SWN PRODUCTION COMPANY, LLC

KIRK HADLEY PAD

GENERAL PERMIT G-70A CLASS II ADMINISTRATIVE UPDATE

SUBMITTED TO WVDEP DIVISION OF AIR QUALITY
JUNE 2015

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INTRODUCTION

SWN Production Company, LLC (SWN), submits this G70-A General Permit Class II Administrative Update for the Kirk Hadley Pad, a natural gas production facility. The site was constructed by Chesapeake Appalachia, LLC and purchased by SWN. It currently operates under the G70-A General Permit for Oil and Natural Gas Production Facilities Located at the Well Site. SWN requests authorization with this submittal to add a 332-hp Caterpillar G3408TA engine and to represent the gas production unit (GPU) as being routed to the tanks with the flash going to the combustor. The GPU was previously routed to the heater treater, with flash gas sent to the flash gas compressor and the liquid sent to the storage tanks. The heater treater is being removed from the process and the GPU flash losses and liquids will be routed directly to the condensate tanks. This action will increase emissions from the tanks to the combustor.

Emissions of each regulated air pollutant will not increase by more than six (6) pounds per hour or ten (10) tons per year, formaldehyde will not increase by more than 0.5 tons per year and the regulation impacts will not change. The engine authorized by the current permit and the proposed engine are subject to NSPS Subpart JJJJ.

Equipment Description

Currently permitted equipment includes one (1) natural gas-fired 145-hp Caterpillar G3306 NA compressor engine with non-selective catalytic reduction (NSCR) catalytic converter (EU-MC2349), one (1) 3.0-MMSCFD triethylene glycol (TEG) dehydration unit (EU-DEHY1) with 0.25-mmBtu/hr natural gas-fired TEG reboiler (EU-REB1), one (1) 1.0-mmBtu/hr GPU burner (EU-GPU1), one (1) 0.5-mmBtu/hr natural gas-fired heater treater (EU-HT1), three (3) 400-bbl condensate storage tanks (collectively known as EU-TANKS-COND), three (3) 400-bbl produced water storage tanks (collectively known as EU-TANKS-PW), condensate truck loading (EU-LOAD-COND), produced water truck loading (EU-LOAD-PW), associated fugitive emissions (EU-FUG), and fugitive haul road emissions (EU-HR). One (1) 8.0-mmBtu/hr vapor combustor (APC-COMB) with one (1) 50-SCFH natural gas-fired pilot (EU-PILOT) is used to control emissions from the TEG dehydration unit still vent and flash tank, condensate and produced water tanks, as well as condensate and produced water truck loading.

An additional Caterpillar G3408TA engine will be installed following authorization and the heater treater will be removed. Flash emission factors have been updated for the storage tanks and fugitive counts have been updated for equipment changes. No changes will be made to the operation or emissions of the TEG dehydration unit, TEG reboiler, GPU burner, condensate

loading, produced water loading, combustor pilot and haul road emissions. Note that other small storage tanks may be present on site (i.e., methanol, lube oil) but are considered de minimis sources per Table 45-13B and are not addressed further in this application.

Proposed Emissions

Emissions calculations for the proposed facility are presented in Attachment I. 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 engine were calculated with manufacturer data when available and AP-42/EPA emissions factors for the remaining pollutants.

GPU emissions to the tanks were estimated using ProMax process simulation software.

Emissions from the dehydration unit, condensate throughput, produced water throughput and fugitive emissions are not expected to change as a result of this project and are not addressed further.

Greenhouse gas emissions have been updated with the latest EPA factors. 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 in Attachment P.

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 Kirk Hadley 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 Kirk Hadley 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:

The facility currently operates under the General Permit G70-A. Emissions of each regulated air pollutant will not increase by more than six (6) pounds per hour or ten (10) tons per year, formaldehyde will not increase by more than 0.5 tons per year and the regulation impacts will not change. The engine authorized by the current permit and the proposed engine are subject to NSPS Subpart JJJJ.

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 new engine was manufactured after June 12, 2006 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.

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. The storage vessels have estimated VOC emissions below 6 TPY per tank and are not subject to the requirements of 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. The facility is a minor (area) source of HAP. 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 subject to NSPS Subpart JJJJ 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):
095-00030

10. List all current 45CSR13 and other General Permit numbers associated with this process (for existing facilities only):
G70A-A101

A: PRIMARY OPERATING SITE INFORMATION

11A. Facility name of primary operating site:	12A. Address of primary operating site:
Kirk Hadley Pad	**Not applicable. Facility is located at 39.46316, -80.93232.**

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 WV 18 and County Route 18/6 (State Ridge Road), in Middlebourne, take WV 18 south for .6 miles to Bridgeway Road. Turn right onto Bridgeway Road and go .1 miles to Middlebourne-Wick Road. Turn left onto Middlebourne-Wick Road and go 3.1 miles to Little Sanco Creek Road (Co. Rt. 6/3). Turn slightly right onto Little Sancho Creek Road and go 1.1 miles to the well access on the right.

15A. Nearest city or town:	16A. County:	17A. UTM Coordinates:
Middlebourne, WV	**Tyler**	Northing (KM): **4,368.178** Easting (KM): **505.822** Zone: **17N**

18A. Briefly describe the proposed new operation or change (s) to the facility:	19A. Latitude & Longitude Coordinates (NAD83, Decimal Degrees to 5 digits):
A compressor engine will be added, a heater treater removed and the gas production unit routed directly to the tanks. Flash emission factors have been updated for the condensate and produced water. Fugitive counts have been updated based on changes in equipment.	Latitude: **39.46316** Longitude: **-80.93232**

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: **Upon issuance of the permit update.** ☐ 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: **Upon issuance of the permit update.**

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 _____ 6/30/15

(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 gas production unit (GPU), where the first stage of separation occurs. Fluids (condensate and produced water) and flash gas from the GPU flow to the condensate and produced water storage tanks. Natural gas from the GPU is captured and routed to the natural gas-fired engine-driven compressors.

After exiting the compressors, recovered gas is routed to the TEG dehydration unit for water removal. The dehydration unit is used to remove water from the gas before it exits the facility. In the dehydration process, gas passes through a contactor vessel where water is absorbed by the TEG. The "rich" TEG containing water flashes off most of the soluble gas in the flash tank, where hydrocarbon vapors are removed and any liquid hydrocarbons are skimmed from the glycol. After leaving the flash tank, the rich TEG goes to the glycol dehydrator reboiler where heat is used to boil off the water. The heat is supplied by a natural gas-fired reboiler that exhausts to the atmosphere. Still vent vapors are controlled by an air-cooled condenser. Non-condensable vapors and flash tank off-gases are routed to the vapor combustor with 100% capture efficiency to be burned with at least 98% combustion efficiency.

The dehydrated natural gas stream will exit the facility for transmission via pipeline. Condensate and produced water are transported offsite via tank truck. Condensate and produced water loading emissions will be controlled with vapor return, which has at least 70% capture efficiency, and routed to the vapor combustor with at least 98% combustion efficiency. Working, breathing and flashing vapors from the condensate and produced water storage tanks will be routed to the vapor combustor with a 98% capture efficiency to be burned with at least 98% combustion efficiency. The vapor combustor has one (1) natural gas-fired pilot to ensure a constant flame for combustion.

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

ATTACHMENT C: DESCRIPTION OF FUGITIVE EMISSIONS

Fugitive emissions at this site 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} $PM_{2.5}$	0.60 0.16 0.03	1.98 0.49 0.06	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	3.79 0.30 <0.01 0.02 0.02 0.06 <0.01 0.04	Does not apply	1.14 0.09 <0.01 0.01 0.01 0.02 <0.01 0.01	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	0.12 0.01 <0.01 <0.01 <0.01 <0.01 <0.01 <0.01	Does not apply	0.04 <0.01 <0.01 <0.01 <0.01 <0.01 <0.01 <0.01	O – AP-42 5.2-4 / API 5-12

Equipment Leaks	VOC n-Hexane Benzene Toluene Ethylbenzene Xylenes Carbon Dioxide Methane	Does not apply	2.16 0.18 <0.01 0.01 0.01 0.03 0.02 2.97	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*]	0	N/A	N/A	0
	Non-VOC[9]				
Valves[10]	Gas VOC	55	N/A	N/A	995
	Light Liquid VOC	38	N/A	N/A	1,831
	Heavy Liquid VOC				
	Non-VOC				
Safety Relief Valves[11]	Gas VOC	14	N/A	N/A	495
	Non VOC				
Open-ended Lines[12]	VOC	0	N/A	N/A	0
	Non-VOC				
Sampling Connections[13]	VOC				
	Non-VOC				
Compressors	VOC	6	N/A	N/A	212
	Non-VOC				
Flanges	VOC	299 (Gas), 146 (LL)	N/A	N/A	469 (Gas), 310 (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. Since no emission factor is available for pumps in heavy liquid service, the emission factor for a pump in light liquid service was used.

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.

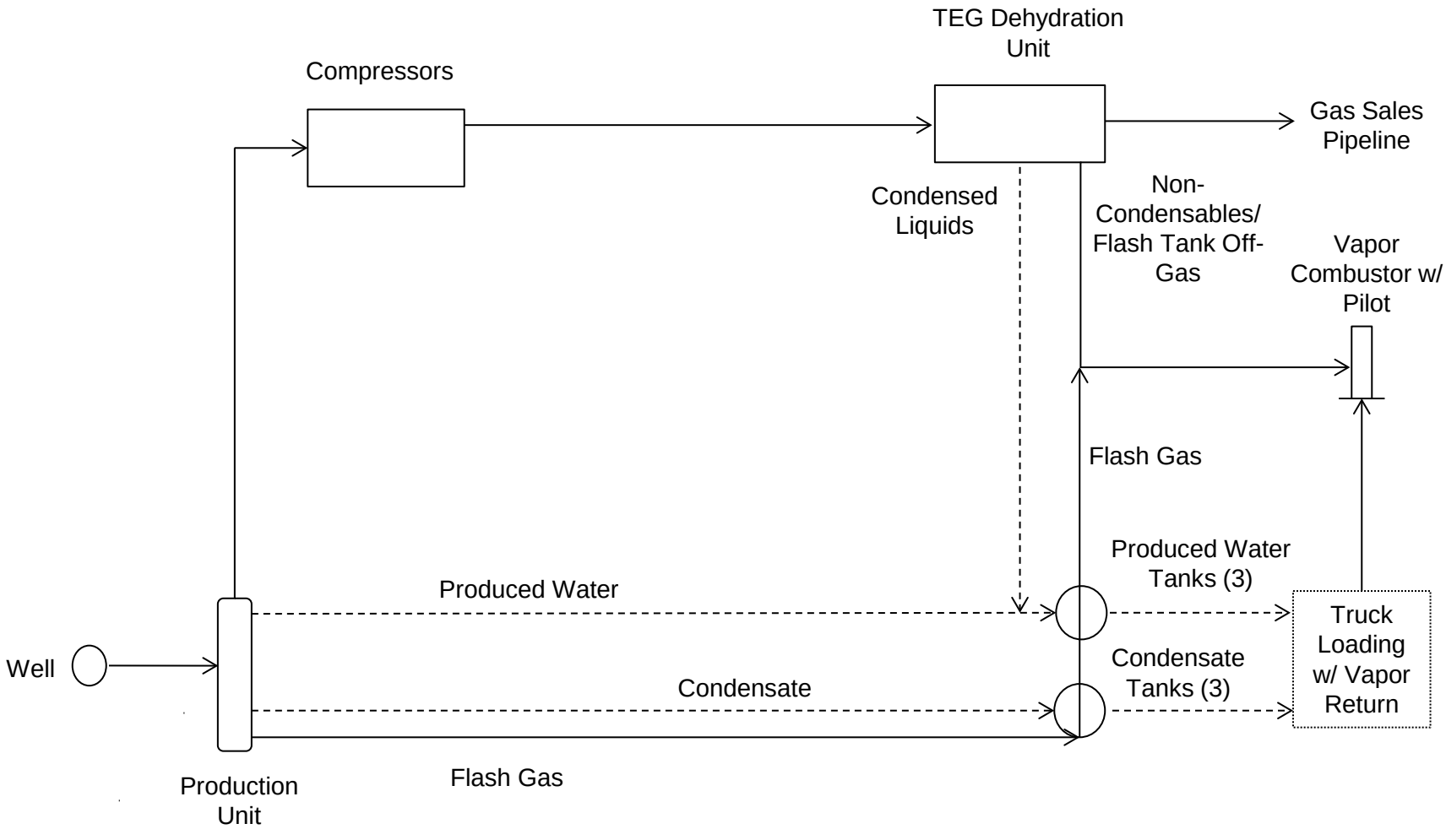
10. Include all process valves whether in-line or on an open-ended line such as sample, drain and purge valves. Do not include safety-relief valves, or leakless valves such as check, diaphragm, and bellows seal valves.

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



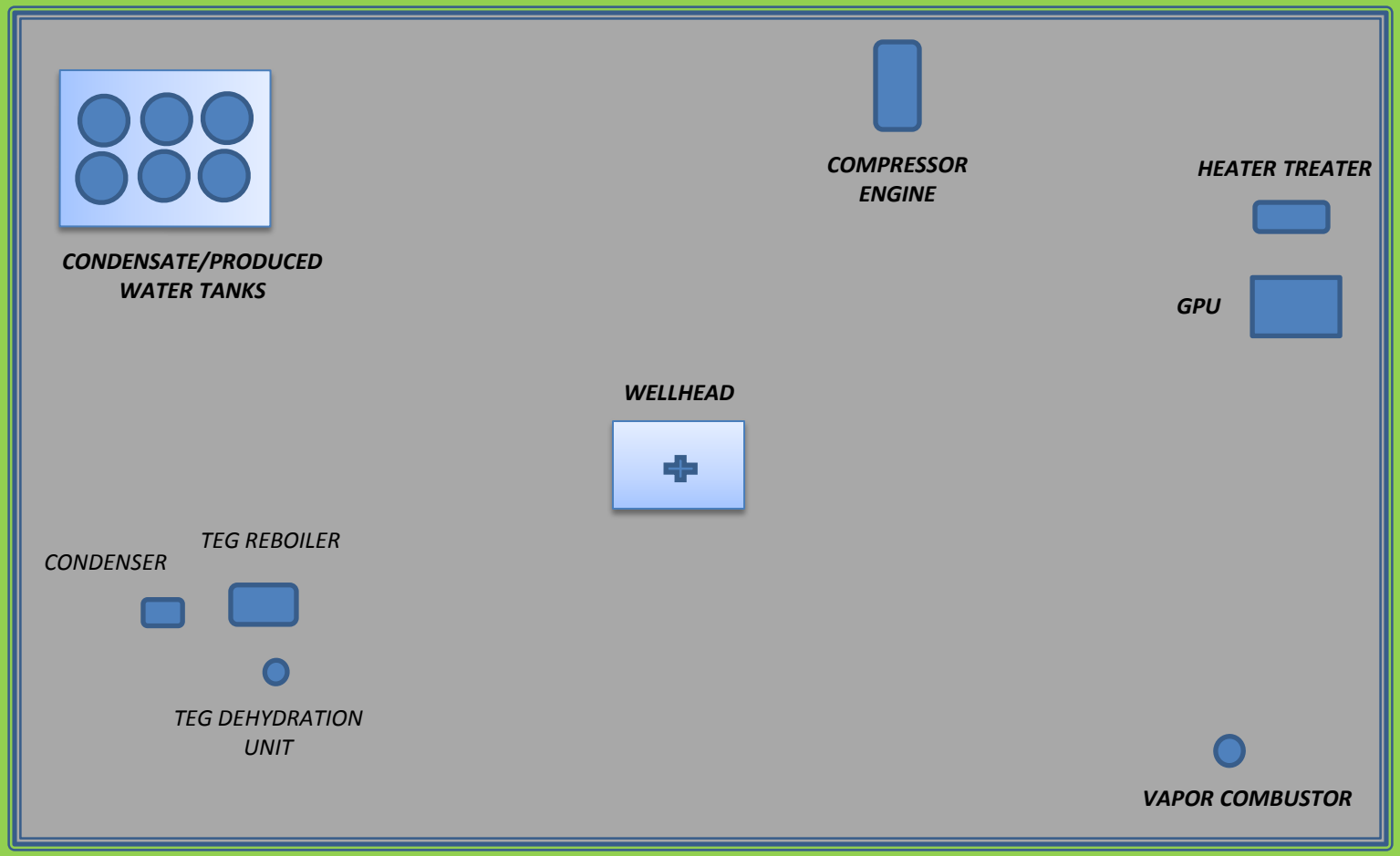
Gas/Vapor

Condensate/Water

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

SWN Production Company, LLC
Kirk Hadley Pad
Attachment D: Process Flow Diagram
June 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
Kirk Hadley Pad
Simple Plot Plan
June 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

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-MC2349	EP-MC2349	Caterpillar G3306 NA Engine	2013	145-hp	Existing	NSCR
EU-ENG2	EP-ENG2	Caterpillar G3408 TA	2015	332-hp	New	NSCR
EU-DEHY1	EP-DEHY1	TEG Dehydration Unit	2013	3.00-MMSCFD	Existing	APC-COND, EP-REB1 and APC-COMB
EU-REB1	EP-REB1	TEG Reboiler	2013	0.25-mmBtu/hr	Existing	N/A
EU-GPU1	EP-GPU1	GPU Burner	2013	1.0-mmBtu/hr	Existing	N/A
EU-HT1	EP-HT1	Heater Treater	2015	0.5-mmBtu/hr	Removed	N/A
EU-TANKS-COND	EP-TANKS-COND	Three (3) Condensate Tanks	2015	400-bbl each	Modified	APC-COMB
EU-TANKS-PW	EP-TANKS-PW	Three (3) Produced Water Tanks	2015	400-bbl each	Modified	APC-COMB
EU-LOAD-COND	EP-LOAD-COND	Condensate Truck Loading	2013	767,000 gallons	Existing	Vapor Return and APC-COMB
EU-LOAD-PW	EP-LOAD-PW	Produced Water Truck Loading	2013	3,066,000 gallons	Existing	Vapor Return and APC-COMB
APC-COMB	APC-COMB	Vapor Combustor	2015	8.0-mmBtu/hr	Modified	N/A
EU-PILOT	EP-PILOT	Vapor Combustor Pilot	2013	50-SCFH	Existing	N/A
EU-FUG	EP-FUG	Fugitive Emissions	2015	N/A	Modified	N/A
EU-HR	EP-HR	Fugitive Haul Road Emissions	2013	N/A	Existing	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.

** Equipment has been removed from service but may remain on-site.*

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 Three (3) 400-bbl Condensate Storage Tanks
3. Emission Unit ID number EU-TANKS-COND	4. Emission Point ID number EP-TANKS-COND
5. Date Installed or Modified *(for existing tanks)* 2013	6. Type of change: ☐ New construction ☐ New stored material ☒ Other
7A. Description of Tank Modification *(if applicable)* Tank flash emission factor (in lb/bbl) updated by process simulation.	
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) 766,500 (Total for all tanks)	13B. Maximum daily throughput (gal/day) 2,100 (Total for all tanks)
14. Number of tank turnovers per year 47.68 (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:			

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 Three (3) 400-bbl Produced Water Storage Tanks
3. Emission Unit ID number EU-TANKS-PW	4. Emission Point ID number EP-TANKS-PW
5. Date Installed or Modified *(for existing tanks)* 2013	6. Type of change: ☐ New construction ☐ New stored material ☒ Other
7A. Description of Tank Modification *(if applicable)* Tank flash emission factor (in lb/bbl) updated by process simulation.	
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) 3,066,000 (Total for all tanks)	13B. Maximum daily throughput (gal/day) 8,400 (Total for all tanks)
14. Number of tank turnovers per year 190.74 (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-MC2349		EU-ENG2			
Emission Point ID No. [2]		EP-MC2349		EU-ENG2			
Engine Manufacturer and Model		Caterpillar G3306 NA		Caterpillar G3408 TA			
Manufacturer's Rated bhp/rpm		145-hp/1,800-rpm		332-hp/1,500-rpm			
Source Status[3]		ES		NS			
Date Installed/Modified/Removed[4]		2013		2015			
Engine Manufactured/Reconstruction Date[5]		7/19/2007		12/7/2012			
Is this engine subject to 40CFR60, Subpart JJJJ?		Yes*		Yes			
Is this a Certified Stationary Spark Ignition Engine according to 40CFR60, Subpart JJJJ? (Yes or No)[6]		No		No			
Is this engine subject to 40CFR63, Subpart ZZZZ? (yes or no)		Yes		Yes			
Engine, Fuel and Combustion Data	Engine Type[7]	RB4S		RB4S			
	APCD Type[8]	NSCR		NSCR			
	Fuel Type[9]	RG		RG			
	H_2S (gr/100 scf)	Negligible		Negligible			
	Operating bhp/rpm	145-hp/1,800-rpm		332-hp/1,500-rpm			
	BSFC (Btu/bhp-hr)	8,625		7,507			
	Fuel throughput (ft^3/hr)	1,382		2,754			
	Fuel throughput ($MMft^3$/yr)	12.11		24.12			
	Operation (hrs/yr)	8,760		8,760			
Reference[10]	Potential Emissions[11]	lbs/hr	tpy	lbs/hr	tpy		
MD	NO_X	0.64	2.80	0.73	3.20		
MD	CO	0.64	2.80	1.46	6.39		
MD	VOC**	0.36	1.67	0.61	2.89		
AP	SO_2	<0.01	<0.01	<0.01	<0.01		
AP	PM_{10}	0.01	0.04	0.05	0.22		
AP	Formaldehyde	0.02	0.09	0.05	0.22		
MRR[12]	Proposed Monitoring:	N/A		Maintenance required by NSPS JJJJ			
	Proposed Recordkeeping:	N/A		Maintenance records required by NSPS JJJJ			
	Proposed Reporting:	N/A		Test reports required by NSPS JJJJ			

*** The engine was constructed after June 12, 2006, but prior to the applicable date for the compliance requirements of NSPS Subpart JJJJ for an engine of its size and type; therefore, it has no requirements under MACT Subpart ZZZZ and NSPS Subpart JJJJ.**

**** Formaldehyde has been added to the VOC manufacture emission factor.**

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.

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

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**	2. Installation Date: 2013 ☐ New	
3. Maximum Rated Total Flow Capacity: **6,125** scfh **147,000** scfd	4. Maximum Design Heat Input: **8.0** MMBtu/hr	5. Design Heat Content: **2,450** BTU/scf

Control Device Information

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

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

7. Manufacturer: **MRW Technologies** Model No.: **TBF-5.5-30-147000**	8. Hours of operation per year: **8,760**

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

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 -	**30** 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)
102	**2,450**	**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	**1**	**50**	**45,250**	☒ 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	**98**	**≥98**
HAP	**98**	**≥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 Flare Specification Sheet
MRW Technologies, Inc.
Flare Model Number: TBF-5.5-30-147000

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

Description of Control Scheme:

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

ATTACHMENT I: EMISSIONS CALCULATIONS

SWN Production Company, LLC
Kirk Hadley Pad
Summary of Criteria Air Pollutant Emissions

Equipment	Unit 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
145-hp Caterpillar G3306 NA Engine	EU-MC2349	0.64	2.80	0.64	2.80	0.36	1.67	<0.01	<0.01	0.02	0.09
145-hp Caterpillar G3306 NA Engine w/ Catalytic Converter - Added	*EU-ENG2*	*0.73*	*3.20*	*1.46*	*6.39*	*0.61*	*2.89*	*0.01*	*0.04*	*0.05*	*0.22*
3.0-MMSCFD TEG Dehydration Unit with Condenser/Combustor Controls	EU-DEHY1	-	-	-	-	2.72	11.91	-	-	-	-
0.25-mmBtu/hr TEG Reboiler	EU-REB1	0.03	0.13	0.02	0.09	<0.01	0.01	<0.01	<0.01	<0.01	0.01
1.0-mmBtu/hr GPU Burner	EU-GPU1	0.11	0.48	0.09	0.39	0.01	0.03	<0.01	<0.01	0.01	0.04
0.5-mmBtu/hr Heater Treater - Removed	*EU-HT1*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Three (3) 400-bbl Condensate Tanks Routed to Vapor Combustor - Revised	*EU-TANKS-COND*	-	-	-	-	*1.37*	*6.02*	-	-	-	-
Three (3) 400-bbl Produced Water Tanks Routed to Vapor Combustor - Revised	*EU-TANKS-PW*	-	-	-	-	*<0.01*	*<0.01*	-	-	-	-
Condensate Truck Loading w/ Vapor Return Routed to Vapor Combustor	EU-LOAD-COND	-	-	-	-	0.26	1.14	-	-	-	-
Produced Water Truck Loading w/ Vapor Return Routed to Vapor Combustor	EU-LOAD-PW	-	-	-	-	0.01	0.04	-	-	-	-
8.0-mmBtu/hr Vapor Combustor - Revised	*APC-COMB*	*1.10*	*4.82*	*2.20*	*9.64*	*1.88*	*8.23*	-	-	*0.02*	*0.09*
Vapor Combustor Pilot	EU-PILOT	0.01	0.04	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fugitive Emissions - Revised	*EU-FUG*	-	-	-	-	*0.49*	*2.16*	-	-	-	-
Fugitive Haul Road Emissions	EU-HR	-	-	-	-	-	-	-	-	0.60	1.98
Allowable Emissions =		**2.62**	**11.48**	**4.41**	**19.33**	**7.71**	**34.11**	**0.01**	**0.05**	**0.70**	**2.42**
Current Permit Allowable Emissions =		**1.95**	**8.54**	**3.00**	**13.16**	**5.95**	**26.06**	**<0.01**	**0.01**	**0.66**	**2.22**
Net Allowable Emissions =		**0.67**	**2.94**	**1.41**	**6.17**	**1.76**	**8.05**	**0.01**	**0.04**	**0.05**	**0.20**

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 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
Kirk Hadley 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 HAPs
145-hp Caterpillar G3306 NA Engine	EU-MC2349	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	-	<0.01	<0.01	0.03
145-hp Caterpillar G3306 NA Engine w/ Catalytic Converter - Added	*EU-ENG2*	*0.01*	*0.01*	*<0.01*	*<0.01*	*0.05*	*0.01*	*-*	*<0.01*	*<0.01*	*0.08*
3.0-MMSCFD TEG Dehydration Unit with Condenser/Combustor Controls	EU-DEHY1	-	-	0.05	0.02	-	-	0.08	0.07	0.04	0.27
0.25-mmBtu/hr TEG Reboiler	EU-REB1	-	-	<0.01	-	<0.01	-	<0.01	<0.01	-	<0.01
1.0-mmBtu/hr GPU Burner	EU-GPU1	-	-	<0.01	-	<0.01	-	<0.01	<0.01	-	<0.01
0.5-mmBtu/hr Heater Treater - Removed	*EU-HT1*	-	-	*0.00*	-	*0.00*	-	*0.00*	*0.00*	-	*0.00*
Three (3) 400-bbl Condensate Tanks Routed to Vapor Combustor - Revised	*EU-TANKS-COND*	-	-	*<0.01*	*0.01*	-	-	*0.14*	*0.01*	*0.02*	*0.19*
Three (3) 400-bbl Produced Water Tanks Routed to Vapor Combustor - Revised	*EU-TANKS-PW*	-	-	*<0.01*	*<0.01*	-	-	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Condensate Truck Loading w/ Vapor Return Routed to Vapor Combustor	EU-LOAD-COND	-	-	<0.01	<0.01	-	-	0.02	<0.01	<0.01	0.03
Produced Water Truck Loading w/ Vapor Return Routed to Vapor Combustor	EU-LOAD-PW	-	-	<0.01	<0.01	-	-	<0.01	<0.01	<0.01	<0.01
8.0-mmBtu/hr Vapor Combustor - Revised	*APC-COMB*	-	-	*<0.01*	*0.01*	-	-	*0.15*	*0.01*	*0.02*	*0.19*
Vapor Combustor Pilot	EU-PILOT	-	-	<0.01	-	<0.01	-	<0.01	<0.01	-	<0.01
Fugitive Emissions - Revised	*EU-FUG*	-	-	*<0.01*	*<0.01*	-	-	*0.04*	*<0.01*	*0.01*	*0.06*
Fugitive Haul Road Emissions	EU-HR	-	-	-	-	-	-	-	-	-	-
Allowable Emissions =		**0.01**	**0.01**	**0.07**	**0.04**	**0.07**	**0.01**	**0.44**	**0.10**	**0.10**	**0.85**

Continued on Next Page

SWN Production Company, LLC
Kirk Hadley 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 HAPs
145-hp Caterpillar G3306 NA Engine	EU-MC2349	0.02	0.01	0.01	<0.01	0.09	0.02	-	<0.01	<0.01	0.15
145-hp Caterpillar G3306 NA Engine w/ Catalytic Converter - Added	*EU-ENG2*	*0.03*	*0.03*	*0.02*	*<0.01*	*0.22*	*0.03*	-	*0.01*	*<0.01*	*0.34*
3.0-MMSCFD TEG Dehydration Unit with Condenser/Combustor Controls	EU-DEHY1	-	-	0.23	0.08	-	-	0.35	0.31	0.19	1.16
0.25-mmBtu/hr TEG Reboiler	EU-REB1	-	-	<0.01	-	<0.01	-	<0.01	<0.01	-	<0.01
1.0-mmBtu/hr GPU Burner	EU-GPU1	-	-	<0.01	-	<0.01	-	0.01	<0.01	-	0.01
0.5-mmBtu/hr Heater Treater - Removed	*EU-HT1*	-	-	*0.00*	-	*0.00*	-	*0.00*	*0.00*	-	*0.00*
Three (3) 400-bbl Condensate Tanks Routed to Vapor Combustor - Revised	*EU-TANKS-COND*	-	-	*0.01*	*0.03*	-	-	*0.63*	*0.04*	*0.10*	*0.82*
Three (3) 400-bbl Produced Water Tanks Routed to Vapor Combustor - Revised	*EU-TANKS-PW*	-	-	*<0.01*	*<0.01*	-	-	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Condensate Truck Loading w/ Vapor Return Routed to Vapor Combustor	EU-LOAD-COND	-	-	<0.01	0.01	-	-	0.09	0.01	0.02	0.12
Produced Water Truck Loading w/ Vapor Return Routed to Vapor Combustor	EU-LOAD-PW	-	-	<0.01	<0.01	-	-	<0.01	<0.01	<0.01	<0.01
8.0-mmBtu/hr Vapor Combustor - Revised	*APC-COMB*	-	-	*0.01*	*0.03*	-	-	*0.66*	*0.04*	*0.10*	*0.84*
Vapor Combustor Pilot	EU-PILOT	-	-	<0.01	-	<0.01	-	<0.01	<0.01	-	<0.01
Fugitive Emissions - Revised	*EU-FUG*	-	-	*<0.01*	*0.01*	-	-	*0.18*	*0.01*	*0.03*	*0.23*
Fugitive Haul Road Emissions	EU-HR	-	-	-	-	-	-	-	-	-	-
Allowable Emissions =		**0.05**	**0.04**	**0.29**	**0.16**	**0.31**	**0.05**	**1.93**	**0.42**	**0.44**	**3.68**
Current Permit Allowable Emissions =		**0.02**	**0.01**	**0.25**	**0.13**	**0.09**	**0.02**	**1.25**	**0.39**	**0.36**	**2.52**
Net Allowable Emissions =		**0.03**	**0.03**	**0.04**	**0.03**	**0.22**	**0.03**	**0.68**	**0.03**	**0.08**	**1.16**

SWN Production Company, LLC
Kirk Hadley 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
145-hp Caterpillar G3306 NA Engine	EU-MC2349	155.04	616.05	<0.01	0.01	0.07	0.27	<0.01	<0.01	0.08	0.33	155.19	616.65
145-hp Caterpillar G3306 NA Engine w/ Catalytic Converter - Added	*EU-ENG2*	*358.64*	*1,425.04*	*0.01*	*0.02*	*0.14*	*0.55*	*<0.01*	*<0.01*	*0.16*	*0.65*	*358.94*	*1,426.24*
3.0-MMSCFD TEG Dehydration Unit with Condenser/Combustor Controls	EU-DEHY1	0.02	0.06	2.11	8.38	52.72	209.47	-	-	-	-	52.73	209.53
0.25-mmBtu/hr TEG Reboiler	EU-REB1	29.24	116.20	<0.01	<0.01	0.01	0.05	<0.01	<0.01	0.02	0.07	29.27	116.32
1.0-mmBtu/hr GPU Burner	EU-GPU1	116.98	464.80	<0.01	0.01	0.06	0.22	<0.01	<0.01	0.07	0.26	117.10	465.28
0.5-mmBtu/hr Heater Treater - Removed	*EU-HT1*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Three (3) 400-bbl Condensate Tanks Routed to Vapor Combustor[2]	EU-TANKS-COND	-	-	-	-	-	-	-	-	-	-	-	-
Three (3) 400-bbl Produced Water Tanks Routed to Vapor Combustor[2]	EU-TANKS-PW	-	-	-	-	-	-	-	-	-	-	-	-
Condensate Truck Loading w/ Vapor Return Routed to Vapor Combustor[3]	EU-LOAD-COND	<0.01	<0.01	<0.01	0.01	0.07	0.28	-	-	-	-	0.07	0.28
Produced Water Truck Loading w/ Vapor Return Routed to Vapor Combustor	EU-LOAD-PW	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	-	-	0.00	0.00
8.0-mmBtu/hr Vapor Combustor - Revised	*APC-COMB*	*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*
Vapor Combustor Pilot	EU-PILOT	5.29	21.03	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	5.30	21.05
Fugitive Emissions - Revised	*EU-FUG*	*0.00*	*0.02*	*0.68*	*2.69*	*17.00*	*67.36*	*-*	*-*	*-*	*-*	*17.00*	*67.38*
Fugitive Haul Road Emissions	EU-HR	-	-	-	-	-	-	-	-	-	-	-	-
Allowable Emissions =		**1,601.03**	**6,361.64**	**2.82**	**11.20**	**70.51**	**279.97**	**<0.01**	**0.01**	**0.86**	**3.40**	**1,672.38**	**6,645.01**

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.

[3] Due to the use of a stabilizer, there were no detectable amounts of CH_4 or CO_2 present in the condensate; therefore, GHG emissions calculations have not been included for this emission unit.

SWN Production Company, LLC
Kirk Hadley 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
145-hp Caterpillar G3306 NA Engine	EU-MC2349	155.04	679.07	<0.01	0.01	0.07	0.30	<0.01	<0.01	0.08	0.36	155.19	679.74
145-hp Caterpillar G3306 NA Engine w/ Catalytic Converter - Added	*EU-ENG2*	*358.64*	*1,570.84*	*0.01*	*0.02*	*0.14*	*0.60*	*<0.01*	*<0.01*	*0.16*	*0.72*	*358.94*	*1,572.16*
3.0-MMSCFD TEG Dehydration Unit with Condenser/Combustor Controls	EU-DEHY1	0.02	0.07	2.11	9.24	52.72	230.90	-	-	-	-	52.73	230.97
0.25-mmBtu/hr TEG Reboiler	EU-REB1	29.24	128.09	<0.01	<0.01	0.01	0.06	<0.01	<0.01	0.02	0.07	29.27	128.22
1.0-mmBtu/hr GPU Burner	EU-GPU1	116.98	512.36	<0.01	0.01	0.06	0.24	<0.01	<0.01	0.07	0.29	117.10	512.89
0.5-mmBtu/hr Heater Treater - Removed	*EU-HT1*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Three (3) 400-bbl Condensate Tanks Routed to Vapor Combustor[3]	EU-TANKS-COND	-	-	-	-	-	-	-	-	-	-	-	-
Three (3) 400-bbl Produced Water Tanks Routed to Vapor Combustor[3]	EU-TANKS-PW	-	-	-	-	-	-	-	-	-	-	-	-
Condensate Truck Loading w/ Vapor Return Routed to Vapor Combustor[4]	EU-LOAD-COND	<0.01	<0.01	<0.01	0.01	0.07	0.31	-	-	-	-	0.07	0.31
Produced Water Truck Loading w/ Vapor Return Routed to Vapor Combustor	EU-LOAD-PW	<0.01	<0.01	<0.01	<0.01	<0.01	0.00	-	-	-	-	0.00	0.00
8.0-mmBtu/hr Vapor Combustor - Revised	*APC-COMB*	*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*
Vapor Combustor Pilot	EU-PILOT	5.29	23.18	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	5.30	23.21
Fugitive Emissions - Revised	*EU-FUG*	*0.00*	*0.02*	*0.68*	*2.97*	*17.00*	*74.25*	-	-	-	-	*17.00*	*74.27*
Fugitive Haul Road Emissions	EU-HR	-	-	-	-	-	-	-	-	-	-	-	-
Allowable Emissions =		**1,601.03**	**7,012.51**	**2.82**	**12.35**	**70.51**	**308.61**	**<0.01**	**0.01**	**0.86**	**3.75**	**1,672.38**	**7,324.87**

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.

[4] Due to the use of a stabilizer, there were no detectable amounts of CH_4 or CO_2 present in the condensate; therefore, GHG emissions calculations have not been included for this emission unit.

SWN Production Company, LLC
Kirk Hadley Pad
Engine Emissions Calculations - Criteria Air Pollutants

Equipment Information

Unit ID:	EU-MC2349	EU-ENG2
Make:	Caterpillar	Caterpillar
Model:	G3306 NA	G3408 TA
Design Class:	4S-RB	4S-RB
Controls:	NSCR	NSCR
Horsepower (hp):	145	332
Fuel Use (Btu/hp-hr):	8,625	7,507
Fuel Use (scfh):	1,382	2,754
Annual Fuel Use (mmscf):	12.11	24.12
Fuel Use (mmBtu/hr):	1.25	2.49
Exhaust Flow (acfm):	678	1,335
Exhaust Temp (°F):	1,101	957
Serial Number:	G6X03318	To be determined
Manufacture Date:	7/19/2007	12/7/2012
Operating Hours:	8,760	8,760
Fuel Heating Value (Btu/scf):	905	905

Uncontrolled Manufacturer Emission Factors [1]

NOx (g/hp-hr):	13.47	14.11
CO (g/hp-hr):	13.47	14.10
NMNEHC/VOC (g/hp-hr):	0.22	0.22
Total VOC = NMNEHC + HCHO (g/hp-hr):	0.49	0.49

Post-Catalyst Emission Factors

NOx Control Eff. %	85.15%	90.00%
CO Control Eff. %	85.15%	90.00%
VOC Control Eff. %	0.00%	0.00%
NOx (g/hp-hr):	2.00	1.00
CO (g/hp-hr):	2.00	2.00
NMNEHC/VOC (g/hp-hr):	1.00	0.70
Total VOC = NMNEHC + HCHO (g/hp-hr):	1.06	0.76

Uncontrolled Criteria Air Pollutant Emissions

Unit ID:	EU-MC2349		EU-ENG2	
Pollutant	**lb/hr**	**TPY**	**lb/hr**	**TPY**
NOx	4.31	18.88	10.33	45.25
CO	4.31	18.88	10.32	45.20
NMNEHC/VOC (does not include HCHO)	0.07	0.31	0.16	0.70
Total VOC (includes HCHO)	0.25	1.47	0.21	1.14
SO_2	<0.01	<0.01	<0.01	0.04
$PM_{10/2.5}$	0.01	0.04	0.02	0.09
PM_{COND}	0.01	0.04	0.02	0.09
PM_{TOT}	0.02	0.09	0.05	0.22

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

Proposed Criteria Air Pollutant Emissions[2]

Unit ID:	EU-MC2349		EU-ENG2	
Pollutant	**lb/hr**	**TPY**	**lb/hr**	**TPY**
NOx	0.64	2.80	0.73	3.20
CO	0.64	2.80	1.46	6.39
NMNEHC/VOC (does not include HCHO)	0.32	1.40	0.51	2.23
Total VOC (includes HCHO)	0.36	1.67	0.61	2.89
SO_2	<0.01	<0.01	<0.01	0.04
$PM_{10/2.5}$	0.01	0.04	0.02	0.09
PM_{COND}	0.01	0.04	0.02	0.09
PM_{TOT}	0.02	0.09	0.05	0.22

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

Pollutant	3.2-3 (7/00)
SO_2	5.88E-04
$PM_{10/2.5}$	9.50E-03
PM_{COND}	9.91E-03
PM_{TOT}	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.

[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
Kirk Hadley Pad
Engine Emissions Calculations - Hazardous Air Pollutants

Equipment Information

Unit ID:	EU-MC2349	EU-ENG2
Make:	Caterpillar	Caterpillar
Model:	G3306 NA	G3408 TA
Design Class:	4S-RB	4S-RB
Controls:	NSCR	NSCR
Horsepower (hp):	145	332
Fuel Use (Btu/hp-hr):	8,625	7,507
Fuel Use (scfh):	1,382	2,754
Annual Fuel Use (mmscf):	12.11	24.12
Fuel Use (mmBtu/hr):	1.25	2.49
Exhaust Flow (acfm):	678	1,335
Exhaust Temp (°F):	1,101	957
Serial Number:	G6X03318	To be determined
Manufacture Date:	7/19/2007	12/7/2012
Operating Hours:	8,760	8,760
HAP Control Eff. %	0.00%	0.00%

Uncontrolled HAP Emissions

Unit ID:	EU-MC2349		EU-ENG2	
Pollutant	**lb/hr**	**TPY**	**lb/hr**	**TPY**
Formaldehyde	0.09	0.39	0.20	0.88
Total HAPs =	**0.10**	**0.45**	**0.23**	**1.01**

Proposed HAP Emissions[1]

Unit ID:	EU-MC2349		EU-ENG2	
Pollutant	**lb/hr**	**TPY**	**lb/hr**	**TPY**
Acetaldehyde	<0.01	0.02	0.01	0.03
Acrolein	<0.01	0.01	0.01	0.03
Benzene	<0.01	0.01	<0.01	0.02
Ethylbenzene	<0.01	<0.01	<0.01	<0.01
Formaldehyde	0.02	0.09	0.05	0.22
Methanol	<0.01	0.02	0.01	0.03
Toluene	<0.01	<0.01	<0.01	0.01
Xylenes	<0.01	<0.01	<0.01	<0.01
Total HAPs =	**0.03**	**0.15**	**0.08**	**0.34**

SWN Production Company, LLC
Kirk Hadley Pad
Engine Emissions Calculations - Hazardous Air Pollutants (Continued)

AP-42 Emission Factors (lb/mmBtu)

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

Notes:

[1] For conservative estimate, no reduction taken for any HAP other than formaldehyde.
Manuf. data for uncontrolled formaldehyde emissions (g/hp-hr): 0.27
Controlled (76% Control Efficiency) = 0.06

SWN Production Company, LLC
Kirk Hadley Pad
Engine Emissions Calculations - Greenhouse Gases

Equipment Information

Unit ID:	**EU-MC2349**	**EU-ENG2**
Make:	Caterpillar	Caterpillar
Model:	G3306 NA	G3408 TA
Design Class:	4S-RB	4S-RB
Controls:	NSCR	NSCR
Horsepower (hp):	145	332
Fuel Use (Btu/hp-hr):	8,625	7,507
Fuel Use (scfh):	1,382	2,754
Fuel Use (mmBtu/hr):	1.25	2.49
Exhaust Flow (acfm):	678	1,335
Exhaust Temp (°F):	1,101	957
Operating Hours:	8,760	8,760

Manufacturer data used to calculate CO_2 emissions (g/hp-hr):

EU-MC2349	**EU-ENG2**
485	490

Greenhouse Gas (GHG) Emissions[1]

Unit ID:	**EU-MC2349**		**EU-ENG2**	
Pollutant	**lb/hr**	**tonnes/yr**	**lb/hr**	**tonnes/yr**
CO_2	155.04	616.05	358.64	1,425.04
CH_4	<0.01	0.01	0.01	0.02
N_2O	<0.01	<0.01	<0.01	<0.01
CH_4 as CO_2e	0.07	0.27	0.14	0.55
N_2O as CO_2e	0.08	0.33	0.16	0.65
Total CO_2 + CO_2e =	**155.19**	**616.65**	**358.94**	**1,426.24**

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

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
Kirk Hadley Pad
Storage Tank Emissions - Criteria Air Pollutants

Tank Information

Unit ID:	EU-TANKS-COND	EU-TANKS-PW
Contents: [1]	Condensate	Produced Water
Number of Tanks: [2]	3	3
Capacity (bbl) - Per Tank:	400	400
Capacity (gal) - Per Tank:	16,800	16,800
Total Throughput (bbl/yr):	18,250	73,000
Total Throughput (gal/yr):	766,500	3,066,000
Total Throughput (bbl/d):	50	200
Total Prod. Water as Condensate (gal/yr): [2]	-	30,660
Total Prod. Water as Condensate (bbl/d):	-	2.0
Tank Flashing Emission Factor (lb/bbl):	0.33	0.00
Total Working Losses (lb/yr): [3]	6,833.55	109.65
Breathing Losses per Tank (lb/yr): [3]	6,669.28	12.36
Tank Vapor Capture Efficiency:	98%	98%
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	0.78	3.42	0.01	0.05
Breathing Losses	2.28	9.99	0.01	0.03
Flashing Losses	0.68	2.99	0.00	0.00
GPU Flash Losses[4]	65.00	284.70	-	-
Total VOC =	**68.74**	**301.10**	**0.02**	**0.08**

SWN Production Company, LLC
Kirk Hadley Pad
Storage Tank Emissions - Criteria Air Pollutants (Continued)

Uncaptured Storage Tank Emissions

Unit ID: **EU-TANKS-COND** **EU-TANKS-PW**

Emissions	lb/hr	TPY	lb/hr	TPY
Working Losses	0.02	0.07	<0.01	<0.01
Breathing Losses	0.05	0.20	<0.01	<0.01
Flashing Losses	0.01	0.06	0.00	0.00
GPU Flash Losses	1.30	5.69	-	-
Total VOC =	**1.37**	**6.02**	**<0.01**	**<0.01**

Notes:

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

[2] SWN requests to combine 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 losses were determined by process simulation. Reports located in Appendix A. Uncontrolled tank emissions are routed to a vapor combustor with 98% capture efficiency. Uncaptured emissions shown represent those not captured by the collection system or controlled by the vapor combustor.

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

[4] GPU flash losses were estimated using process simulation software.

SWN Production Company, LLC
Kirk Hadley 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]	**68.74**	**301.10**	**0.02**	**0.08**
n-Hexane	7.25	31.74	<0.01	0.01
Benzene	0.12	0.51	<0.01	<0.01
Toluene	0.48	2.11	<0.01	<0.01
Ethylbenzene	0.39	1.69	<0.01	<0.01
Xylenes	1.12	4.89	<0.01	<0.01
Total HAPs =	**9.35**	**40.93**	**<0.01**	**0.01**

Uncaptured Storage Tank Emissions[2]

Unit ID: **EU-TANKS-COND** **EU-TANKS-PW**

Pollutant	lb/hr	TPY	lb/hr	TPY
Total VOC = [1]	**1.37**	**6.02**	**<0.01**	**<0.01**
n-Hexane	0.14	0.63	<0.01	<0.01
Benzene	<0.01	0.01	<0.01	<0.01
Toluene	0.01	0.04	<0.01	<0.01
Ethylbenzene	0.01	0.03	<0.01	<0.01
Xylenes	0.02	0.10	<0.01	<0.01
Total HAPs =	**0.19**	**0.82**	**<0.01**	**<0.01**

SWN Production Company, LLC
Kirk Hadley Pad
Storage Tank Emissions - Hazardous Air Pollutants (Continued)

Estimated HAP Composition (% by Weight)[3]

Pollutant	Wt%
n-Hexane	7.936%
Benzene	0.126%
Toluene	0.637%
Ethylbenzene	0.546%
Xylenes	1.609%
Total HAPs =	**10.854%**

Notes:

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

[2] Uncontrolled tank working/breathing/flashing emissions are routed to a vapor combustor with 98% capture efficiency. Uncaptured emissions shown represent those not captured by the collection system or controlled by the vapor combustor.

[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. HAP emissions from GPU flash losses estimated using process simulation and added to total lb/hr tank losses.

SWN Production Company, LLC
Kirk Hadley Pad
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	NOx	0.138	-	-	-	1.10	4.82
	CO	0.2755	-		-	2.20	9.64
	PM	7.6	-		-	0.02	0.09
	VOC	Mass Balance	94.10	412.12	98.00%	1.88	8.23
	n-Hexane	Mass Balance	7.51	32.91	98.00%	0.15	0.66
	Benzene	Mass Balance	0.12	0.55	98.00%	<0.01	0.01
	Toluene	Mass Balance	0.49	2.13	98.00%	0.01	0.04
	Ethylbenzene	Mass Balance	0.39	1.68	98.00%	0.01	0.03
	Xylenes	Mass Balance	1.11	4.86	98.00%	0.02	0.10

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 each combustor = 8.0 mmBtu/hr per Combustor

8.0 mmBtu/hr Total Heat Input

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

SWN Production Company, LLC
Kirk Hadley Pad
Vapor Combustor Emissions Calculations - Criteria and Hazardous Air Pollutants (Continued)

Source	Captured VOC Emissions	
	lb/hr	TPY
Dehydration Unit Flash Tank Vapors	26.08	114.23
Condensate Storage Tanks	67.37	295.08
Produced Water Storage Tanks	0.02	0.08
Condensate Truck Loading	0.61	2.65
Produced Water Truck Loading	0.02	0.08
Total VOC =	**94.10**	**412.12**

Source	Captured HAP Emissions (lb/hr)				
	n-Hexane	Benzene	Toluene	Ethylbenzene	Xylenes
Dehydration Unit Flash Tank Vapors	0.36	0.01	0.01	<0.01	<0.01
Condensate Storage Tanks	7.10	0.11	0.47	0.38	1.09
Produced Water Storage Tanks	<0.01	<0.01	<0.01	<0.01	<0.01
Condensate Truck Loading	0.05	<0.01	<0.01	<0.01	0.01
Produced Water Truck Loading	<0.01	<0.01	<0.01	<0.01	<0.01
Total HAP =	**7.51**	**0.12**	**0.49**	**0.39**	**1.11**

Source	Captured HAP Emissions (TPY)				
	n-Hexane	Benzene	Toluene	Ethylbenzene	Xylenes
Dehydration Unit Flash Tank Vapors	1.58	0.04	0.05	0.01	0.02
Condensate Storage Tanks	31.10	0.50	2.06	1.65	4.79
Produced Water Storage Tanks	0.01	<0.01	<0.01	<0.01	<0.01
Condensate Truck Loading	0.21	<0.01	0.02	0.01	0.04
Produced Water Truck Loading	0.01	<0.01	<0.01	<0.01	<0.01
Total HAP =	**32.91**	**0.55**	**2.13**	**1.68**	**4.86**

[3] For permitting purposes, uncombusted emissions from the TEG dehydration unit condenser vent stream (non-condensables) and flash tank off-gases are reported at EP-DEHY1 and have not been included with these calculations to prevent duplicate reporting of emissions.

SWN Production Company, LLC
Kirk Hadley Pad
Vapor Combustor Emissions Calculations - Greenhouse Gases

Equipment Information

Unit ID:	**APC-COMB**
Description:	Vapor Combustor
Number of Combustors:	1
Burner Design Capacity (mmBtu/hr):	8.0
Stream HHV (Btu/scf):	2,450
Annual Throughput (mmscf):	28.60
Annual Operating Hours:	8,760

Greenhouse Gas (GHG) Emissions

Pollutant	lb/hr	tonnes/yr	tons/yr
CO_2	935.82	3,718.44	4,098.88
CH_4	0.02	0.07	0.08
N_2O	<0.01	0.01	0.01
CH_4 as CO_2e	0.44	1.75	1.93
N_2O as CO_2e	0.53	2.09	2.30
Total CO_2 + CO_2e =	**936.78**	**3,722.28**	**4,103.11**

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
Kirk Hadley 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	55	9.92E-03	0.00%	0.55	2.41	20.824%
Flanges - Gas	299	8.60E-04	0.00%	0.26	1.14	20.824%
Compressor Seals - Gas	6	1.94E-02	0.00%	0.12	0.53	20.824%
Relief Valves - Gas	14	1.94E-02	0.00%	0.27	1.18	20.824%
Open-Ended Lines - Gas	0	4.41E-03	0.00%	0.00	0.00	20.824%
Total TOC (Gas Components) =				**1.20**	**5.26**	-
Valves - Light Oil	38	5.51E-03	0.00%	0.21	0.92	99.811%
Flanges - Light Oil	146	2.43E-04	0.00%	0.04	0.18	99.811%
Pump Seals - Light Oil	0	2.87E-02	0.00%	0.00	0.00	99.811%
Other - Light Oil	0	1.65E-02	0.00%	0.00	0.00	99.811%
Total TOC (Liquid Components) =				**0.25**	**1.10**	-

VOC and Greenhouse Gas Emissions

Source Type/Service	VOC		CH_4		CO_2	
	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY
Valves - Gas	0.11	0.50	0.31	1.36	<0.01	0.01
Flanges - Gas	0.05	0.23	0.15	0.64	<0.01	<0.01
Compressor Seals - Gas	0.02	0.11	0.07	0.30	<0.01	<0.01
Relief Valves - Gas	0.06	0.25	0.15	0.67	<0.01	<0.01
Open-Ended Lines - Gas	0.00	0.00	0.00	0.00	0.00	0.00
Components in Gas Service =	**0.25**	**1.09**	**0.68**	**2.97**	**0.00**	**0.02**
Valves - Light Oil	0.21	0.92	<0.01	<0.01	<0.01	<0.01
Flanges - Light Oil	0.04	0.15	<0.01	<0.01	<0.01	<0.01
Pump Seals - Light Oil	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
Components in Liquid Service =	**0.24**	**1.07**	**0.00**	**0.00**	**<0.01**	**<0.01**
Total (Gas+Liquid Components) =	**0.49**	**2.16**	**0.68**	**2.97**	**0.00**	**0.02**

SWN Production Company, LLC
Kirk Hadley 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	<0.01	<0.01	0.00	<0.01
Flanges - Gas	<0.01	<0.01	<0.01	<0.01	<0.01	0.00	<0.01
Compressor Seals - Gas	<0.01	<0.01	<0.01	<0.01	<0.01	0.00	<0.01
Relief Valves - Gas	<0.01	<0.01	<0.01	<0.01	<0.01	0.00	<0.01
Open-Ended Lines - Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Components in Gas Service =	**<0.01**	**<0.01**	**<0.01**	**<0.01**	**<0.01**	**0.00**	**<0.01**
Valves - Light Oil	0.02	<0.01	<0.01	<0.01	<0.01	0.00	0.02
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 =	**0.02**	**<0.01**	**<0.01**	**<0.01**	**<0.01**	**0.00**	**0.03**
Total (Gas+Liquid Components) =	**0.04**	**<0.01**	**<0.01**	**<0.01**	**0.01**	**0.00**	**0.06**

Hazardous Air Pollutant (HAP) Emissions (TPY)

Source Type/Service	n-Hexane	Benzene	Toluene	Ethylbenzene	Xylenes	2,2,4-Tri.	Total
Valves - Gas	0.01	<0.01	<0.01	<0.01	<0.01	0.00	0.01
Flanges - Gas	<0.01	<0.01	<0.01	<0.01	<0.01	0.00	<0.01
Compressor Seals - Gas	<0.01	<0.01	<0.01	<0.01	<0.01	0.00	<0.01
Relief Valves - Gas	<0.01	<0.01	<0.01	<0.01	<0.01	0.00	<0.01
Open-Ended Lines - Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Components in Gas Service =	**0.02**	**<0.01**	**<0.01**	**<0.01**	**<0.01**	**0.00**	**0.02**
Valves - Light Oil	0.07	<0.01	0.01	0.01	0.01	0.00	0.10
Flanges - Light Oil	0.01	<0.01	<0.01	<0.01	<0.01	0.00	0.02
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 =	**0.08**	**<0.01**	**0.01**	**0.01**	**0.02**	**0.00**	**0.11**
Total (Gas+Liquid Components) =	**0.18**	**<0.01**	**0.01**	**0.01**	**0.03**	**0.00**	**0.24**

SWN Production Company, LLC
Kirk Hadley 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
Valves - Gas	12	3	2	5	5	0	0
Flanges - Gas	37	15	9	24	33	3	2
Compressor Seals - Gas	0	0	0	0	3	0	0
Relief Valves - Gas	1	3	1	1	1	1	1
Open-Ended Lines - Gas	0	0	0	0	0	0	0
Valves - Light Oil	0	5	6	12	3	6	9
Connectors - Light Oil	0	20	24	48	12	24	30
Pump Seals - Light Oil	0	0	0	0	0	0	0
Other - Light Oil	0	0	0	0	0	0	0

Equipment Type	WH	GPU	HT	LPT	FGC	OT	TT-O
Number of Each Type On Pad =	1	1	0	0	2	3	1

Source Type/Service	NGL	STB	DHY
Valves - Gas	29	56	30
Flanges - Gas	182	250	170
Compressor Seals - Gas	0	0	0
Relief Valves - Gas	4	6	4
Open-Ended Lines - Gas	0	0	0
Valves - Light Oil	0	16	0
Connectors - Light Oil	0	80	0
Pump Seals - Light Oil	0	0	0
Other - Light Oil	0	0	0

Equipment Type	NGL	STB	DHY
Number of Each Type On Pad =	0	0	1

SWN Production Company, LLC
Kirk Hadley 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%	0.0000	0.000%	-	0.00	0.00
Carbon Dioxide	44.010	0.193%	0.0850	0.397%	-	<0.01	0.02
Nitrogen	28.013	0.464%	0.1300	0.608%	-	0.01	0.03
Methane	16.042	74.593%	11.9662	55.916%	56.483%	0.68	2.97
Ethane	30.069	15.989%	4.8076	22.465%	22.693%	0.27	1.19
Propane	44.096	5.743%	2.5326	11.834%	11.954%	0.14	0.63
i-Butane	58.122	0.645%	0.3749	1.752%	1.770%	0.02	0.09
n-Butane	58.122	1.486%	0.8639	4.037%	4.078%	0.05	0.21
i-Pentane	72.149	0.275%	0.1981	0.926%	0.935%	0.01	0.05
n-Pentane	72.149	0.332%	0.2396	1.120%	1.131%	0.01	0.06
n-Hexane	86.175	0.058%	0.0502	0.235%	0.237%	<0.01	0.01
Other Hexanes	86.175	0.090%	0.0776	0.362%	0.366%	<0.01	0.02
Heptanes (as n-Heptane)	100.202	0.049%	0.0492	0.230%	0.232%	<0.01	0.01
Benzene	78.114	0.001%	0.0008	0.004%	0.004%	<0.01	<0.01
Toluene	92.141	0.002%	0.0014	0.007%	0.007%	<0.01	<0.01
Ethylbenzene	106.167	0.001%	0.0005	0.003%	0.003%	<0.01	<0.01
Xylenes	106.167	0.001%	0.0013	0.006%	0.006%	<0.01	<0.01
2,2,4-Trimethylpentane	114.230	0.000%	0.0000	0.000%	0.000%	0.00	0.00
Octanes (as n-Octane)	114.229	0.014%	0.0154	0.072%	0.073%	<0.01	<0.01
Nonanes (as n-Nonane)	128.255	0.003%	0.0038	0.018%	0.018%	<0.01	<0.01
Decanes+ (as n-Decane)	142.282	0.002%	0.0023	0.011%	0.011%	<0.01	<0.01
	TOTAL =	**99.900%**	**21.400**	**100.000%**	**100.000%**	**1.21**	**5.31**
		TOTAL HC =	**21.185**	**TOTAL VOC =**	**20.824%**	**0.25**	**1.10**
				TOTAL HAP =	**0.256%**	**0.00**	**0.01**

SWN Production Company, LLC
Kirk Hadley Pad
Fugitive Emissions Calculations (Continued)

Speciated Oil 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	0.001%	0.001	0.001%	-	<0.01	<0.01
Nitrogen	28.013	0.000%	0.000	0.000%	-	<0.01	<0.01
Methane	16.042	0.029%	0.005	0.005%	0.005%	<0.01	<0.01
Ethane	30.069	0.565%	0.170	0.184%	0.184%	<0.01	<0.01
Propane	44.096	3.377%	1.489	1.615%	1.615%	<0.01	0.02
i-Butane	58.122	2.261%	1.314	1.425%	1.425%	<0.01	0.02
n-Butane	58.122	9.926%	5.769	6.256%	6.256%	0.02	0.07
i-Pentane	72.149	7.127%	5.142	5.576%	5.576%	0.01	0.06
n-Pentane	72.149	12.789%	9.227	10.005%	10.005%	0.03	0.11
n-Hexane	86.175	8.493%	7.319	7.936%	7.936%	0.02	0.09
Other Hexanes	86.175	9.363%	8.069	8.749%	8.750%	0.02	0.10
Heptanes (as n-Heptane)	100.202	15.914%	15.946	17.291%	17.291%	0.04	0.19
Benzene	78.114	0.149%	0.116	0.126%	0.126%	<0.01	<0.01
Toluene	92.141	0.637%	0.587	0.637%	0.637%	<0.01	0.01
Ethylbenzene	106.167	0.474%	0.503	0.546%	0.546%	<0.01	0.01
Xylenes	106.167	1.398%	1.484	1.609%	1.609%	<0.01	0.02
2,2,4-Trimethylpentane	114.230	0.000%	0.000	0.000%	0.000%	0.00	0.00
Octanes (as n-Octane)	114.229	10.641%	12.155	13.180%	13.180%	0.03	0.14
Nonanes (as n-Nonane)	128.255	5.586%	7.165	7.769%	7.769%	0.02	0.09
Decanes+ (as n-Decane)	142.282	11.078%	15.762	17.092%	17.092%	0.04	0.19
	TOTAL =	**99.800%**	**92.223**	**100.000%**	**100.000%**	**0.25**	**1.10**
		TOTAL HC =	**92.222**	**TOTAL VOC =**	**99.811%**	**0.25**	**1.10**
				TOTAL HAP =	**10.854%**	**0.03**	**0.12**

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. Emissions from components in NGL service were calculated using gas emission factors since they are only liquids under pressure.

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

[4] Analyses located in Appendix A.

ATTACHMENT J: CLASS II 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 Class II Administrative Update to a general permit registration for a change to the emissions and operations of the Kirk Hadley Pad, a natural gas production facility located near Middlebourne in Tyler County, West Virginia. From the intersection of WV 18 and County Route 18/6 (State Ridge Road) in Middlebourne, travel south on WV 18 for 0.6 mile to Bridgeway Road. Turn right onto Bridgeway Road and go 0.1 mile to Middlebourne-Wick Road. Turn left onto Middlebourne-Wick Road and go 3.1 miles to Little Sancho Creek Road (Co. Rt. 6/3). Turn slightly right onto Little Sancho Creek Road and go 1.1 miles to well access on right. The latitude and longitude coordinates are: 39.46316, -80.93232.

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

Nitrogen Oxides (NOx)	11.48 tons/yr
Carbon Monoxide (CO)	19.33 tons/yr
Volatile Organic Compounds (VOC)	34.11 tons/yr
Sulfur Dioxide (SO_2)	0.05 tons/yr
Particulate Matter (PM)	2.42 tons/yr
Acetaldehyde	0.05 tons/yr
Acrolein	0.04 tons/yr
Benzene	0.29 tons/yr
Ethylbenzene	0.16 tons/yr
Formaldehyde	0.31 tons/yr
Methanol	0.05 tons/yr
n-Hexane	1.93 tons/yr
Toluene	0.42 tons/yr
Xylenes	0.44 tons/yr
Carbon Dioxide	7,012.51 tons/yr
Methane	12.35 tons/yr
Nitrous Oxide	0.01 tons/yr
CO_2 Equivalent	7,324.87 tons/yr

The change in equipment and operations is planned to begin on or about August 8, 2015. 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 1227, during normal business hours.

Dated this the 25th of June, 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)

Health	1
Flammability	4
Reactivity	0
PPE	

Material Safety Data Sheet

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 %

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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

Health	1
Flammability	4
Reactivity	0
PPE	

Material Safety Data Sheet

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.

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*** 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

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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 * * *

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

ATTACHMENT O: EMISSION SUMMARY SHEET

G70-A EMISSIONS SUMMARY SHEET

Emission Point ID No.	Emission Point Type[1]	Emission Unit Vented Through This Point		Air Pollution Control Device		All Regulated Pollutants - Chemical Name/CAS[2] *(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-MC2349	Upward vertical stack	EU-MC2349	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	4.31 4.31 0.36 <0.01 0.01 0.02 <0.01 <0.01 <0.01 <0.01 0.09 <0.01 <0.01 <0.01 155.04 <0.01 <0.01	18.88 18.88 1.67 <0.01 0.04 0.09 0.02 0.01 0.01 <0.01 0.39 0.02 <0.01 <0.01 679.07 0.01 <0.01	0.64 0.64 0.36 <0.01 0.01 0.02 <0.01 <0.01 <0.01 <0.01 0.02 <0.01 <0.01 <0.01 155.04 <0.01 <0.01	2.80 2.80 1.67 <0.01 0.04 0.09 0.02 0.01 0.01 <0.01 0.09 0.02 <0.01 <0.01 679.07 0.01 <0.01	Gas/Vapor	O = Manufacturer Data, AP-42

EP-ENG-2	Upward vertical stack	EU-ENG2	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	10.33 10.32 0.61 <0.01 0.02 0.05 0.01 0.01 <0.01 <0.01 0.20 0.01 <0.01 <0.01 358.64 0.01 <0.01	45.25 45.20 1.14 0.04 0.09 0.22 0.03 0.03 0.02 <0.01 0.88 0.03 0.01 <0.01 1,570.84 0.02 <0.01	0.73 1.46 0.61 <0.01 0.02 0.05 0.01 0.01 <0.01 <0.01 0.05 0.01 <0.01 <0.01 358.64 0.01 <0.01	3.20 6.39 2.89 0.04 0.09 0.22 0.03 0.03 0.02 <0.01 0.22 0.03 0.01 <0.01 1,570.84 0.02 <0.01	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-DEHY1*	Upward vertical stack	EU-DEHY1	TEG Dehydration Unit	Condenser/ Combustion	APC-COND/ EU-REB1/ APC-COMB	VOC n-Hexane Benzene Toluene Ethylbenzene Xylenes Carbon Dioxide Methane	26.80 0.46 0.14 0.27 0.12 0.33 0.31 44.03	117.38 2.00 0.60 1.20 0.51 1.42 1.37 192.83	1.75 0.07 0.05 0.07 0.02 0.04 0.02 2.11	7.67 0.29 0.23 0.31 0.08 0.19 0.07 9.24	Gas/Vapor	O = GLYCalc

EP-REB1	Upward vertical stack	EU-REB1	TEG REboiler	N/A	None	NOx CO VOC SO_2 PM_{10} PM Total n-Hexane Formaldehyde Benzene Toluene Carbon Dioxide Methane Nitrous Oxide	0.03 0.02 <0.01 <0.01 <0.01 <0.01 <0.01 <0.01 <0.01 <0.01 29.24 <0.01 <0.01	0.35 0.31 0.02 <0.01 0.02 0.03 0.01 <0.01 <0.01 <0.01 128.09 <0.01 <0.01	N/A	N/A	Gas/Vapor	O = AP-42
EP-TANKS-COND	Tank vent(s)	EU-TANKS-COND	Three (3) 400-bbl Condensate Tanks	Vapor Combustor	APC-COMB	VOC n-Hexane Benzene Toluene Ethylbenzene Xylenes	68.74 7.25 0.12 0.48 0.39 1.12	301.10 31.74 0.51 2.11 1.69 4.89	1.37 0.14 <0.01 0.01 0.01 0.02	6.02 0.63 0.01 0.04 0.03 0.10	Gas/Vapor	O = EPA TANKS 4.0.9d/ ProMax
EP-TANKS-PW	Tank vent(s)	EU-TANKS-PW	Three (3) 400-bbl Produced Water Tanks	Vapor Combustor	APC-COMB	VOC n-Hexane Benzene Toluene Ethylbenzene Xylenes	0.02 <0.01 <0.01 <0.01 <0.01 <0.01	0.08 0.01 <0.01 <0.01 <0.01 <0.01	<0.01 <0.01 <0.01 <0.01 <0.01 <0.01	<0.01 <0.01 <0.01 <0.01 <0.01 <0.01	Gas/Vapor	O = EPA TANKS 4.0.9d/ ProMax
EP-LOAD-COND	Fugitive	EU-LOAD-COND	Condensate Truck Loading	Vapor Combustor	APC-COMB	VOC n-Hexane Benzene Toluene Ethylbenzene Xylenes Carbon Dioxide Methane	N/A	3.79 0.30 <0.01 0.02 0.02 0.06 <0.01 0.04	N/A	1.14 0.09 <0.01 0.01 0.01 0.02 <0.01 0.01	Gas/Vapor	O = AP-42

EP-LOAD-PW	Fugitive	EU-LOAD-PW	Produced Water Truck Loading	Vapor Combustor	APC-COMB	VOC n-Hexane Benzene Toluene Ethylbenzene Xylenes Carbon Dioxide Methane	N/A	0.12 0.01 <0.01 <0.01 <0.01 <0.01 <0.01 <0.01	N/A	0.04 <0.01 <0.01 <0.01 <0.01 <0.01 <0.01 <0.01	Gas/Vapor	O = AP-42
APC-COMB	Upward vertical stack	APC-COMB	Vapor Combustor	-	None	NOx CO PM VOC n-Hexane Benzene Toluene Ethylbenzene Xylenes Carbon Dioxide Methane Nitrous Oxide	1.10 2.20 0.02 94.10 7.51 0.12 0.49 0.39 1.11 935.82 0.02 <0.01	4.82 9.64 0.09 412.12 32.91 0.55 2.13 1.68 4.86 4,098.88 0.08 0.01	1.10 2.20 0.02 1.88 0.15 <0.01 0.01 0.01 0.02 935.82 0.02 <0.01	4.82 9.64 0.09 8.23 0.66 0.01 0.04 0.03 0.10 4,098.88 0.08 0.01	Gas/Vapor	O (AP-42, Mass Balance)
EP-PILOTS	Upward vertical stack	EU-PILOTS	Vapor Combustor Pilots	-	None	NOx CO VOC SO_2 PM Total n-Hexane Formaldehyde Benzene Toluene Ethylbenzene Xylenes Carbon Dioxide Methane Nitrous Oxide	0.01 <0.01 <0.01 <0.01 <0.01 <0.01 <0.01 <0.01 <0.01 - - 5.29 <0.01 <0.01	0.04 0.02 <0.01 <0.01 <0.01 <0.01 <0.01 <0.01 <0.01 - - 23.18 <0.01 <0.01	N/A	N/A	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	2.16 0.18 <0.01 0.01 0.01 0.03 0.02 2.97	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} $PM_{2.5}$	0.60 0.16 0.03	1.98 0.49 0.06	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. Uncaptured flash tank emissions are reported at the produced water tanks and uncombusted emissions are reported at the combustor.

ATTACHMENT P: SUPPORT DOCUMENTS

ENGINE SPECIFICATION SHEETS

AP-42 AND EPA EMISSION FACTORS

REPRESENTATIVE GAS AND LIQUIDS ANALYSES

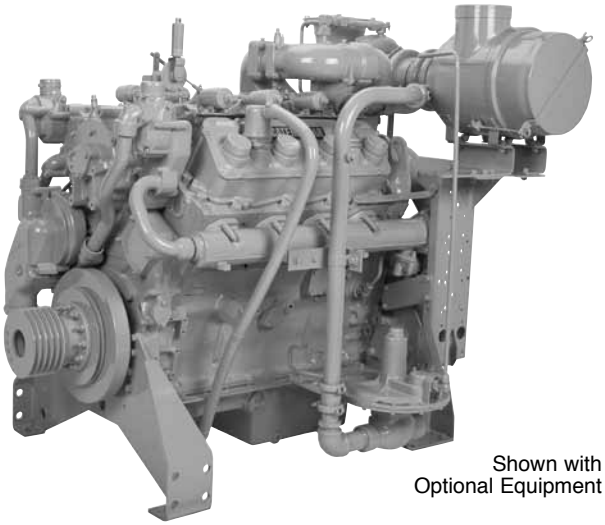
PROMAX PROCESS SIMULATION RESULTS

TANKS 4.0.9D REPORTS

G3408 Gas Petroleum Engine

190-298 bkW (255-400 bhp) 1500 & 1800 rpm

2.0% O_2 Rating



Shown with Optional Equipment

CAT® ENGINE SPECIFICATIONS

V-8, 4-Stroke-Cycle

Bore	137 mm (5.4 in.)
Stroke	152 mm (6.0 in.)
Displacement	18 L (1099 cu. in.)
Aspiration	Naturally Aspirated or Turbocharged-Aftercooled
Governor and Protection	Woodward PSG
Combustion	Rich Burn
Engine Weight, net dry (approx)	1678.3 kg (3700 lb)
Power Density	5.6 kg/kW (9.3 lb/bhp)
Power per Displacement	22.2 bhp/L
Engine only Cooling System Capacity	54.9 L (14.5 gal)
Lube Oil System (refill)	46.2 L (12.2 gal)
Oil Change Interval	750 hours
Rotation (from flywheel end)	Counterclockwise
Flywheel and Flywheel Housing	SAE No. 0
Flywheel Teeth	136

FEATURES

Engine Design
- Improved 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

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 — single element with service indicator

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

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. 0 flywheel
SAE No. 0 flywheel housing
SAE standard rotation

Fuel System
Gas pressure regulator
Natural gas carburetor

Ignition System
Digital ignition system

Instrumentation
Service meter

Lube System
Crankcase breather — top mounted
Oil cooler
Oil filter — RH
Auxiliary oil reservoir
Rear sump oil pan
Oil filler in valve cover and 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
Air cleaner — dual element
Air inlet adapter
Precleaner
Air cleaner rain cap

Charging System
Battery chargers
Charging alternators
Ammeter gauge
Ammeter gauge and wiring
Control mounting

Control System
EG3P/2301A speed control governor
PSG electric governor
PSG pneumatic governor

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

Exhaust System
Flexible fittings
Elbows
Flanges
Rain caps
Mufflers
Exhaust manifold

Fuel System
Dual gas regulator
Low energy fuel carburetor
Low pressure gas conversion
Propane and natural gas valve and jet kits
Fuel filter

Ignition System
CSA ignition
Ignition ground wiring harness
Power supply — digital ignition system

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
Clutch support
Front stub shaft
Flywheel stub shaft
Pulley removal

Protection System
Gas valves

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

TECHNICAL DATA

G3408 Gas Petroleum Engine — 1500 and 1800 rpm

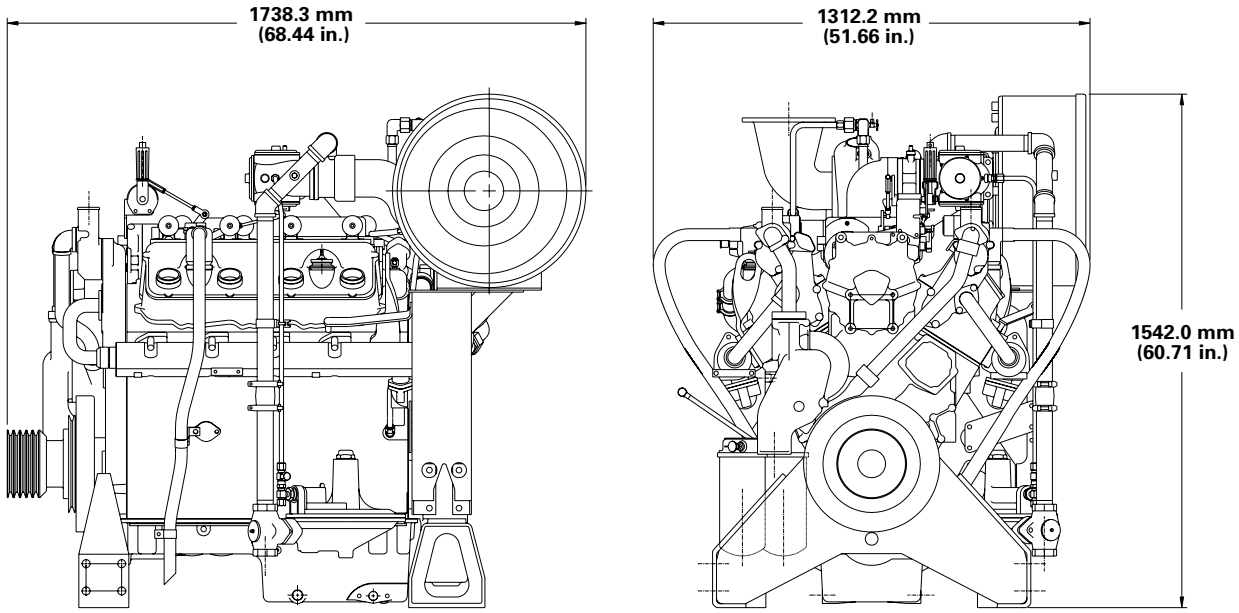
		DM8633-01	TM9151-05	TM9213-04
Engine Power				
@ 100% Load	bkW (bhp)	248 (332)	190 (255)	298 (400)
@ 75% Load	bkW (bhp)	186 (249)	143 (191)	224 (300)
Engine Speed	rpm	1500	1800	1800
Max Altitude @ Rated Torque and 38°C (100°F)	m (ft)	914.4 (3000)	0	1219.2 (4000)
Speed Turndown @ Max Altitude, Rated Torque, and 38°C (100°F)	%	0	45	0
SCAC Temperature	°C (°F)	54 (130)	N/A	54 (130)
Emissions*				
NOx	g/bkW-hr (g/bhp-hr)	18.92 (14.11)	34.39 (25.64)	35.23 (26.27)
CO	g/bkW-hr (g/bhp-hr)	18.91 (14.10)	2 (1.5)	2.15 (1.6)
CO_2	g/bkW-hr (g/bhp-hr)	657 (490)	654 (488)	616 (459)
VOC**	g/bkW-hr (g/bhp-hr)	—	.3 (.22)	.21 (.16)
Fuel Consumption***				
@ 100% Load	MJ/bkW-hr (Btu/bhp-hr)	10.62 (7507)	10.71 (7568)	9.92 (7008)
@ 75% Load	MJ/bkW-hr (Btu/bhp-hr)	11.14 (7874)	11.64 (8225)	10.40 (7350)
Heat Balance				
Heat Rejection to Jacket Water				
@ 100% Load	bkW (Btu/min)	279.73 (15,922)	179 (10,169)	253 (14,372)
@ 75% Load	bkW (Btu/min)	209.84 (11,944)	164 (9324)	217 (12,368)
Heat Rejection to Aftercooler				
@ 100% Load	bkW (Btu/min)	4.36 (248)	N/A	22.7 (1292)
@ 75% Load	bkW (Btu/min)	1.74 (99)	N/A	14.5 (828)
Heat Rejection to Exhaust				
@ 100% Load	bkW (Btu/min)	168.24 (9576)	151 (8583)	183 (10,382)
@ 75% Load	bkW (Btu/min)	121.07 (6891)	114 (6501)	136 (7749)
Exhaust System				
Exhaust Gas Flow Rate				
@ 100% Load	m^3/min (cfm)	38.37 (1355)	34.57 (1221)	45.08 (1592)
@ 75% Load	m^3/min (cfm)	28.94 (1022)	26.33 (930)	34.43 (1216)
Exhaust Stack Temperature				
@ 100% Load	°C (°F)	513.89 (957)	576 (1069)	490 (914)
@ 75% Load	°C (°F)	478.89 (894)	565 (1050)	464 (867)
Intake System				
Air Inlet Flow Rate				
@ 100% Load	m^3/min (scfm)	12.97 (458)	10.90 (385)	15.83 (559)
@ 75% Load	m^3/min (scfm)	10.25 (362)	8.35 (295)	12.52 (442)
Gas Pressure	kPag (psig)	10.3-34.5 (1.5-5)	10.34-34.47 (1.5-5)	137.9-172.4 (20-25)

*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.)	1738.3 (68.44)
Width	mm (in.)	1312.2 (51.66)
Height	mm (in.)	1542.0 (60.71)
Shipping Weight	kg (lb)	1678.3 (3700)

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.

Performance Numbers: DM8633-01, TM9151-05, TM9213-04
LEHW0030-00 (11-09)
Supersedes LEHW0747-05

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:

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

[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)

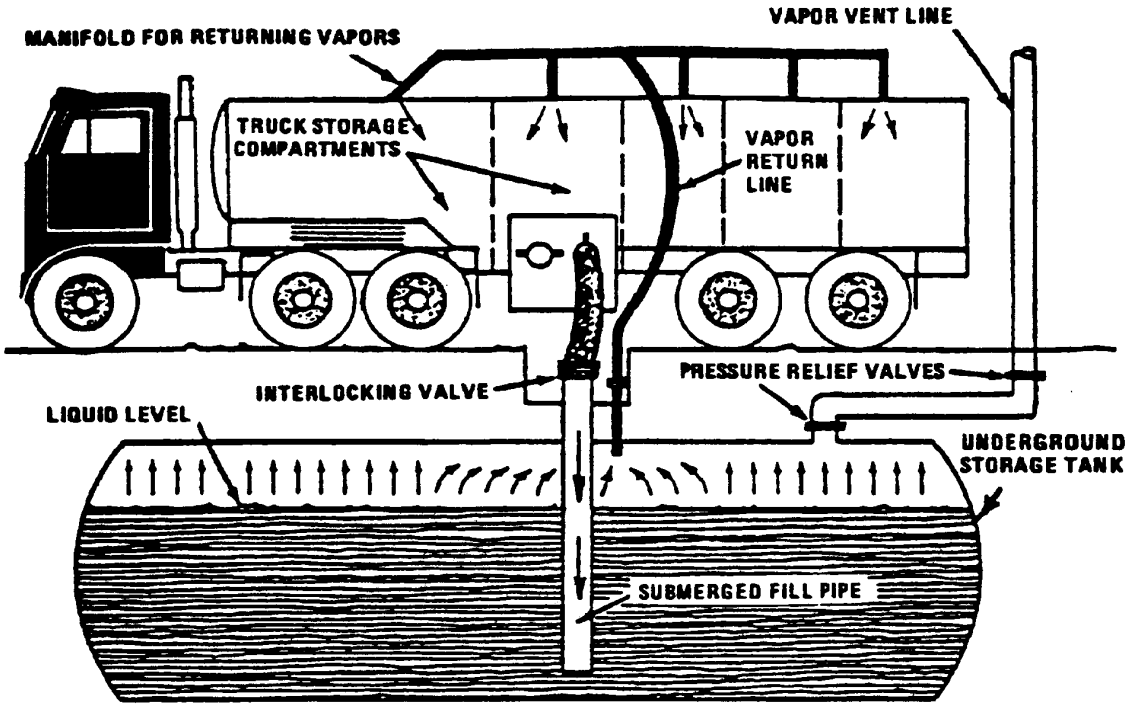


Figure 5.2-5. Tank truck unloading into a service station underground storage tank and practicing "vapor balance" form of emission control.

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.

Wet Gas Composition (stream entering dehydrator)		
T (F)	85.8	
P (psig)	900	
MMscfd	3.00095	
	mol %	mass %
Nitrogen	0.464119	0.607231
CO2	0.193033	0.396768
C1	74.59322	55.88932
C2	15.98856	22.45367
C3	5.743281	11.82807
Isobutane	0.644995	1.750883
n-Butane	1.486285	4.03462
2,2-Dimethylpropane	0.016579	0.055865
Isopentane	0.274588	0.92527
n-Pentane	0.314067	1.058304
2-2-Dimethylbutane	0.004688	0.018867
Cyclopentane	0.001426	0.00467
2-3-Dimethylbutane	0.006474	0.026056
2-Methylpentane	0.043101	0.173473
3-Methylpentane	0.025023	0.100712
C6	0.058302	0.234652
Methylcyclopentane	0.004473	0.017581
Benzene	0.001047	0.00382
Cyclohexane	0.006247	0.024556
Hexane, 2-Methyl-	0.010874	0.05089
3-Methylhexane	0.00966	0.045209
2,2,4-Trimethylpentane	0	0
C7	0.020917	0.09789
Methylcyclohexane	0.007645	0.035056
Toluene	0.001515	0.006518
C8	0.013507	0.07206
Ethylbenzene	0.000504	0.002499
m-Xylene	0.000288	0.001426
p-Xylene	0.000297	0.001473
o-Xylene	0.000668	0.003313
C9	0.002955	0.017699
C10	0.00114	0.007576
Undecane	0.000323	0.002359
Dodecane	9.82E-05	0.000781
Tridecane	2.50E-05	0.000216

Tetradecane	7.89E-06	7.31E-05
Pentadecane	2.06E-06	2.04E-05
Hexadecane	6.32E-07	6.68E-06
Heptadecane	1.95E-07	2.19E-06
Octadecane	3.18E-08	3.77E-07
Nonadecane	1.17E-08	1.47E-07
Eicosane	1.65E-09	2.18E-08
Heneicosane	5.08E-10	7.04E-09
Docosane	1.90E-10	2.75E-09
Tricosane	3.87E-11	5.87E-10
Tetracosane	1.80E-11	2.85E-10
Pentacosane	0	0
Hexacosane	0	0
Heptacosane	0	0
Octacosane	0	0
Nonacosane	0	0
Triacontane	1.36E-11	2.68E-10
Water	0.060062	0.050536
TEG	3.42E-16	2.40E-15
O2	0	0

TABLE 1-B

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

SEPARATOR GOR.....: 10922 Scf/Sep Bbl
SEPARATOR PRESSURE.....: 900 psig
SEPARATOR TEMPERATURE.....: 80 °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	0.470	0.000	0.066	0.023	0.425	0.000
Carbon Dioxide	0.194	0.000	0.075	0.041	0.181	0.000
Methane	75.086	0.000	23.326	12.604	69.352	0.000
Ethane	15.686	4.229	17.538	14.954	15.891	4.285
Propane	5.448	1.511	14.440	12.668	6.444	1.788
Iso-butane	0.611	0.201	2.806	2.926	0.854	0.282
N-butane	1.428	0.454	8.449	8.488	2.206	0.701
2-2 Dimethylpropane	0.017	0.007	0.097	0.119	0.026	0.010
Iso-pentane	0.297	0.110	3.223	3.760	0.621	0.229
N-pentane	0.364	0.133	4.706	5.435	0.845	0.309
2-2 Dimethylbutane	0.006	0.003	0.125	0.167	0.019	0.008
Cyclopentane	0.003	0.001	0.000	0.000	0.003	0.001
2-3 Dimethylbutane	0.009	0.004	0.232	0.304	0.034	0.014
2 Methylpentane	0.063	0.026	1.660	2.197	0.240	0.100
3 Methylpentane	0.038	0.016	1.068	1.389	0.152	0.063
Other Hexanes	0.000	0.000	0.000	0.000	0.000	0.000
n-Hexane	0.095	0.039	3.021	3.960	0.419	0.174
Methylcyclopentane	0.007	0.002	0.254	0.286	0.034	0.012
Benzene	0.002	0.001	0.045	0.040	0.007	0.002
Cyclohexane	0.010	0.003	0.424	0.460	0.056	0.019
2-Methylhexane	0.018	0.008	1.232	1.825	0.152	0.071
3-Methylhexane	0.019	0.009	1.069	1.564	0.135	0.063
2,2,4 Trimethylpentane	0.000	0.000	0.000	0.000	0.000	0.000
Other Heptanes	0.017	0.007	0.601	0.835	0.082	0.036
n-Heptane	0.030	0.014	2.016	2.965	0.250	0.116
Methylcyclohexane	0.016	0.006	1.067	1.368	0.132	0.054
Toluene	0.004	0.001	0.227	0.243	0.029	0.010
Other C-8's	0.030	0.014	2.984	4.460	0.357	0.169
n-Octane	0.009	0.005	1.207	1.970	0.142	0.073
Ethylbenzene	0.000	0.000	0.232	0.285	0.026	0.010
M&P-Xylene	0.002	0.001	0.244	0.302	0.029	0.011
O-Xylene	0.000	0.000	0.378	0.458	0.042	0.016
Other C-9's	0.012	0.006	1.535	2.562	0.181	0.095
n-Nonane	0.003	0.002	0.695	1.247	0.080	0.045
Other C10's	0.004	0.002	1.428	2.619	0.162	0.094
n-Decane	0.001	0.001	0.396	0.775	0.045	0.028
Undecanes Plus	0.001	0.001	3.133	6.702	0.348	0.235
TOTAL	100.000	6.817	100.000	100.000	100.000	9.121

TABLE 1-B

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

SEPARATOR GOR.....: 10922 Scf/Sep Bbl
SEPARATOR PRESSURE.....: 900 psig
SEPARATOR TEMPERATURE.....: 80 °F

UNDECANES PLUS (C_{11+}) FRACTION CHARACTERISTICS					
	Specific Gravity		Molecular Weight	Vapor Volume	Gross Heating Value
COMPONENT	°API	**	lb/lb-mole	Scf/Gal	***
Gas	N/A	0.8250	156.000	16.558	8,400
Oil	43.041	0.8107	171.700	14.783	128,815
Wellstream	N/A	0.8107	171.659	14.787	N/A

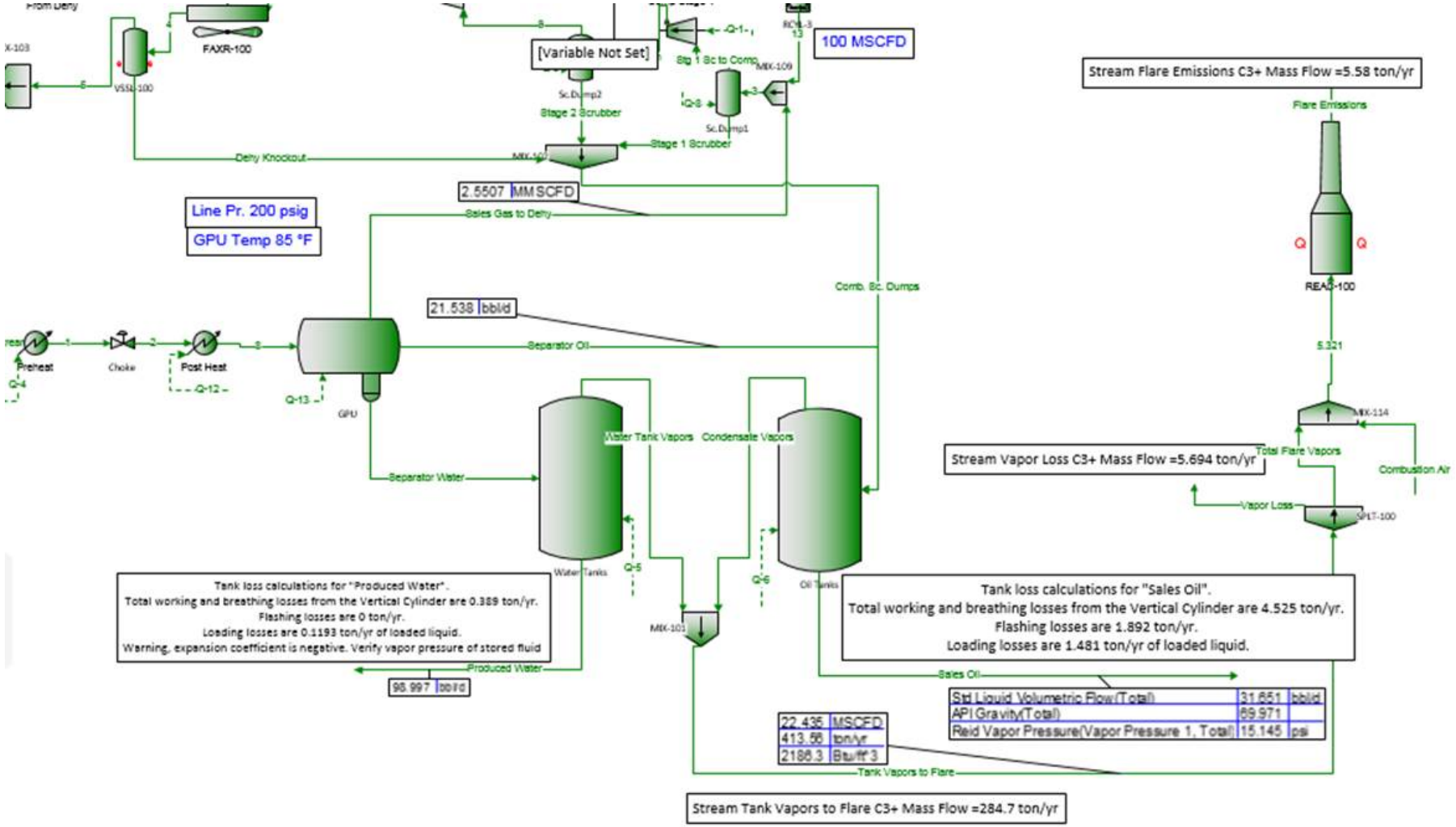
TOTAL SAMPLE CHARACTERISTICS						
	Specific Gravity		Molecular Weight	Vapor Volume	Gross Heating Value	
					Dry	Saturated
COMPONENT	°API	**	lb/lb-mole	Scf/Gal	***	***
Gas	N/A	0.7429	21.433	146.682	1,306	1,284
Oil	117.863	0.5674	56.179	31.625	N/A	99,015
Wellstream	N/A	0.8729	25.282	47.509	N/A	N/A

* 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.

Kirk Hadley Pad ProMax Process Simulation Results



Names	Units	Reservoir Water	Test Sep Oil	Test Sep Gas	PW Tank FLash	Oil Flash	Sales Gas to Dehy	Sales Oil	Produced Water
Temperature	°F	80*	80*	80*	60	50	85*	50#	60#
Pressure	psia	914.7*	914.7*	914.7*	15.196	15.196	214.7*	15.196*	15.196*
Mole Fraction Vapor	%	0	0	99.643	100	100	100	0	0
Mole Fraction Light Liquid	%	100	100	0.35699	0	0	0	82.111	100
Mole Fraction Heavy Liquid	%	0	0	0	0	0	0	17.889	0
Molecular Weight	lb/lbmol	18.015	56.583	21.434	21.199	38.498	21.72	82.717	18.016
Molar Flow	lbmol/h	80.987	7.0303	274.5	0.023767	2.4395	280.06	3.887	80.167
Mass Flow	lb/h	1459	397.79	5883.6	0.50384	93.916	6083.1	321.52	1444.3
Enthalpy	Btu/h	-9.9448e+006	-4.3292e+005	-9.6827e+006	-878.27	-1.0855e+005	-9.7627e+006	-3.7885e+005	-9.8759e+006
Nitrogen(Mole Fraction)	%	0*	0.066002*	0.47*	0.24394	0.060743	0.4622	8.1773e-005	3.3025e-006
CO2(Mole Fraction)	%	0*	0.075002*	0.194*	1.272	0.15476	0.19139	0.0024945	0.00077029
C1(Mole Fraction)	%	0*	23.327*	75.086*	73.324	26.078	74.13	0.12442	0.0020376
C2(Mole Fraction)	%	0*	17.539*	15.686*	16.039	24.642	15.764	0.85791	0.00054191
C3(Mole Fraction)	%	0*	14.44*	5.448*	5.4417	22.193	5.6444	3.0688	0.00022761
Isobutane(Mole Fraction)	%	0*	2.8061*	0.611*	0.22952	4.2755	0.6536	1.6317	3.2157e-006
n-Butane(Mole Fraction)	%	0*	8.4493*	1.428*	1.1563	11.754	1.5594	6.7147	3.4454e-005
2,2-Dimethylpropane(Mole Fraction)	%	0*	0.097003*	0.017*	0.0060102	0.14564	0.018281	0.1147	9.0338e-008
Isopentane(Mole Fraction)	%	0*	3.2231*	0.297*	0.16151	2.9518	0.34462	4.6454	3.5234e-006
n-Pentane(Mole Fraction)	%	0*	4.7061*	0.364*	0.20614	3.6357	0.43007	7.8774	4.2202e-006

TANKS 4.0.9d
Emissions Report - Summary Format
Tank Indentification and Physical Characteristics

Identification

User Identification:	Kirk Hadley Condensate Tank
City:	
State:	West Virginia
Company:	
Type of Tank:	Vertical Fixed Roof Tank
Description:	

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:	47.68
Net Throughput(gal/yr):	766,500.00
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

Kirk Hadley Condensate Tank - Vertical Fixed Roof Tank

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
Kirk Hadley Model	All	51.94	47.06	56.81	50.33	12.4150	11.5356	13.3429	50.5320			94.97	Option 4: RVP=15.81

TANKS 4.0.9d
Emissions Report - Summary Format
Individual Tank Emission Totals

Emissions Report for: Annual

Kirk Hadley Condensate Tank - Vertical Fixed Roof Tank

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Kirk Hadley Model	6,833.55	6,669.28	13,502.82

TANKS 4.0.9d
Emissions Report - Summary Format
Tank Indentification and Physical Characteristics

Identification

User Identification:	Kirk Hadley Produced Water Tank
City:	
State:	West Virginia
Company:	
Type of Tank:	Vertical Fixed Roof Tank
Description:	

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:	190.74
Net Throughput(gal/yr):	3,066,000.00
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

Kirk Hadley Produced Water Tank - Vertical Fixed Roof Tank

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	0.2145	0.1810	0.2535	21.6203			18.17	
Kirk Hadley Model						12.4150	11.5356	13.3429	50.5320	0.0100	0.2588	94.97	Option 4: RVP=15.81
Water						0.1911	0.1592	0.2284	18.0200	0.9900	0.7412	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

Kirk Hadley Produced Water Tank - Vertical Fixed Roof Tank

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Produced Water	109.65	12.36	122.01
Water	81.27	9.16	90.43
Kirk Hadley Model	28.38	3.20	31.58