SWN PRODUCTION COMPANY, LLC

BONNETTE MSH PAD

GENERAL PERMIT G-70A
CONSTRUCTION PERMIT APPLICATION

SUBMITTED TO WVDEP DIVISION OF AIR QUALITY
OCTOBER 2015

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INTRODUCTION

SWN Production Company, LLC (SWN), submits this G70-A General Permit Construction Permit application for the Bonnette MSH Pad (Bonnette), a natural gas production facility in Marshall County. Bonnette was previously authorized under Permit No. R13-3017A issued on January 17, 2014. All previously authorized equipment has been removed; therefore, all equipment in this application is new to Bonnette. SWN requests authorization with this submittal to construct and operate under the General Permit G-70A for Oil and Natural Gas Production Facilities. The equipment to be added includes the following:

- Two (2) Caterpillar G3306 NA Compressor Engines
- Eight (8) 1.0-mmBtu/hr Gas Production Units (GPU)
- Two (2) 0.5-mmBtu/hr Heater Treaters
- One (1) Low Pressure Tower (LPT)
- Three (3) 400-bbl Condensate Tanks
- Three (3) 400-bbl Produced Water Tanks
- One (1) 15-mmBtu/hr Vapor Combustor with Pilot
- One (1) Flogistix VRU with Associated Engine
- Condensate Loading
- Produced Water Loading
- Fugitive Emissions
- Fugitive 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 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 engines, Bucks VRU engine, and heaters were calculated with manufacturer data when available and AP-42/EPA emissions factors for the remaining pollutants.

Condensate tank emissions were calculated by creating a profile in the EPA TANKS 4.0.9d model using properties obtained in a representative liquids analysis as the tank contents. Although produced water storage tanks contain primarily water, a profile was created in EPA TANKS 4.0.9d assuming 1% of the total throughput as condensate and 99% as water to provide a conservative

emissions estimate of the trace hydrocarbons that may be entrained in the water. Flashing emissions were calculated using ProMax process simulation software. Condensate loading has been calculated using the properties from EPA TANKS 4.0.9d and process simulation.

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

Greenhouse gas emissions were calculated with the latest EPA factors. 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 Bonnette 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 Bonnette 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 requests to operate under the General Permit G70-A. Emissions of each regulated air pollutant are less than 100 tons per year for each criteria pollutant, less than 10 tons per year for each hazardous air pollutant and less than 25 tons for total hazardous air pollutants. The engines are subject to NSPS Subpart JJJJ and MACT Subpart ZZZZ.

45 CSR 22 - AIR QUALITY MANAGEMENT FEE PROGRAM:

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

45 CSR 30 - REQUIREMENTS FOR OPERATING PERMITS:

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

FEDERAL

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

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

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

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

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

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

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

The engines were manufactured after June 12, 2006 and are subject to the requirements of this subpart. The manufacture dates of the two Caterpillar G3306 NA engines and the VRU engine are not yet known but are presumed to be subject to NSPS Subpart JJJJ as new engines.

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 above 6 TPY per tank and are expected to be 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 and does not have an affected facility as defined by the area source requirements (TEG dehydrators).

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):
051-00155

10. List all current 45CSR13 and other General Permit numbers associated with this process (for existing facilities only):
R13-3017A

A: PRIMARY OPERATING SITE INFORMATION

11A. Facility name of primary operating site:	12A. Address of primary operating site:
Bonnette MSH Pad	**Not applicable. Facility is located at 39.72144, -80.71203.**

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**.

Merge onto Interstate 79N toward US-19. Take Exit 137 toward W Virginia 310N/Co Road 3/1/E Grafton Road. Turn left at W Virginia 310 N/Co Road 3/1/E Grafton Road and continue to follow W Virginia 310 N/E Grafton Road for 0.4 miles. Turn left at E Park Avenue and after 1 mile take slight left at Merchant Street. Take third right onto Jefferson Street and after 0.4 miles turn right at US-19 S/US-250 N. Continue on US-250 N for 37.4 miles. Turn left at Amos Hollow Road/Co Route 89 and go 3.3 miles. Turn left to stay on Amos Hollow Road/Co Route 89. Continue on Co Road 89 for 9.1 miles. Turn right to stay on Co Rd 89 for 62 feet, then turn right to stay on Co Rd 89 and go 3.1 miles. Make sharp right at Co Road 4/St Joseph Baker Hill and continue 2.2 miles. Turn left to stay on Co Rd 4/St Joseph Baker Hill and go 2 miles. Take slight right to stay on Co Rd 4/St Joseph Baker Hill for 0.2 miles. Continue onto Co Route 21/Emr Route 2. Well pad access will be on the left after 144 feet.

15A. Nearest city or town:	16A. County:	17A. UTM Coordinates:
Proctor, WV	**Marshall**	Northing (KM): **4,396.88024** Easting (KM): **524.68064** Zone: **17T**

18A. Briefly describe the proposed new operation or change (s) to the facility:	19A. Latitude & Longitude Coordinates (NAD83, Decimal Degrees to 5 digits):
Three engines, ten heaters, three condensate tanks, three produced water tanks, and a vapor combustor will be added. Fugitive emissions, condensate loading, produced water loading and haul road emissions will also occur.	Latitude: **39.72144** Longitude: **-80.71203**

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 permit issuance** ☐ 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: **November 7, 2015**

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

HOURS PER DAY **24** DAYS PER WEEK **7** WEEKS PER YEAR **52** PERCENTAGE OF OPERATION **100%**

SECTION III. ATTACHMENTS AND SUPPORTING DOCUMENTS

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

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

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

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

- ☒ ATTACHMENT A : CURRENT BUSINESS CERTIFICATE
- ☒ ATTACHMENT B: PROCESS DESCRIPTION
- ☒ ATTACHMENT C: DESCRIPTION OF FUGITIVE EMISSIONS
- ☒ ATTACHMENT D: PROCESS FLOW DIAGRAM
- ☒ ATTACHMENT E: PLOT PLAN
- ☒ ATTACHMENT F: AREA MAP
- ☒ ATTACHMENT G: EQUIPMENT DATA SHEETS AND REGISTRATION SECTION APPLICABILITY FORM
- ☒ ATTACHMENT H: AIR POLLUTION CONTROL DEVICE SHEETS
- ☒ ATTACHMENT I: EMISSIONS CALCULATIONS
- ☒ ATTACHMENT J: CLASS I LEGAL ADVERTISEMENT
- ☐ ATTACHMENT K: ELECTRONIC SUBMITTAL
- ☒ ATTACHMENT L: GENERAL PERMIT REGISTRATION APPLICATION FEE
- ☐ ATTACHMENT M: SITING CRITERIA WAIVER
- ☒ 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 _____ 10/9/15
(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 will also occur on-site. A description of the facility process is as follows: Condensate, gas and water come from the wellhead(s) to the production unit(s), where the first stage of separation occurs. Fluids (condensate and produced water) will be sent to the heater treater(s). Produced water from the heater treater(s) flows into the produced water storage tank(s). Condensate flows into the condensate storage tank(s). Flash gases from the heater treater(s) are routed via hard-piping (with 100% capture efficiency) to the inlet of the flash gas compressor(s) to be compressed.

The natural gas stream will exit the facility for transmission via pipeline. Condensate and produced water are transported offsite via truck. Loading emissions will be controlled with vapor return, which has at least 70% capture efficiency, and will be routed to the vapor combustor for at least 98% destruction efficiency, for an overall control efficiency of 69%. Working, breathing and flashing vapors from the condensate and produced water storage tanks will be controlled by the VRU but are represented in the calculations as being controlled by the combustor for operational flexibility and as a conservative calculation of emissions. 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. Information required for the Leak Source Data Sheet can be found with the emission calculations in Attachment I.

G70-A FUGITIVE EMISSIONS SUMMARY SHEET

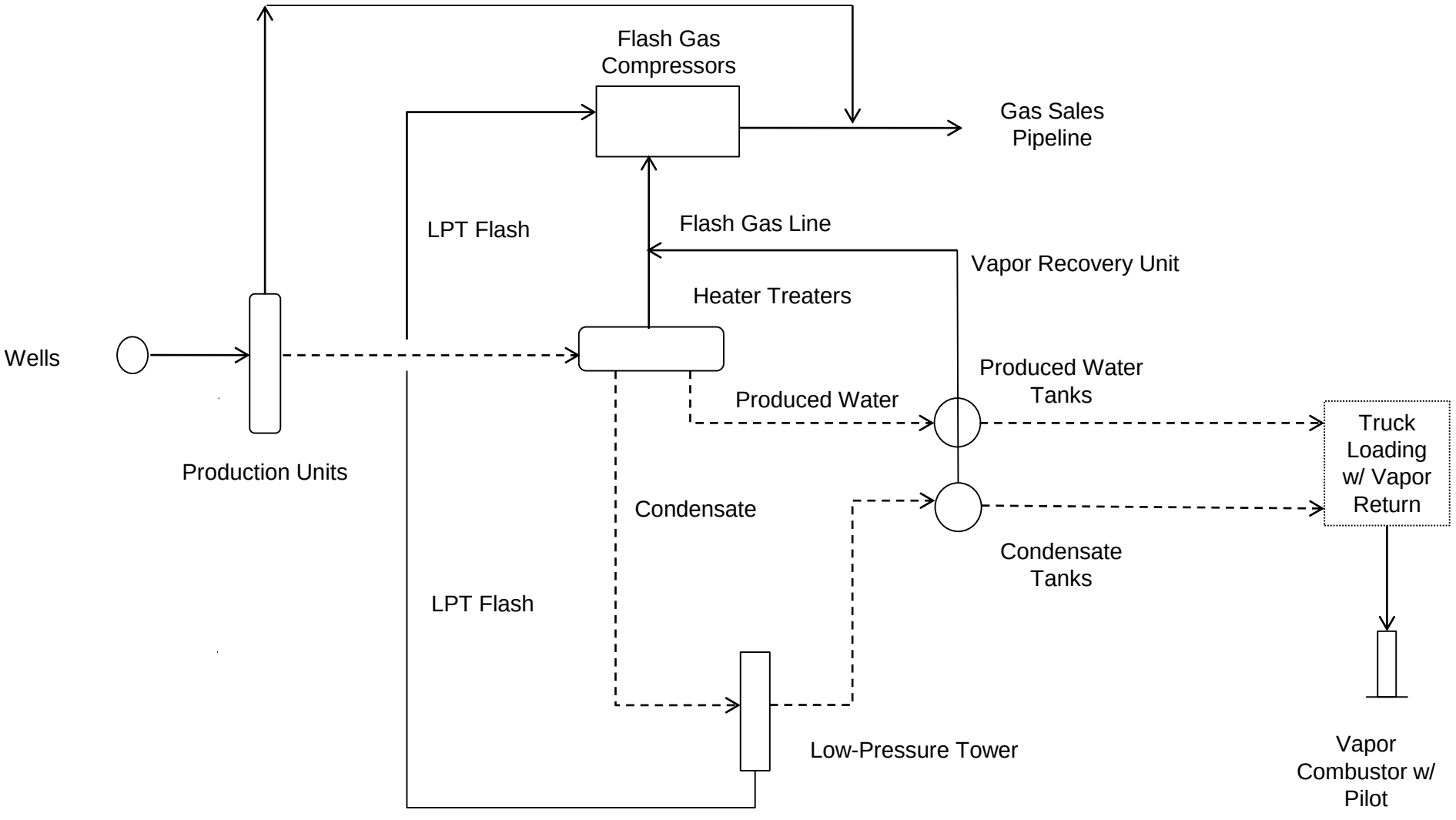
FUGITIVE EMISSIONS SUMMARY	All Regulated Pollutants - Chemical Name/CAS [1]	Maximum Potential Uncontrolled Emissions [2]		Maximum Potential Controlled Emissions [3]		Est. Method Used [4]
		lb/hr	ton/yr	lb/hr	ton/yr	
Haul Road/Road Dust Emissions Paved Haul Roads						
Unpaved Haul Roads	PM Total PM_{10} $PM_{2.5}$	1.47 0.36 0.04	4.83 1.18 0.12	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	57.89 3.35 0.04 0.23 0.24 0.83 0.01 0.39	Does not apply	17.37 1.01 0.01 0.07 0.07 0.25 <0.01 0.12	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	0.54 0.03 <0.01 <0.01 <0.01 0.01 0.09 5.49	Does not apply	0.16 0.01 <0.01 <0.01 <0.01 <0.01 0.03 1.65	O – AP-42 5.2-4 / API 5-12

Equipment Leaks	VOC n-Hexane Benzene Toluene Ethylbenzene Xylenes Carbon Dioxide Methane	Does not apply	4.69 0.20 <0.01 0.01 0.01 0.04 0.02 4.33	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.

ATTACHMENT D: PROCESS FLOW DIAGRAM



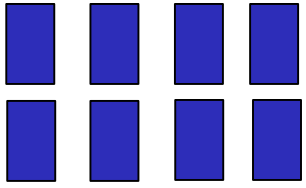
Gas/Vapor

Liquids (Condensate and Produced Water)

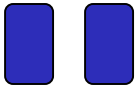
Note: Drawing is a depiction of general facility process and is not intended to represent facility and/or equipment layout.

SWN Production Company, LLC
Bonnette MSH Pad
Attachment D: Process Flow Diagram
October 2015

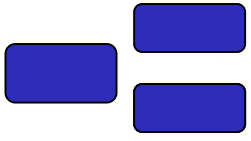
ATTACHMENT E: PLOT PLAN



GPUs

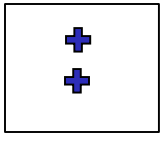


Heater Treaters

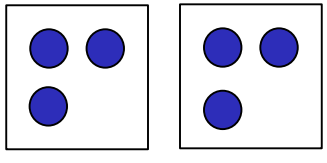


Compressor Engines

Wellheads



Low-Pressure Tower



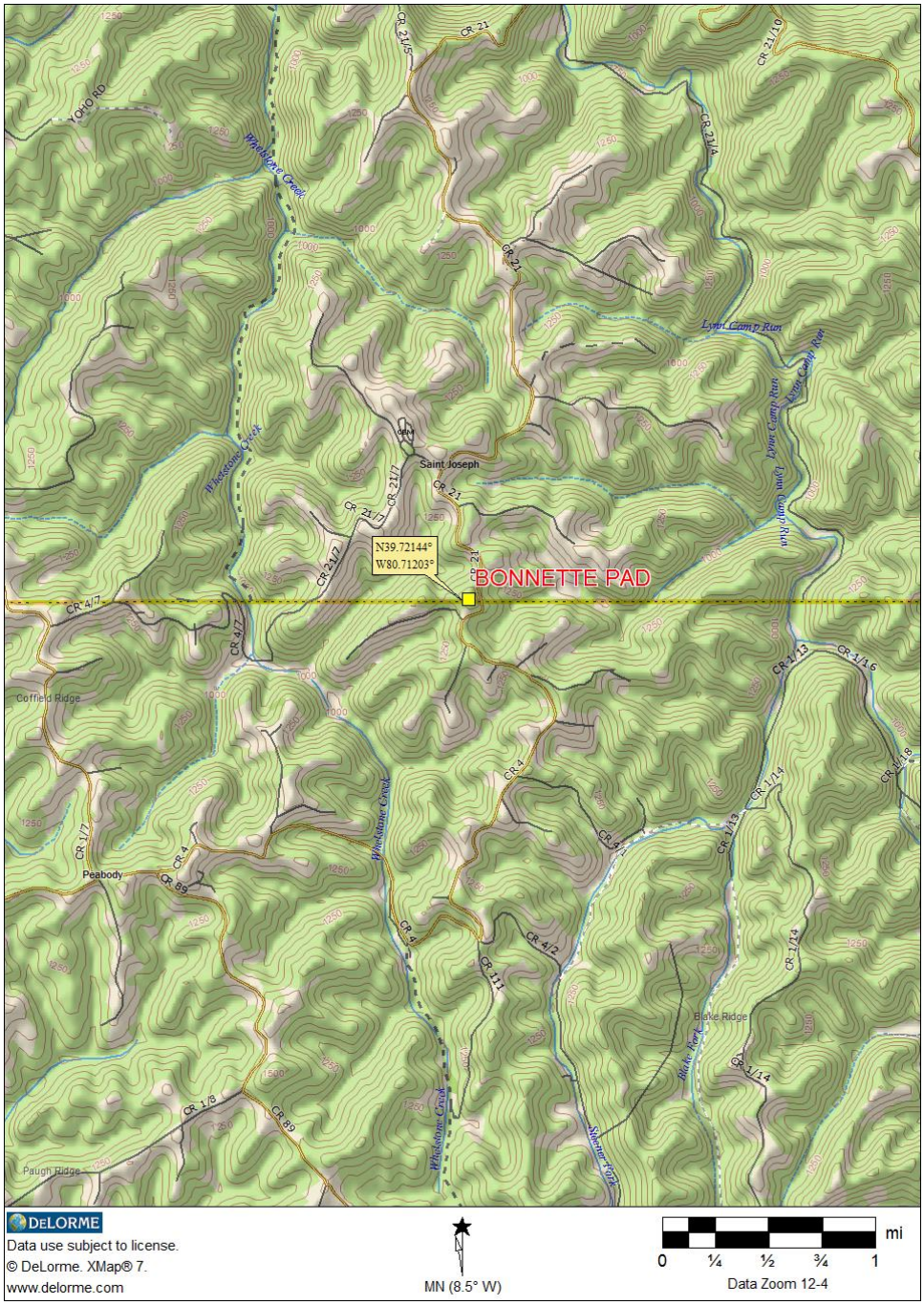
Condensate/Produced Water Storage Tanks

Vapor Combustor

The equipment demonstrates general location layout and equipment counts may be different than what is shown.

SWN Production Company, LLC
Bonnette MSH Pad
Attachment E: Simple Plot Plan
October 2015

ATTACHMENT F: AREA MAP



Bonnette MSH Pad
Marshall County, WV
October 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-ENG1	EP-ENG1	Caterpillar G3306 NA Engine	TBD	145-hp	New	NSCR
EU-ENG2	EP-ENG2	Caterpillar G3306 NA Engine	TBD	145-hp	New	NSCR
EU-ENG3	EU-ENG3	Bucks GM Vortec 5.7L	TBD	146.2-kW	New	NSCR
EU-GPU1	EP-GPU1	GPU Burner	TBD	1.0-mmBtu/hr	New	N/A
EU-GPU2	EP-GPU2	GPU Burner	TBD	1.0-mmBtu/hr	New	N/A
EU-GPU3	EP-GPU3	GPU Burner	TBD	1.0-mmBtu/hr	New	N/A
EU-GPU4	EP-GPU4	GPU Burner	TBD	1.0-mmBtu/hr	New	N/A
EU-GPU5	EP-GPU5	GPU Burner	TBD	1.0-mmBtu/hr	New	N/A
EU-GPU6	EP-GPU6	GPU Burner	TBD	1.0-mmBtu/hr	New	N/A
EU-GPU7	EP-GPU7	GPU Burner	TBD	1.0-mmBtu/hr	New	N/A
EU-GPU8	EP-GPU8	GPU Burner	TBD	1.0-mmBtu/hr	New	N/A
EU-HT1	EP-HT1	Heater Treater	TBD	0.5-mmBtu/hr	New	N/A
EU-HT2	EP-HT2	Heater Treater	TBD	0.5-mmBtu/hr	New	N/A
EU-TANKS-COND	APC-COMB-TKLD	Three (3) Condensate Tanks	TBD	400-bbl each	New	APC-COMB-TKLD
EU-TANKS-PW	APC-COMB-TKLD	Three (3) Produced Water Tanks	TBD	400-bbl each	New	APC-COMB-TKLD
EU-LOAD-COND	EP-LOAD-COND	Condensate Truck Loading	N/A	19,929,000 gal/yr	New	Vapor Return and APC-COMB-TKLD
EU-LOAD-PW	EP-LOAD-PW	Produced Water Truck Loading	N/A	15,330,000 gal/yr	New	Vapor Return and APC-COMB-TKLD
APC-COMB-TKLD	APC-COMB-TKLD	Vapor Combustor	TBD	15.0-mmBtu/hr	New	N/A
EU-PILOT	EP-PILOT	Vapor Combustor Pilot	TBD	50-SCFH	New	N/A
EU-FUG	EP-FUG	Fugitive Emissions	N/A	N/A	New	N/A

EU-HR	EP-HR	Fugitive Haul Road Emissions	N/A	N/A	New	N/A

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

STORAGE VESSEL EMISSION UNIT DATA SHEET

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

I. GENERAL INFORMATION (required)

1. Bulk Storage Area Name Condensate Storage	2. Tank Name 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)* TBD	6. Type of change: ☒ New construction ☐ New stored material ☐ Other
7A. Description of Tank Modification *(if applicable)* N/A	
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) 19,929,000 (Total for all tanks)	13B. Maximum daily throughput (gal/day) 54,600 (Total for all tanks)
14. Number of tank turnovers per year 1,239.78 (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 ☐ Rupture Disc (psig)

☐ Carbon Adsorption[1] ☐ Inert Gas Blanket of _____

☒ Vent to Vapor Combustion Device[1] (vapor combustors, flares, thermal oxidizers)

☐ Condenser[1] ☐ Conservation Vent (psig

☐ Other[1] (describe) 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)* TBD	6. Type of change: ☒ New construction ☐ New stored material ☐ Other
7A. Description of Tank Modification *(if applicable)* N/A	
7B. Will more than one material be stored in this tank? *If so, a separate form must be completed for each material.* ☐ Yes ☒ No	
7C. Provide any limitations on source operation affecting emissions. (production variation, etc.) Not applicable	

II. TANK INFORMATION (required)

8. Design Capacity *(specify barrels or gallons).* Use the internal cross-sectional area multiplied by internal height. 400 barrels (per tank)	
9A. Tank Internal Diameter (ft.) 12	9B. Tank Internal Height (ft.) 20
10A. Maximum Liquid Height (ft.) 19	10B. Average Liquid Height (ft.) 10
11A. Maximum Vapor Space Height (ft.) 20	11B. Average Vapor Space Height (ft.) 10
12. Nominal Capacity *(specify barrels or gallons).* This is also known as "working volume. 16,074.56 gallons (per EPA TANKS 4.0.9d)	
13A. Maximum annual throughput (gal/yr) 15,330,000 (Total for all tanks)	13B. Maximum daily throughput (gal/day) 42,000 (Total for all tanks)
14. Number of tank turnovers per year 953.68 (Total for all tanks, per EPA TANKS 4.0.9d)	15. Maximum tank fill rate (gal/min) Unknown
16. Tank fill method ☐ Submerged ☒ Splash ☐ Bottom Loading	
17. Is the tank system a variable vapor space system? ☐ Yes ☒ No If yes, (A) What is the volume expansion capacity of the system (gal)? (B) What are the number of transfers into the system per year?	
18. Type of tank (check all that apply): ☒ Fixed Roof _X_ vertical ___ horizontal ___ flat roof _X_ cone roof ___ dome roof ___ other (describe) ☐ External Floating Roof ___ pontoon roof ___ double deck roof ☐ Domed External (or Covered) Floating Roof ☐ Internal Floating Roof ___ vertical column support ___ self-supporting ☐ Variable Vapor Space ___ lifter roof ___ diaphragm ☐ Pressurized ___ spherical ___ cylindrical ☐ Underground ☐ Other (describe)	

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

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

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

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

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

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

VI. EMISSIONS AND CONTROL DEVICE DATA (required)

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

☐ Does Not Apply
☐ Carbon Adsorption[1]
☒ Vent to Vapor Combustion Device[1] (vapor combustors, flares, thermal oxidizers)
☐ Condenser[1]
☐ Other[1] (describe)
☐ Rupture Disc (psig)
☐ Inert Gas Blanket of _____
☐ Conservation Vent (psig
Vacuum Setting Pressure Setting
☐ Emergency Relief Valve (psig)

[1] Complete appropriate Air Pollution Control Device Sheet

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

Material Name and CAS No.	**Flashing Loss**		**Breathing Loss**		**Working Loss**		**Total Emissions Loss**		**Estimation Method[1]**
	lb/hr	**tpy**	**lb/hr**	**tpy**	**lb/hr**	**tpy**	**lb/hr**	**tpy**	
Refer to Attachment I Emissions Calculations and enclosed TANKS Summary Sheet.									

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

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

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

TANK CONSTRUCTION AND OPERATION INFORMATION **Refer to enclosed TANKS Summary Sheet.**		
19. Tank Shell Construction: ☐ Riveted ☐ Gunite lined ☐ Epoxy-coated rivets ☐ Other (describe)		
20A. Shell Color:	20B. Roof Color:	20C. Year Last Painted:
21. Shell Condition (if metal and unlined): ☐ No Rust ☐ Light Rust ☐ Dense Rust ☐ Not applicable		
22A. Is the tank heated? ☐ Yes ☐ No	22B. If yes, operating temperature:	22C. If yes, how is heat provided to tank?
23. Operating Pressure Range (psig):		
24. Is the tank a **Vertical Fixed Roof Tank**? ☐ Yes ☐ No	24A. If yes, for dome roof provide radius (ft):	24B. If yes, for cone roof, provide slop (ft/ft):
25. Complete item 25 for **Floating Roof Tanks** ☐ Does not apply ☐		
25A. Year Internal Floaters Installed:		
25B. Primary Seal Type *(check one):* ☐ Metallic (mechanical) shoe seal ☐ Liquid mounted resilient seal ☐ Vapor mounted resilient seal ☐ Other (describe):		
25C. Is the Floating Roof equipped with a secondary seal? ☐ Yes ☐ No		
25D. If yes, how is the secondary seal mounted? *(check one)* ☐ Shoe ☐ Rim ☐ Other (describe):		
25E. Is the floating roof equipped with a weather shield? ☐ Yes ☐ No		
25F. Describe deck fittings:		

26. Complete the following section for **Internal Floating Roof Tanks** ☐ Does not apply			
26A. Deck Type: ☐ Bolted ☐ Welded		26B. For bolted decks, provide deck construction:	
26C. Deck seam. Continuous sheet construction: ☐ 5 ft. wide ☐ 6 ft. wide ☐ 7 ft. wide ☐ 5 x 7.5 ft. wide ☐ 5 x 12 ft. wide ☐ other (describe)			
26D. Deck seam length (ft.):	26E. Area of deck (ft^2):	26F. For column supported tanks, # of columns:	26G. For column supported tanks, diameter of column:
SITE INFORMATION:			
27. Provide the city and state on which the data in this section are based:			
28. Daily Avg. Ambient Temperature (°F):		29. Annual Avg. Maximum Temperature (°F):	
30. Annual Avg. Minimum Temperature (°F):		31. Avg. Wind Speed (mph):	
32. Annual Avg. Solar Insulation Factor (BTU/ft^2-day):		33. Atmospheric Pressure (psia):	
LIQUID INFORMATION:			
34. Avg. daily temperature range of bulk liquid (°F):	34A. Minimum (°F):	34B. Maximum (°F):	
35. Avg. operating pressure range of tank (psig):	35A. Minimum (psig):	35B. Maximum (psig):	
36A. Minimum liquid surface temperature (°F):		36B. Corresponding vapor pressure (psia):	
37A. Avg. liquid surface temperature (°F):		37B. Corresponding vapor pressure (psia):	
38A. Maximum liquid surface temperature (°F):		38B. Corresponding vapor pressure (psia):	
39. Provide the following for each liquid or gas to be stored in the tank. Add additional pages if necessary.			
39A. Material name and composition:			
39B. CAS number:			
39C. Liquid density (lb/gal):			
39D. Liquid molecular weight (lb/lb-mole):			
39E. Vapor molecular weight (lb/lb-mole):			
39F. Maximum true vapor pressure (psia):			
39G. Maxim Reid vapor pressure (psia):			
39H. Months Storage per year. From: To:			

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

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

Emission Unit (Source) ID No.[1]		EU-ENG1		EU-ENG2		EU-ENG3	
Emission Point ID No. [2]		EP-ENG1		EP-ENG2		EP-ENG3	
Engine Manufacturer and Model		Caterpillar G3306 NA		Caterpillar G3306 NA		Bucks GM Vortec 5.7L	
Manufacturer's Rated bhp/rpm		145-hp/1,800-rpm		145-hp/1,800-rpm		196.0-hp/2,200-rpm	
Source Status[3]		NS		NS		NS	
Date Installed/Modified/Removed[4]		TBD		TBD		TBD	
Engine Manufactured/Reconstruction Date[5]		TBD		TBD		TBD	
Is this engine subject to 40CFR60, Subpart JJJJ?		Yes		Yes		Yes	
Is this a Certified Stationary Spark Ignition Engine according to 40CFR60, Subpart JJJJ? (Yes or No)[6]		No		No		Yes	
Is this engine subject to 40CFR63, Subpart ZZZZ? (yes or no)		Yes		Yes		Yes	
Engine, Fuel and Combustion Data	Engine Type[7]	RB4S		RB4S		RB4S	
	APCD Type[8]	NSCR		NSCR		NSCR	
	Fuel Type[9]	RG		RG		RG	
	H_2S (gr/100 scf)	Negligible		Negligible		Negligible	
	Operating bhp/rpm	145-hp/1,800-rpm		145-hp/1,800-rpm		196.0-hp/2,200-rpm	
	BSFC (Btu/bhp-hr)	8,625		8,625		16,185	
	Fuel throughput (ft^3/hr)	1,382		1,382		1,949	
	Fuel throughput ($MMft^3$/yr)	12.11		12.11		17.07	
	Operation (hrs/yr)	8,760		8,760		8,760	
Reference[10]	Potential Emissions[11]	lbs/hr	tpy	lbs/hr	tpy	lbs/hr	tpy
MD	NO_X	0.32	1.40	0.32	1.40	0.43	1.88
MD	CO	0.64	2.80	0.64	2.80	0.86	3.77
MD	VOC*	0.09	0.39	0.09	0.39	0.30	1.31
AP	SO_2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
AP	PM_{10}	0.01	0.04	0.01	0.04	0.02	0.07
AP	Formaldehyde	0.02	0.09	0.02	0.09	0.04	0.16
MRR[12]	Proposed Monitoring:	Maintenance required by NSPS JJJJ		Maintenance required by NSPS JJJJ		Maintenance required by NSPS JJJJ	
	Proposed Recordkeeping:	Maintenance records required by NSPS JJJJ		Maintenance records required by NSPS JJJJ		Maintenance records required by NSPS JJJJ	
	Proposed Reporting:	Test reports required by NSPS JJJJ		Test reports required by NSPS JJJJ		Test reports required by NSPS 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™ , 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-TKLD**	2. Installation Date: TBD ☒ New	
3. Maximum Rated Total Flow Capacity: **6,125** scfh **147,000** scfd	4. Maximum Design Heat Input: **15.0** 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-TKLD**)*

10. Emission Unit ID#	Emission Source Description:	Emission Unit ID#	Emission Source Description:
EU-TANKS-COND	**Condensate Tanks**	**EU-LOAD-PW**	**Produced Water Truck Loading**
EU-TANKS-PW	**Produced Water Tanks**		
EU-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)
204.17	**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 Combustor Specification Sheet
MRW Technologies, Inc.
Combustor Model Number: TBF-5.5-30-147000

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

Description of Control Scheme:

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

ATTACHMENT I: EMISSIONS CALCULATIONS

SWN Production Company, LLC
Bonnette MSH 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 w/ Catalytic Converter	EU-ENG1	0.32	1.40	0.64	2.80	0.09	0.39	<0.01	<0.01	0.02	0.09
145-hp Caterpillar G3306 NA Engine w/ Catalytic Converter	EU-ENG2	0.32	1.40	0.64	2.80	0.09	0.39	<0.01	<0.01	0.02	0.09
146.2-kw Bucks GM Vortec 5.7L Engine	EU-ENG3	0.43	1.88	0.86	3.77	0.30	1.31	<0.01	<0.01	0.03	0.15
Eight (8) 1.0-mmBtu/hr GPU Burners	EU-GPU1 to EU-GPU8	0.88	3.84	0.72	3.12	0.05	0.24	0.01	0.02	0.07	0.29
Two (2) 0.5-mmBtu/hr Heater Treaters	EU-HT1 to EU-HT2	0.12	0.52	0.10	0.44	0.01	0.02	<0.01	<0.01	0.01	0.04
Three (3) 400-bbl Condensate Tanks Routed to Vapor Combustor	EU-TANKS-COND	-	-	-	-	-	-	-	-	-	-
Three (3) 400-bbl Produced Water Tanks Routed to Vapor Combustor	EU-TANKS-PW	-	-	-	-	-	-	-	-	-	-
Condensate Truck Loading w/ Vapor Return Routed to Combustor	EU-LOAD-COND	-	-	-	-	3.97	17.37	-	-	-	-
Produced Water Truck Loading w/ Vapor Return Routed to Combustor	EU-LOAD-PW	-	-	-	-	0.04	0.16	-	-	-	-
One (1) 15.0-mmBtu/hr Vapor Combustor - Tank/Loading Stream	APC-COMB-TKLD	2.07	9.07	4.13	18.09	5.15	22.56	-	-	0.04	0.18
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	EU-FUG	-	-	-	-	1.07	4.69	-	-	-	-
Fugitive Haul Road Emissions	EU-HR	-	-	-	-	-	-	-	-	1.47	4.83
Total Allowable Emissions =		**4.15**	**18.16**	**7.09**	**31.04**	**10.76**	**47.13**	**0.01**	**0.04**	**1.66**	**5.66**

Notes:

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

SWN Production Company, LLC
Bonnette MSH Pad
Summary of Hazardous Air Pollutants

Equipment	Unit ID	Estimated Emissions (lb/hr)									
		Acetalde-hyde	Acrolein	Benzene	Ethyl-benzene	Formalde-hyde	Methanol	n-Hexane	Toluene	Xylenes	Total HAP
145-hp Caterpillar G3306 NA Engine w/ Catalytic Converter	EU-ENG1	<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	EU-ENG2	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	-	<0.01	<0.01	0.03
146.2-kw Bucks GM Vortec 5.7L Engine	EU-ENG3	<0.01	<0.01	<0.01	<0.01	0.04	0.01	-	<0.01	<0.01	0.06
Eight (8) 1.0-mmBtu/hr GPU Burners	EU-GPU1 to EU-GPU8	-	-	<0.01	-	<0.01	-	0.02	<0.01	-	0.02
Two (2) 0.5-mmBtu/hr Heater Treaters	EU-HT1 to EU-HT2	-	-	<0.01	-	<0.01	-	<0.01	<0.01	-	<0.01
Three (3) 400-bbl Condensate Tanks Routed to Vapor Combustor	EU-TANKS-COND	-	-	-	-	-	-	-	-	-	-
Three (3) 400-bbl Produced Water Tanks Routed to Vapor Combustor	EU-TANKS-PW	-	-	-	-	-	-	-	-	-	-
Condensate Truck Loading w/ Vapor Return Routed to Combustor	EU-LOAD-COND	-	-	<0.01	0.02	-	-	0.23	0.02	0.06	0.32
Produced Water Truck Loading w/ Vapor Return Routed to Combustor	EU-LOAD-PW	-	-	<0.01	<0.01	-	-	<0.01	<0.01	<0.01	<0.01
One (1) 15.0-mmBtu/hr Vapor Combustor - Tank/Loading Stream	APC-COMB-TKLD	-	-	<0.01	0.02	-	-	0.30	0.02	0.07	0.42
Vapor Combustor Pilot	EU-PILOT	-	-	<0.01	-	<0.01	-	<0.01	<0.01	-	<0.01
Fugitive Emissions	EU-FUG	-	-	<0.01	<0.01	-	-	0.05	<0.01	0.01	0.06
Fugitive Haul Road Emissions	EU-HR	-	-	-	-	-	-	-	-	-	-
Total Allowable Emissions =		**0.01**	**0.01**	**0.01**	**0.04**	**0.08**	**0.01**	**0.59**	**0.04**	**0.14**	**0.94**

Continued on Next Page

SWN Production Company, LLC
Bonnette MSH Pad
Summary of Hazardous Air Pollutants (Continued)

Equipment	Unit ID	Estimated Emissions (TPY)									
		Acetalde-hyde	Acrolein	Benzene	Ethyl-benzene	Formalde-hyde	Methanol	n-Hexane	Toluene	Xylenes	Total HAP
145-hp Caterpillar G3306 NA Engine w/ Catalytic Converter	EU-ENG1	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	EU-ENG2	0.02	0.01	0.01	<0.01	0.09	0.02	-	<0.01	<0.01	0.15
146.2-kw Bucks GM Vortec 5.7L Engine	EU-ENG3	0.02	0.02	0.01	<0.01	0.16	0.02	-	<0.01	<0.01	0.24
Eight (8) 1.0-mmBtu/hr GPU Burners	EU-GPU1 to EU-GPU8	-	-	<0.01	-	<0.01	-	0.07	<0.01	-	0.07
Two (2) 0.5-mmBtu/hr Heater Treaters	EU-HT1 to EU-HT2	-	-	<0.01	-	<0.01	-	0.01	<0.01	-	0.01
Three (3) 400-bbl Condensate Tanks Routed to Vapor Combustor	EU-TANKS-COND	-	-	-	-	-	-	-	-	-	-
Three (3) 400-bbl Produced Water Tanks Routed to Vapor Combustor	EU-TANKS-PW	-	-	-	-	-	-	-	-	-	-
Condensate Truck Loading w/ Vapor Return Routed to Combustor	EU-LOAD-COND	-	-	0.01	0.07	-	-	1.01	0.07	0.25	1.41
Produced Water Truck Loading w/ Vapor Return Routed to Combustor	EU-LOAD-PW	-	-	<0.01	<0.01	-	-	0.01	<0.01	<0.01	0.01
One (1) 15.0-mmBtu/hr Vapor Combustor - Tank/Loading Stream	APC-COMB-TKLD	-	-	0.02	0.10	-	-	1.31	0.09	0.32	1.84
Vapor Combustor Pilot	EU-PILOT	-	-	<0.01	-	<0.01	-	<0.01	<0.01	-	<0.01
Fugitive Emissions	EU-FUG	-	-	<0.01	0.01	-	-	0.20	0.01	0.04	0.26
Fugitive Haul Road Emissions	EU-HR	-	-	-	-	-	-	-	-	-	-
Total Allowable Emissions =		**0.05**	**0.05**	**0.06**	**0.18**	**0.34**	**0.06**	**2.60**	**0.18**	**0.62**	**4.14**

SWN Production Company, LLC
Bonnette MSH 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 w/ Catalytic Converter	EU-ENG1	155.04	616.04	<0.01	0.01	0.07	0.27	<0.01	<0.01	0.08	0.33	155.19	616.64
145-hp Caterpillar G3306 NA Engine w/ Catalytic Converter	EU-ENG2	155.04	616.04	<0.01	0.01	0.07	0.27	<0.01	<0.01	0.08	0.33	155.19	616.64
146.2-kw Bucks GM Vortec 5.7L Engine	EU-ENG3	206.41	820.16	<0.01	0.02	0.10	0.39	<0.01	<0.01	0.12	0.46	206.62	821.00
Eight (8) 1.0-mmBtu/hr GPU Burners	EU-GPU1 to EU-GPU8	935.82	3,718.44	0.02	0.07	0.44	1.75	<0.01	0.01	0.53	2.09	936.78	3,722.28
Two (2) 0.5-mmBtu/hr Heater Treaters	EU-HT1 to EU-HT2	116.98	464.80	<0.01	0.01	0.06	0.22	<0.01	<0.01	0.07	0.26	117.10	465.28
Four (4) 400-bbl Condensate Tanks Routed to Vapor Combustor	EU-TANKS-COND	-	-	-	-	-	-	-	-	-	-	-	-
Three (3) 400-bbl Produced Water Tanks Routed to Vapor Combustor	EU-TANKS-PW	-	-	-	-	-	-	-	-	-	-	-	-
Condensate Truck Loading w/ Vapor Return Routed to Combustor	EU-LOAD-COND	<0.01	<0.01	0.03	0.10	0.66	2.62	-	-	-	-	0.66	2.63
Produced Water Truck Loading w/ Vapor Return Routed to Combustor	EU-LOAD-PW	0.01	0.03	0.38	1.49	9.40	37.34	-	-	-	-	9.40	37.37
One (1) 15.0-mmBtu/hr Vapor Combustor - Tank/Loading Stream	APC-COMB-TKLD	1,754.66	6,972.07	0.03	0.13	0.83	3.28	<0.01	0.01	0.99	3.92	1,756.47	6,979.27
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	EU-FUG	0.01	0.02	0.99	3.93	24.75	98.20	-	-	-	-	24.76	98.22
Fugitive Haul Road Emissions	EU-HR	-	-	-	-	-	-	-	-	-	-	-	-
Total Allowable Emissions =		**3,329.24**	**13,228.62**	**1.45**	**5.77**	**36.37**	**144.37**	**0.01**	**0.02**	**1.86**	**7.39**	**3,367.47**	**13,380.38**

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 VRU in this case), working and breathing loss emissions of these gases are very small in production and virtually non-existent in the downstream segments. Therefore, GHG emissions from the condensate and produced water tanks are assumed to be negligible.

SWN Production Company, LLC
Bonnette MSH 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 w/ Catalytic Converter	EU-ENG1	155.04	679.06	<0.01	0.01	0.07	0.30	<0.01	<0.01	0.08	0.36	155.19	679.73
145-hp Caterpillar G3306 NA Engine w/ Catalytic Converter	EU-ENG2	155.04	679.06	<0.01	0.01	0.07	0.30	<0.01	<0.01	0.08	0.36	155.19	679.73
146.2-kw Bucks GM Vortec 5.7L Engine	EU-ENG3	206.41	904.07	<0.01	0.02	0.10	0.43	<0.01	<0.01	0.12	0.51	206.62	905.00
Eight (8) 1.0-mmBtu/hr GPU Burners	EU-GPU1 to EU-GPU8	935.82	4,098.88	0.02	0.08	0.44	1.93	<0.01	0.01	0.53	2.30	936.78	4,103.11
Two (2) 0.5-mmBtu/hr Heater Treaters	EU-HT1 to EU-HT2	116.98	512.36	<0.01	0.01	0.06	0.24	<0.01	<0.01	0.07	0.29	117.10	512.89
Four (4) 400-bbl Condensate Tanks Routed to Vapor Combustor	EU-TANKS-COND	-	-	-	-	-	-	-	-	-	-	-	-
Three (3) 400-bbl Produced Water Tanks Routed to Vapor Combustor	EU-TANKS-PW	-	-	-	-	-	-	-	-	-	-	-	-
Condensate Truck Loading w/ Vapor Return Routed to Combustor	EU-LOAD-COND	<0.01	<0.01	0.03	0.12	0.66	2.89	-	-	-	-	0.66	2.89
Produced Water Truck Loading w/ Vapor Return Routed to Combustor	EU-LOAD-PW	0.01	0.03	0.38	1.65	9.40	41.16	-	-	-	-	9.40	41.19
One (1) 15.0-mmBtu/hr Vapor Combustor - Tank/Loading Stream	APC-COMB-TKLD	1,754.66	7,685.39	0.03	0.14	0.83	3.62	<0.01	0.01	0.99	4.32	1,756.47	7,693.33
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	EU-FUG	0.01	0.02	0.99	4.33	24.75	108.25	-	-	-	-	24.76	108.27
Fugitive Haul Road Emissions	EU-HR	-	-	-	-	-	-	-	-	-	-	-	-
Total Allowable Emissions =		**3,329.24**	**14,582.06**	**1.45**	**6.36**	**36.37**	**159.14**	**0.01**	**0.02**	**1.86**	**8.15**	**3,367.47**	**14,749.34**

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 VRU in this case), working and breathing loss emissions of these gases are very small in production and virtually non-existent in the downstream segments. Therefore, GHG emissions from the condensate and produced water tanks are assumed to be negligible.

SWN Production Company, LLC
Bonnette MSH Pad
Engine Emissions Calculations - Criteria Air Pollutants

Equipment Information

Unit ID:	**EU-ENG1**	**EU-ENG2**
Make:	Caterpillar	Caterpillar
Model:	G3306 NA	G3306 NA
Design Class:	4S-RB	4S-RB
Controls:	NSCR	NSCR
Horsepower (hp):	145	145
Fuel Use (Btu/hp-hr):	8,625	8,625
Fuel Use (scfh):	1,382	1,382
Annual Fuel Use (mmscf):	12.11	12.11
Fuel Use (mmBtu/hr):	1.25	1.25
Exhaust Flow (acfm):	678	678
Exhaust Temp (°F):	1,101	1,101
Serial Number:	To be determined	To be determined
Manufacture Date:	After 1/1/2011	After 1/1/2011
Operating Hours:	8,760	8,760
Fuel Heating Value (Btu/scf):	905	905

Uncontrolled Manufacturer Emission Factors [1]

NOx (g/hp-hr):	13.47	13.47
CO (g/hp-hr):	13.47	13.47
NMNEHC/VOC (g/hp-hr):	0.22	0.22
Total VOC = NMNEHC + HCHO (g/hp-hr):	0.28	0.28

Post-Catalyst Emission Factors

NOx Control Eff. %	92.58%	92.58%
CO Control Eff. %	85.15%	85.15%
NOx (g/hp-hr):	1.00	1.00
CO (g/hp-hr):	2.00	2.00
NMNEHC/VOC (g/hp-hr):	0.22	0.22
Total VOC = NMNEHC + HCHO (g/hp-hr):	0.28	0.28

Uncontrolled Criteria Air Pollutant Emissions

Unit ID:	**EU-ENG1**		**EU-ENG2**	
Pollutant	**lb/hr**	**TPY**	**lb/hr**	**TPY**
NOx	4.31	18.88	4.31	18.88
CO	4.31	18.88	4.31	18.88
NMNEHC/VOC (does not include HCHO)	0.07	0.31	0.07	0.31
Total VOC (includes HCHO)	0.09	0.39	0.09	0.39
SO_2	<0.01	<0.01	<0.01	<0.01
$PM_{10/2.5}$	0.01	0.04	0.01	0.04
PM_{COND}	0.01	0.04	0.01	0.04
PM_{TOT}	0.02	0.09	0.02	0.09

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

Proposed Criteria Air Pollutant Emissions[2]

Unit ID:	EU-ENG1		EU-ENG2	
Pollutant	**lb/hr**	**TPY**	**lb/hr**	**TPY**
NOx	0.32	1.40	0.32	1.40
CO	0.64	2.80	0.64	2.80
NMNEHC/VOC (does not include HCHO)	0.07	0.31	0.07	0.31
Total VOC (includes HCHO)	0.09	0.39	0.09	0.39
SO_2	<0.01	<0.01	<0.01	<0.01
$PM_{10/2.5}$	0.01	0.04	0.01	0.04
PM_{COND}	0.01	0.04	0.01	0.04
PM_{TOT}	0.02	0.09	0.02	0.09

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

	4S-RB
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] Post-catalyst emission factors based on catalyst manufacturer data and/or NSPS Subpart JJJJ limits, if applicable. Per NSPS Subpart JJJJ, VOC limit does not include HCHO; therefore, HCHO emissions have been added to the NSPS JJJJ VOC emission rates for demonstration purposes only.

[2] 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
Bonnette MSH Pad
Engine Emissions Calculations - Hazardous Air Pollutants

Equipment Information

Unit ID:	**EU-ENG1**	**EU-ENG2**
Make:	Caterpillar	Caterpillar
Model:	G3306 NA	G3306 NA
Design Class:	4S-RB	4S-RB
Controls:	NSCR	NSCR
Horsepower (hp):	145	145
Fuel Use (Btu/hp-hr):	8,625	8,625
Fuel Use (scfh):	1,382	1,382
Annual Fuel Use (mmscf):	12.11	12.11
Fuel Use (mmBtu/hr):	1.25	1.25
Exhaust Flow (acfm):	678	678
Exhaust Temp (°F):	1,101	1,101
Operating Hours:	8,760	8,760

Manufacturer Formaldehyde Factor

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

Uncontrolled HAP Emissions

Unit ID:	**EU-ENG1**		**EU-ENG2**	
Pollutant	**lb/hr**	**TPY**	**lb/hr**	**TPY**
Acetaldehyde	<0.01	0.02	<0.01	0.02
Acrolein	<0.01	0.01	<0.01	0.01
Benzene	<0.01	0.01	<0.01	0.01
Ethylbenzene	<0.01	<0.01	<0.01	<0.01
Formaldehyde	0.09	0.38	0.09	0.38
Methanol	<0.01	0.02	<0.01	0.02
Toluene	<0.01	<0.01	<0.01	<0.01
Xylenes	<0.01	<0.01	<0.01	<0.01
Total HAPs =	**0.10**	**0.44**	**0.10**	**0.44**

SWN Production Company, LLC
Bonnette MSH Pad
Engine Emissions Calculations - Hazardous Air Pollutants

Proposed HAP Emissions

Unit ID:	EU-ENG1		EU-ENG2	
Pollutant	**lb/hr**	**TPY**	**lb/hr**	**TPY**
Acetaldehyde	<0.01	0.02	<0.01	0.02
Acrolein	<0.01	0.01	<0.01	0.01
Benzene	<0.01	0.01	<0.01	0.01
Ethylbenzene	<0.01	<0.01	<0.01	<0.01
Formaldehyde	0.02	0.09	0.02	0.09
Methanol	<0.01	0.02	<0.01	0.02
Toluene	<0.01	<0.01	<0.01	<0.01
Xylenes	<0.01	<0.01	<0.01	<0.01
Total HAPs =	**0.03**	**0.15**	**0.03**	**0.15**

AP-42 Emission Factors (lb/mmBtu)

	4S-RB
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.

SWN Production Company, LLC
Bonnette MSH Pad
Engine Emissions Calculations - Greenhouse Gases

Equipment Information

Unit ID:	**EU-ENG1**	**EU-ENG2**
Make:	Caterpillar	Caterpillar
Model:	G3306 NA	G3306 NA
Design Class:	4S-RB	4S-RB
Controls:	NSCR	NSCR
Horsepower (hp):	145	145
Fuel Use (Btu/hp-hr):	8,625	8,625
Fuel Use (scfh):	1,382	1,382
Fuel Use (mmBtu/hr):	1.25	1.25
Exhaust Flow (acfm):	678	678
Exhaust Temp (°F):	1,101	1,101
Operating Hours:	8,760	8,760

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

	485	485

Greenhouse Gas (GHG) Emissions[1]

Unit ID:	**EU-ENG1**		**EU-ENG2**	
Pollutant	**lb/hr**	**tonnes/yr**	**lb/hr**	**tonnes/yr**
CO_2	155.04	616.04	155.04	616.04
CH_4	<0.01	0.01	<0.01	0.01
N_2O	<0.01	<0.01	<0.01	<0.01
CH_4 as CO_2e	0.07	0.27	0.07	0.27
N_2O as CO_2e	0.08	0.33	0.08	0.33
Total CO_2 + CO_2e =	**155.19**	**616.64**	**155.19**	**616.64**

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
Bonnette MSH Pad
Proposed Engine Emissions Calculations - Criteria Air Pollutants

Equipment Information

Unit ID:	**EU-ENG3**
Make:	Bucks
Model:	GM Vortec 5.7L
Design Class:	4S-RB
Capacity (kW):	146.2
Capacity(hp):	196.1
Fuel Use (Btu/kW-hr):	12,069
Fuel Use (scfh):	1,950
Annual Fuel Use (mmscf):	17.08
Fuel Use (mmBtu/hr):	1.76
Manufacture Date:	after 1/1/2011
Operating Hours:	8,760
Fuel Heating Value (Btu/scf):	905

Emission Factors[1]

NMHC+NOx as NOx (g/kW-hr):	1.34
CO (g/kW-hr):	2.68
NMHC+NOx as VOC (g/kW-hr):	0.94

Proposed Criteria Air Pollutant Emissions

Unit ID: **EU-ENG3**

Pollutant	lb/hr	TPY
NMHC+NOx as NOx	0.43	1.88
CO	0.86	3.77
NMHC+NOx as VOC	0.30	1.31
SO_2	<0.01	<0.01
$PM_{10/2.5}$	0.02	0.07
PM_{COND}	0.02	0.08
PM_{TOT}	0.03	0.15

AP-42 Emission Factors (lb/mmBtu)[2]

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] EU-ENG3 emissions factors are from NSPS Subpart JJJJ emission limits for Stage 2 engines, converted to g/kw-hr.
[2] 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
Bonnette MSH Pad
Proposed Engine Emissions Calculations - Hazardous Air Pollutants

Equipment Information

Unit ID:	**EU-ENG3**
Make:	Bucks
Model:	GM Vortec 5.7L
Design Class:	4S-RB
Capacity (kW):	146.2
Fuel Use (Btu/kW-hr):	12,069
Fuel Use (scfh):	1,950
Annual Fuel Use (mmscf):	17.08
Fuel Use (mmBtu/hr):	1.76
Manufacture Date:	after 1/1/2011
Operating Hours:	8,760
Fuel Heating Value (Btu/scf):	905

Proposed HAP Emissions

Unit ID: **EU-ENG3**

Pollutant	lb/hr	TPY
Acetaldehyde	<0.01	0.02
Acrolein	<0.01	0.02
Benzene	<0.01	0.01
Ethylbenzene	<0.01	<0.01
Formaldehyde	0.04	0.16
Methanol	0.01	0.02
Toluene	<0.01	<0.01
Xylenes	<0.01	<0.01
Total HAP =	**0.06**	**0.24**

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
Formaldehyde	2.05E-02
Methanol	3.06E-03
Toluene	5.58E-04
Xylenes	1.95E-04

SWN Production Company, LLC
Bonnette MSH Pad
Proposed Engine Emissions Calculations - Greenhouse Gases

Equipment Information

Unit ID:	**EU-ENG3**
Make:	Bucks
Model:	GM Vortec 5.7L
Design Class:	4S-RB
Controls:	NSCR
Capacity (kW):	146.2
Fuel Use (Btu/kW-hr):	12,069
Fuel Use (scfh):	1,950
Annual Fuel Use (mmscf):	17.08
Fuel Use (mmBtu/hr):	1.76
Operating Hours:	8,760
Fuel Heating Value (Btu/scf):	905

Greenhouse Gas (GHG) Emissions

Unit ID: **EU-ENG3**

Pollutant	lb/hr	tonnes/yr
CO_2	206.41	820.16
CH_4	<0.01	0.02
N_2O	<0.01	<0.01
CH_4 as CO_2e	0.10	0.39
N_2O as CO_2e	0.12	0.46
Total CO_2 + CO_2e =	**206.62**	**821.00**

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
Bonnette MSH Pad
Gas Production Unit Burner Emissions Calculations - Criteria Air Pollutants

Equipment Information

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

Criteria Air Pollutant Emissions

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

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

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

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

SWN Production Company, LLC
Bonnette MSH Pad
Gas Production Unit Burner Emissions Calculations - Hazardous Air Pollutants

Equipment Information

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

Hazardous Air Pollutant Emissions

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

AP-42 Emission Factors (lb/mmscf)

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

SWN Production Company, LLC
Bonnette MSH Pad
Gas Production Unit Burner Emissions Calculations - Greenhouse Gases

Equipment Information

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

Greenhouse Gas (GHG) Emissions[1]

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

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

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

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

SWN Production Company, LLC
Bonnette MSH Pad
Heater Treater Emissions Calculations - Criteria Air Pollutants

Equipment Information

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

Criteria Air Pollutant Emissions

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

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

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

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

SWN Production Company, LLC
Bonnette MSH Pad
Heater Treater Emissions Calculations - Hazardous Air Pollutants

Equipment Information

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

Hazardous Air Pollutant Emissions

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

AP-42 Emission Factors (lb/mmscf)

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

SWN Production Company, LLC
Bonnette MSH Pad
Heater Treater Emissions Calculations - Greenhouse Gases

Equipment Information

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

Greenhouse Gas (GHG) Emissions[1]

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

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

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

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

SWN Production Company, LLC
Bonnette MSH 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):	474,500	365,000
Total Throughput (gal/yr):	19,929,000	15,330,000
Total Throughput (bbl/d):	1,300	1,000
Tank Flashing Emission Factor (lb/bbl):	4.5000	0.03000
Total Working Losses (lb/yr): [3]	24,846.70	223.29
Breathing Losses per Tank (lb/yr): [3]	1,155.38	11.00
Tank Vapor Capture Efficiency:	100%	100%
Captured Vapors Routed to:	Vapor Combustor	Vapor Combustor

Uncontrolled Storage Tank Emissions

Unit ID:	**EU-TANKS-COND**		**EU-TANKS-PW**	
Emissions	**lb/hr**	**TPY**	**lb/hr**	**TPY**
Working Losses	2.84	12.42	0.03	0.11
Breathing Losses	0.40	1.74	0.01	0.03
Flashing Losses	243.75	1,067.63	1.25	5.48
Total VOC =	**246.98**	**1,081.79**	**1.28**	**5.62**

Notes:

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

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

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

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

SWN Production Company, LLC
Bonnette MSH 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]	**246.98**	**1,081.79**	**1.28**	**5.62**
n-Hexane	14.28	62.56	0.07	0.33
Benzene	0.17	0.75	<0.01	<0.01
Toluene	0.96	4.22	0.01	0.02
Ethylbenzene	1.04	4.55	0.01	0.02
Xylenes	3.54	15.49	0.02	0.08
Total HAP =	**20.00**	**87.58**	**0.10**	**0.45**

Estimated HAP Composition (% by Weight)[3]

Pollutant	Wt%
n-Hexane	5.783%
Benzene	0.070%
Toluene	0.390%
Ethylbenzene	0.421%
Xylenes	1.432%
Total HAP =	**8.096%**

Notes:

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

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

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

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

Loading Information

Unit ID:	**EU-LOAD-COND**
Fill Method:	Submerged
Type of Service:	Dedicated
Mode of Operation:	Normal
Saturation Factor:	0.6
Em. Factor (lb/1000 gal): [1]	5.81
Throughput (1000 gal):	19,929
Control Type:	Vapor Return/Combustion
Vapor Capture Efficiency: [2]	70%
Average Fill Rate (gal/hr):	7,500
Captured Vapors Routed to:	Vapor Combustor

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

Uncontrolled Loading Emissions[4]

Pollutant	Max. lb/hr	Avg. lb/hr	TPY
VOC =	**43.58**	**13.22**	**57.89**
n-Hexane	2.52	0.76	3.35
Benzene	0.03	0.01	0.04
Toluene	0.17	0.05	0.23
Ethylbenzene	0.18	0.06	0.24
Xylenes	0.62	0.19	0.83
Total HAP [5] =	**3.53**	**1.07**	**4.69**

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

Uncaptured Loading Emissions[4]

Pollutant	Max. lb/hr	Avg. lb/hr	TPY
VOC =	**13.07**	**3.97**	**17.37**
n-Hexane	0.76	0.23	1.01
Benzene	0.01	<0.01	0.01
Toluene	0.05	0.02	0.07
Ethylbenzene	0.06	0.02	0.07
Xylenes	0.19	0.06	0.25
Total HAP [5] =	**1.06**	**0.32**	**1.41**

Notes:

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

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

[3] AP-42 Section 7.1 - Properties of Selected Petroleum Liquids correlation with RVP estimated based on stabilization process.

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

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

Pollutant	Wt%
n-Hexane	5.783%
Benzene	0.070%
Toluene	0.390%
Ethylbenzene	0.421%
Xylenes	1.432%
Total HAPs =	**8.096%**

SWN Production Company, LLC
Bonnette MSH Pad
Condensate Truck Loading Emissions - Greenhouse Gases

Loading Information

Unit ID:	**EU-LOAD-COND**
Fill Method:	Submerged
Type of Service:	Dedicated
Mode of Operation:	Normal
TOC Em. Factor (tonne/10^6 gal): [1]	0.91
Throughput (10^6 gal):	19.929
Control Type:	Vapor Return/Combustion
Vapor Capture Efficiency: [2]	70.00%
Average Fill Rate (gal/hr):	7,500
Captured Vapors Routed to:	Vapor Combustor

Input CH_4 from Promax =	1.9277%
Input CO_2 from Promax =	0.0586%

Uncontrolled Loading Emissions[3, 4]

Pollutant	Max. lb/hr	Avg. lb/hr	tonnes/yr	tons/yr
CH_4	0.29	0.09	0.35	0.39
CH_4 as CO_2e	7.25	2.20	8.74	9.63
CO_2	0.01	<0.01	0.01	0.01
Total CO_2 + CO_2e =	**7.26**	**2.20**	**8.75**	**9.65**

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

Uncaptured Loading Emissions[3, 4]

Pollutant	Max. lb/hr	Avg. lb/hr	tonnes/yr	tons/yr
CH_4	0.09	0.03	0.10	0.12
CH_4 as CO_2e	2.18	0.66	2.62	2.89
CO_2	<0.01	<0.01	<0.01	<0.01
Total CO_2 + CO_2e =	**2.18**	**0.66**	**2.63**	**2.89**

API Compendium Table 5-12

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

Notes:

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

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

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

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

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

Loading Information

Unit ID:	**EU-LOAD-PW**
Fill Method:	Submerged
Type of Service:	Dedicated
Mode of Operation:	Normal
Saturation Factor:	0.6
Em. Factor (lb/1000 gal): [1]	0.07
Throughput (1000 gal):	15,330
Control Type:	Vapor Return/Combustion
Vapor Capture Efficiency: [2]	70%
Average Fill Rate (gal/hr):	7,500
Captured Vapors Routed to:	Vapor Combustor

0.2427	= P, True vapor pressure of liquid loaded (max psia)
20.1493	= M, Molecular weight of vapor (lb/lb-mol)
50.33	= T, Temperature of bulk liquid loaded (average °F)
510.33	= T, Temperature of bulk liquid loaded (°F + 460 = °R)

Uncontrolled Loading Emissions[3]

Pollutant	Max. lb/hr	Avg. lb/hr	TPY
VOC =	**0.53**	**0.12**	**0.54**
n-Hexane	0.03	0.01	0.03
Benzene	<0.01	<0.01	<0.01
Toluene	<0.01	<0.01	<0.01
Ethylbenzene	<0.01	<0.01	<0.01
Xylenes	0.01	<0.01	0.01
Total HAP[4] =	**0.04**	**0.01**	**0.04**

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

Uncaptured Loading Emissions[3]

Pollutant	Max. lb/hr	Avg. lb/hr	TPY
VOC =	**0.16**	**0.04**	**0.16**
n-Hexane	0.01	<0.01	0.01
Benzene	<0.01	<0.01	<0.01
Toluene	<0.01	<0.01	<0.01
Ethylbenzene	<0.01	<0.01	<0.01
Xylenes	<0.01	<0.01	<0.01
Total HAP[4] =	**0.01**	**<0.01**	**0.01**

Notes:

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

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

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

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

Pollutant	Wt%
n-Hexane	5.783%
Benzene	0.070%
Toluene	0.390%
Ethylbenzene	0.421%
Xylenes	1.432%
Total HAPs =	**8.096%**

SWN Production Company, LLC
Bonnette MSH Pad
Produced Water Truck Loading Emissions - Greenhouse Gases

Loading Information

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

Input CH_4 from Promax =	35.6910%
Input CO_2 from Promax =	0.6029%

Uncontrolled Loading Emissions[3, 4]

Pollutant	Max. lb/hr	Avg. lb/hr	tonnes/yr	tons/yr
CH_4	5.37	1.25	4.98	5.49
CH_4 as CO_2e	134.26	31.33	124.48	137.21
CO_2	0.09	0.02	0.08	0.09
Total CO_2 + CO_2e =	**134.35**	**31.35**	**124.56**	**137.30**

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

Uncaptured Loading Emissions[3, 4]

Pollutant	Max. lb/hr	Avg. lb/hr	tonnes/yr	tons/yr
CH_4	1.61	0.38	1.49	1.65
CH_4 as CO_2e	40.28	9.40	37.34	41.16
CO_2	0.03	0.01	0.03	0.03
Total CO_2 + CO_2e =	**40.30**	**9.40**	**37.37**	**41.19**

API Compendium Table 5-12

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

Notes:

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

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

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

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

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

Criteria and Hazardous Air Pollutant Emissions

Unit ID	Pollutant	Emission Factors[1]	Total Captured Emissions[2]		Combustor Destruction Efficiency	Total Controlled Emissions (Post-Capture and Combustion)	
			lb/hr	TPY	%	lb/hr	TPY
APC-COMB-TKLD	NOx	0.138	-	-	-	2.07	9.07
	CO	0.2755	-		-	4.13	18.09
	PM	7.6	-		-	0.04	0.18
	VOC	Mass Balance	257.59	1,128.31	98.00%	5.15	22.56
	n-Hexane	Mass Balance	14.89	65.26	98.00%	0.30	1.31
	Benzene	Mass Balance	0.18	0.78	98.00%	<0.01	0.02
	Toluene	Mass Balance	1.01	4.40	98.00%	0.02	0.09
	Ethylbenzene	Mass Balance	1.09	4.74	98.00%	0.02	0.10
	Xylenes	Mass Balance	3.69	16.16	98.00%	0.07	0.32

Notes:

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

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

NOx and CO emission factors (lb/mmBtu): *TCEQ Air Permit Technical Guidance for Chemical Sources: Flares and Vapor Oxidizers:* High Btu waste streams (>1,000 Btu/scf) based on heat input to the combustor = 15.00 mmBtu/hr Total Heat Input

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

3 Emissions will be controlled by a VRU, but are shown as being controlled by the combutor for operational flexibility and a conservative estimate of emissions.

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

Source	Captured VOC Emissions	
	lb/hr	TPY
Condensate Storage Tanks	246.98	1,081.79
Produced Water Storage Tanks	1.28	5.62
Condensate Truck Loading	9.25	40.52
Produced Water Truck Loading	0.08	0.38
Total VOC =	**257.59**	**1,128.31**

Source	Captured HAP Emissions (lb/hr)				
	n-Hexane	Benzene	Toluene	Ethylbenzene	Xylenes
Condensate Storage Tanks	14.28	0.17	0.96	1.04	3.54
Produced Water Storage Tanks	0.07	0.00	0.01	0.01	0.02
Condensate Truck Loading	0.54	0.01	0.04	0.04	0.13
Produced Water Truck Loading	<0.01	<0.01	<0.01	<0.01	<0.01
Total HAP =	**14.89**	**0.18**	**1.01**	**1.09**	**3.69**

Source	Captured HAP Emissions (TPY)				
	n-Hexane	Benzene	Toluene	Ethylbenzene	Xylenes
Condensate Storage Tanks	62.56	0.75	4.22	4.55	15.49
Produced Water Storage Tanks	0.33	0.00	0.02	0.02	0.08
Condensate Truck Loading	2.34	0.03	0.16	0.17	0.58
Produced Water Truck Loading	0.02	<0.01	<0.01	<0.01	0.01
Total HAP =	**65.26**	**0.78**	**4.40**	**4.74**	**16.16**

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

Equipment Information

Unit ID:	**APC-COMB-TKLD**
Description:	Vapor Combustor
Number of Combustors:	1
Burner Design Capacity (mmBtu/hr):	15.00
Stream HHV (Btu/scf):	2,682
Annual Throughput (mmscf):	48.99
Annual Operating Hours:	8,760

Greenhouse Gas (GHG) Emissions

Pollutant	lb/hr	tonnes/yr	tons/yr
CO_2	1,754.66	6,972.07	7,685.39
CH_4	0.03	0.13	0.14
N_2O	<0.01	0.01	0.01
CH_4 as CO_2e	0.83	3.28	3.62
N_2O as CO_2e	0.99	3.92	4.32
Total CO_2 + CO_2e =	**1,756.47**	**6,979.27**	**7,693.33**

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
Bonnette MSH Pad
Vapor Combustor Pilot Emissions Calculations - Criteria Air Pollutants

Criteria Air Pollutant Emissions

Unit ID	Pollutant	Emission Factors [1] (lb/mmscf)	Emissions lb/hr	Emissions TPY
EU-PILOT	NOx	100	0.01	0.04
	CO	84	<0.01	0.02
	VOC	5.5	<0.01	<0.01
	SO_2	0.6	<0.01	<0.01
	PM	7.6	<0.01	<0.01

905	Pilot Stream Heat Content (Btu/SCF)
8,760	Pilot Hours/Yr
50	Pilot Gas Flow Rate (SCFH)
45,250	Total Pilot Gas Fuel Use (Btu/hr)
0.44	Total Annual Fuel Use (MMSCF)

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

SWN Production Company, LLC
Bonnette MSH Pad
Vapor Combustor Pilot Emissions Calculations - Hazardous Air Pollutants

Hazardous Air Pollutant Emissions

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

905	Pilot Stream Heat Content (Btu/SCF)
8,760	Pilot Hours/Yr
50	Pilot Gas Flow Rate (SCFH)
45,250	Total Pilot Gas Fuel Use (Btu/hr)
0.44	Total Annual Fuel Use (MMSCF)

Notes:

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

SWN Production Company, LLC
Bonnette MSH Pad
Vapor Combustor Pilot Emissions Calculations - Greenhouse Gases

Greenhouse Gas (GHG) Emissions

Unit ID	Pollutant	Emissions		
		lb/hr	tonnes/yr	tons/yr
EU-PILOT	CO_2	5.29	21.03	23.18
	CH_4	<0.01	<0.01	<0.01
	N_2O	<0.01	<0.01	<0.01
	CH_4 as CO_2e	<0.01	0.01	0.01
	N_2O as CO_2e	<0.01	0.01	0.01
Total CO_2 + CO_2e =		**5.30**	**21.05**	**23.21**

905	Pilot Stream Heat Content (Btu/SCF)
8,760	Pilot Hours/Yr
50	Pilot Gas Flow Rate (SCFH)
45,250	Total Pilot Gas Fuel Use (Btu/hr)
0.44	Total Annual Fuel Use (MMSCF)

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

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

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

SWN Production Company, LLC
Bonnette MSH 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	72	9.92E-03	0.00%	0.71	3.11	24.18%
Flanges - Gas	346	8.60E-04	0.00%	0.30	1.31	24.18%
Compressor Seals - Gas	9	1.94E-02	0.00%	0.17	0.74	24.18%
Relief Valves - Gas	36	1.94E-02	0.00%	0.70	3.07	24.18%
Open-Ended Lines - Gas	0	4.41E-03	0.00%	0.00	0.00	24.18%
Total TOC (Gas Components) =				**1.88**	**8.23**	-
Valves - Light Oil	100	5.51E-03	0.00%	0.55	2.41	94.29%
Flanges - Light Oil	394	2.43E-04	0.00%	0.10	0.44	94.29%
Pump Seals - Light Oil	0	2.87E-02	0.00%	0.00	0.00	94.29%
Other - Light Oil	0	1.65E-02	0.00%	0.00	0.00	94.29%
Total TOC (Liquid Components) =				**0.65**	**2.85**	-

VOC and Greenhouse Gas Emissions

Source Type/Service	VOC			CH_4		CO_2	
	lb/hr	TPY	lb/yr	lb/hr	TPY	lb/hr	TPY
Valves - Gas	0.17	0.76	1,512.92	0.37	1.62	<0.01	0.01
Flanges - Gas	0.07	0.32	630.10	0.16	0.68	<0.01	<0.01
Compressor Seals - Gas	0.04	0.18	369.82	0.09	0.38	<0.01	<0.01
Relief Valves - Gas	0.17	0.74	1,479.30	0.36	1.60	<0.01	0.01
Open-Ended Lines - Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Components in Gas Service =	**0.46**	**2.00**	**3,992.14**	**0.98**	**4.28**	**0.01**	**0.02**
Valves - Light Oil	0.52	2.28	4,552.51	0.01	0.04	<0.01	<0.01
Flanges - Light Oil	0.09	0.39	789.22	<0.01	0.01	<0.01	<0.01
Pump Seals - Light Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other - Light Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Components in Liquid Service =	**0.61**	**2.69**	**5,343.60**	**0.01**	**0.05**	**<0.01**	**<0.01**
Total (Gas + Liquid Components) =	**1.07**	**4.69**	**9,335.74**	**0.99**	**4.33**	**0.01**	**0.02**

SWN Production Company, LLC
Bonnette MSH 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	0.03	<0.01	<0.01	<0.01	0.01	0.00	0.04
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 =	**0.04**	**<0.01**	**<0.01**	**<0.01**	**0.01**	**0.00**	**0.05**
Total (Gas + Liquid Components) =	**0.05**	**<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 =	**0.03**	**<0.01**	**<0.01**	**<0.01**	**<0.01**	**0.00**	**0.03**
Valves - Light Oil	0.14	<0.01	0.01	0.01	0.03	0.00	0.20
Flanges - Light Oil	0.02	<0.01	<0.01	<0.01	0.01	0.00	0.03
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 =	**0.16**	**<0.01**	**0.01**	**0.01**	**0.04**	**0.00**	**0.23**
Total (Gas + Liquid Components) =	**0.20**	**<0.01**	**0.01**	**0.01**	**0.04**	**0.00**	**0.26**

SWN Production Company, LLC
Bonnette MSH 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 =	2	8	2	1	3	3	1

SWN Production Company, LLC
Bonnette MSH Pad
Fugitive Emissions Calculations (Continued)

Speciated Gas Analysis[4]

Component	Molecular Weight	Mole %	Equiv. Wt. Basis	Weight %	HC Weight %	lb/hr	TPY
Hydrogen Sulfide	34.082	0.000%	0.000	0.000%	-	0.00	0.00
Carbon Dioxide	44.010	0.149%	0.066	0.295%	-	0.01	0.02
Nitrogen	28.013	0.513%	0.144	0.646%	-	0.01	0.05
Methane	16.042	71.427%	11.458	51.479%	51.968%	0.98	4.28
Ethane	30.069	17.491%	5.259	23.629%	23.853%	0.45	1.96
Propane	44.096	6.802%	2.999	13.476%	13.603%	0.26	1.12
i-Butane	58.122	0.668%	0.388	1.744%	1.761%	0.03	0.14
n-Butane	58.122	1.828%	1.062	4.773%	4.819%	0.09	0.40
i-Pentane	72.149	0.327%	0.236	1.060%	1.070%	0.02	0.09
n-Pentane	72.149	0.440%	0.317	1.426%	1.440%	0.03	0.12
n-Hexane	86.175	0.107%	0.092	0.414%	0.418%	0.01	0.03
Other Hexanes	86.175	0.135%	0.116	0.523%	0.528%	0.01	0.04
Heptanes (as n-Heptane)	100.202	0.078%	0.078	0.351%	0.354%	0.01	0.03
Benzene	78.114	0.001%	0.001	0.004%	0.004%	<0.01	<0.01
Toluene	92.141	0.002%	0.002	0.008%	0.008%	<0.01	<0.01
Ethylbenzene	106.167	0.000%	0.000	0.001%	0.001%	<0.01	<0.01
Xylenes	106.167	0.001%	0.001	0.005%	0.005%	<0.01	<0.01
2,2,4-Trimethylpentane	114.230	0.000%	0.000	0.000%	0.000%	0.00	0.00
Octanes (as n-Octane)	114.229	0.022%	0.025	0.113%	0.114%	<0.01	0.01
Nonanes (as n-Nonane)	128.255	0.006%	0.008	0.035%	0.035%	<0.01	<0.01
Decanes (as n-Decane)	142.282	0.003%	0.004	0.019%	0.019%	<0.01	<0.01
TOTAL =		**100.00%**	**22.26**	**100.00%**	**100.00%**	**1.90**	**8.31**
		TOTAL HC =	**22.05**	**TOTAL VOC =**	**24.18%**	**0.45**	**1.99**
				TOTAL HAP =	**0.44%**	**0.01**	**0.04**

SWN Production Company, LLC
Bonnette MSH Pad
Fugitive Emissions Calculations (Continued)

Speciated Liquids Analysis[4]

Component	Molecular Weight	Mole %	Equiv. Wt. Basis	Weight %	HC Weight %	lb/hr	TPY
Hydrogen Sulfide	34.082	0.000%	0.000	0.000%	-	0.00	0.00
Carbon Dioxide	44.010	0.013%	0.006	0.007%	-	<0.01	<0.01
Nitrogen	28.013	0.026%	0.007	0.009%	-	<0.01	<0.01
Methane	16.042	8.861%	1.421	1.836%	1.836%	0.01	0.05
Ethane	30.069	9.965%	2.996	3.870%	3.871%	0.03	0.11
Propane	44.096	11.708%	5.163	6.668%	6.669%	0.04	0.19
i-Butane	58.122	2.480%	1.441	1.862%	1.862%	0.01	0.05
n-Butane	58.122	9.597%	5.578	7.204%	7.206%	0.05	0.21
i-Pentane	72.149	3.683%	2.657	3.432%	3.433%	0.02	0.10
n-Pentane	72.149	6.541%	4.719	6.095%	6.096%	0.04	0.17
n-Hexane	86.175	5.195%	4.477	5.782%	5.783%	0.04	0.16
Other Hexanes	86.175	5.393%	4.647	6.002%	6.003%	0.04	0.17
Heptanes (as n-Heptane)	100.202	10.008%	10.028	12.952%	12.954%	0.08	0.37
Benzene	78.114	0.069%	0.054	0.070%	0.070%	<0.01	<0.01
Toluene	92.141	0.328%	0.302	0.390%	0.390%	<0.01	0.01
Ethylbenzene	106.167	0.307%	0.326	0.421%	0.421%	<0.01	0.01
Xylenes	106.167	1.044%	1.108	1.432%	1.432%	0.01	0.04
2,2,4-Trimethylpentane	114.230	0.000%	0.000	0.000%	0.000%	0.00	0.00
Octanes (as n-Octane)	114.229	7.566%	8.643	11.162%	11.164%	0.07	0.32
Nonanes (as n-Nonane)	128.255	4.597%	5.896	7.615%	7.616%	0.05	0.22
Decanes (as n-Decane)	142.282	12.619%	17.955	23.190%	23.193%	0.15	0.66
TOTAL =		**100.00%**	**77.43**	**100.00%**	**100.00%**	**0.65**	**2.85**
		TOTAL HC =	**77.41**	**TOTAL VOC =**	**94.29%**	**0.61**	**2.69**
				TOTAL HAP =	**8.10%**	**0.05**	**0.23**

Notes:

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

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

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

[4] Analyses located in Appendix A.

SWN Production Company, LLC
Bonnette MSH Pad
Fugitive Unpaved Haul Road Emissions Calculations

Facility Data [1]

Vehicle Type	Light Vehicles (Pick-ups and Cars)	Medium Trucks (Service Trucks)	Heavy Trucks (Tanker Trucks)[2]
Average vehicle weight ((empty + full)/2) (tons)	2	15	23.5
Number of wheels per vehicle type (w)	4	10	18
Average number of round trips/day/vehicle type	7	4	12
Distance per round trip (miles/trip)	0.42	0.42	0.42
Vehicle miles travelled (miles/day)	2.92	1.67	5.04
Number of days operational (days/yr)	365	365	365
Vehicle miles travelled VMT (miles/yr)	1,064.58	608.33	1,841.01
Average vehicle speed S (mph)	10	10	10
Average number of round trips/hour/vehicle type	0.39	0.22	0.67
Average number of round trips/year/vehicle type	2,555	1,460	4,418
Estimated maximum number of round trips/hour/vehicle type	3	3	2
Estimated maximum number of round trips/day/vehicle type	7	4	15
Estimated maximum number of round trips/year/vehicle type	2,683	1,533	5,749

190	Average Tanker Volume (bbl)
7,980	Gallons Tanker Volume
1,000	bwpd
1,300	bopd
12.11	Tanker Trucks per Day
650	Length Leased Access Road (ft)
450	Longest Pad Side (ft)
2,200	Total Round Trip Feet

Formula & Calculation Inputs

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

where:

	Rate	Units	Comment
Days per year	365		
Annual average hours per day of road operations	18		
k = PM Particle Size Multiplier	4.90	lb/VMT	AP-42 Section 13.2.2 (11/06), Table 13.2.2-2 (PM)
k = PM10 Particle Size Multiplier	1.50	lb/VMT	AP-42 Section 13.2.2 (11/06), Table 13.2.2-2 (PM_{10})
k = PM2.5 Particle Size Multiplier	0.15	lb/VMT	AP-42 Section 13.2.2 (11/06), Table 13.2.2-2 ($PM_{2.5}$)
s = Surface Material Silt Content	3.9	%	State Default Data from AP-42 Data (1999 NEI Data)
P = Number of days > 0.01 inch of rain	150	days/year	AP-42 Section 13.2.2 (11/06), Figure 13.2.2-1
a = PM Constant	0.70	unitless	AP-42 Section 13.2.2 (11/06), Table 13.2.2-2 (PM)
a = PM10 & PM2.5 Constant	0.90	unitless	AP-42 Section 13.2.2 (11/06), Table 13.2.2-2 (PM_{10} & $PM_{2.5}$)
b = PM, PM10, & PM2.5 Constant	0.45	unitless	AP-42 Section 13.2.2 (11/06), Table 13.2.2-2
Total hourly fleet vehicle miles travelled (miles/hr)	0.53	VMT/hr	
Total annual fleet vehicle miles travelled (miles/yr)[3]	3,513.93	VMT/yr	
Average wheels[4]	12		
Average vehicle weight of the fleet (W)[5]	15.5	tons	
Moisture Ratio	1.00		Estimated based on 0.2% uncontrolled surface water content assuming no watering
Control Efficiency (CF)	0.00	%	Based on Moisture Ratio and Figure 13.2.2-2 Control

EPA - BID Document 13.2.2 - 1998

Continued on Next Page

SWN Production Company, LLC
Bonnette MSH Pad
Fugitive Unpaved Haul Road Emissions Calculations

Emission Calculations

	Emission Factors			Control Efficiency	Total Vehicle Miles Travelled		Uncontrolled Emission Rates			Uncontrolled Emission Rates		
	PM	PM_{10}	$PM_{2.5}$				Total PM	Total PM_{10}	$PM_{2.5}$	Total PM	Total PM_{10}	$PM_{2.5}$
Vehicle Type	**(lbs/VMT)**	**(lbs/VMT)**	**(lbs/VMT)**	**(%)**	**(VMT/hr)**	**(VMT/yr)**	**(lb/hr)**	**(lb/hr)**	**(lb/hr)**	**(tons/yr)**	**(tons/yr)**	**(tons/yr)**
Light Vehicles	2.75	0.67	0.07	0.00	0.16	1,064.58	0.44	0.11	0.01	1.46	0.36	0.04
Medium Trucks	2.75	0.67	0.07	0.00	0.09	608.33	0.26	0.06	0.01	0.84	0.20	0.02
Heavy Trucks	2.75	0.67	0.07	0.00	0.28	1,841.01	0.77	0.19	0.02	2.53	0.62	0.06
			Total =	**0.00**	**0.53**	**3,513.92**	**1.47**	**0.36**	**0.04**	**4.83**	**1.18**	**0.12**

Notes:

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

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

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

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

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

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

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

Calculation of Emission Factors (AP-42, 13.2.2)

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

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

s = surface material silt content %

W = mean vehicle weight (tons)

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

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

EF = emission factor from Equation 1a

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

Calculation of Emissions

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

E = annual emissions (tons/yr)

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

CF = control efficiency (%)

ATTACHMENT J: CLASS 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 general permit registration for a natural gas production facility (Bonnette MSH Pad) located in Marshall County, West Virginia. Merge onto Interstate 79N toward US-19. Take Exit 137 toward W Virginia 310N/Co Road 3/1/E Grafton Road. Turn left at W Virginia 310 N/Co Road 3/1/E Grafton Road and continue to follow W Virginia 310 N/E Grafton Road for 0.4 miles. Turn left at E Park Avenue and after 1 mile take slight left at Merchant Street. Take third right onto Jefferson Street and after 0.4 miles turn right at US-19 S/US-250 N. Continue on US-250 N for 37.4 miles. Turn left at Amos Hollow Road/Co Route 89 and go 3.3 miles. Turn left to stay on Amos Hollow Road/Co Route 89. Continue on Co Road 89 for 9.1 miles. Turn right to stay on Co Rd 89 for 62 feet, then turn right to stay on Co Rd 89 and go 3.1 miles. Make sharp right at Co Road 4/St Joseph Baker Hill and continue 2.2 miles. Turn left to stay on Co Rd 4/St Joseph Baker Hill and go 2 miles. Take slight right to stay on Co Rd 4/St Joseph Baker Hill for 0.2 miles. Continue onto Co Route 21/Emr Route 2. Well pad access will be on the left after 144 feet. Bonnette is located at 39.72144, -80.71203.

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

Nitrogen Oxides (NOx)	18.16 tons/yr
Carbon Monoxide (CO)	31.04 tons/yr
Volatile Organic Compounds (VOC)	47.13 tons/yr
Sulfur Dioxide (SO_2)	0.04 tons/yr
Particulate Matter (PM)	5.66 tons/yr
Acetaldehyde	0.05 tons/yr
Acrolein	0.05 tons/yr
Benzene	0.06 tons/yr
Ethylbenzene	0.18 tons/yr
Formaldehyde	0.34 tons/yr
Methanol	0.06 tons/yr
n-Hexane	2.60 tons/yr
Toluene	0.18 tons/yr
Xylenes	0.62 tons/yr
Carbon Dioxide	14,582.06 tons/yr
Methane	6.36 tons/yr
Nitrous Oxide	0.02 tons/yr
CO_2 Equivalent	14,749.34 tons/yr

The change in equipment and operations is planned to begin on or about November 6, 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 xx of October, 2015

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

ATTACHMENT L: APPLICATION FEE

ATTACHMENT N: MATERIAL SAFETY DATA SHEETS (MSDS)

Material Safety Data Sheet

Health	1
Flammability	4
Reactivity	0
PPE	

Material Name: Natural Gas

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

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

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

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

*** Section 2 - Hazards Identification ***

Emergency Overview

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

Potential Health Effects: Eyes

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

Potential Health Effects: Skin

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

Potential Health Effects: Ingestion

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

Potential Health Effects: Inhalation

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

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

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

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

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

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

First Aid: Eyes

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

First Aid: Skin

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

First Aid: Ingestion

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

First Aid: Inhalation

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

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

General Fire Hazards

See Section 9 for Flammability Properties.

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

Hazardous Combustion Products

Combustion may yield carbon monoxide and/or carbon dioxide.

Extinguishing Media

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

Fire Fighting Equipment/Instructions

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

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

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

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

Containment Procedures

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

Evacuation Procedures

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

Special Procedures

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

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

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

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

A: Component Exposure Limits

Natural Gas (8006-14-2)

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

Methane (74-82-8)

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

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

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

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

PERSONAL PROTECTIVE EQUIPMENT

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

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

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

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

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

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

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

Properties of this material will vary with actual composition.

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

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

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

Incompatibility
Strong oxidizers such as nitrates, chlorates, peroxides.

Hazardous Decomposition
Combustion produces carbon monoxide and carbon dioxide.

Possibility of Hazardous Reactions
Will not occur.

*** Section 11 - Toxicological Information ***

Acute Dose Effects

Component Analysis - LD50/LC50

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

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

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

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

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

*** Section 12 - Ecological Information ***

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

*** Section 13 - Disposal Considerations ***

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

*** Section 14 - Transportation Information ***

US DOT Information

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

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

*** Section 15 - Regulatory Information ***

US Federal Regulations

Component Analysis

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

State Regulations

Component Analysis - State

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

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

Component Analysis - WHMIS IDL

No components are listed in the WHMIS IDL.

Additional Regulatory Information

Component Analysis - Inventory

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

* * * Section 16 - Other Information * * *

Other Information

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

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

Key/Legend

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

Health	1
Flammability	4
Reactivity	0
PPE	

Material Safety Data Sheet

Material Name: Natural Gas Condensate

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

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

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

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

* * * Section 2 - Hazards Identification * * *

Emergency Overview

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

Potential Health Effects: Eyes

May cause moderate irritation.

Potential Health Effects: Skin

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

Potential Health Effects: Ingestion

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

Potential Health Effects: Inhalation

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

Medical Conditions Aggravated by Exposure

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

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

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

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

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

First Aid: Eyes

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

First Aid: Skin

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

First Aid: Ingestion

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

First Aid: Inhalation

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

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

General Fire Hazards

See Section 9 for Flammability Properties.

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

Hazardous Combustion Products

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

Extinguishing Media

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

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

Fire Fighting Equipment/Instructions

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

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

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

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

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

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

Containment Procedures

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

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

Clean-Up Procedures

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

Evacuation Procedures

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

Special Procedures

Avoid excessive skin contact with the spilled material.

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

Handling Procedures

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

Storage Procedures

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

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

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

A: Component Exposure Limits

Benzene (71-43-2)

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

Engineering Controls

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

PERSONAL PROTECTIVE EQUIPMENT

Personal Protective Equipment: Eyes/Face

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

Personal Protective Equipment: Skin

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

Personal Protective Equipment: Respiratory

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

Personal Protective Equipment: General

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

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

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

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

Chemical Stability

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

Chemical Stability: Conditions to Avoid

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

Incompatibility

Keep away from strong oxidizers

Hazardous Decomposition

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

Possibility of Hazardous Reactions

Will not occur.

* * * Section 11 - Toxicological Information * * *

Acute Dose Effects

Component Analysis - LD50/LC50

Natural gas condensate (68919-39-1)

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

Benzene (71-43-2)

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

Carcinogenicity

Component Carcinogenicity

Benzene (71-43-2)

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

*** Section 12 - Ecological Information ***

Ecotoxicity

Component Analysis - Ecotoxicity - Aquatic Toxicity

Natural gas condensate (68919-39-1)

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

Benzene (71-43-2)

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

*** Section 13 - Disposal Considerations ***

US EPA Waste Number & Descriptions

A: General Product Information

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

B: Component Waste Numbers

Benzene (71-43-2)

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

Disposal Instructions

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

*** Section 14 - Transportation Information ***

US DOT Information

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

*** Section 15 - Regulatory Information ***

US Federal Regulations

Component Analysis

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

Benzene (71-43-2)

SARA 313: 0.1 % de minimis concentration

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

State Regulations

Component Analysis - State

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

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

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

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

Component Analysis - WHMIS IDL

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

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

Additional Regulatory Information

Component Analysis - Inventory

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

* * * Section 16 - Other Information * * *

Other Information

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Key/Legend

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

Material Safety Data Sheet

Health	1
Flammability	4
Reactivity	0
PPE	

Material Name: Produced Water

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

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

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

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

* * * Section 2 - Hazards Identification * * *

Emergency Overview

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

Potential Health Effects: Eyes

May cause eye irritation.

Potential Health Effects: Skin

Contact may cause skin irritation.

Potential Health Effects: Ingestion

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

Potential Health Effects: Inhalation

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

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

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

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

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

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

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

First Aid: Eyes

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

First Aid: Skin

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

First Aid: Ingestion

Do not induce vomiting. Seek medical attention.

First Aid: Inhalation

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

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

General Fire Hazards

See Section 9 for Flammability Properties.

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

Hazardous Combustion Products

Not Determined.

Extinguishing Media

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

Fire Fighting Equipment/Instructions

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

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

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

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

Containment Procedures

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

Clean-Up Procedures

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

Evacuation Procedures

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

Special Procedures

Avoid excessive skin contact with the spilled material.

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

Handling Procedures

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

Storage Procedures

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

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

A: Component Exposure Limits

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

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

NIOSH: 350 mg/m^3 TWA

1800 mg/m^3 Ceiling (15 min)

Benzene (71-43-2)

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

Engineering Controls

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

PERSONAL PROTECTIVE EQUIPMENT

Personal Protective Equipment: Eyes/Face

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

Personal Protective Equipment: Skin

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

Personal Protective Equipment: Respiratory

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

Personal Protective Equipment: General

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

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

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

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

Chemical Stability

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

Chemical Stability: Conditions to Avoid

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

Incompatibility

Keep away from strong oxidizers.

Hazardous Decomposition

Not Determined.

Possibility of Hazardous Reactions

Will not occur.

*** Section 11 - Toxicological Information ***

Acute Dose Effects

Component Analysis - LD50/LC50

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

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

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

Carcinogenicity

Component Carcinogenicity

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

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

*** Section 12 - Ecological Information ***

Ecotoxicity

Component Analysis - Ecotoxicity - Aquatic Toxicity

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

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

Benzene (71-43-2)

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

* * * Section 13 - Disposal Considerations * * *

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

* * * Section 14 - Transportation Information * * *

US DOT Information

Shipping Name: Not Regulated

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

* * * Section 15 - Regulatory Information * * *

US Federal Regulations

Component Analysis

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

Benzene (71-43-2)

SARA 313: 0.1 % de minimis concentration

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

State Regulations

Component Analysis - State

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

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

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

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

Component Analysis - WHMIS IDL

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

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

Additional Regulatory Information

Material Safety Data Sheet

Material Name: Produced Water

Component Analysis - Inventory

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

* * * Section 16 - Other Information * * *

Other Information

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Key/Legend

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

Material Safety Data Sheet

Health	1
Flammability	4
Reactivity	0
PPE	

Material Name: Petroleum Crude Oil

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

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

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

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

* * * Section 2 - Hazards Identification * * *

Emergency Overview

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

Potential Health Effects: Eyes

Contact with eyes may cause moderate to severe irritation.

Potential Health Effects: Skin

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

Potential Health Effects: Ingestion

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

Potential Health Effects: Inhalation

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

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

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

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

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

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

First Aid: Eyes

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

First Aid: Skin

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

First Aid: Ingestion

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

First Aid: Inhalation

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

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

General Fire Hazards

See Section 9 for Flammability Properties.

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

Hazardous Combustion Products

Carbon Monoxide, Carbon Dioxide and Reactive Hydrocarbon Compounds.

Extinguishing Media

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

Fire Fighting Equipment/Instructions

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

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

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

Containment Procedures

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

Clean-Up Procedures

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

Evacuation Procedures

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

Special Procedures

Avoid excessive skin contact with the spilled material.

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

Handling Procedures

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

Storage Procedures

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

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

A: Component Exposure Limits

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

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

Toluene (108-88-3)

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

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

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

Benzene (71-43-2)

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

Ethyl benzene (100-41-4)

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

Engineering Controls

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

PERSONAL PROTECTIVE EQUIPMENT

Personal Protective Equipment: Eyes/Face

Chemical splash goggles or safety glasses are recommended.

Personal Protective Equipment: Skin

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

Personal Protective Equipment: Respiratory

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

Personal Protective Equipment: General

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

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

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

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

Chemical Stability

This is a stable material.

Chemical Stability: Conditions to Avoid

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

Incompatibility

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

Hazardous Decomposition

Carbon Monoxide, Carbon Dioxide and Reactive Hydrocarbon Compounds.

Possibility of Hazardous Reactions

Will not occur.

* * * Section 11 - Toxicological Information * * *

Acute Dose Effects

Component Analysis - LD50/LC50

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

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

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

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

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

Carcinogenicity

Component Carcinogenicity

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

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

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

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

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

*** Section 12 - Ecological Information ***

Ecotoxicity

Component Analysis - Ecotoxicity - Aquatic Toxicity

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

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

Toluene (108-88-3)

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

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

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

Benzene (71-43-2)

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

Ethyl benzene (100-41-4)

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

* * * Section 13 - Disposal Considerations * * *

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

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

* * * Section 14 - Transportation Information * * *

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

US DOT Information

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

* * * Section 15 - Regulatory Information * * *

US Federal Regulations

Component Analysis

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

Toluene (108-88-3)

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

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

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

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

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

State Regulations

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

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

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

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

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

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

Additional Regulatory Information

Component Analysis - Inventory

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

* * * Section 16 - Other Information * * *

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-ENG1	Upward vertical stack	EU-ENG1	Flash Gas Compressor Engine	N/A	NSCR	NOx	4.31	18.88	0.32	1.40	Gas/Vapor	O = Manufacturer Data, AP-42
						CO	4.31	18.88	0.64	2.80		
						VOC	0.07	0.31	0.07	0.31		
						SO_2	<0.01	<0.01	<0.01	<0.01		
						PM_{10}	0.01	0.04	0.01	0.04		
						PM Total	0.02	0.09	0.02	0.09		
						Acetaldehyde	<0.01	0.02	<0.01	0.02		
						Acrolein	<0.01	0.01	<0.01	0.01		
						Benzene	<0.01	0.01	<0.01	0.01		
						Ethylbenzene	<0.01	<0.01	<0.01	<0.01		
						Formaldehyde	0.09	0.38	0.02	0.09		
						Methanol	<0.01	0.02	<0.01	0.02		
						Toluene	<0.01	<0.01	<0.01	<0.01		
						Xylenes	<0.01	<0.01	<0.01	<0.01		
						Carbon Dioxide	155.04	679.06	155.04	679.06		
						Methane	<0.01	0.01	<0.01	0.01		
						Nitrous Oxide	<0.01	<0.01	<0.01	<0.01		
EP-ENG2	Upward vertical stack	EU-ENG2	Flash Gas Compressor Engine	N/A	NSCR	NOx	4.31	18.88	0.32	1.40	Gas/Vapor	O = Manufacturer Data, AP-42
						CO	4.31	18.88	0.64	2.80		
						VOC	0.07	0.31	0.07	0.31		
						SO_2	<0.01	<0.01	<0.01	<0.01		
						PM_{10}	0.01	0.04	0.01	0.04		
						PM Total	0.02	0.09	0.02	0.09		
						Acetaldehyde	<0.01	0.02	<0.01	0.02		
						Acrolein	<0.01	0.01	<0.01	0.01		
						Benzene	<0.01	0.01	<0.01	0.01		
						Ethylbenzene	<0.01	<0.01	<0.01	<0.01		
						Formaldehyde	0.09	0.38	0.02	0.09		
						Methanol	<0.01	0.02	<0.01	0.02		
						Toluene	<0.01	<0.01	<0.01	<0.01		
						Xylenes	<0.01	<0.01	<0.01	<0.01		
						Carbon Dioxide	155.04	679.06	155.04	679.06		
						Methane	<0.01	0.01	<0.01	0.01		
						Nitrous Oxide	<0.01	<0.01	<0.01	<0.01		

EP-ENG3	Upward vertical stack	EU-ENG3	Flash Gas Compressor Engine	N/A	N/A	NOx CO VOC SO_2 PM_{10} PM Total Acetaldehyde Acrolein Benzene Ethylbenzene Formaldehyde Methanol Toluene Xylenes Carbon Dioxide Methane Nitrous Oxide	N/A	N/A	0.43 0.86 0.30 <0.01 0.02 0.03 <0.01 <0.01 <0.01 <0.01 0.04 0.01 <0.01 <0.01 206.41 <0.01 <0.01	1.88 3.77 1.31 <0.01 0.09 0.13 0.02 0.02 0.01 <0.01 0.16 0.02 <0.01 <0.01 904.07 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-GPU2	Upward vertical stack	EU-GPU2	GPU Burner	N/A	None	NOx CO VOC SO_2 PM_{10} PM Total n-Hexane Formaldehyde Benzene Toluene Carbon Dioxide Methane Nitrous Oxide	0.11 0.09 0.01 <0.01 0.01 0.01 <0.01 <0.01 <0.01 <0.01 116.98 <0.01 <0.01	0.48 0.39 0.03 <0.01 0.03 0.04 0.01 <0.01 <0.01 <0.01 512.36 0.01 <0.01	N/A	N/A	Gas/Vapor	O = AP-42

EP-GPU3	Upward vertical stack	EU-GPU3	GPU Burner	N/A	None	NOx CO VOC SO_2 PM_{10} PM Total n-Hexane Formaldehyde Benzene Toluene Carbon Dioxide Methane Nitrous Oxide	0.11 0.09 0.01 <0.01 0.01 0.01 <0.01 <0.01 <0.01 <0.01 116.98 <0.01 <0.01	0.48 0.39 0.03 <0.01 0.03 0.04 0.01 <0.01 <0.01 <0.01 512.36 0.01 <0.01	N/A	N/A	Gas/Vapor	O = AP-42
EP-GPU4	Upward vertical stack	EU-GPU4	GPU Burner	N/A	None	NOx CO VOC SO_2 PM_{10} PM Total n-Hexane Formaldehyde Benzene Toluene Carbon Dioxide Methane Nitrous Oxide	0.11 0.09 0.01 <0.01 0.01 0.01 <0.01 <0.01 <0.01 <0.01 116.98 <0.01 <0.01	0.48 0.39 0.03 <0.01 0.03 0.04 0.01 <0.01 <0.01 <0.01 512.36 0.01 <0.01	N/A	N/A	Gas/Vapor	O = AP-42
EP-GPU5	Upward vertical stack	EU-GPU5	GPU Burner	N/A	None	NOx CO VOC SO_2 PM_{10} PM Total n-Hexane Formaldehyde Benzene Toluene Carbon Dioxide Methane Nitrous Oxide	0.11 0.09 0.01 <0.01 0.01 0.01 <0.01 <0.01 <0.01 <0.01 116.98 <0.01 <0.01	0.48 0.39 0.03 <0.01 0.03 0.04 0.01 <0.01 <0.01 <0.01 512.36 0.01 <0.01	N/A	N/A	Gas/Vapor	O = AP-42

EP-GPU6	Upward vertical stack	EU-GPU6	GPU Burner	N/A	None	NOx CO VOC SO_2 PM_{10} PM Total n-Hexane Formaldehyde Benzene Toluene Carbon Dioxide Methane Nitrous Oxide	0.11 0.09 0.01 <0.01 0.01 0.01 <0.01 <0.01 <0.01 <0.01 116.98 <0.01 <0.01	0.48 0.39 0.03 <0.01 0.03 0.04 0.01 <0.01 <0.01 <0.01 512.36 0.01 <0.01	N/A	N/A	Gas/Vapor	O = AP-42
EP-GPU7	Upward vertical stack	EU-GPU7	GPU Burner	N/A	None	NOx CO VOC SO_2 PM_{10} PM Total n-Hexane Formaldehyde Benzene Toluene Carbon Dioxide Methane Nitrous Oxide	0.11 0.09 0.01 <0.01 0.01 0.01 <0.01 <0.01 <0.01 <0.01 116.98 <0.01 <0.01	0.48 0.39 0.03 <0.01 0.03 0.04 0.01 <0.01 <0.01 <0.01 512.36 0.01 <0.01	N/A	N/A	Gas/Vapor	O = AP-42
EP-GPU8	Upward vertical stack	EU-GPU8	GPU Burner	N/A	None	NOx CO VOC SO_2 PM_{10} PM Total n-Hexane Formaldehyde Benzene Toluene Carbon Dioxide Methane Nitrous Oxide	0.11 0.09 0.01 <0.01 0.01 0.01 <0.01 <0.01 <0.01 <0.01 116.98 <0.01 <0.01	0.48 0.39 0.03 <0.01 0.03 0.04 0.01 <0.01 <0.01 <0.01 512.36 0.01 <0.01	N/A	N/A	Gas/Vapor	O = AP-42

EP-HT1	Upward vertical stack	EU-HT1	Heater Treater	N/A	None	NOx CO VOC SO_2 PM_{10} PM Total n-Hexane Formaldehyde Benzene Toluene Carbon Dioxide Methane Nitrous Oxide	0.06 0.05 <0.01 <0.01 <0.01 <0.01 <0.01 <0.01 <0.01 <0.01 58.49 <0.01 <0.01	0.26 0.22 0.01 <0.01 0.01 0.02 <0.01 <0.01 <0.01 <0.01 256.18 <0.01 <0.01	N/A	N/A	Gas/Vapor	O = AP-42
EP-HT2	Upward vertical stack	EU-HT2	Heater Treater	N/A	None	NOx CO VOC SO_2 PM_{10} PM Total n-Hexane Formaldehyde Benzene Toluene Carbon Dioxide Methane Nitrous Oxide	0.06 0.05 <0.01 <0.01 <0.01 <0.01 <0.01 <0.01 <0.01 <0.01 58.49 <0.01 <0.01	0.26 0.22 0.01 <0.01 0.01 0.02 <0.01 <0.01 <0.01 <0.01 256.18 <0.01 <0.01	N/A	N/A	Gas/Vapor	O = AP-42
APC-COMB-TKLD	Upward vertical stack	APC-COMB, EU-TANKS-COND, EU-TANKS-PW, EU-LOAD-COND, EU-LOAD-PW, EU-PILOT	Vapor Combustor	-	None	NOx CO PM SO2 VOC n-Hexane Benzene Toluene Ethylbenzene Xylenes Carbon Dioxide Methane Nitrous Oxide	2.08 4.13 0.04 <0.01 505.86 29.25 0.35 1.98 2.13 7.25 1,759.95 0.03 <0.01	9.11 18.11 0.18 <0.01 2,274.15 131.52 1.58 8.87 9.57 32.56 7,708.68 6.02 0.01	2.07 4.13 0.04 - 5.15 0.30 <0.01 0.02 0.02 0.07 1,754.66 0.03 <0.01	9.07 18.09 0.18 - 40.09 2.33 0.03 0.16 0.17 0.57 7,685.42 1.91 0.01	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	4.69 0.20 <0.01 0.01 0.01 0.04 0.02 4.33	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} $PM_{2.5}$	1.47 0.36 0.04	4.83 1.18 0.12	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).

ATTACHMENT P: SUPPORT DOCUMENTS

ENGINE SPECIFICATION SHEETS

AP-42 AND EPA EMISSION FACTORS

REPRESENTATIVE GAS ANALYSES

PROMAX PROCESS SIMULATION RESULTS

TANKS 4.0.9D REPORTS

G3306 NA

GAS COMPRESSION APPLICATION

GAS ENGINE SITE SPECIFIC TECHNICAL DATA

CATERPILLAR®

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

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

CONDITIONS AND DEFINITIONS

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

For notes information consult page three.

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

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

Prepared For:
Jason Stinson
MIDCON COMPRESSION, LP

MANUFACTURED ON OR AFTER 1/1/2011

INFORMATION PROVIDED BY CATERPILLAR

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

Uncontrolled Emissions

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

POST CATALYST EMISSIONS

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

CONTROL EQUIPMENT

Catalytic Converter

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

Air Fuel Ratio Controller

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

GM POWERTRAIN Industrial Engines

VORTEC ENGINES

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

Applications

Industrial, Agriculture Construction & Oilfield

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

Available Factory Installed Options

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

Vortec™ 5.7L 8 Cylinder - 350 Cubic Inches

Features & Benefits

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

UE Powertrain
Buck's Engines

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

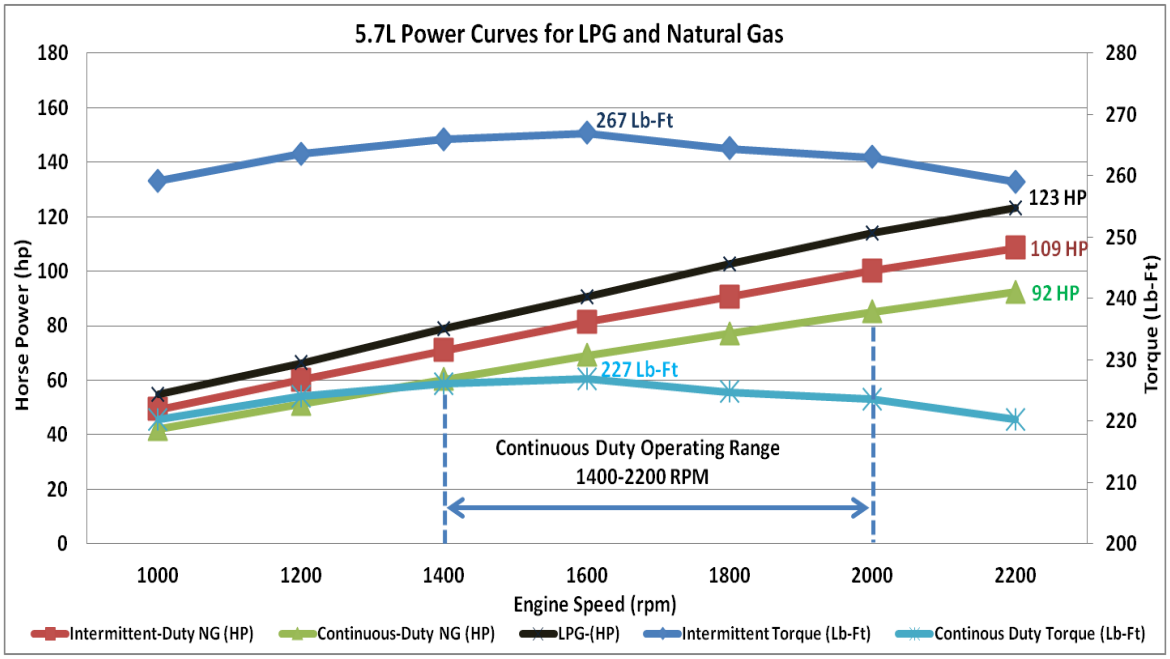
515 North I-27
Lubbock, TX 79403
806-762-0455

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

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

GM POWERTRAIN Industrial Engines

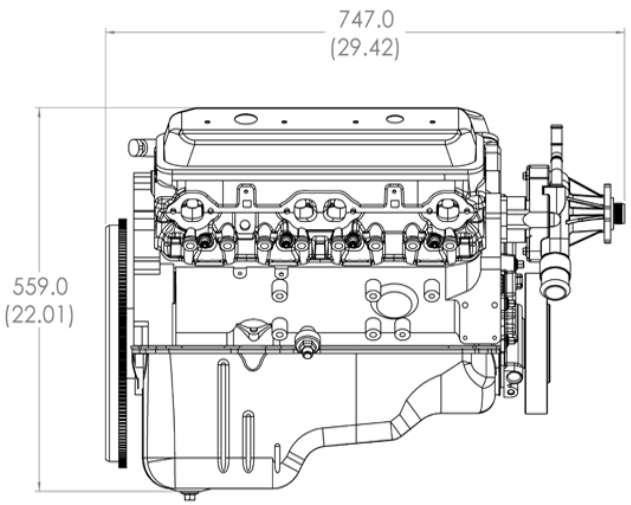
Vortec™ 5.7L 8 Cylinder – 350 Cubic Inches

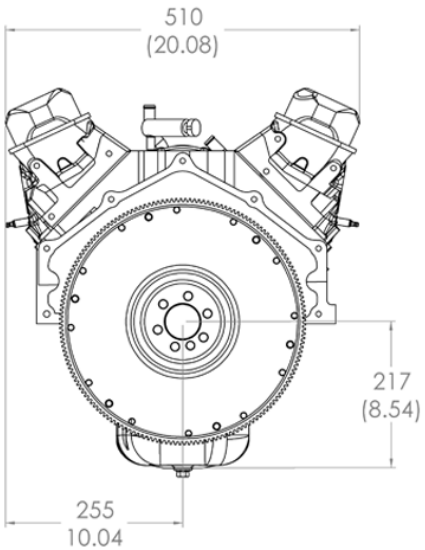


Power and torque values provided by Buck's Engines per SAE1349. Actual power levels may vary depending on fuel selection and quality, calibration, application, altitude and ambient air temperatures.

CONTINUOUS BRAKE HORSEPOWER

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





Specifications and Materials

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

Manufactured with US, North American and Global Sourced Content

Vortec 5.7L V-8

Industrial

The Vortec 5.7L V-8 engine delivers excellent performance and durability for a variety of applications.

- High-flow cylinder head with straighter intake ports and a higher compression ratio delivers impressive horsepower
- Valvetrain features advanced design silent timing chain for added durability and positive inlet valve stem seals for reduced oil consumption
- Roller valve lifters for reduced friction and improved performance
- Composite front timing cover for noise reduction and corrosion protection
- Water pump features include:
- Revised housing - a reservoir cavity replaces the weep hole
- Upgraded shaft, bearing, and seal for extended life
- Shrouded impeller for improved efficiency
- Cylinder head gaskets have stainless steel core for corrosion resistance

Available Options

- A Marine Engine Fuel Injection (MEFI) electronic control module and related parts are available in kit form. The controller uses state-of-the-art technology to optimize fuel spark requirements.
- Integral Air Fuel Module (IAFM) inlet manifold (gasoline only).
- EST and HEI distributors and coils are available in kit form.

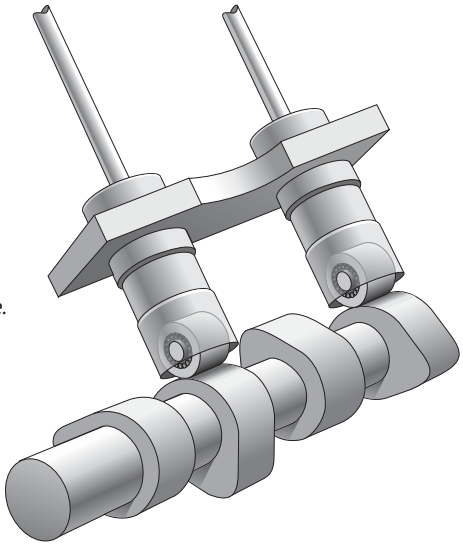
Vortec 5.7L V-8

Feature Focus

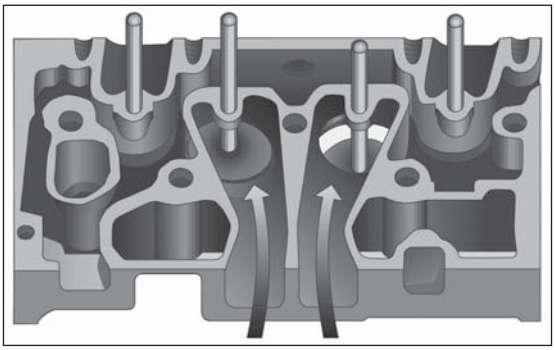
All GM industrial engines are Vortec engines. Vortec means uncompromised power — outstanding power with no sacrifice in fuel efficiency or durability and very little required maintenance.

GM Powertrain takes its expertise in designing outstanding Vortec truck and SUV engines and leverages it to make sophisticated yet extremely durable industrial engines. In addition, the well-recognized Vortec brand name by itself has become a valuable selling tool for OEMs.

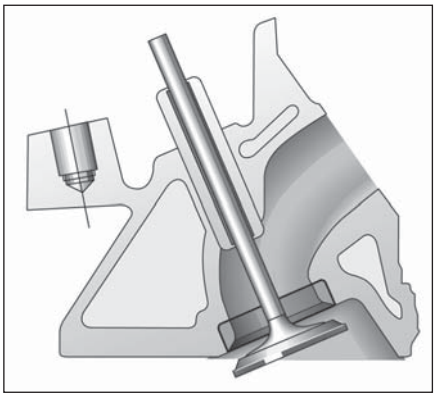
The Vortec 5.7L V-8 engine is part of GM's small block V-8 series, one of the most successful engines in automotive history.



Roller valve lifters reduce friction and improve performance.



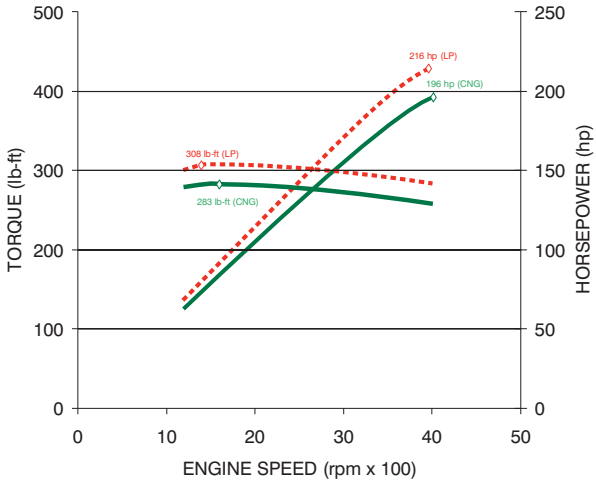
A high-flow cylinder head with straighter intake ports and a higher compression ratio delivers significantly better combustion for all fuels.



The exhaust valve seat inserts in the cylinder head provide superb durability.

Vortec 5.7L V-8

Specifications



Actual power levels may vary depending on OEM calibration and application.

Vortec 5.7L V-8 Specification Focus

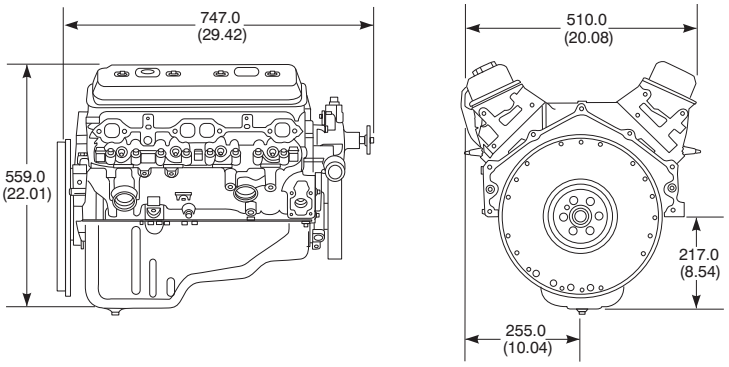
Type: 5.7L V-8 Gen 1e Small Block
Displacement: 350 cid (5736 cc)
Engine Orientation: Longitudinal
Compression Ratio: 9.4:1
Valve Configuration: Overhead Valves (2 valves per cylinder)
Assembly Site: Toluca, Mexico
Valve Lifters: Hydraulic Roller
Firing Order: 1-8-4-3-6-5-7-2
Bore x Stroke: 101.60 x 88.39 mm
Bore Center: 111.76 mm
Bore Area: 648.59 cm²
Fuel System: None
Fuel Type: LP & CNG
Horsepower:
216 hp (161 kW) @ 4000 rpm (Propane)
196 hp (146 kW) @ 4000 rpm (Natural Gas)
Torque:
308 lb-ft (418 Nm) @ 1400 rpm (Propane)
283 lb-ft (384 Nm) @ 1600 rpm (Natural Gas)

Actual power levels may vary depending on OEM calibration and application.

Fuel Shutoff: N/A
Shipping Weight: 432 lb (196 kg)
Emissions Controls: Positive Crankcase Ventilation

Materials:
Block: Cast Iron GM232-M
Cylinder Head: Cast Iron
Intake Manifold: None
Exhaust Manifold: None
Main Bearing Caps: Cast Iron GM232-M
Crankshaft: Nodular Iron
Camshaft: 5150 Steel Billet
Connecting Rods: Forged - SAE 1141

Information may vary with application. All specifications listed are based on the latest product information available at the time of publication. The right is reserved to make changes at any time without notice.



5.7L Bucks Engine-Out Emissions on Pipeline Natural Gas

Engine	5.7L Bucks	5.7L Bucks	5.7L Bucks
Test Description	Steady-State Raw Engine-Out Emissions	Steady-State Raw Engine-Out Emissions	Steady-State Raw Engine-Out Emissions
Date	1/4/08	1/4/08	1/4/08
Flywheel	Bucks Cert Cell 5	Bucks Cert Cell 6	Bucks Cert Cell 7
Catalyst	Model TG192W-3, SN NX-0316	Model TG192W-3, SN NX-0316	Model TG192W-3, SN NX-0316
Calibration	MI07SEQ064_GM574X_B_EMS_D_015.cal	MI07SEQ064_GM574X_B_EMS_D_015.cal	MI07SEQ064_GM574X_B_EMS_D_015.cal
Speed	2400	2400	2400
TQ (Nm)	337	337	337
UEGO PHI	0.990	1.000	1.010
Fuel	Pipeline NG	Pipeline NG	Pipeline NG
THC ppm	597	586	616
NMHC ppm (est)	35.8	35.2	36.9
NOx ppm	2007	2001	2056
NMHC + NOx ppm	2043	2036	2093
CO %	0.927	1.120	1.287
CO2 %	10.36	10.27	10.27
BTE	31.2	31.2	31.2
NOTES	PHI using UEGO Sensor	PHI using UEGO Sensor	PHI using UEGO Sensor

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

A second method of loading is submerged loading. Two types are the submerged fill pipe method and the bottom loading method. In the submerged fill pipe method, the fill pipe extends almost to the bottom of the cargo tank. In the bottom loading method, a permanent fill pipe is attached to the cargo tank bottom. During most of submerged loading by both methods, the fill pipe opening is below the liquid surface level. Liquid turbulence is controlled significantly during submerged loading, resulting in much lower vapor generation than encountered during splash loading.

The recent loading history of a cargo carrier is just as important a factor in loading losses as the method of loading. If the carrier has carried a nonvolatile liquid such as fuel oil, or has just been cleaned, it will contain vapor-free air. If it has just carried gasoline and has not been vented, the air in the carrier tank will contain volatile organic vapors, which will be expelled during the loading operation along with newly generated vapors.

Cargo carriers are sometimes designated to transport only one product, and in such cases are practicing "dedicated service". Dedicated gasoline cargo tanks return to a loading terminal containing air fully or partially saturated with vapor from the previous load. Cargo tanks may also be "switch loaded" with various products, so that a nonvolatile product being loaded may expel the vapors remaining from a previous load of a volatile product such as gasoline. These circumstances vary with the type of cargo tank and with the ownership of the carrier, the petroleum liquids being transported, geographic location, and season of the year.

One control measure for vapors displaced during liquid loading is called "vapor balance service", in which the cargo tank retrieves the vapors displaced during product unloading at bulk plants or service stations and transports the vapors back to the loading terminal. Figure 5.2-5 shows a tank truck in vapor balance service filling a service station underground tank and taking on displaced gasoline vapors for return to the terminal. A cargo tank returning to a bulk terminal in vapor balance service normally is saturated with organic vapors, and the presence of these vapors at the start of submerged loading of the tanker truck results in greater loading losses than encountered during nonvapor balance, or "normal", service. Vapor balance service is usually not practiced with marine vessels, although some vessels practice emission control by means of vapor transfer within their own cargo tanks during ballasting operations, discussed below.

Emissions from loading petroleum liquid can be estimated (with a probable error of ±30 percent)[4] using the following expression:

$$L_L = 12.46 \frac{SPM}{T} \quad (1)$$

where:

L_L = loading loss, pounds per 1000 gallons ($lb/10^3$ gal) of liquid loaded

S = a saturation factor (see Table 5.2-1)
P = true vapor pressure of liquid loaded, pounds per square inch absolute (psia) (see Figure 7.1-5, Figure 7.1-6, and Table 7.1-2)
M = molecular weight of vapors, pounds per pound-mole (lb/lb-mole) (see Table 7.1-2)
T = temperature of bulk liquid loaded, °R (°F + 460)

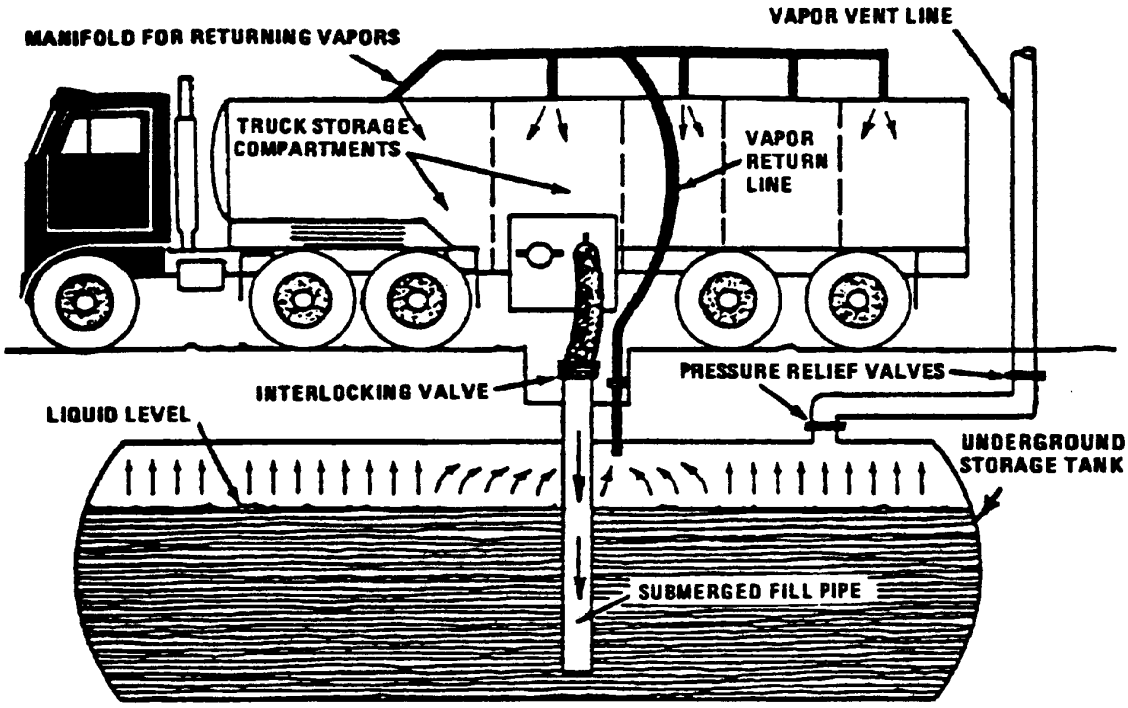


Figure 5.2-5. Tank truck unloading into a service station underground storage tank and practicing "vapor balance" form of emission control.

Table 5.2-1. SATURATION (S) FACTORS FOR CALCULATING PETROLEUM LIQUID LOADING LOSSES

Cargo Carrier	Mode Of Operation	S Factor
Tank trucks and rail tank cars	Submerged loading of a clean cargo tank	0.50
	Submerged loading: dedicated normal service	0.60
	Submerged loading: dedicated vapor balance service	1.00
	Splash loading of a clean cargo tank	1.45
	Splash loading: dedicated normal service	1.45
	Splash loading: dedicated vapor balance service	1.00
Marine vessels[a]	Submerged loading: ships	0.2
	Submerged loading: barges	0.5

[a] For products other than gasoline and crude oil. For marine loading of gasoline, use factors from Table 5.2-2. For marine loading of crude oil, use Equations 2 and 3 and Table 5.2-3.

Since flares do not lend themselves to conventional emission testing techniques, only a few attempts have been made to characterize flare emissions. Recent EPA tests using propylene as flare gas indicated that efficiencies of 98 percent can be achieved when burning an offgas with at least 11,200 kJ/m^3 (300 Btu/ft^3). The tests conducted on steam-assisted flares at velocities as low as 39.6 meters per minute (m/min) (130 ft/min) to 1140 m/min (3750 ft/min), and on air-assisted flares at velocities of 180 m/min (617 ft/min) to 3960 m/min (13,087 ft/min) indicated that variations in incoming gas flow rates have no effect on the combustion efficiency. Flare gases with less than 16,770 kJ/m^3 (450 Btu/ft^3) do not smoke.

Table 13.5-1 presents flare emission factors, and Table 13.5-2 presents emission composition data obtained from the EPA tests.[1] Crude propylene was used as flare gas during the tests. Methane was a major fraction of hydrocarbons in the flare emissions, and acetylene was the dominant intermediate hydrocarbon species. Many other reports on flares indicate that acetylene is always formed as a stable intermediate product. The acetylene formed in the combustion reactions may react further with hydrocarbon radicals to form polyacetylenes followed by polycyclic hydrocarbons.[2]

In flaring waste gases containing no nitrogen compounds, NO is formed either by the fixation of atmospheric nitrogen (N) with oxygen (O) or by the reaction between the hydrocarbon radicals present in the combustion products and atmospheric nitrogen, by way of the intermediate stages, HCN, CN, and OCN.[2] Sulfur compounds contained in a flare gas stream are converted to SO_2 when burned. The amount of SO_2 emitted depends directly on the quantity of sulfur in the flared gases.

Table 13.5-1 (English Units). EMISSION FACTORS FOR FLARE OPERATIONS[a]

EMISSION FACTOR RATING: B

Component	Emission Factor ($lb/10^6$ Btu)
Total hydrocarbons[b]	0.14
Carbon monoxide	0.37
Nitrogen oxides	0.068
Soot[c]	0 - 274

[a] Reference 1. Based on tests using crude propylene containing 80% propylene and 20% propane.
[b] Measured as methane equivalent.
[c] Soot in concentration values: nonsmoking flares, 0 micrograms per liter (µg/L); lightly smoking flares, 40 µg/L; average smoking flares, 177 µg/L; and heavily smoking flares, 274 µg/L.

TABLE 2-4. OIL AND GAS PRODUCTION OPERATIONS AVERAGE EMISSION FACTORS (kg/hr/source)

Equipment Type	Service[a]	Emission Factor (kg/hr/source)[b]
Valves	Gas	4.5E-03
	Heavy Oil	8.4E-06
	Light Oil	2.5E-03
	Water/Oil	9.8E-05
Pump seals	Gas	2.4E-03
	Heavy Oil	NA
	Light Oil	1.3E-02
	Water/Oil	2.4E-05
Others[c]	Gas	8.8E-03
	Heavy Oil	3.2E-05
	Light Oil	7.5E-03
	Water/Oil	1.4E-02
Connectors	Gas	2.0E-04
	Heavy Oil	7.5E-06
	Light Oil	2.1E-04
	Water/Oil	1.1E-04
Flanges	Gas	3.9E-04
	Heavy Oil	3.9E-07
	Light Oil	1.1E-04
	Water/Oil	2.9E-06
Open-ended lines	Gas	2.0E-03
	Heavy Oil	1.4E-04
	Light Oil	1.4E-03
	Water/Oil	2.5E-04

[a]Water/Oil emission factors apply to water streams in oil service with a water content greater than 50%, from the point of origin to the point where the water content reaches 99%. For water streams with a water content greater than 99%, the emission rate is considered negligible.

[b]These factors are for total organic compound emission rates (including non-VOC's such as methane and ethane) and apply to light crude, heavy crude, gas plant, gas production, and off shore facilities. "NA" indicates that not enough data were available to develop the indicated emission factor.

[c]The "other" equipment type was derived from compressors, diaphrams, drains, dump arms, hatches, instruments, meters, pressure relief valves, polished rods, relief valves, and vents. This "other" equipment type should be applied for any equipment type other than connectors, flanges, open-ended lines, pumps, or valves.

Chesapeake Energy Corporation
George Gantzer No. 8-H

TABLE 1-B

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

SEPARATOR GOR.....: 16357 Scf/Sep Bbl
SEPARATOR PRESSURE.....: 390 psig
SEPARATOR TEMPERATURE.....: 83 °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	0.513	0.000	0.026	0.008	0.483	0.000
Carbon Dioxide	0.149	0.000	0.013	0.006	0.140	0.000
Methane	71.427	0.000	8.861	3.883	67.513	0.000
Ethane	17.491	4.716	9.965	6.891	17.020	4.589
Propane	6.802	1.887	11.708	8.331	7.109	1.972
Iso-butane	0.668	0.220	2.480	2.097	0.781	0.258
N-butane	1.828	0.581	9.597	7.820	2.314	0.735
2-2 Dimethylpropane	0.008	0.003	0.080	0.079	0.012	0.005
Iso-pentane	0.316	0.117	3.603	3.409	0.522	0.192
N-pentane	0.440	0.161	6.541	6.127	0.822	0.300
2-2 Dimethylbutane	0.005	0.002	0.123	0.133	0.012	0.005
Cyclopentane	0.003	0.001	0.000	0.000	0.003	0.001
2-3 Dimethylbutane	0.009	0.004	0.351	0.372	0.030	0.013
2 Methylpentane	0.065	0.027	2.260	2.425	0.202	0.085
3 Methylpentane	0.038	0.016	1.493	1.575	0.129	0.053
Other Hexanes	0.000	0.000	0.000	0.000	0.000	0.000
n-Hexane	0.107	0.044	5.195	5.523	0.425	0.176
Methylcyclopentane	0.008	0.003	0.422	0.386	0.034	0.012
Benzene	0.001	0.000	0.069	0.050	0.005	0.001
Cyclohexane	0.010	0.003	0.744	0.655	0.056	0.019
2-Methylhexane	0.014	0.007	1.868	2.245	0.130	0.061
3-Methylhexane	0.015	0.007	1.690	2.006	0.120	0.055
2,2,4 Trimethylpentane	0.000	0.000	0.000	0.000	0.000	0.000
Other Heptanes	0.013	0.006	0.902	1.015	0.069	0.030
n-Heptane	0.025	0.012	3.836	4.576	0.263	0.123
Methylcyclohexane	0.011	0.004	1.712	1.779	0.117	0.048
Toluene	0.002	0.001	0.328	0.284	0.022	0.008
Other C-8's	0.017	0.008	5.124	6.211	0.336	0.159
n-Octane	0.005	0.003	2.442	3.234	0.157	0.081
Ethylbenzene	0.000	0.000	0.307	0.306	0.019	0.007
M&P-Xylene	0.001	0.000	0.359	0.360	0.023	0.009
O-Xylene	0.000	0.000	0.685	0.673	0.043	0.016
Other C-9's	0.005	0.003	3.105	4.203	0.199	0.105
n-Nonane	0.001	0.001	1.492	2.172	0.094	0.053
Other C10's	0.002	0.001	3.126	4.651	0.197	0.115
n-Decane	0.000	0.000	0.894	1.419	0.056	0.035
Undecanes Plus	0.001	0.001	8.599	15.098	0.539	0.369
TOTAL	100.000	7.837	100.000	100.000	100.000	9.690

TABLE 1-B

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

SEPARATOR GOR.....: 16357 Scf/Sep Bbl
SEPARATOR PRESSURE.....: 390 psig
SEPARATOR TEMPERATURE.....: 83 °F

UNDECANES PLUS (C_{11+}) FRACTION CHARACTERISTICS

COMPONENT	Specific Gravity °API	Specific Gravity **	Molecular Weight lb/lb-mole	Vapor Volume Scf/Gal	Gross Heating Value ***
Gas	N/A	0.8250	156.000	16.558	8,400
Oil	42.783	0.8119	174.000	14.609	128,920
Wellstream	N/A	0.8119	173.968	14.612	N/A

TOTAL SAMPLE CHARACTERISTICS

COMPONENT	Specific Gravity °API	Specific Gravity **	Molecular Weight lb/lb-mole	Vapor Volume Scf/Gal	Gross Heating Value Dry ***	Gross Heating Value Saturated ***
Gas	N/A	0.7718	22.258	127.606	1,352	1,330
Oil	84.980	0.6536	79.788	25.649	N/A	111,577
Wellstream	N/A	0.8928	25.856	46.942	N/A	N/A

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

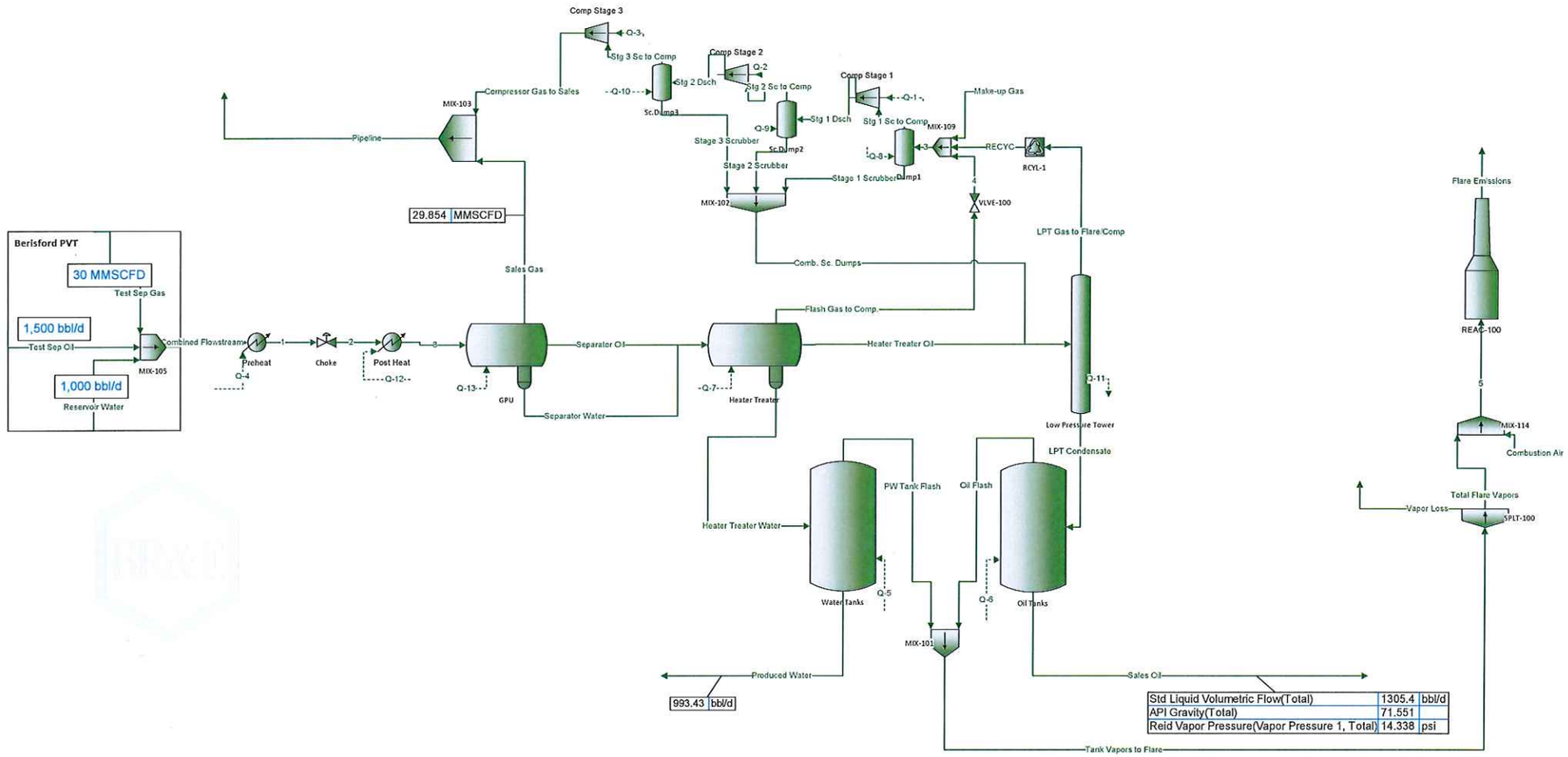
** Gas specific gravity and wellstream specific gravity determined relative to air (SG=1.000).
Oil specific gravity determined relative to water (SG=1.000).

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

Names	Units	Test Sep Gas	Test Sep Oil	Reservoir Water	Oil Flash	PW Tank Flash	Sales Gas	Sales Oil	Produced Water
Temperature	°F	94*	94*	94*	80#	85	75*	80	85#
Pressure	psia	429.7*	429.7*	429.7*	15.196	15.196	364.7*	15.196*	15.196*
Mole Fraction Vapor	%	100	0	0	100	100	100	0	0
Mole Fraction Light Liquid	%	0	100	100	0	0	0	99.527	100
Mole Fraction Heavy Liquid	%	0	0	0	0	0	0	0.47271	0
Molecular Weight	lb/lbmol	21.075	79.801	18.015	50.028	31.618	20.813	97.737	18.016
Molar Flow	lbmol/h	3293.9	176.74	809.87	3.047	0.04399	3277.9	134.69	804.48
Mass Flow	lb/h	69420	14104	14590	152.44	1.3909	68224	13164	14493
Enthalpy	Btu/h	-1.1354e+008	-1.3654e+007	-9.9267e+007	-1.5809e+005	-1865.3	-1.1329e+008	-1.2286e+007	-9.8749e+007
Nitrogen(Mole Fraction)	%	0.433*	0.073002*	0*	0.00051735	0.041366	0.43794	8.1698e-007	4.762e-007
CO2(Mole Fraction)	%	0.18*	0.043001*	0*	0.058611	0.60294	0.17915	0.00089836	0.00027438
C1(Mole Fraction)	%	77.38*	10.266*	0*	1.9277	35.691	77.726	0.0099296	0.00084197
C2(Mole Fraction)	%	14.005*	9.0163*	0*	17.807	28.516	14.005	0.56961	0.00076479
C3(Mole Fraction)	%	4.82*	9.0733*	0*	32.635	18.617	4.7411	3.6917	0.00051838
n-Butane(Mole Fraction)	%	1.329*	7.3102*	0*	18.949	6.9592	1.2326	7.8149	0.00015397
n-Butane(Mole Fraction)	%	1.329*	7.3102*	0*	18.949	6.9592	1.2326	7.8149	0.00015397
2,2-Dimethylpropane(Mole Fraction)	%	0.018*	0.085003*	0*	0.24493	0.041042	0.014898	0.13735	3.9702e-007
Isopentane(Mole Fraction)	%	0.35*	4.1431*	0*	5.4477	1.3053	0.29939	5.7094	1.9096e-005
n-Pentane(Mole Fraction)	%	0.366*	5.5072*	0*	5.6401	1.4694	0.30144	7.8757	2.188e-005

Oil Flash Factor – 4.50 lb/bbl

Produced water – 0.03 lb/bbl



Std Liquid Volumetric Flow(Total)	1305.4	bbl/d
API Gravity(Total)	71.551	
Reid Vapor Pressure(Vapor Pressure 1, Total)	14.338	psi

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

Identification

User Identification:	Bonnette MSH Pad - 1,300 BOPD
City:	
State:	
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:	1,239.78
Net Throughput(gal/yr):	19,929,000.00
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

Bonnette MSH Pad - 1,300 BOPD - 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
Bonnette MSH Pad - Gantzer	All	51.94	47.06	56.81	50.33	7.3119	6.7359	7.9250	50.0280			97.74	Option 4: RVP=10.86

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

Emissions Report for: Annual

Bonnette MSH Pad - 1,300 BOPD - Vertical Fixed Roof Tank

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Bonnette MSH Pad - Gantzer	24,846.70	1,155.38	26,002.07

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

Identification

User Identification:	Bonnette MSH Pad - 1,000 BWPD
City:	
State:	
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:	953.68
Net Throughput(gal/yr):	15,330,000.00
Is Tank Heated (y/n):	N

Paint Characteristics

Shell Color/Shade:	White/White
Shell Condition	Good
Roof Color/Shade:	White/White
Roof Condition:	Good

Roof Characteristics

Type:	Cone
Height (ft)	0.00
Slope (ft/ft) (Cone Roof)	0.06

Breather Vent Settings

Vacuum Settings (psig):	-0.03
Pressure Settings (psig)	0.03

Meterological Data used in Emissions Calculations: Pittsburgh, Pennsylvania (Avg Atmospheric Pressure = 14.11 psia)

TANKS 4.0.9d
Emissions Report - Summary Format
Liquid Contents of Storage Tank

Bonnette MSH Pad - 1,000 BWPD - 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	0.2043	0.1714	0.2427	20.1493			18.17	
Bonnette MSH Pad - Gantzer						7.3119	6.7359	7.9250	50.0280	0.0100	0.1652	97.74	Option 4: RVP=10.86
Water						0.1911	0.1592	0.2284	18.0200	0.9900	0.8348	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

Bonnette MSH Pad - 1,000 BWPD - Vertical Fixed Roof Tank

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Bonnette MSH Pad - Gantzer	36.88	1.82	38.70
Produced Water	223.29	11.00	234.29
Water	186.41	9.19	195.59