8.50e-001
Methane	7.18e+001	1.01e+002
Ethane	1.66e+001	4.39e+001
Propane	6.08e+000	2.36e+001
Isobutane	8.94e-001	4.57e+000
n-Butane	1.85e+000	9.45e+000
Isopentane	4.71e-001	2.99e+000
n-Pentane	4.46e-001	2.83e+000
Cyclopentane	1.24e-002	7.63e-002
n-Hexane	1.61e-001	1.22e+000
Cyclohexane	4.04e-002	2.99e-001
Other Hexanes	2.44e-001	1.85e+000
Heptanes	2.07e-001	1.82e+000
Methylcyclohexane	6.28e-002	5.43e-001
Benzene	2.00e-002	1.38e-001
Toluene	3.61e-002	2.92e-001
Ethylbenzene	1.06e-002	9.88e-002
Xylenes	2.30e-002	2.15e-001
C8+ Heavies	3.92e-002	5.88e-001
Total Components	100.00	1.99e+002

FLASH TANK GLYCOL STREAM

Temperature: 150.00 deg. F
Flow Rate: 7.60e+000 gpm

Component	Conc. (wt%)	Loading (lb/hr)
TEG	9.73e+001	4.16e+003
Water	2.30e+000	9.85e+001
Carbon Dioxide	2.29e-003	9.78e-002
Nitrogen	1.41e-004	6.04e-003
Methane	1.72e-002	7.34e-001
Ethane	2.50e-002	1.07e+000
Propane	2.68e-002	1.14e+000
Isobutane	7.53e-003	3.22e-001
n-Butane	1.99e-002	8.51e-001
Isopentane	7.10e-003	3.03e-001
n-Pentane	8.27e-003	3.53e-001
Cyclopentane	9.01e-004	3.85e-002
n-Hexane	6.17e-003	2.63e-001
Cyclohexane	6.35e-003	2.71e-001
Other Hexanes	7.30e-003	3.12e-001
Heptanes	1.82e-002	7.76e-001
Methylcyclohexane	1.44e-002	6.15e-001
Benzene	1.82e-002	7.78e-001

Toluene	5.97e-002	2.55e+000
Ethylbenzene	3.46e-002	1.48e+000
Xylenes	1.09e-001	4.64e+000
C8+ Heavies	4.64e-002	1.98e+000
Total Components	100.00	4.27e+003

FLASH GAS EMISSIONS

Flow Rate: 1.28e+004 scfh
Control Method: Combustion Device
Control Efficiency: 98.00

Component	Conc. (vol%)	Loading (lb/hr)
Water	6.23e+001	3.78e+002
Carbon Dioxide	3.71e+001	5.50e+002
Nitrogen	9.00e-002	8.50e-001
Methane	3.75e-001	2.03e+000
Ethane	8.67e-002	8.78e-001
Propane	3.18e-002	4.72e-001
Isobutane	4.67e-003	9.14e-002
n-Butane	9.65e-003	1.89e-001
Isopentane	2.46e-003	5.98e-002
n-Pentane	2.33e-003	5.67e-002
Cyclopentane	6.46e-005	1.53e-003
n-Hexane	8.41e-004	2.44e-002
Cyclohexane	2.11e-004	5.98e-003
Other Hexanes	1.28e-003	3.71e-002
Heptanes	1.08e-003	3.65e-002
Methylcyclohexane	3.28e-004	1.09e-002
Benzene	1.05e-004	2.76e-003
Toluene	1.88e-004	5.85e-003
Ethylbenzene	5.52e-005	1.98e-003
Xylenes	1.20e-004	4.31e-003
C8+ Heavies	2.05e-004	1.18e-002
Total Components	100.00	9.33e+002

REGENERATOR OVERHEADS STREAM

Temperature: 212.00 deg. F
Pressure: 14.70 psia
Flow Rate: 8.38e+002 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	8.84e+001	3.52e+001
Carbon Dioxide	1.01e-001	9.78e-002
Nitrogen	9.76e-003	6.04e-003
Methane	2.07e+000	7.34e-001
Ethane	1.61e+000	1.07e+000

Propane	1.17e+000	1.14e+000
Isobutane	2.51e-001	3.22e-001
n-Butane	6.63e-001	8.51e-001
Isopentane	1.85e-001	2.95e-001
n-Pentane	2.16e-001	3.44e-001
Cyclopentane	2.45e-002	3.80e-002
n-Hexane	1.36e-001	2.59e-001
Cyclohexane	1.37e-001	2.55e-001
Other Hexanes	1.57e-001	2.99e-001
Heptanes	3.46e-001	7.66e-001
Methylcyclohexane	2.64e-001	5.73e-001
Benzene	4.25e-001	7.33e-001
Toluene	1.14e+000	2.33e+000
Ethylbenzene	5.60e-001	1.31e+000
Xylenes	1.71e+000	4.02e+000
C8+ Heavies	4.60e-001	1.73e+000
Total Components	100.00	5.23e+001

CONDENSER PRODUCED WATER STREAM

Temperature: 100.00 deg. F
Flow Rate: 6.99e-002 gpm

Component	Conc. (wt%)	Loading (lb/hr)	(ppm)
Water	1.00e+002	3.50e+001	999608.
Carbon Dioxide	1.51e-003	5.27e-004	15.
Nitrogen	2.13e-006	7.47e-007	0.
Methane	5.25e-004	1.84e-004	5.
Ethane	9.13e-004	3.19e-004	9.
Propane	8.02e-004	2.80e-004	8.
Isobutane	1.17e-004	4.11e-005	1.
n-Butane	4.02e-004	1.41e-004	4.
Isopentane	7.94e-005	2.78e-005	1.
n-Pentane	9.04e-005	3.16e-005	1.
Cyclopentane	6.38e-005	2.23e-005	1.
n-Hexane	3.53e-005	1.23e-005	0.
Cyclohexane	1.66e-004	5.82e-005	2.
Other Hexanes	4.05e-005	1.42e-005	0.
Heptanes	2.67e-005	9.35e-006	0.
Methylcyclohexane	1.00e-004	3.50e-005	1.
Benzene	1.26e-002	4.42e-003	126.
Toluene	1.23e-002	4.29e-003	123.
Ethylbenzene	2.06e-003	7.22e-004	21.
Xylenes	7.36e-003	2.58e-003	74.
C8+ Heavies	1.16e-007	4.05e-008	0.
Total Components	100.00	3.50e+001	1000000.

CONDENSER RECOVERED OIL STREAM

Temperature: 100.00 deg. F
Flow Rate: 2.77e-002 gpm

Component	Conc. (wt%)	Loading (lb/hr)
Water	3.71e-002	4.38e-003
Carbon Dioxide	5.60e-003	6.61e-004
Nitrogen	1.78e-004	2.10e-005
Methane	1.49e-002	1.76e-003
Ethane	1.14e-001	1.34e-002
Propane	6.40e-001	7.55e-002
Isobutane	3.52e-001	4.15e-002
n-Butane	1.23e+000	1.45e-001
Isopentane	8.75e-001	1.03e-001
n-Pentane	1.22e+000	1.44e-001
Cyclopentane	1.63e-001	1.93e-002
n-Hexane	1.42e+000	1.68e-001
Cyclohexane	1.56e+000	1.84e-001
Other Hexanes	1.42e+000	1.68e-001
Heptanes	5.47e+000	6.45e-001
Methylcyclohexane	4.12e+000	4.86e-001
Benzene	4.73e+000	5.57e-001
Toluene	1.81e+001	2.13e+000
Ethylbenzene	1.08e+001	1.27e+000
Xylenes	3.31e+001	3.91e+000
C8+ Heavies	1.47e+001	1.73e+000
Total Components	100.00	1.18e+001

CONDENSER VENT STREAM

Temperature: 100.00 deg. F
Pressure: 14.00 psia
Flow Rate: 5.75e+001 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	6.85e+000	1.87e-001
Carbon Dioxide	1.45e+000	9.66e-002
Nitrogen	1.42e-001	6.02e-003
Methane	3.01e+001	7.32e-001
Ethane	2.32e+001	1.06e+000
Propane	1.60e+001	1.07e+000
Isobutane	3.18e+000	2.80e-001
n-Butane	8.01e+000	7.06e-001
Isopentane	1.76e+000	1.92e-001
n-Pentane	1.83e+000	2.01e-001
Cyclopentane	1.76e-001	1.87e-002
n-Hexane	6.94e-001	9.07e-002
Cyclohexane	5.54e-001	7.07e-002
Other Hexanes	1.00e+000	1.31e-001
Heptanes	7.95e-001	1.21e-001
Methylcyclohexane	5.88e-001	8.76e-002

Benzene	1.44e+000	1.71e-001
Toluene	1.39e+000	1.95e-001
Ethylbenzene	2.62e-001	4.21e-002
Xylenes	6.57e-001	1.06e-001
C8+ Heavies	3.63e-003	9.37e-004
Total Components	100.00	5.56e+000

COMBUSTION DEVICE OFF GAS STREAM

Temperature: 1000.00 deg. F
Pressure: 14.70 psia
Flow Rate: 2.63e+001 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Methane	3.28e+001	3.66e-001
Ethane	2.53e+001	5.28e-001
Propane	1.74e+001	5.34e-001
Isobutane	3.47e+000	1.40e-001
n-Butane	8.75e+000	3.53e-001
Isopentane	1.92e+000	9.61e-002
n-Pentane	2.00e+000	1.00e-001
Cyclopentane	1.93e-001	9.37e-003
n-Hexane	7.58e-001	4.53e-002
Cyclohexane	6.05e-001	3.54e-002
Other Hexanes	1.10e+000	6.57e-002
Heptanes	8.68e-001	6.04e-002
Methylcyclohexane	6.43e-001	4.38e-002
Benzene	1.58e+000	8.55e-002
Toluene	1.52e+000	9.74e-002
Ethylbenzene	2.86e-001	2.11e-002
Xylenes	7.17e-001	5.29e-002
C8+ Heavies	3.96e-003	4.68e-004
Total Components	100.00	2.63e+000

ANNUAL AIR-COOLED CONDENSER PERFORMANCE:

ANNUAL AIR-COOLED CONDENSER PERFORMANCE

Nearest Site for Air Temperature Data: Charleston, WV

Ambient Air Dry Bulb Temperature (deg. F)	Frequency (%)	Condenser Outlet Temperature (deg. F)
<=50	39.66	<=70
51-55	8.12	71-75
56-60	8.65	76-80
61-65	9.55	81-85
66-70	11.00	86-90
71-75	9.30	91-95
76-80	6.39	96-100

81-85	4.50	101-105
86-90	2.27	106-110
91-95	0.49	111-115
96-100	0.06	116-120
>100	0.01	>120

Condenser outlet temperature approach to ambient: 20.00 deg. F

Annual air-cooled condenser emissions and control efficiency:

	Uncontrolled emissions tons/year	Controlled emissions tons/year	% Control
Benzene	3.210	0.490	84.72
BTEX	36.770	1.366	96.29
Total HAP	37.903	1.636	95.68
VOC	66.887	12.774	80.90

TABLE 1-B

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

SEPARATOR GOR.....: 55817 Scf/Sep Bbl
SEPARATOR PRESSURE.....: 267 psig
SEPARATOR TEMPERATURE.....: 73 °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	0.364	0.000	0.026	0.007	0.358	0.000
Carbon Dioxide	0.159	0.000	0.018	0.008	0.156	0.000
Methane	77.183	0.000	7.419	3.193	75.866	0.000
Ethane	14.716	3.968	8.764	5.953	14.604	3.938
Propane	4.782	1.327	9.825	6.866	4.877	1.353
Iso-butane	0.647	0.213	3.048	2.531	0.692	0.228
N-butane	1.210	0.384	8.045	6.438	1.339	0.425
2-2 Dimethylpropane	0.014	0.005	0.162	0.158	0.017	0.006
Iso-pentane	0.306	0.113	5.021	4.666	0.395	0.146
N-pentane	0.271	0.099	5.869	5.399	0.377	0.138
2-2 Dimethylbutane	0.011	0.005	0.363	0.385	0.018	0.007
Cyclopentane	0.007	0.002	0.000	0.000	0.007	0.002
2-3 Dimethylbutane	0.009	0.004	0.555	0.577	0.019	0.008
2 Methylpentane	0.069	0.029	3.334	3.514	0.131	0.055
3 Methylpentane	0.042	0.017	2.220	2.301	0.083	0.034
Other Hexanes	0.000	0.000	0.000	0.000	0.000	0.000
n-Hexane	0.079	0.033	5.090	5.315	0.174	0.072
Methylcyclopentane	0.006	0.002	0.458	0.411	0.015	0.005
Benzene	0.002	0.001	0.103	0.073	0.004	0.001
Cyclohexane	0.008	0.003	0.716	0.619	0.021	0.007
2-Methylhexane	0.017	0.008	2.801	3.307	0.070	0.033
3-Methylhexane	0.016	0.007	2.320	2.705	0.059	0.028
2,2,4 Trimethylpentane	0.000	0.000	0.000	0.000	0.000	0.000
Other Heptanes	0.019	0.008	1.444	1.597	0.046	0.020
n-Heptane	0.020	0.009	3.645	4.271	0.088	0.041
Methylcyclohexane	0.012	0.005	2.249	2.296	0.054	0.022
Toluene	0.003	0.001	0.568	0.483	0.014	0.005
Other C-8's	0.017	0.008	6.298	7.496	0.136	0.064
n-Octane	0.005	0.003	2.264	2.944	0.048	0.025
Ethylbenzene	0.000	0.000	0.508	0.498	0.010	0.004
M&P-Xylene	0.001	0.000	0.541	0.533	0.011	0.004
O-Xylene	0.000	0.000	0.785	0.758	0.015	0.006
Other C-9's	0.004	0.002	2.891	3.844	0.058	0.031
n-Nonane	0.001	0.001	1.315	1.880	0.026	0.015
Other C10's	0.000	0.000	2.858	4.175	0.054	0.031
n-Decane	0.000	0.000	0.814	1.270	0.015	0.010
Undecanes Plus	0.000	0.000	7.660	13.529	0.145	0.101
TOTAL	100.000	6.257	100.000	100.000	100.000	6.864

TABLE 1-B

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

SEPARATOR GOR.....: 55817 Scf/Sep Bbl
SEPARATOR PRESSURE.....: 267 psig
SEPARATOR TEMPERATURE.....: 73 °F

UNDECANES PLUS (C_{11+}) FRACTION CHARACTERISTICS

COMPONENT	Specific Gravity °API	Specific Gravity **	Molecular Weight lb/lb-mole	Vapor Volume Scf/Gal	Gross Heating Value ***
Gas	N/A	0.8250	156.000	16.558	8,400
Oil	53.492	0.7649	167.900	14.264	128,476
Wellstream	N/A	0.7649	167.900	14.264	N/A

TOTAL SAMPLE CHARACTERISTICS

COMPONENT	Specific Gravity °API	Specific Gravity **	Molecular Weight lb/lb-mole	Vapor Volume Scf/Gal	Gross Heating Value Dry ***	Gross Heating Value Saturated ***
Gas	N/A	0.7247	20.912	159.829	1,280	1,259
Oil	84.429	0.6553	81.446	25.191	N/A	112,760
Wellstream	N/A	0.7615	22.054	50.270	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.

FORK RIDGE EXTENDED ANALYSIS FROM PROMAX

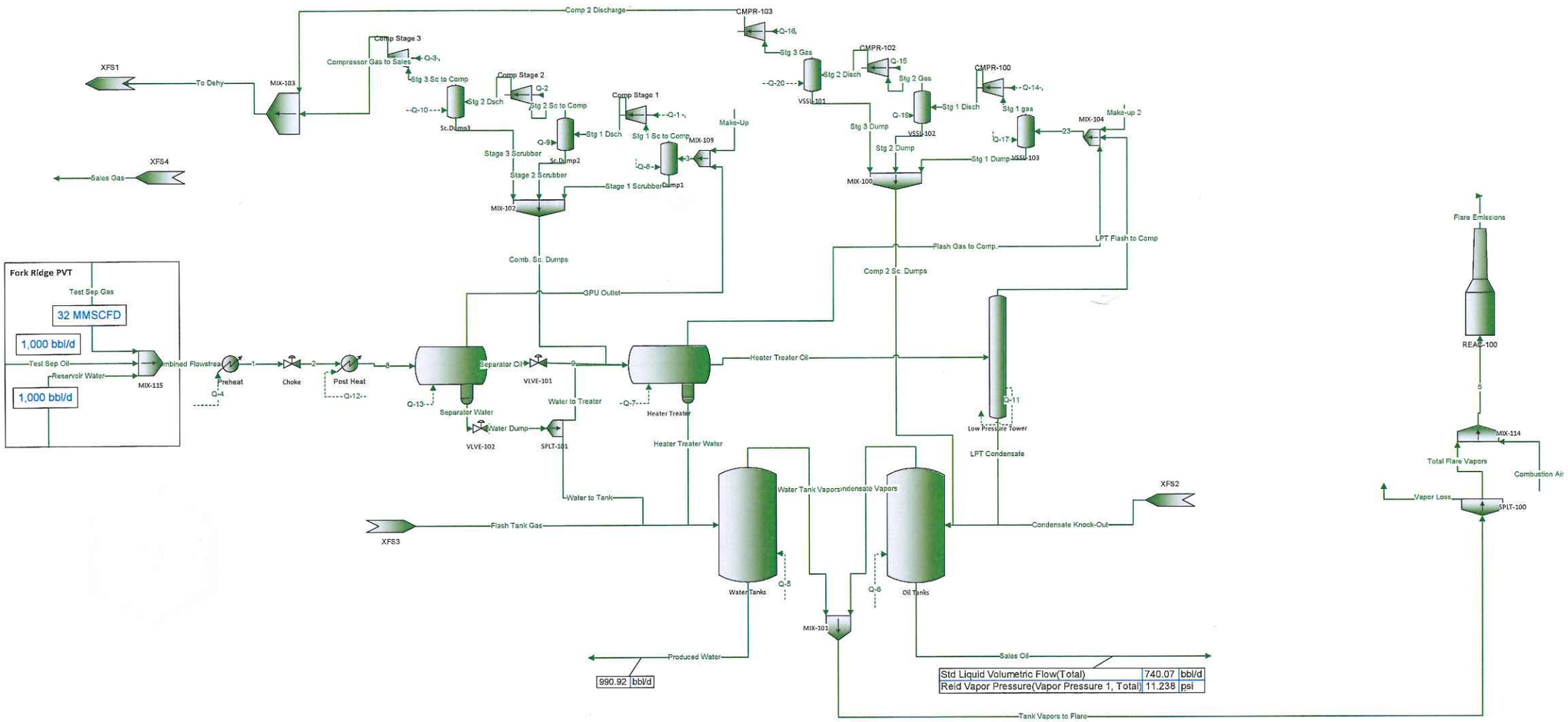
Nitrogen	0.361065
CO2	0.157191
C1	76.80929
C2	14.85247
C3	4.917038
Isobutane	0.655389
n-Butane	1.20923
2,2-Dimethylpropane	0.014878
Isopentane	0.301776
n-Pentane	0.266333
2-2-Dimethylbutane	0.010549
Cyclopentane	0.003362
2-3-Dimethylbutane	0.010825
2-Methylpentane	0.067728
3-Methylpentane	0.041088
C6	0.079068
Methylcyclopentane	0.006446
Benzene	0.001668
Cyclohexane	0.008671
Hexane, 2-Methyl-	0.022827
3-Methylhexane	0.018618
2,2,4-Trimethylpentane	0
C7	0.036942
Methylcyclohexane	0.014454
Toluene	0.003185
C8	0.027175
Ethylbenzene	0.001235
m-Xylene	0.00062
p-Xylene	0.000642
o-Xylene	0.00156
C9	0.005943
C10	0.002572
Undecane	0.000815
Dodecane	0.000314
Tridecane	0.000107
Tetradecane	2.26E-05
Pentadecane	6.15E-06
Hexadecane	1.52E-06
Heptadecane	4.37E-07
Octadecane	1.22E-07
Nonadecane	3.09E-08
Eicosane	4.29E-09
Heneicosane	1.49E-09

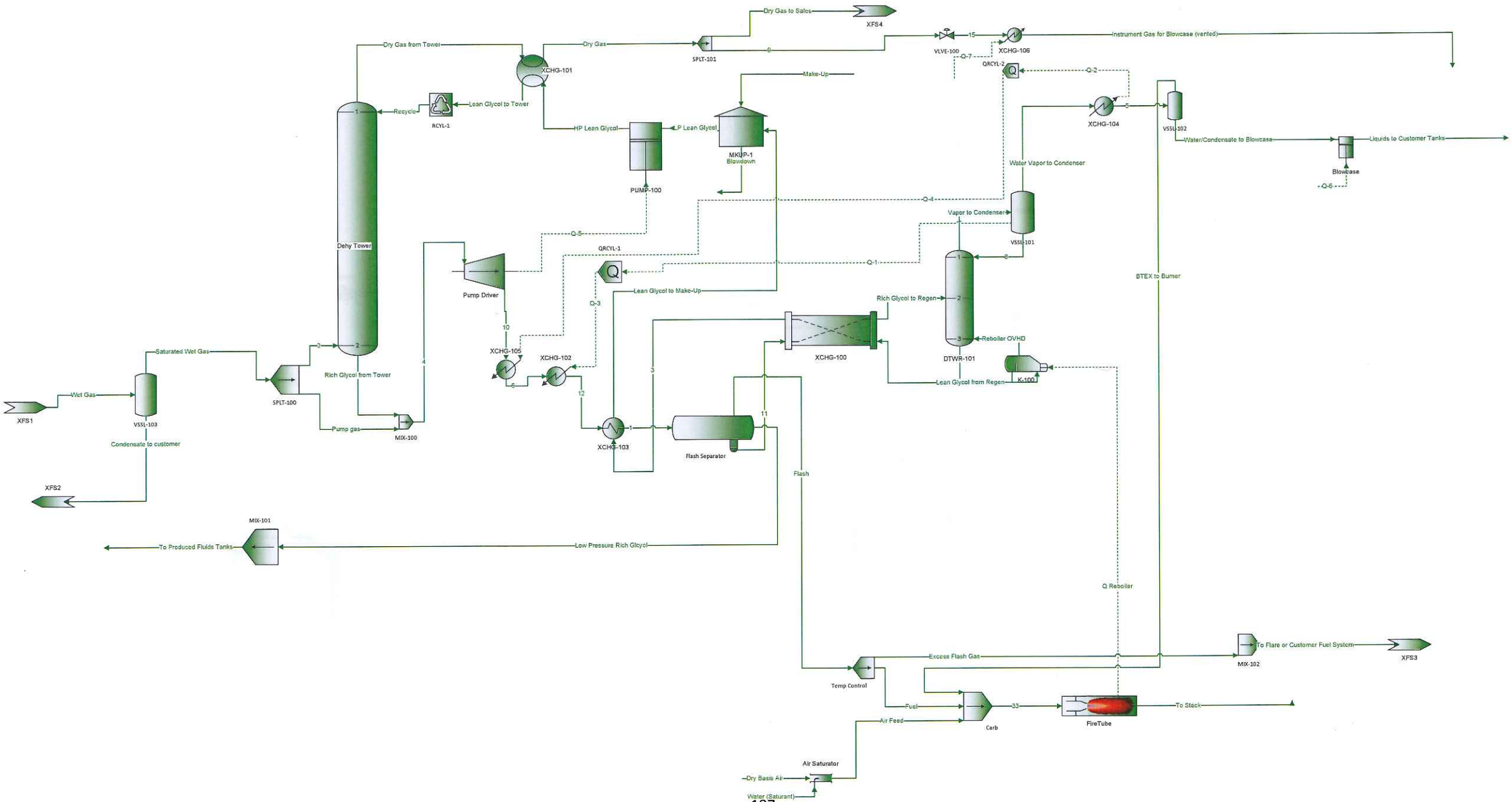
Docosane	4.23E-10
Tricosane	5.87E-11
Tetracosane	2.78E-11
Pentacosane	0
Hexacosane	0
Heptacosane	0
Octacosane	0
Nonacosane	0
Triacontane	0
Water	0.088889

Process Simulation Results

Names	Units	Reservoir Water	Test Sep Gas	Test Sep Oil	Condensate Vapors	Water Tank Vapors	Sales Gas	Sales Oil	Produced Water
Temperature	°F	73*	73*	73*	95#	105	191.45	95	105#
Pressure	psia	281.7*	281.7*	281.7*	15.196	15.196	909.7	15.196*	15.196*
Mole Fraction Vapor	%	0	100	0.3406	100	100	100	0	0
Mole Fraction Light Liquid	%	100	0	99.659	0	0	0	99.377	100
Mole Fraction Heavy Liquid	%	0	0	0	0	0	0	0.6231	0
Molecular Weight	lb/lbmol	18.015	20.912	82.433	50.43	23.417	21.152	104.54	18.015
Molar Flow	lbmol/h	809.87	3513.5	115	4.5394	3.3084	3563.3	72.555	802.48
Enthalpy	Btu/h	-9.9574e+007	-1.2104e+008	-9.2235e+006	-2.4225e+005	-1.3453e+005	-1.2016e+008	-6.9184e+006	-9.822e+007
Nitrogen(Mole Fraction)	%	0*	0.364*	0.026002*	0.0009202	0.21909	0.35953	1.4393e-006	2.2759e-006
CO2(Mole Fraction)	%	0*	0.159*	0.018001*	0.040097	0.48836	0.15671	0.00057863	0.00018288
C1(Mole Fraction)	%	0*	77.183*	7.4195*	4.1514	62.513	76.488	0.020096	0.0013247
C2(Mole Fraction)	%	0*	14.716*	8.7646*	16.069	17.227	14.806	0.44974	0.00039869
C3(Mole Fraction)	%	0*	4.782*	9.8257*	28.175	7.0231	4.9648	2.6534	0.00015007
Isobutane(Mole Fraction)	%	0*	0.647*	3.0482*	7.6523	0.94844	0.6894	1.7687	7.5353e-006
n-Butane(Mole Fraction)	%	0*	1.21*	8.0456*	17.5	2.1281	1.3117	5.693	3.9234e-005
Isopentane(Mole Fraction)	%	0*	0.306*	5.0214*	6.133	0.63764	0.3551	4.9047	7.2765e-006
n-Pentane(Mole Fraction)	%	0*	0.271*	5.8694*	5.889	0.62083	0.32221	6.1823	7.6442e-006
Water(Mole Fraction)	%	100*	0*	0*	5.3437	7.2787	0.10622	0.69839	99.998

- Oil Flash : 7.0 lb/bbl
- Water Flash : 0.866 lb/bbl


Comp 2 Discharge
CMPR-103
Q-16
Stg 3 Gas
CMPR-102
Q-15
Stg 2 Gas
CMPR-100
Q-14
Comp Stage 3
Compressor Gas to Sales
Q-3
XFS1
To Dehy
MIX-103
Stg 3 Sc to Comp
Comp Stage 2
Q-2
Stg 2 Dsch
Stg 2 Sc to Comp
Comp Stage 1
Q-1
Q-10
Sc.Dump3
Q-9
Stg 1 Dsch
Stg 1 Sc to Comp
MIX-109
Make-Up
Stg 3 Dump
VSSL-101
Stg 2 Disch
Q-20
Q-19
Stg 1 Disch
Stg 1 gas
MIX-104
Make-up 2
Q-17
VSSL-102
VSSL-103
Stg 2 Dump
Stg 1 Dump
XFS4
Sales Gas
Stage 3 Scrubber
Sc.Dump2
Q-8
Stage 2 Scrubber
Stage 1 Scrubber
Dump1
MIX-100
MIX-102
Flash Gas to Comp.
LPT Flash to Comp
Comb. Sc. Dumps
Comp 2 Sc. Dumps
GPU Outlet
Fork Ridge PVT
Test Sep Gas
32 MMSCFD
1,000 bbl/d
Test Sep Oil
Reservoir Water
1,000 bbl/d
MIX-115
Combined Flowstream
Preheat
Q-4
Choke
Post Heat
Q-12
Separator Oil
VLVE-101
Heater Treater Oil
Q-13
Separator Water
Water to Treater
Q-7
Heater Treater
Water Dump
VLVE-102
SPLT-101
Heater Treater Water
Low Pressure Tower
Q-11
LPT Condensate
Flare Emissions
REAC-100
MIX-114
Total Flare Vapors
Combustion Air
Vapor Loss
SPLT-100
Water to Tank
Water Tank Vapors
Condensate Vapors
XFS2
XFS3
Flash Tank Gas
Condensate Knock-Out
Water Tanks
Q-5
Oil Tanks
Q-6
MIX-101
Produced Water
990.92
bbl/d
Sales Oil
Std Liquid Volumetric Flow(Total) 740.07 bbl/d
Reid Vapor Pressure(Vapor Pressure 1, Total) 11.238 psi
Tank Vapors to Flare


Dry Gas to Sales
XFS4
Dry Gas from Tower
Dry Gas
SPLT-101
VLVE-100
XCHG-106
Instrument Gas for Blowcase (vented)
XCHG-101
QRCYL-2
Make-Up
Recycle
Lean Glycol to Tower
RCYL-1
XCHG-104
VSSL-102
Water/Condensate to Blowcase
Liquids to Customer Tanks
Blowcase
HP Lean Glycol
LP Lean Glycol
MKUP-1
Blowdown
PUMP-100
Water Vapor to Condenser
Vapor to Condenser
VSSL-101
Dehy Tower
QRCYL-1
Pump Driver
Lean Glycol to Make-Up
Rich Glycol to Regen
BTEX to Burner
XCHG-105
XCHG-102
XCHG-100
DTWR-101
Reboiler OVHD
K-100
Saturated Wet Gas
Rich Glycol from Tower
Lean Glycol from Regen
Wet Gas
XFS1
SPLT-100
VSSL-103
Pump gas
MIX-100
XCHG-103
Flash Separator
Condensate to customer
XFS2
Flash
MIX-101
To Produced Fluids Tanks
Low Pressure Rich Glycol
Q Reboiler
Excess Flash Gas
To Flare or Customer Fuel System
MIX-102
XFS3
Temp Control
Fuel
Air Feed
Carb
FireTube
To Stack
Air Saturator
Dry Basis Air
Water (Saturant)

TANKS 4.0.9d
Emissions Report - Summary Format
Tank Indentification and Physical Characteristics

Identification

User Identification:	Fork Ridge Pad - Condensate
City:	Marshall County
State:	West Virginia
Company:	Southwestern Energy
Type of Tank:	Vertical Fixed Roof Tank
Description:	Five (5) 400-bbl condensate tanks modeled with Fork Ridge PVT oil stream

Tank Dimensions

Shell Height (ft):	20.00
Diameter (ft):	12.00
Liquid Height (ft) :	19.00
Avg. Liquid Height (ft):	10.00
Volume (gallons):	16,074.56
Turnovers:	762.94
Net Throughput(gal/yr):	12,264,000.00
Is Tank Heated (y/n):	N

Paint Characteristics

Shell Color/Shade:	White/White
Shell Condition	Good
Roof Color/Shade:	White/White
Roof Condition:	Good

Roof Characteristics

Type:	Cone
Height (ft)	0.00
Slope (ft/ft) (Cone Roof)	0.06

Breather Vent Settings

Vacuum Settings (psig):	-0.03
Pressure Settings (psig)	0.03

Meterological Data used in Emissions Calculations: Pittsburgh, Pennsylvania (Avg Atmospheric Pressure = 14.11 psia)

TANKS 4.0.9d
Emissions Report - Summary Format
Liquid Contents of Storage Tank

Fork Ridge Pad - Condensate - Vertical Fixed Roof Tank
Marshall County, West Virginia

Mixture/Component	Month	Daily Liquid Surf. Temperature (deg F) Avg.	Min.	Max.	Liquid Bulk Temp (deg F)	Vapor Pressure (psia) Avg.	Min.	Max.	Vapor Mol. Weight.	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Fork Ridge PVT Analysis	All	51.94	47.06	56.81	50.33	7.6732	7.0742	8.3102	50.4300			104.54	Option 4: RVP=11.238

TANKS 4.0.9d
Emissions Report - Summary Format
Individual Tank Emission Totals

Emissions Report for: Annual

Fork Ridge Pad - Condensate - Vertical Fixed Roof Tank
Marshall County, West Virginia

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Fork Ridge PVT Analysis	17,456.38	1,271.49	18,727.87

TANKS 4.0.9d
Emissions Report - Summary Format
Tank Indentification and Physical Characteristics

Identification

User Identification:	Fork Ridge Pad - Produced Water
City:	Marshall COunty
State:	West Virginia
Company:	Southwestern Energy
Type of Tank:	Vertical Fixed Roof Tank
Description:	Five (5) 400-bbl produced water tanks modeled with 1% Fork Ridge PVT oil stream and 99% water

Tank Dimensions

Shell Height (ft):	20.00
Diameter (ft):	12.00
Liquid Height (ft) :	19.00
Avg. Liquid Height (ft):	10.00
Volume (gallons):	16,074.56
Turnovers:	953.68
Net Throughput(gal/yr):	15,330,000.00
Is Tank Heated (y/n):	N

Paint Characteristics

Shell Color/Shade:	White/White
Shell Condition	Good
Roof Color/Shade:	White/White
Roof Condition:	Good

Roof Characteristics

Type:	Cone
Height (ft)	0.00
Slope (ft/ft) (Cone Roof)	0.06

Breather Vent Settings

Vacuum Settings (psig):	-0.03
Pressure Settings (psig)	0.03

Meterological Data used in Emissions Calculations: Pittsburgh, Pennsylvania (Avg Atmospheric Pressure = 14.11 psia)

TANKS 4.0.9d
Emissions Report - Summary Format
Liquid Contents of Storage Tank

Fork Ridge Pad - Produced Water - Vertical Fixed Roof Tank
Marshall COunty, West Virginia

Mixture/Component	Month	Daily Liquid Surf. Temperature (deg F) Avg.	Min.	Max.	Liquid Bulk Temp (deg F)	Vapor Pressure (psia) Avg.	Min.	Max.	Vapor Mol. Weight.	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Produced Water	All	51.94	47.06	56.81	50.33	0.2041	0.1712	0.2425	20.1380			18.17	
Fork Ridge PVT Analysis						7.6732	7.0742	8.3102	50.4300	0.0100	0.1637	104.54	Option 4: RVP=11.238
Water						0.1911	0.1592	0.2284	18.0200	0.9900	0.8363	18.02	Option 2: A=8.10765, B=1750.286, C=235

TANKS 4.0.9d
Emissions Report - Summary Format
Individual Tank Emission Totals

Emissions Report for: Annual

Fork Ridge Pad - Produced Water - Vertical Fixed Roof Tank
Marshall COunty, West Virginia

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Produced Water	222.91	10.98	233.89
Water	186.43	9.19	195.61
Fork Ridge PVT Analysis	36.48	1.80	38.28