SWN Production Company, LLC
P O Box 12359
Spring, Texas 77391-2359
www.swn.com

# RUTH KELLER

## G70-D REGISTRATION APPLICATION

| REV | BY | DATE | DESCRIPTION | FACILITIES REVIEWED | DATE |
|---|---|---|---|---|---|
| I | CM | 4/17/2017 | G70-D REGISTRATION | JPH | 4/27/2017 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

# TABLE OF CONTENTS

# INTRODUCTION

SWN Production Company, LLC (SWN), submits this G70-D General Permit application for the Ruth Keller Pad, a proposed natural gas production facility in Marshall County. With this application, SWN requests authorization to operate under the General Permit G70-D for Oil and Natural Gas Production Facilities. Equipment to be authorized includes the following:

- One (1) Caterpillar G3306 NA Compressor Engine
- One (1) Zenith ZPP-644 4.4 L Compressor Engine
- One (1) 1.0-mmBtu/hr Gas Production Unit
- One (1) 0.5-mmBtu/hr Heater Treater
- One (1) 24-MMSCFD TEG Dehydration Unit
- One (1) 0.75-mmBtu/hr TEG Reboiler
- Two (2) 400-bbl Condensate Tanks
- Two (2) 400-bbl Produced Water Tanks
- Condensate Truck Loading
- Produced Water Truck Loading
- One (1) 15.0-mmBtu/hr Vapor Combustor with Pilot
- 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 listed on the application form.

## Proposed Emissions

Emissions calculations for the facility are presented in Attachment T. A fuel heating value of 905 Btu/scf was used to calculate emissions from natural gas-fired equipment. Actual heating value may vary (generally 905 - 1,300) but using a lower heating value in the emissions calculations provides a more conservative (higher) estimate of fuel use.

Emissions from the Caterpillar engine and the Zenith engine were calculated with manufacturer data when available and AP-42/EPA emissions factors for the remaining pollutants.

Condensate and produced water tank emissions and loading emissions were calculated using ProMax process simulation software. Tank emissions are routed to a vapor combustor with 100% capture efficiency and 98% destruction efficiency. Loading emissions are routed to a vapor combustor with 70% capture efficiency and 98% destruction efficiency.

TEG dehydration unit emissions were estimated using the George Gantzer No. 8-H PVT and GRI-GLYCalc™ 4.0 software. Still vent emissions are reduced by an air-cooled condenser and non-condensable gases are routed to the reboiler as fuel with an estimated 50% destruction efficiency. Flash tank off-gases are routed to the heater treater and then recompressed. Flash tank off-gases can also be used as supplemental fuel for the reboiler; therefore, a destruction efficiency of 98% was used in GLYCalc as a conservative measure.

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

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

## 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-D. Emissions of carbon monoxide and volatile organic compounds are less than 80 tons per year (TPY). Oxides of nitrogen emissions are less than 50 TPY and particulate matter 10/2.5 and sulfur dioxide emissions are each less than 20 TPY. Also, the facility will have less than 8 TPY for each hazardous air pollutant and less than 20 tons for total hazardous air pollutants.

**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 proposed 145-hp, four-stroke, rich-burn natural gas-fired flash gas compressor engine is assumed to have been constructed after the June 12, 2006 effective date and manufactured after July 1, 2008; therefore, it will be subject to this Subpart. Although final selection of the engine has not yet been made, it is presumed that the engine was manufactured after January 1, 2011 and therefore subject to Stage 2 emission limitations under this Subpart. The Zenith engine will be certified to meet the standards of this Subpart. SWN will comply with all applicable requirements.

**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 and before September 18, 2015.

The existing well at this location was completed during the effective date of this Subpart and is subject to the compliance requirements. The remaining proposed equipment at this production pad will be constructed after the effective date of this Subpart.

**40 CFR PART 60 SUBPART OOOOA - STANDARDS OF PERFORMANCE FOR CRUDE OIL AND NATURAL GAS FACILITIES FOR WHICH CONSTRUCTION, MODIFICATION, OR RECONSTRUCTION COMMENCED AFTER SEPTEMBER 18, 2015:**

The emission sources affected by this Subpart include well completions, centrifugal compressors, reciprocating compressors, pneumatic controllers, storage vessels, fugitive sources at well sites, fugitive sources at compressor stations, pneumatic pumps, equipment leaks from natural gas processing plants and sweetening units at natural gas processing plants which are constructed, modified or reconstructed after September 18, 2015.

The well at this location was completed before the effective date of this Subpart and is not subject to the compliance requirements. There is no centrifugal compressor using wet gas seals at this facility. The pneumatic controllers utilized at the facility are considered low-bleed and are not subject to this Subpart. The storage vessel venting is controlled to less than six (6) TPY VOC and federally enforceable limits are requested; therefore, the storage vessels are not subject to this Subpart.

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

The site is a minor (area) source of hazardous air pollutants. This Subpart applies to affected emission points that are located at facilities that are major and area sources of HAP, and either process, upgrade, or store hydrocarbon liquids prior to custody transfer or that process, upgrade, or store natural gas prior to entering the natural gas transmission and storage source category. For purposes of this Subpart natural gas enters the natural gas transmission and storage source category after the natural gas processing plant, if present. Even though the TEG dehydration unit at this facility is considered an affected area source, it is exempt from the requirements of § 63.764(d)(2) since the actual average emissions of benzene from the glycol dehydration unit process vent to the atmosphere are less than 0.90 Mg (1.0 TPY), as determined by the procedures specified in § 63.772(b)(2). However, the facility must maintain records of the de minimis determination as required in § 63.774(d)(1).

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

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

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

The original rule, published on February 26, 2004, initially affected new (constructed or reconstructed after December 19, 2002) reciprocating internal combustion engines (RICE) with a site-rating greater than 500 brake horsepower (HP) 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 145-hp, four-stroke, rich-burn natural gas-fired flash gas compressor engine is considered a new engine manufactured after January 1, 2011 and will meet the requirements of this Subpart by complying with requirements under NSPS Subpart JJJJ. The Zenith engine will meet the requirements of this Subpart by complying with requirements under NSPS Subpart JJJJ.

# APPLICATION FOR GENERAL PERMIT REGISTRATION

| | | |
|---|---|---|
| dep | **west virginia** department of environmental protection | Division of Air Quality<br>601 57th Street SE<br>Charleston, WV 25 4<br>Phone (304) 926-0475<br>Fax (304) 926-0479<br>www.dep.wv.gov |

# G70-D GENERAL PERMIT REGISTRATION APPLICATION

**PREVENTION AND CONTROL OF AIR POLLUTION IN REGARD TO THE CONSTRUCTION, MODIFICATION, RELOCATION, ADMINISTRATIVE UPDATE AND OPERATION OF NATURAL GAS PRODUCTION FACILITIES LOCATED AT THE WELL SITE**

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

## SECTION 1. GENERAL INFORMATION

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

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

Applicant's Mailing Address: 10000 Energy Drive

| City: Spring | State: TX | ZIP Code: 77389 |
|---|---|---|

Facility Name: Ruth Keller Pad

Operating Site Physical Address: 4025 Glen Dale Heights Rd.
If none available, list road, city or town and zip of facility.

| City: Glen Dale | Zip Code: 26038 | County: Marshall |
|---|---|---|

Latitude & Longitude Coordinates (NAD83, Decimal Degrees to 5 digits):
Latitude: 39.98601
Longitude: -80.69714

| SIC Code: 1311<br><br>NAICS Code: 211111 | DAQ Facility ID No. (For existing facilities) |
|---|---|

## CERTIFICATION OF INFORMATION

This G70-D 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 the 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, 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 G70-D Registration Application will be returned to the applicant. Furthermore, if the G70-D forms are not utilized, the application will be returned to the applicant. No substitution of forms is allowed.**

I hereby certify that Carla Suszkowski 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 Division of Air Quality immediately.

I hereby certify that all information contained in this G70-D 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.

Responsible Official Signature: Carla Suszkowski
Name and Title: Carla Suszkowski — Phone: 832-796-1000 — Fax: 405-849-3102
Email: Carla_Suszkowski@SWN.com — Date: 5-15-17

If applicable:
Authorized Representative Signature: _____
Name and Title: — Phone: — Fax:
Email: — Date:

If applicable:
Environmental Contact
Name and Title: Clay Murral — Phone: 304-884-1715 — Fax:
Email: Clay_Murral@SWN.com — Date:

| OPERATING SITE INFORMATION | |
|---|---|
| Briefly describe the proposed new operation and/or any change(s) to the facility: This application includes two (2) Caterpillar G3306 NA engines (EU-ENG1 – EU-ENG2), one (1) Zenith ZPP-644 4.4 L engine (EU-ENG3), one (1) 1.0-mmBtu/hr natural gas-fired gas production unit (GPU) burner (EU-GPU1), one (1) 0.5-mmBtu/hr natural gas-fired heater treater (EU-HT1), one (1) 24-MMSCFD TEG dehydration unit (EU-DEHY1), one (1) 0.75-mmBtu/hr TEG reboiler (EU-RB1), two (2) 400-bbl condensate tanks (EU-TANKS-COND), two (2) 400-bbl produced water tanks (EU-TANKS-PW), condensate and produced water truck loading (EU-LOAD-COND and EU-LOAD-PW), one (1) 15.0-mmBtu/hr vapor combustor (APC-COMB) with one (1) 50-SCFH pilot (EU-PILOT), fugitive emissions (EU-FUG), and fugitive haul road emissions (EU-HR). | |
| Directions to the facility: From I-470 east take exit 2 and turn right, (or 470 west, turn left), on CR-91/1 south, (Spruce St), for 0.46 miles to intersection of CR-91/1 and SR-88 (Ridgecrest Road). Turn right on SR-88 south and travel 4.15 miles to junction of SR-88 and SR-86, (Grandview Road), and turn right on SR-86. Travel SR-86 for 1.2 miles with access road on left. | |
| **ATTACHMENTS AND SUPPORTING DOCUMENTS** | |
| **I have enclosed the following required documents:** | |
| Check payable to WVDEP – Division of Air Quality with the appropriate application fee (per 45CSR13 and 45CSR22).<br><br>☒ Check attached to front of application.<br>☐ I wish to pay by electronic transfer. Contact for payment (incl. name and email address):<br>☐ I wish to pay by credit card. Contact for payment (incl. name and email address):<br><br>☒$500 (Construction, Modification, and Relocation) ☐$300 (Class II Administrative Update)<br>☒$1,000 NSPS fee for 40 CFR60, Subpart IIII, JJJJ, OOOO and/or OOOOa [1]<br>☐$2,500 NESHAP fee for 40 CFR63, Subpart ZZZZ and/or HH [2]<br><br>[1] Only one NSPS fee will apply.<br>[2] Only one NESHAP fee will apply. The Subpart ZZZZ NESHAP fee will be waived for new engines that satisfy requirements by complying with NSPS, Subparts IIII and/or JJJJ.<br>*NSPS and NESHAP fees apply to new construction or if the source is being modified.* | |
| ☒ Responsible Official or Authorized Representative Signature (if applicable) | |
| ☒ Single Source Determination Form **(must be completed)** – Attachment A | |
| ☐ Siting Criteria Waiver (if applicable) – Attachment B | ☒ Current Business Certificate – Attachment C |
| ☒ Process Flow Diagram – Attachment D | ☒ Process Description – Attachment E |
| ☒ Plot Plan – Attachment F | ☒ Area Map – Attachment G |
| ☒ G70-D Section Applicability Form – Attachment H | ☒ Emission Units/ERD Table – Attachment I |
| ☒ Fugitive Emissions Summary Sheet – Attachment J | |
| ☒ Gas Well Affected Facility Data Sheet (if applicable) – Attachment K | |
| ☒ Storage Vessel(s) Data Sheet (include gas sample data, USEPA Tanks, simulation software (e.g. ProMax, E&P Tanks, HYSYS, etc.), etc. where applicable) – Attachment L | |
| ☒ Natural Gas Fired Fuel Burning Unit(s) Data Sheet (GPUs, Heater Treaters, In-Line Heaters if applicable) – Attachment M | |
| ☒ Internal Combustion Engine Data Sheet(s) (include manufacturer performance data sheet(s) if applicable) – Attachment N | |
| ☒ Tanker Truck/Rail Car Loading Data Sheet (if applicable) – Attachment O | |
| ☒ Glycol Dehydration Unit Data Sheet(s) (include wet gas analysis, GRI- GLYCalc™ input and output reports and information on reboiler if applicable) – Attachment P | |
| ☒ Pneumatic Controllers Data Sheet – Attachment Q | |
| ☒ Pneumatic Pump Data Sheet – Attachment R | |
| ☒ Air Pollution Control Device/Emission Reduction Device(s) Sheet(s) (include manufacturer performance data sheet(s) if applicable) – Attachment S | |
| ☒ Emission Calculations (please be specific and include all calculation methodologies used) – Attachment T | |
| ☒ Facility-wide Emission Summary Sheet(s) – Attachment U | |
| ☒ Class I Legal Advertisement – Attachment V | |
| ☒ One (1) paper copy and two (2) copies of CD or DVD with pdf copy of application and attachments | |

**All attachments must be identified by name, divided into sections, and submitted in order.**

# ATTACHMENT A: SINGLE SOURCE DETERMINATION

## ATTACHMENT A - SINGLE SOURCE DETERMINATION FORM

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

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

The Source Determination Rule for the oil and gas industry was published in the Federal Register on June 3, 2016 and will become effective on August 2, 2016. EPA defined the term "adjacent" and stated that equipment and activities in the oil and gas sector that are under common control will be considered part of the same source if they are located on the same site or on sites that share equipment and are within ¼ mile of each other.

Is there equipment and activities in the same industrial grouping (defined by SIC code)?
Yes ☐ No ☒

Is there equipment and activities under the control of the same person/people?
Yes ☐ No ☒

Is there equipment and activities located on the same site or on sites that share equipment and are within ¼ mile of each other?
Yes ☐ No ☒

# Proximity Map


SWN Production Company™

**Ruth Keller Pad**
Lease Road: 186.20 Feet
NAD83 UTM Zone 17N
525.982 4,426.205 Kilometers
-80.696468 39.985831 Decimal Degrees

- Schools
- Rivers and Lakes
- Keller Quarter Mile
- Keller_Pad
- Compressor Stations
- Processing Plant
- Power Plant
- Hospital

# ATTACHMENT C: 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.**

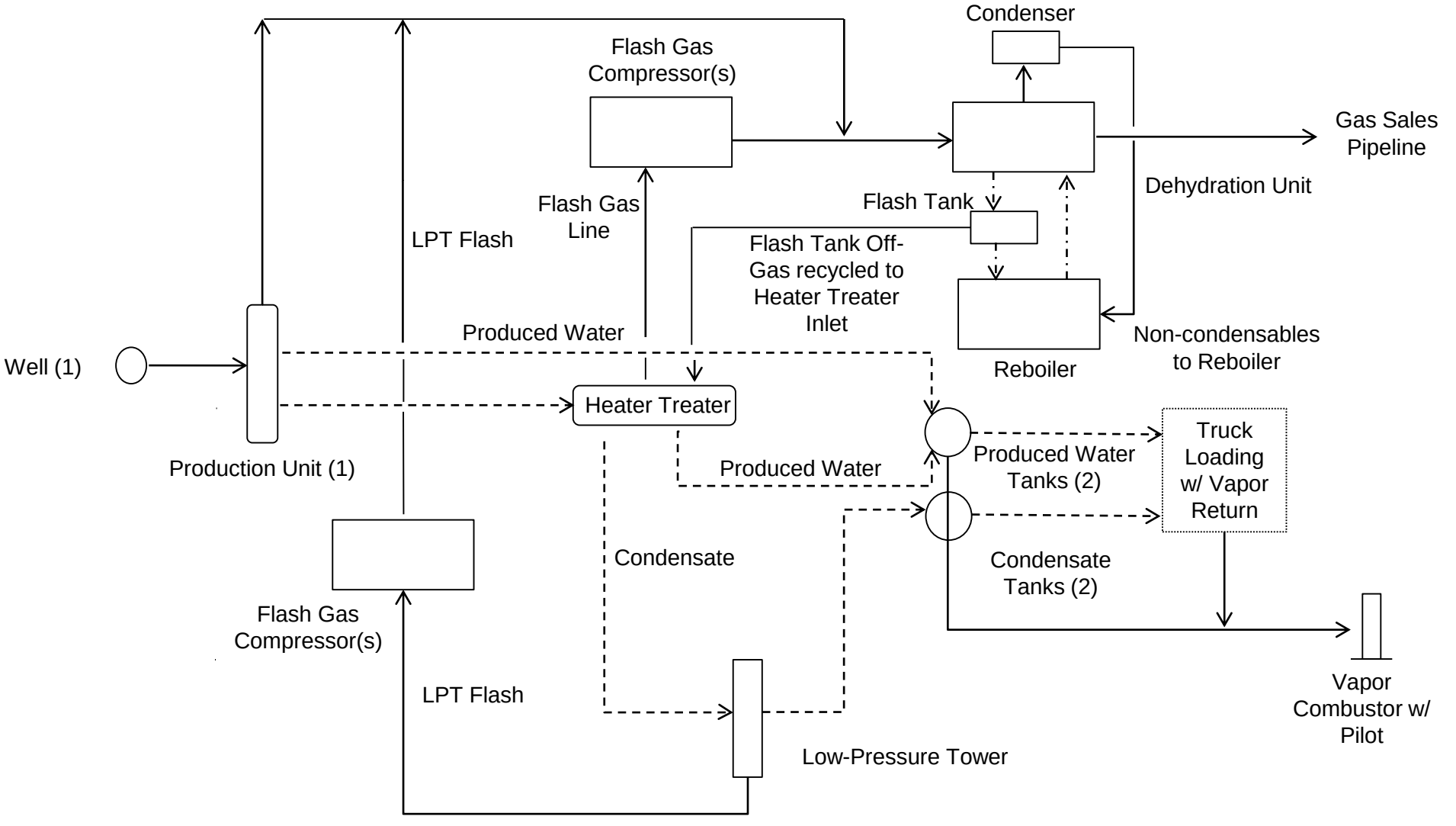
This certificate shall be permanent until cessation of the business for which the certificate of registration was granted or until it is suspended, revoked or cancelled by the Tax Commissioner.

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 D: PROCESS FLOW DIAGRAM




Gas/Vapor

Liquids (Condensate and Produced Water)

Glycol

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

**SWN Production Company, LLC**

**Ruth Keller Pad**

Attachment D: Process Flow Diagram

April 2017

# ATTACHMENT E: PROCESS DESCRIPTION

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

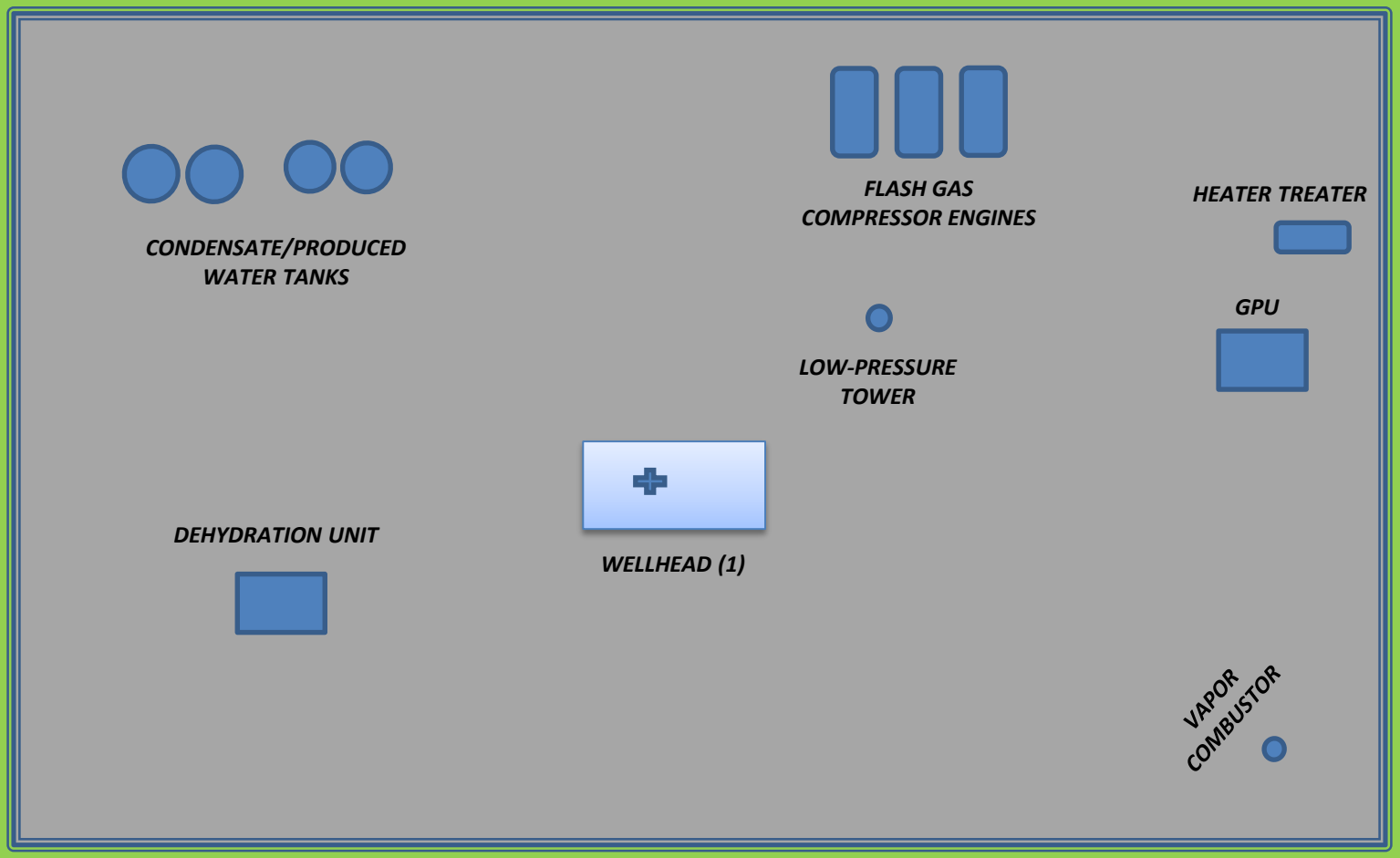
Working, breathing and flashing vapors from the condensate and produced water storage tanks are routed to the vapor combustor with 100% capture efficiency to be burned with at least 98% combustion efficiency. The vapor combustor has one (1) natural gas-fired pilot to ensure a constant flame for combustion.

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

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

# ATTACHMENT F: PLOT PLAN

Please note that the simple plot plan provided is only a representation of production/emissions equipment to be installed. Actual location specifications and equipment placement are not to scale.

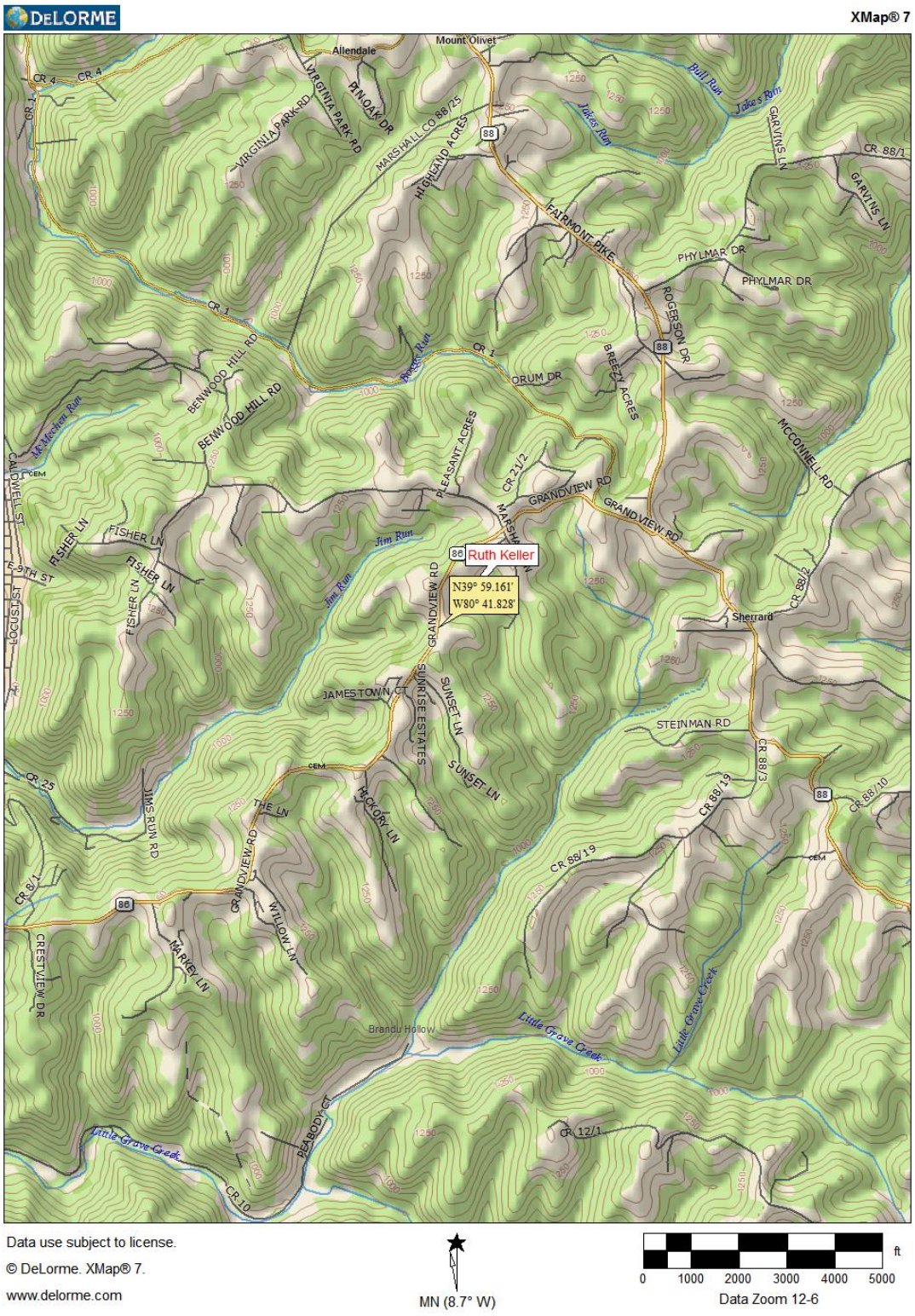



***NOTE**: Image is only a representation of production/emissions equipment. Actual location specifications and equipment placement are not to scale.*

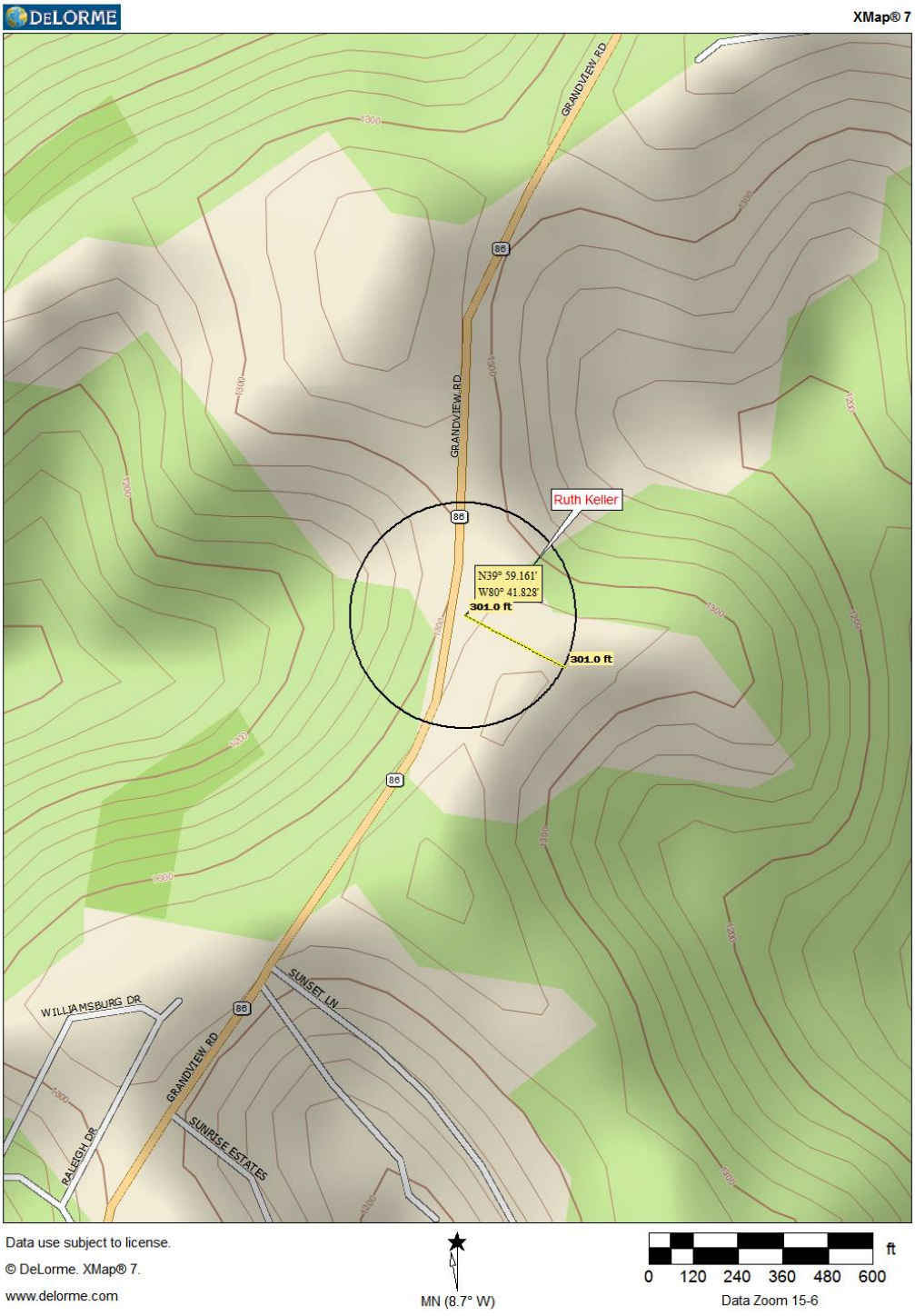


**SWN Production Company, LLC**
**Ruth Keller Pad**
Attachment F: Simple Plot Plan
April 2017

# ATTACHMENT G: AREA MAPS




**SWN Production Company, LLC**
**Ruth Keller**
Attachment G: Area Map
April 2017




**SWN Production Company, LLC**
**Ruth Keller**
Attachment G: Area Map with 300' Radius
April 2017

# ATTACHMENT H: G70-D SECTION APPLICABILITY FORM

# General Permit G70-D Registration
# Section Applicability Form

General Permit G70-D was developed to allow qualified applicants to seek registration for a variety of sources. These sources include gas well affected facilities, storage vessels, gas production units, in-line heaters, heater treaters, glycol dehydration units and associated reboilers, pneumatic controllers, pneumatic pumps, reciprocating internal combustion engines (RICEs), tank truck/rail car loading, fugitive emissions, 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-D 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.

| GENERAL PERMIT G70-D APPLICABLE SECTIONS | |
|---|---|
| ☒Section 5.0 | Gas and Oil Well Affected Facility (NSPS, Subpart OOOO/OOOOa) |
| ☒Section 6.0 | Storage Vessels Containing Condensate and/or Produced Water[1] |
| ☐Section 7.0 | Storage Vessel Affected Facility (NSPS, Subpart OOOO/OOOOa) |
| ☒Section 8.0 | Control Devices and Emission Reduction Devices not subject to NSPS Subpart OOOO/OOOOa and/or NESHAP Subpart HH |
| ☒Section 9.0 | Small Heaters and Reboilers not subject to 40CFR60 Subpart Dc |
| ☐Section 10.0 | Pneumatic Controllers Affected Facility (NSPS, Subpart OOOO/OOOOa) |
| ☐Section 11.0 | Pneumatic Pump Affected Facility (NSPS, Subpart OOOOa) |
| ☐Section 12.0 | Fugitive Emissions GHG and VOC Standards (NSPS, Subpart OOOOa) |
| ☒Section 13.0 | Reciprocating Internal Combustion Engines, Generator Engines |
| ☒Section 14.0 | Tanker Truck/Rail Car Loading[2] |
| ☒Section 15.0 | Glycol Dehydration Units[3] |

*1 Applicants that are subject to Section 6 may also be subject to Section 7 if the applicant is subject to the NSPS, Subparts OOOO or OOOOa control requirements or the applicable control device requirements of Section 8.*

*2 Applicants that are subject to Section 14 may also be subject to control device and emission reduction device requirements of Section 8.*

*3 Applicants that are subject to Section 15 may also be subject to the requirements of Section 9 (reboilers). Applicants that are subject to Section 15 may also be subject to control device and emission reduction device requirements of Section 8.*

# ATTACHMENT I: EMISSIONS UNITS/ERD TABLE

## ATTACHMENT I - EMISSION UNITS/EMISSION REDUCTION DEVICES (ERD) TABLE

Include ALL emission units and air pollution control devices/ERDs that will be part of this permit application review. Do not include fugitive emission sources in this table. Deminimis storage tanks shall be listed in the Attachment L table. This information is required for all sources regardless of whether it is a construction, modification, or administrative update.

| Emission Unit ID[1] | Emission Point ID[2] | Emission Unit Description | Year Installed | Manufac. Date[3] | Design Capacity | Type[4] and Date of Change | Control Device(s)[5] | ERD(s)[6] |
|---|---|---|---|---|---|---|---|---|
| EU-ENG1 | EP-ENG1 | 145-hp Caterpillar G3306 NA Engine | TBD | after 1/1/2011 | 145-hp | New | NSCR | NSCR |
| EU-ENG2 | EP-ENG2 | 145-hp Caterpillar G3306 NA Engine | TBD | after 1/1/2011 | 145-hp | New | NSCR | NSCR |
| EU-ENG3 | EP-ENG3 | 103.3-hp Zenith ZPP-644 4.4 L Engine | TBD | after 1/1/2011 | 103.3-hp | New | NSCR | NSCR |
| EU-GPU1 | EP-GPU1 | 1.0-mmBtu/hr GPU Burner | TBD | N/A | 1.0-mmBtu/hr | New | N/A | N/A |
| EU-HT1 | EP-HT1 | 0.5-mmBtu/hr Heater Treater | TBD | N/A | 0.5-mmBtu/hr | New | N/A | N/A |
| EU-DEHY1 | EP-RB1 | 24.0-MMSCFD TEG Dehydration Unit | TBD | N/A | 24.0 MMSCFD | New | Condenser and EU-RB1 | Condenser and EU-RB1 |
| EU-RB1 | EP-RB1 | 0.75-mmBtu/hr TEG Reboiler | TBD | N/A | 0.75-mmBtu/hr | New | N/A | N/A |
| EU-TANKS-COND | APC-COMB | Two (2) 400-bbl Condensate Tanks Routed to Vapor Combustor | TBD | N/A | 400-bbl | New | APC-COMB | APC-COMB |
| EU-TANKS-PW | APC-COMB | Two (2) 400-bbl Produced Water Tanks Routed to Vapor Combustor | TBD | N/A | 400-bbl | New | APC-COMB | APC-COMB |
| EU-LOAD-COND | APC-COMB | Condensate Truck Loading w/ Vapor Return Routed to Combustor | TBD | N/A | 6,132,000 gal/yr | New | Vapor Return and APC-COMB | Vapor Return and APC-COMB |
| EU-LOAD-PW | APC-COMB | Produced Water Truck Loading w/ Vapor Return Routed to Combustor | TBD | N/A | 5,365,500 gal/yr | New | Vapor Return and APC-COMB | Vapor Return and APC-COMB |
| APC-COMB | APC-COMB | 15.0-mmBtu/hr Vapor Combustor | TBD | N/A | 15.0-mmBtu/hr | New | N/A | N/A |
| EU-PILOT | APC-COMB | Vapor Combustor Pilot | TBD | N/A | 50-scfh | New | N/A | N/A |
| EU-FUG | EP-FUG | Fugitive Emissions | TBD | N/A | N/A | New | N/A | N/A |
| EU-HR | EP-HR | Fugitive Haul Road Emissions | TBD | N/A | N/A | New | N/A | N/A |
| | | | | | | | | |

[1] For Emission Units (or Sources) use the following numbering system:1S, 2S, 3S,... or other appropriate designation.

[2] For Emission Points use the following numbering system:1E, 2E, 3E, ... or other appropriate designation.

[3] When required by rule

[4] New, modification, removal, existing

[5] For Control Devices use the following numbering system: 1C, 2C, 3C,... or other appropriate designation.

[6] For ERDs use the following numbering system: 1D, 2D, 3D,... or other appropriate designation.

# ATTACHMENT J: FUGITIVE EMISSIONS SUMMARY SHEET

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

## ATTACHMENT J – FUGITIVE EMISSIONS SUMMARY SHEET

Sources of fugitive emissions may include loading operations, equipment leaks, blowdown emissions, etc.
Use extra pages for each associated source or equipment if necessary.

Source/Equipment: EU-FUG

| Leak Detection Method Used | ☐ Audible, visual, and olfactory (AVO) inspections | ☐ Infrared (FLIR) cameras | ☐ Other (please describe) | ☒ None required |
|---|---|---|---|---|

| Component Type | Closed Vent System | Count | Source of Leak Factors (EPA, other (specify)) | Stream type (gas, liquid, etc.) | Estimated Emissions (tpy) | | |
|---|---|---|---|---|---|---|---|
| | | | | | VOC | HAP | GHG (methane, $CO_2e$) |
| Pumps | ☐ Yes<br>☐ No | | | ☐ Gas<br>☐ Liquid<br>☐ Both | | | |
| Valves | ☐ Yes<br>☒ No | 61 – gas<br>53 – LL | EPA | ☐ Gas<br>☐ Liquid<br>☒ Both | 0.64 – gas<br>1.21 – LL | 0.01 – gas<br>0.10 – LL | 34.44 – gas<br>0.59 – LL |
| Safety Relief Valves | ☐ Yes<br>☒ No | 14 | EPA | ☒ Gas<br>☐ Liquid<br>☐ Both | 0.29 | 0.01 | 15.46 |
| Open Ended Lines | ☐ Yes<br>☒ No | 2 | EPA | ☒ Gas<br>☐ Liquid<br>☐ Both | 0.01 | <0.01 | 0.50 |
| Sampling Connections | ☐ Yes<br>☐ No | | | ☐ Gas<br>☐ Liquid<br>☐ Both | | | |
| Connections (Not sampling) | ☐ Yes<br>☒ No | 206 | EPA | ☐ Gas<br>☒ Liquid<br>☐ Both | 0.39 | 0.03 | 0.19 |
| Compressors | ☐ Yes<br>☒ No | 9 | EPA | ☒ Gas<br>☐ Liquid<br>☐ Both | 0.18 | <0.01 | 9.94 |
| Flanges | ☐ Yes<br>☒ No | 282 | EPA | ☒ Gas<br>☐ Liquid<br>☐ Both | 0.26 | <0.01 | 13.80 |
| Other[1] | ☐ Yes<br>☐ No | | | ☐ Gas<br>☐ Liquid<br>☐ Both | | | |

[1] Other equipment types may include compressor seals, relief valves, diaphragms, drains, meters, etc.

Please provide an explanation of the sources of fugitive emissions (e.g. pigging operations, equipment blowdowns, pneumatic controllers, etc.):
Equipment leaks

| |
|---|
| Please indicate if there are any closed vent bypasses (include component):<br>N/A |
| Specify all equipment used in the closed vent system (e.g. VRU, ERD, thief hatches, tanker truck/rail car loading, etc.)<br>N/A |

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.

# ATTACHMENT K: GAS WELL AFFECTED FACILITY DATA SHEET

## ATTACHMENT K – GAS WELL AFFECTED FACILITY DATA SHEET

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

| API Number | Date of Flowback | Date of Well Completion | Green Completion and/or Combustion Device | Subject to OOOO or OOOOa? |
|---|---|---|---|---|
| 047-051-01501 | 9/13/2012 | 6/28/2012 | Green Completion | OOOO |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

*Note: If future wells are planned and no API number is available please list as PLANNED.*
*If there are existing wells that commenced construction prior to August 23, 2011, please acknowledge as existing.*

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

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

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

*Where,*

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

# ATTACHMENT L: STORAGE VESSELS DATA SHEET

REPRESENTATIVE GAS ANALYSES

PROMAX PROCESS SIMULATION RESULTS

## ATTACHMENT L – STORAGE VESSEL DATA SHEET

Complete this data sheet if you are the owner or operator of a storage vessel that contains condensate and/or produced water. This form must be completed for ***each*** new or modified bulk liquid storage vessel(s) that contains condensate and/or produced water. (If you have more than one (1) identical tank (i.e. 4-400 bbl condensate tanks), then you can list all on one (1) data sheet). **Include gas sample analysis, flashing emissions, working and breathing losses, USEPA Tanks, simulation software (ProMax, E&P Tanks, HYSYS, etc.), and any other supporting documents where applicable.**

**The following information is REQUIRED:**

☒ Composition of the representative sample used for the simulation
☒ For each stream that contributes to flashing emissions:
- ☒ Temperature and pressure (inlet and outlet from separator(s))
- ☒ Simulation-predicted composition
- ☒ Molecular weight
- ☒ Flow rate

☒ Resulting flash emission factor or flashing emissions from simulation
☒ Working/breathing loss emissions from tanks and/or loading emissions if simulation is used to quantify those emissions

*Additional information may be requested if necessary.*

**GENERAL INFORMATION (REQUIRED)**

| | |
|---|---|
| 1. Bulk Storage Area Name<br>Condensate Storage | 2. Tank Name<br>Two (2) 400-bbl Condensate Storage Tanks |
| 3. Emission Unit ID number<br>EU-TANKS-COND | 4. Emission Point ID number<br>APC-COMB |
| 5. Date Installed , Modified or Relocated *(for existing tanks)*<br>TBD<br>Was the tank manufactured after August 23, 2011 and on or before September 18, 2015?<br>☐ Yes ☒ No<br>Was the tank manufactured after September 18, 2015?<br>☒ Yes ☐ No | 6. Type of change:<br>☒ New construction ☐ New stored material ☐ Other<br>☐ Relocation |
| 7A. Description of Tank Modification *(if applicable)* | |
| 7B. Will more than one material be stored in this tank? *If so, a separate form must be completed for each material.*<br>☐ Yes ☒ No | |
| 7C. Was USEPA Tanks simulation software utilized?<br>☐ Yes ☒ No<br>***If Yes, please provide the appropriate documentation and items 8-42 below are not required.*** | |

| | |
|---|---|
| 1. Bulk Storage Area Name<br>Produced Water Storage | 2. Tank Name<br>Two (2) 400-bbl Produced Water Storage Tanks |
| 3. Emission Unit ID number<br>EU-TANKS-PW | 4. Emission Point ID number<br>APC-COMB |
| 5. Date Installed , Modified or Relocated *(for existing tanks)*<br>TBD<br>Was the tank manufactured after August 23, 2011 and on or before September 18, 2015?<br>☐ Yes ☒ No<br>Was the tank manufactured after September 18, 2015?<br>☒ Yes ☐ No | 6. Type of change:<br>☒ New construction ☐ New stored material ☐ Other<br>☐ Relocation |
| 7A. Description of Tank Modification *(if applicable)* | |
| 7B. Will more than one material be stored in this tank? *If so, a separate form must be completed for each material.*<br>☐ Yes ☒ No | |
| 7C. Was USEPA Tanks simulation software utilized?<br>☐ Yes ☒ No<br>***If Yes, please provide the appropriate documentation and items 8-42 below are not required.*** | |

# STORAGE TANK DATA TABLE

## List all deminimis storage tanks (i.e. lube oil, glycol, diesel etc.)

| Source ID #[1] | Status[2] | Content[3] | Volume[4] |
|---|---|---|---|
| EU-TANKS-LUBEOIL | NEW | Lube Oil | 50 gal |
| EU-TANKS-LUBEOIL | NEW | Lube Oil | 50 gal |
| EU-TANKS-LUBEOIL | NEW | Lube Oil | 50 gal |
| EU-TANKS-METHANOL | NEW | Methanol | 50 gal |
| EU-TANKS-METHANOL | NEW | Methanol | 50 gal |
| EU-TANKS-METHANOL | NEW | Methanol | 50 gal |
| EU-TANKS-METHANOL | EXIST | Methanol | 50 gal |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

1. Enter the appropriate Source Identification Numbers (Source ID #) for each storage tank located at the well site. Tanks should be designated T01, T02, T03, etc.
2. Enter storage tank Status using the following:
   - EXIST Existing Equipment
   - NEW Installation of New Equipment
   - REM Equipment Removed
3. Enter storage tank content such as condensate, pipeline liquids, glycol (DEG or TEG), lube oil, diesel, mercaptan etc.
4. Enter the maximum design storage tank volume in gallons.

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

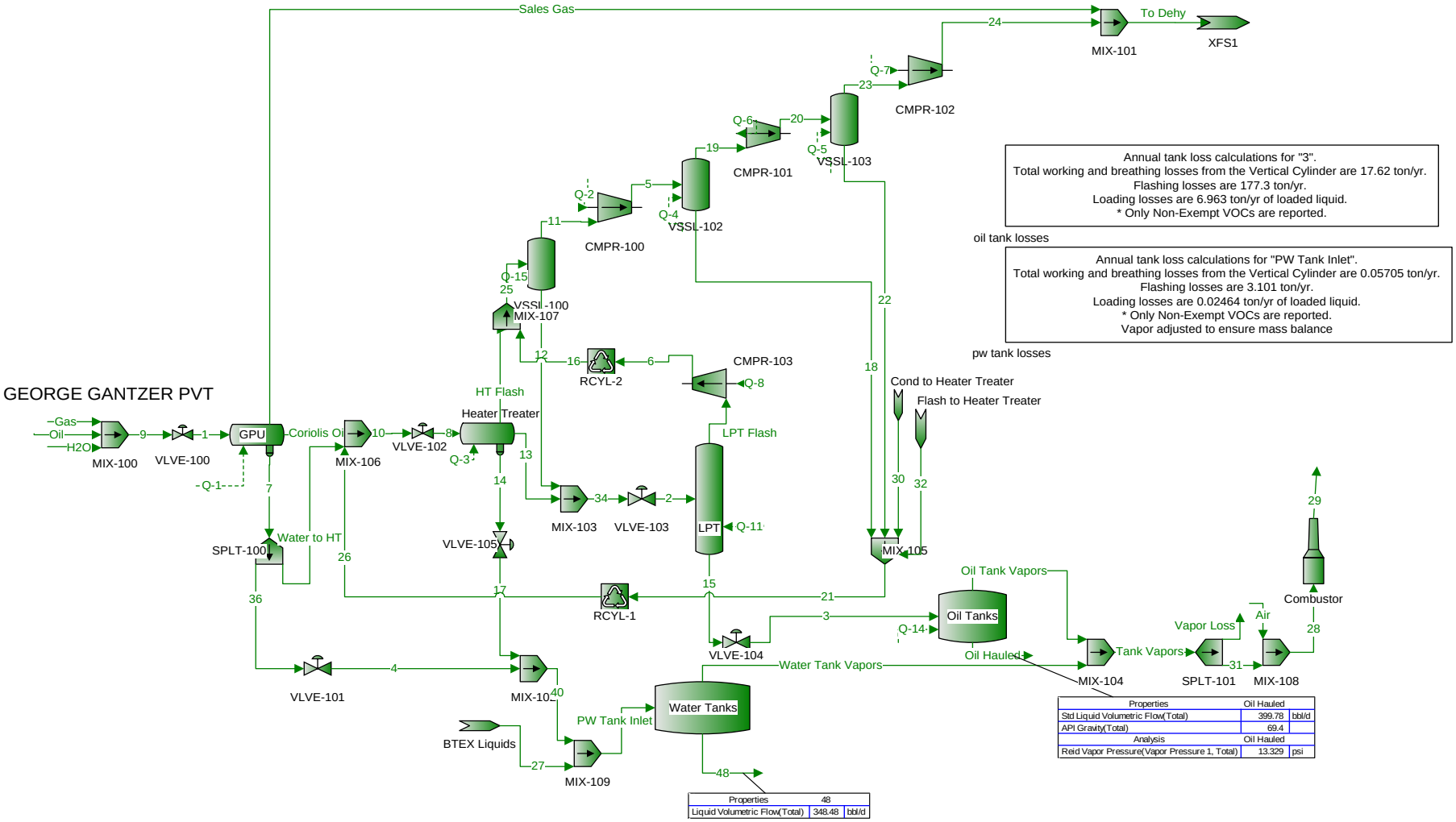
| UNDECANES PLUS ($C_{11+}$) FRACTION CHARACTERISTICS | | | | | |
|---|---|---|---|---|---|
| | Specific Gravity | | Molecular Weight | Vapor Volume | Gross Heating Value |
| COMPONENT | °API | ** | lb/lb-mole | Scf/Gal | *** |
| **Gas** | N/A | 0.8250 | 156.000 | 16.558 | 8,400 |
| **Oil** | 42.783 | 0.8119 | 174.000 | 14.609 | 128,920 |
| **Wellstream** | N/A | 0.8119 | 173.968 | 14.612 | N/A |

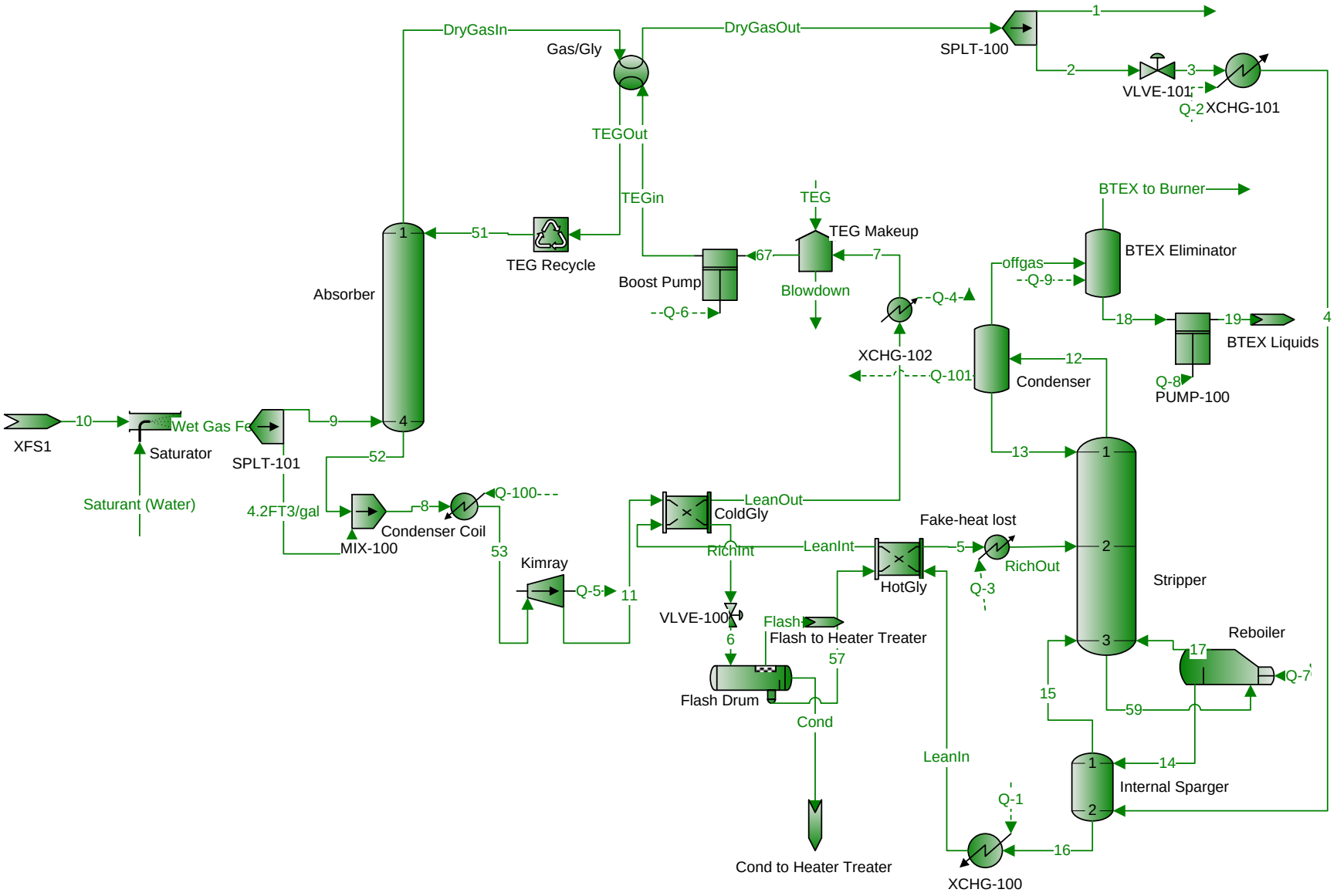
| TOTAL SAMPLE CHARACTERISTICS | | | | | | |
|---|---|---|---|---|---|---|
| | Specific Gravity | | Molecular Weight | Vapor Volume | Gross Heating Value | |
| | | | | | Dry | Saturated |
| COMPONENT | °API | ** | lb/lb-mole | Scf/Gal | *** | *** |
| **Gas** | N/A | 0.7718 | 22.258 | 127.606 | 1,352 | 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.


GEORGE GANTZER PVT
Sales Gas
To Dehy
XFS1
MIX-101
24
Q-7
23
CMPR-102
Q-6
20
Q-5
VSSL-103
19
CMPR-101
Q-2
5
Q-4
VSSL-102
11
CMPR-100
Q-15
25
VSSL-100
MIX-107
12
16
RCYL-2
6
CMPR-103
Q-8
18
22
Cond to Heater Treater
Flash to Heater Treater
HT Flash
Heater Treater
LPT Flash
Gas
Oil
H2O
MIX-100
9
VLVE-100
1
GPU
Coriolis Oi
10
MIX-106
VLVE-102
8
Q-3
13
Q-1
7
14
MIX-103
34
VLVE-103
2
LPT
Q-11
30
32
MIX-105
Water to HT
SPLT-100
26
VLVE-105
36
17
RCYL-1
15
21
Oil Tank Vapors
Oil Tanks
3
Q-14
VLVE-104
Oil Hauled
Tank Vapors
MIX-104
Vapor Loss
Air
SPLT-101
31
MIX-108
28
29
Combustor
VLVE-101
4
MIX-102
40
Water Tank Vapors
PW Tank Inlet
Water Tanks
BTEX Liquids
27
MIX-109
48
Annual tank loss calculations for "3".
Total working and breathing losses from the Vertical Cylinder are 17.62 ton/yr.
Flashing losses are 177.3 ton/yr.
Loading losses are 6.963 ton/yr of loaded liquid.
* Only Non-Exempt VOCs are reported.
oil tank losses
Annual tank loss calculations for "PW Tank Inlet".
Total working and breathing losses from the Vertical Cylinder are 0.05705 ton/yr.
Flashing losses are 3.101 ton/yr.
Loading losses are 0.02464 ton/yr of loaded liquid.
* Only Non-Exempt VOCs are reported.
Vapor adjusted to ensure mass balance
pw tank losses
Properties | Oil Hauled
Std Liquid Volumetric Flow(Total) | 399.78 | bbl/d
API Gravity(Total) | 69.4 |
Analysis | Oil Hauled
Reid Vapor Pressure(Vapor Pressure 1, Total) | 13.329 | psi
Properties | 48
Liquid Volumetric Flow(Total) | 348.48 | bbl/d


DryGasIn
Gas/Gly
DryGasOut
SPLT-100
1
2
3
VLVE-101
Q-2
XCHG-101
TEGOut
TEGin
TEG
TEG Makeup
BTEX to Burner
BTEX Eliminator
offgas
Q-9
51
TEG Recycle
Absorber
Boost Pump
67
7
Blowdown
Q-6
Q-4
XCHG-102
Q-101
Condenser
12
18
19
BTEX Liquids
Q-8
PUMP-100
4
10
XFS1
Wet Gas Fe
Saturator
Saturant (Water)
SPLT-101
9
52
13
4.2FT3/gal
MIX-100
8
Condenser Coil
Q-100
53
Kimray
Q-5
11
ColdGly
LeanOut
RichInt
LeanInt
HotGly
Fake-heat lost
5
RichOut
Q-3
Stripper
VLVE-100
6
Flash
Flash to Heater Treater
57
Flash Drum
Cond
Reboiler
17
Q-7
15
59
LeanIn
14
Internal Sparger
Q-1
16
XCHG-100
Cond to Heater Treater

ProMax AP-42 Emissions Report
Condensate Annual Emissions
Vertical Cylinder

| Components | Working Losses (ton/yr) | Breathing Losses (ton/yr) | Total Losses (ton/yr) |
|---|---|---|---|
| Mixture | 11.2 | 6.418 | 17.62 |
| Propane | 4.702 | 2.694 | 7.396 |
| i-Butane | 0.983 | 0.5633 | 1.546 |
| n-Butane | 3.188 | 1.827 | 5.015 |
| 2,2-Dimethylbutane | 0.01267 | 0.007259 | 0.01993 |
| i-Pentane | 0.6836 | 0.3917 | 1.075 |
| n-Pentane | 0.9168 | 0.5253 | 1.442 |
| 2,2-Dimethylpropane | 0.02168 | 0.01242 | 0.0341 |
| Cyclopentane | 0.001101 | 0.0006306 | 0.001731 |
| 2,3-Dimethylbutane | 0.02485 | 0.01424 | 0.03908 |
| 2-Methylpentane | 0.1441 | 0.08256 | 0.2266 |
| 3-Methylpentane | 0.08438 | 0.04835 | 0.1327 |
| n-Hexane | 0.2273 | 0.1302 | 0.3575 |
| Methylcyclopentane | 0.01635 | 0.009366 | 0.02571 |
| Benzene | 0.001591 | 0.0009116 | 0.002502 |
| Cyclohexane | 0.01944 | 0.01114 | 0.03057 |
| 2-Methylhexane | 0.009949 | 0.005701 | 0.01565 |
| 3-Methylhexane | 0.03157 | 0.01809 | 0.04966 |
| 2,2,4-Trimethylpentane | 0 | 0 | 0 |
| n-Heptane | 0.06361 | 0.03645 | 0.1001 |
| Methylcyclohexane | 0.02303 | 0.0132 | 0.03622 |
| Toluene | 0.002435 | 0.001395 | 0.00383 |
| C8 | 0.03197 | 0.01832 | 0.05029 |
| Ethylbenzene | 0.0008179 | 0.0004687 | 0.001287 |
| m-Xylene | 0.0005897 | 0.0003379 | 0.0009277 |
| o-Xylene | 0.001497 | 0.000858 | 0.002355 |
| C9 | 0.00609 | 0.00349 | 0.00958 |
| C10 | 0.001671 | 0.0009575 | 0.002629 |
| C11 | 0.0003654 | 0.0002094 | 0.0005748 |
| C12 | 7.88E-05 | 4.51E-05 | 0.0001239 |
| C13 | 1.75E-05 | 1.00E-05 | 2.75E-05 |
| C14 | 3.23E-06 | 1.85E-06 | 5.09E-06 |
| C15 | 7.24E-07 | 4.15E-07 | 1.14E-06 |
| C16 | 1.35E-07 | 7.74E-08 | 2.13E-07 |
| C17 | 3.04E-08 | 1.74E-08 | 4.79E-08 |
| C18 | 6.87E-09 | 3.94E-09 | 1.08E-08 |
| C19 | 9.38E-10 | 5.37E-10 | 1.48E-09 |
| C20 | 1.92E-10 | 1.10E-10 | 3.02E-10 |
| C21 | 6.18E-11 | 3.54E-11 | 9.73E-11 |
| C22 | 1.26E-11 | 7.21E-12 | 1.98E-11 |
| C23 | 1.93E-12 | 1.10E-12 | 3.03E-12 |
| C24 | 6.20E-13 | 3.55E-13 | 9.75E-13 |
| C25 | 1.55E-13 | 8.86E-14 | 2.43E-13 |
| C26 | 2.84E-14 | 1.63E-14 | 4.46E-14 |
| C27 | 8.52E-15 | 4.88E-15 | 1.34E-14 |
| C28 | 2.01E-16 | 1.15E-16 | 3.17E-16 |
| C29 | 9.19E-17 | 5.27E-17 | 1.45E-16 |
| C30 | 2.23E-17 | 1.28E-17 | 3.51E-17 |
| TEG | 3.35E-15 | 1.92E-15 | 5.27E-15 |

ProMax Loading Losses Report
Condensate Annual Emissions
Tank Truck or Rail Tank Car with Submerged Loading: Dedicated Normal Service

| Components | Annual Loading Losses (ton/yr) | Max. Hourly Loading Losses (lb/hr) |
|---|---|---|
| Mixture | 6.963 | 10.09 |
| Propane | 2.923 | 4.236 |
| i-Butane | 0.6111 | 0.8856 |
| n-Butane | 1.982 | 2.872 |
| 2,2-Dimethylbutane | 0.007876 | 0.01141 |
| i-Pentane | 0.425 | 0.6159 |
| n-Pentane | 0.57 | 0.8259 |
| 2,2-Dimethylpropane | 0.01348 | 0.01953 |
| Cyclopentane | 0.0006842 | 0.0009915 |
| 2,3-Dimethylbutane | 0.01545 | 0.02238 |
| 2-Methylpentane | 0.08957 | 0.1298 |
| 3-Methylpentane | 0.05246 | 0.07602 |
| n-Hexane | 0.1413 | 0.2047 |
| Methylcyclopentane | 0.01016 | 0.01473 |
| Benzene | 0.0009891 | 0.001433 |
| Cyclohexane | 0.01208 | 0.01751 |
| 2-Methylhexane | 0.006185 | 0.008963 |
| 3-Methylhexane | 0.01963 | 0.02844 |
| 2,2,4-Trimethylpentane | 0 | 0 |
| n-Heptane | 0.03955 | 0.05731 |
| Methylcyclohexane | 0.01432 | 0.02075 |
| Toluene | 0.001514 | 0.002193 |
| C8 | 0.01988 | 0.0288 |
| Ethylbenzene | 0.0005085 | 0.0007369 |
| m-Xylene | 0.0003666 | 0.0005313 |
| o-Xylene | 0.0009309 | 0.001349 |
| C9 | 0.003786 | 0.005487 |
| C10 | 0.001039 | 0.001505 |
| C11 | 0.0002272 | 0.0003292 |
| C12 | 4.90E-05 | 7.10E-05 |
| C13 | 1.09E-05 | 1.58E-05 |
| C14 | 2.01E-06 | 2.91E-06 |
| C15 | 4.50E-07 | 6.52E-07 |
| C16 | 8.40E-08 | 1.22E-07 |
| C17 | 1.89E-08 | 2.74E-08 |
| C18 | 4.27E-09 | 6.19E-09 |
| C19 | 5.83E-10 | 8.45E-10 |
| C20 | 1.19E-10 | 1.73E-10 |
| C21 | 3.84E-11 | 5.57E-11 |
| C22 | 7.83E-12 | 1.13E-11 |
| C23 | 1.20E-12 | 1.74E-12 |
| C24 | 3.85E-13 | 5.58E-13 |
| C25 | 9.61E-14 | 1.39E-13 |
| C26 | 1.76E-14 | 2.56E-14 |
| C27 | 5.29E-15 | 7.67E-15 |
| C28 | 1.25E-16 | 1.81E-16 |
| C29 | 5.71E-17 | 8.28E-17 |
| C30 | 1.39E-17 | 2.01E-17 |
| TEG | 2.08E-15 | 3.02E-15 |

Flashing Emissions Report
Condensate Annual Emissions
Tank flashed at the stream temperature (56.81 °F) and the atmospheric pressure of Pittsburgh, Pennsylvania (14.11 psia)

| Components | Flashing Losses (ton/yr) |
|---|---|
| Mixture | 177.3 |
| Propane | 70.45 |
| i-Butane | 15.81 |
| n-Butane | 50.63 |
| 2,2-Dimethylbutane | 0.2055 |
| i-Pentane | 11.47 |
| n-Pentane | 15.65 |
| 2,2-Dimethylpropane | 0.3659 |
| Cyclopentane | 0.02122 |
| 2,3-Dimethylbutane | 0.4129 |
| 2-Methylpentane | 2.484 |
| 3-Methylpentane | 1.463 |
| n-Hexane | 3.787 |
| Methylcyclopentane | 0.3213 |
| Benzene | 0.04578 |
| Cyclohexane | 0.4069 |
| 2-Methylhexane | 0.6815 |
| 3-Methylhexane | 0.5569 |
| 2,2,4-Trimethylpentane | 0 |
| n-Heptane | 1.162 |
| Methylcyclohexane | 0.419 |
| Toluene | 0.06891 |
| C8 | 0.6014 |
| Ethylbenzene | 0.02136 |
| m-Xylene | 0.01177 |
| o-Xylene | 0.04744 |
| C9 | 0.1151 |
| C10 | 0.03453 |
| C11 | 0.007835 |
| C12 | 0.001828 |
| C13 | 0.0004369 |
| C14 | 8.85E-05 |
| C15 | 2.04E-05 |
| C16 | 4.94E-06 |
| C17 | 1.40E-06 |
| C18 | 3.71E-07 |
| C19 | 6.95E-08 |
| C20 | 1.23E-08 |
| C21 | 4.19E-09 |
| C22 | 1.29E-09 |
| C23 | 2.30E-10 |
| C24 | 5.34E-11 |
| C25 | 1.44E-11 |
| C26 | 2.05E-12 |
| C27 | 5.06E-13 |
| C28 | 6.56E-14 |
| C29 | 3.04E-14 |
| C30 | 4.23E-14 |
| TEG | 2.27E-13 |

ProMax AP-42 Emissions Report
Produced Water Annual Emissions
Vertical Cylinder

| Components | Working Losses (ton/yr) | Breathing Losses (ton/yr) | Total Losses (ton/yr) |
|---|---|---|---|
| Mixture | 0.04322 | 0.01383 | 0.05705 |
| Propane | 0.019 | 0.006081 | 0.02508 |
| i-Butane | 0.0008937 | 0.000286 | 0.00118 |
| n-Butane | 0.003332 | 0.001066 | 0.004399 |
| 2,2-Dimethylbutane | 1.62E-06 | 5.17E-07 | 2.13E-06 |
| i-Pentane | 0.0003106 | 9.94E-05 | 0.00041 |
| n-Pentane | 8.77E-05 | 2.81E-05 | 0.0001157 |
| 2,2-Dimethylpropane | 5.25E-06 | 1.68E-06 | 6.93E-06 |
| Cyclopentane | 2.52E-05 | 8.07E-06 | 3.33E-05 |
| 2,3-Dimethylbutane | 1.93E-05 | 6.19E-06 | 2.55E-05 |
| 2-Methylpentane | 3.92E-05 | 1.25E-05 | 5.17E-05 |
| 3-Methylpentane | 0.0001068 | 3.42E-05 | 0.000141 |
| n-Hexane | 3.74E-05 | 1.20E-05 | 4.93E-05 |
| Methylcyclopentane | 0.0001444 | 4.62E-05 | 0.0001906 |
| Benzene | 0.001377 | 0.0004406 | 0.001817 |
| Cyclohexane | 0.0006816 | 0.0002181 | 0.0008998 |
| 2-Methylhexane | 3.13E-05 | 1.00E-05 | 4.13E-05 |
| 3-Methylhexane | 4.40E-05 | 1.41E-05 | 5.81E-05 |
| 2,2,4-Trimethylpentane | 0 | 0 | 0 |
| n-Heptane | 5.36E-05 | 1.71E-05 | 7.07E-05 |
| Methylcyclohexane | 0.000554 | 0.0001773 | 0.0007312 |
| Toluene | 0.003736 | 0.001195 | 0.004931 |
| C8 | 6.89E-05 | 2.20E-05 | 9.09E-05 |
| Ethylbenzene | 0.003001 | 0.0009605 | 0.003962 |
| m-Xylene | 0.002508 | 0.0008026 | 0.003311 |
| o-Xylene | 0.007061 | 0.00226 | 0.009321 |
| C9 | 6.79E-05 | 2.17E-05 | 8.96E-05 |
| C10 | 1.47E-05 | 4.72E-06 | 1.95E-05 |
| C11 | 5.78E-06 | 1.85E-06 | 7.63E-06 |
| C12 | 4.67E-06 | 1.49E-06 | 6.16E-06 |
| C13 | 2.07E-06 | 6.63E-07 | 2.73E-06 |
| C14 | 4.03E-07 | 1.29E-07 | 5.31E-07 |
| C15 | 6.84E-08 | 2.19E-08 | 9.03E-08 |
| C16 | 1.53E-08 | 4.91E-09 | 2.03E-08 |
| C17 | 3.54E-09 | 1.13E-09 | 4.67E-09 |
| C18 | 3.64E-10 | 1.16E-10 | 4.80E-10 |
| C19 | 2.47E-11 | 7.90E-12 | 3.26E-11 |
| C20 | 1.06E-12 | 3.41E-13 | 1.41E-12 |
| C21 | 3.36E-14 | 1.08E-14 | 4.43E-14 |
| C22 | 4.53E-15 | 1.45E-15 | 5.97E-15 |
| C23 | 4.19E-16 | 1.34E-16 | 5.53E-16 |
| C24 | 7.19E-17 | 2.30E-17 | 9.49E-17 |
| C25 | 2.09E-17 | 6.69E-18 | 2.76E-17 |
| C26 | 3.17E-18 | 1.02E-18 | 4.19E-18 |
| C27 | 8.56E-19 | 2.74E-19 | 1.13E-18 |
| C28 | 1.37E-19 | 4.39E-20 | 1.81E-19 |
| C29 | 5.27E-20 | 1.69E-20 | 6.95E-20 |
| C30 | 8.47E-20 | 2.71E-20 | 1.12E-19 |
| TEG | 2.69E-13 | 8.61E-14 | 3.55E-13 |

ProMax Loading Losses Report
Produced Water Annual Emissions
Tank Truck or Rail Tank Car with Submerged Loading: Dedicated Normal Service

| Components | Annual Loading Losses (ton/yr) | Max. Hourly Loading Losses (lb/hr) |
|---|---|---|
| Mixture | 0.02464 | 0.04269 |
| Propane | 0.01083 | 0.01877 |
| i-Butane | 0.0005095 | 0.0008829 |
| n-Butane | 0.0019 | 0.003292 |
| 2,2-Dimethylbutane | 9.21E-07 | 1.60E-06 |
| i-Pentane | 0.0001771 | 0.0003068 |
| n-Pentane | 5.00E-05 | 8.66E-05 |
| 2,2-Dimethylpropane | 2.99E-06 | 5.18E-06 |
| Cyclopentane | 1.44E-05 | 2.49E-05 |
| 2,3-Dimethylbutane | 1.10E-05 | 1.91E-05 |
| 2-Methylpentane | 2.23E-05 | 3.87E-05 |
| 3-Methylpentane | 6.09E-05 | 0.0001056 |
| n-Hexane | 2.13E-05 | 3.69E-05 |
| Methylcyclopentane | 8.23E-05 | 0.0001427 |
| Benzene | 0.0007849 | 0.00136 |
| Cyclohexane | 0.0003886 | 0.0006734 |
| 2-Methylhexane | 1.79E-05 | 3.09E-05 |
| 3-Methylhexane | 2.51E-05 | 4.35E-05 |
| 2,2,4-Trimethylpentane | 0 | 0 |
| n-Heptane | 3.05E-05 | 5.29E-05 |
| Methylcyclohexane | 0.0003158 | 0.0005472 |
| Toluene | 0.00213 | 0.00369 |
| C8 | 3.93E-05 | 6.80E-05 |
| Ethylbenzene | 0.001711 | 0.002965 |
| m-Xylene | 0.00143 | 0.002478 |
| o-Xylene | 0.004026 | 0.006975 |
| C9 | 3.87E-05 | 6.70E-05 |
| C10 | 8.40E-06 | 1.46E-05 |
| C11 | 3.29E-06 | 5.71E-06 |
| C12 | 2.66E-06 | 4.61E-06 |
| C13 | 1.18E-06 | 2.05E-06 |
| C14 | 2.30E-07 | 3.98E-07 |
| C15 | 3.90E-08 | 6.76E-08 |
| C16 | 8.74E-09 | 1.52E-08 |
| C17 | 2.02E-09 | 3.49E-09 |
| C18 | 2.07E-10 | 3.59E-10 |
| C19 | 1.41E-11 | 2.44E-11 |
| C20 | 6.07E-13 | 1.05E-12 |
| C21 | 1.92E-14 | 3.32E-14 |
| C22 | 2.58E-15 | 4.47E-15 |
| C23 | 2.39E-16 | 4.14E-16 |
| C24 | 4.10E-17 | 7.10E-17 |
| C25 | 1.19E-17 | 2.07E-17 |
| C26 | 1.81E-18 | 3.13E-18 |
| C27 | 4.88E-19 | 8.46E-19 |
| C28 | 7.82E-20 | 1.36E-19 |
| C29 | 3.00E-20 | 5.20E-20 |
| C30 | 4.83E-20 | 8.37E-20 |
| TEG | 1.53E-13 | 2.66E-13 |

Flashing Emissions Report
Produced Water Annual Emissions
Tank flashed at the stream temperature (56.81 °F) and the atmospheric pressure of Pittsburgh, Pennsylvania (14.11 psia)

| Components | Flashing Losses (ton/yr) |
|---|---|
| Mixture | 3.101 |
| Propane | 1.628 |
| i-Butane | 0.103 |
| n-Butane | 0.3122 |
| 2,2-Dimethylbutane | 0.0005049 |
| i-Pentane | 0.03933 |
| n-Pentane | 0.03047 |
| 2,2-Dimethylpropane | 0.0009812 |
| Cyclopentane | 0.0005582 |
| 2,3-Dimethylbutane | 0.00224 |
| 2-Methylpentane | 0.009453 |
| 3-Methylpentane | 0.01023 |
| n-Hexane | 0.01862 |
| Methylcyclopentane | 0.008199 |
| Benzene | 0.009971 |
| Cyclohexane | 0.01621 |
| 2-Methylhexane | 0.01011 |
| 3-Methylhexane | 0.0117 |
| 2,2,4-Trimethylpentane | 0 |
| n-Heptane | 0.03557 |
| Methylcyclohexane | 0.03152 |
| Toluene | 0.02772 |
| C8 | 0.1213 |
| Ethylbenzene | 0.02624 |
| m-Xylene | 0.02075 |
| o-Xylene | 0.06321 |
| C9 | 0.1284 |
| C10 | 0.167 |
| C11 | 0.1384 |
| C12 | 0.07564 |
| C13 | 0.0392 |
| C14 | 0.01094 |
| C15 | 0.002643 |
| C16 | 0.0005864 |
| C17 | 0.0001472 |
| C18 | 4.32E-05 |
| C19 | 9.35E-06 |
| C20 | 1.86E-06 |
| C21 | 1.45E-07 |
| C22 | 5.30E-08 |
| C23 | 2.11E-08 |
| C24 | 1.23E-08 |
| C25 | 1.10E-08 |
| C26 | 6.31E-09 |
| C27 | 8.27E-09 |
| C28 | 3.09E-09 |
| C29 | 2.88E-09 |
| C30 | 1.63E-08 |
| TEG | 9.22E-12 |

# ATTACHMENT M: NATURAL GAS FIRED FUEL BURNING UNITS DATA SHEET

AP-42 EMISSION FACTORS

## ATTACHMENT M – SMALL HEATERS AND REBOILERS NOT SUBJECT TO 40CFR60 SUBPART DC
## DATA SHEET

Complete this data sheet for each small heater and reboiler not subject to 40CFR60 Subpart Dc at the facility. ***The Maximum Design Heat Input (MDHI) must be less than 10 MMBTU/hr.***

| Emission Unit ID#[1] | Emission Point ID#[2] | Emission Unit Description (manufacturer, model #) | Year Installed/ Modified | Type[3] and Date of Change | Maximum Design Heat Input (MMBTU/hr)[4] | Fuel Heating Value (BTU/scf)[5] |
|---|---|---|---|---|---|---|
| EU-GPU1 | EP-GPU1 | Gas Production Unit Burner | TBD | NEW | 1.0 | 905 |
| EU-HT1 | EP-HT1 | Heater Treater | TBD | NEW | 0.5 | 905 |
| EU-RB1 | EP-RB1 | TEG Reboiler | TBD | NEW | 0.75 | 905 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

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

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

3 New, modification, removal

4 Enter design heat input capacity in MMBtu/hr.

5 Enter the fuel heating value in BTU/standard cubic foot.

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.

# ATTACHMENT N: INTERNAL COMBUSTION ENGINE DATA SHEETS

ENGINE SPECIFICATION SHEETS

AP-42 AND EPA EMISSION FACTORS

## ATTACHMENT N – INTERNAL COMBUSTION ENGINE DATA SHEET

Complete this data sheet for each internal combustion engine at the facility. Include manufacturer performance data sheet(s) or any other supporting document if applicable. Use extra pages if necessary. *Generator(s) and microturbine generator(s) shall also use this form.*

| Emission Unit ID#[1] | EU-ENG1 | EU-ENG2 | EU-ENG3 |
|---|---|---|---|
| Engine Manufacturer/Model | Caterpillar G3306 NA | Caterpillar G3306 NA | Zenith ZPP-644 4.4 L |
| Manufacturers Rated bhp/rpm | 145-hp/1,800-rpm | 145-hp/1,800-rpm | 103.3-hp/3,000-rpm |
| Source Status[2] | NS | NS | NS |
| Date Installed/ Modified/Removed/Relocated[3] | TBD | TBD | TBD |
| Engine Manufactured /Reconstruction Date[4] | After 1/1/2011 | After 1/1/2011 | After 1/1/2011 |
| Check all applicable Federal Rules for the engine (include EPA Certificate of Conformity if applicable)[5] | ☒40CFR60 Subpart JJJJ<br>☐JJJJ Certified?<br>☐40CFR60 Subpart IIII<br>☐IIII Certified?<br>☒40CFR63 Subpart ZZZZ<br>☐ NESHAP ZZZZ/ NSPS JJJJ Window<br>☐ NESHAP ZZZZ Remote Sources | ☒40CFR60 Subpart JJJJ<br>☐JJJJ Certified?<br>☐40CFR60 Subpart IIII<br>☐IIII Certified?<br>☐40CFR63 Subpart ZZZZ<br>☒ NESHAP ZZZZ/ NSPS JJJJ Window<br>☐ NESHAP ZZZZ Remote Sources | ☒40CFR60 Subpart JJJJ<br>☒JJJJ Certified?<br>☐40CFR60 Subpart IIII<br>☐IIII Certified?<br>☐40CFR63 Subpart ZZZZ<br>☒ NESHAP ZZZZ/ NSPS JJJJ Window<br>☐ NESHAP ZZZZ Remote Sources |
| Engine Type[6] | 4SRB | 4SRB | 4SRB |
| APCD Type[7] | NSCR | NSCR | NSCR |
| Fuel Type[8] | PQ | PQ | PQ |
| $H_2S$ (gr/100 scf) | Negligible | Negligible | Negligible |
| Operating bhp/rpm | 145-hp/1,800-rpm | 145-hp/1,800-rpm | 103.3-hp/3,000-rpm |
| BSFC (BTU/bhp-hr) | 8,625 | 8,625 | 11,149 |
| Hourly Fuel Throughput | 1,382 $ft^3$/hr<br>gal/hr | 1,382 $ft^3$/hr<br>gal/hr | 707 $ft^3$/hr<br>gal/hr |
| Annual Fuel Throughput (Must use 8,760 hrs/yr unless emergency generator) | 12.11 $MMft^3$/yr<br>gal/yr | 12.11 $MMft^3$/yr<br>gal/yr | 6.20 $MMft^3$/yr<br>gal/yr |
| Fuel Usage or Hours of Operation Metered | Yes ☐ No ☒ | Yes ☐ No ☒ | Yes ☐ No ☒ |

| **Calculation Methodology[9]** | **Pollutant[10]** | **Hourly PTE (lb/hr)[11]** | **Annual PTE (tons/year)[11]** | **Hourly PTE (lb/hr)[11]** | **Annual PTE (tons/year)[11]** | **Hourly PTE (lb/hr)[11]** | **Annual PTE (tons/year)[11]** |
|---|---|---|---|---|---|---|---|
| MD | $NO_x$ | 0.32 | 1.40 | 0.32 | 1.40 | 0.46 | 2.01 |
| MD | CO | 0.64 | 2.80 | 0.64 | 2.80 | 0.75 | 3.29 |
| MD | VOC | 0.22 | 0.98 | 0.22 | 0.98 | 0.46 | 2.01 |
| AP | $SO_2$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| AP | $PM_{10}$ | 0.01 | 0.05 | 0.01 | 0.05 | 0.01 | 0.03 |
| MD | Formaldehyde | 0.09 | 0.38 | 0.09 | 0.38 | 0.01 | 0.06 |
| AP | Total HAPs | 0.10 | 0.44 | 0.10 | 0.44 | 0.02 | 0.09 |
| MD and EPA | GHG ($CO_2e$) | 155.19 | 679.73 | 155.19 | 679.73 | 74.96 | 328.34 |

1 Enter the appropriate Source Identification Number for each natural gas-fueled reciprocating internal combustion engine/generator engine located at the well site. Multiple engines should be designated CE-1, CE-2, CE-3 etc. Generator engines should be designated GE-1, GE-2, GE-3 etc. Microturbine generator engines should be designated MT-1, MT-2, MT-3 etc. If more than three (3) engines exist, please use additional sheets.

2 Enter the Source Status using the following codes:

| | | | |
|---|---|---|---|
| NS | Construction of New Source (installation) | ES | Existing Source |
| MS | Modification of Existing Source | RS | Relocated Source |
| REM | Removal of Source | | |

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

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

5 Is the engine a certified stationary spark ignition internal combustion engine according to 40CFR60 Subpart IIII/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 as appropriate.

**Provide a manufacturer's data sheet for all engines being registered.**

6 Enter the Engine Type designation(s) using the following codes:

| | | | |
|---|---|---|---|
| 2SLB | Two Stroke Lean Burn | 4SRB | Four Stroke Rich Burn |
| 4SLB | Four Stroke Lean Burn | | |

7 Enter the Air Pollution Control Device (APCD) type designation(s) using the following codes:

| | | | |
|---|---|---|---|
| A/F | Air/Fuel Ratio | IR | Ignition Retard |
| HEIS | High Energy Ignition System | SIPC | Screw-in Precombustion Chambers |
| PSC | Prestratified Charge | LEC | Low Emission Combustion |
| NSCR | Rich Burn & Non-Selective Catalytic Reduction | OxCat | Oxidation Catalyst |
| SCR | Lean Burn & Selective Catalytic Reduction | | |

8 Enter the Fuel Type using the following codes:

| | | | | | |
|---|---|---|---|---|---|
| PQ | Pipeline Quality Natural Gas | RG | Raw Natural Gas /Production Gas | D | Diesel |

9 Enter the Potential Emissions Data Reference designation using the following codes. Attach all reference data used.

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

10 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*.

11 PTE for engines shall be calculated from manufacturer's data unless unavailable.

## Engine Air Pollution Control Device
## (Emission Unit ID# APC-NSCR-ENG-1, ENG-2 use extra pages as necessary)

Air Pollution Control Device Manufacturer's Data Sheet included?
Yes ☒ No ☐

☒ NSCR ☐ SCR ☐ Oxidation Catalyst

Provide details of process control used for proper mixing/control of reducing agent with gas stream:

| | |
|---|---|
| Manufacturer: N/A | Model #: N/A |
| Design Operating Temperature: 1,101 ºF | Design gas volume: 678 scfm |
| Service life of catalyst: | Provide manufacturer data? ☒Yes ☐ No |
| Volume of gas handled: acfm at ºF | Operating temperature range for NSCR/Ox Cat: From 600 ºF to 1,250 ºF |
| Reducing agent used, if any: | Ammonia slip (ppm): |

Pressure drop against catalyst bed (delta P): inches of $H_2O$

Provide description of warning/alarm system that protects unit when operation is not meeting design conditions:

Is temperature and pressure drop of catalyst required to be monitored per 40CFR63 Subpart ZZZZ?
☐ Yes ☒ No

How often is catalyst recommended or required to be replaced (hours of operation)?

How often is performance test required?
☒ Initial
☐ Annual
☐ Every 8,760 hours of operation
☐ Field Testing Required
☐ No performance test required. If so, why (please list any maintenance required and the applicable sections in NSPS/GACT,

# 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<br>4-Wire Narrowband O2 Sensor<br>Digital Power Valve<br>O2 Sensor Weldment<br>Wiring Harness<br>(2) 25' Type K Thermocouple |
| Digital Power Valve Size: | 0.75" NPT |

ZENITH POWER PRODUCTS LLC

ABOUT ZPP
ENGINE MODELS
Model 410
Model 416
Model 420
Model 428
Model 644
EPA/CARB EMISSIONS
DISTRIBUTORS
NEWS
CONTACT US


DUAL FUEL/GASOLINE & NATURAL GAS 4.4 Liter

For Industrial Application

# ZPP 644

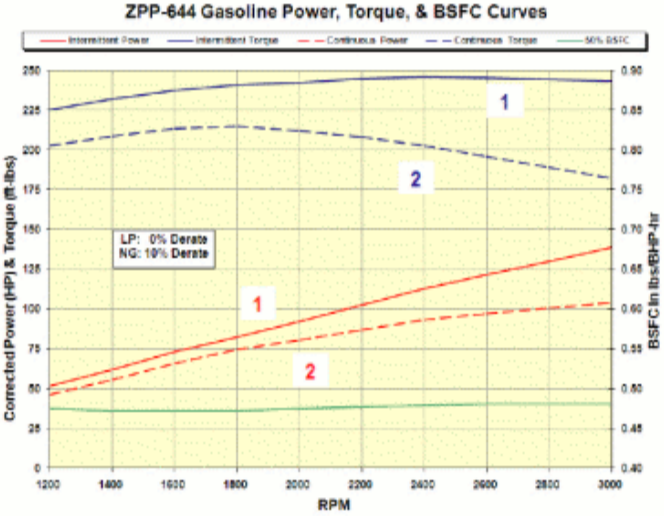
click to enlarge >

## SPECIFICATION DATA

| | |
|---|---|
| Intermittent output | 139 HP/3,000 rpm |
| Continuous output | 104 HP/3,000 rpm |
| Peak torque | 246 ft-lbs/2,200 rpm |
| Fuel and type | Gasoline / Multi-port - LPG/NG mixer type |
| Engine configuration | 6 Cylinder in-line, OHV |
| Block Material / Head Material | Cast Iron / Cast Iron |
| Bore x stroke (mm) | 98.4 x 91.0 |
| Total piston displacement | 4416 cc |
| Compression ratio | 9.7:1 |
| Length x width x height (mm) | 1054 x 586 x 810 |
| Dry weight (excluding shipped lose parts) | 193 Kg |
| Catalyst (2007 emmisions compliance) | Remote mounted |

Note: HP and Torque figures shown for 2008 LSI - EPA/CARB certified engine with catalyst.

## PERFORMANCE CURVES




**Curve 1 - Intermittent Gross Output**

This is the highest out put obtainable at standard ambient conditions from a basic engine equipped only with the built-in accessories essential to its operation. These levels may be only maintained for operating periods of short duration.

*Applications: Scissor lifts, Aerial platforms, Scrubbers / Sweepers, Utility vehicles, Construction equipment*

**Curve 2 - Continuous Gross Output**

This is the output that can be obtained at standard ambient conditions from a basice engine, operating in a continuous duty mode.

*Applications: Generator, Welders Water pumps, Gas compressors Carpet cleaners, etc*

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

back to top >

## ENGINE SPECIFICATIONS

| General | |
|---|---|
| Cylinders | 6 |
| Cylinder Arrangement | Vertical in-line |
| Bore | 3.94 in / 98.43 mm |
| Stroke | 3.64 in / 90.98 mm |
| Cylinder Displacement | 42.24 cu in / 692.3 cc |
| Total Displacement | 269.6 cu in / 4416 cc |
| Compression Ratio | 9.7:1 |

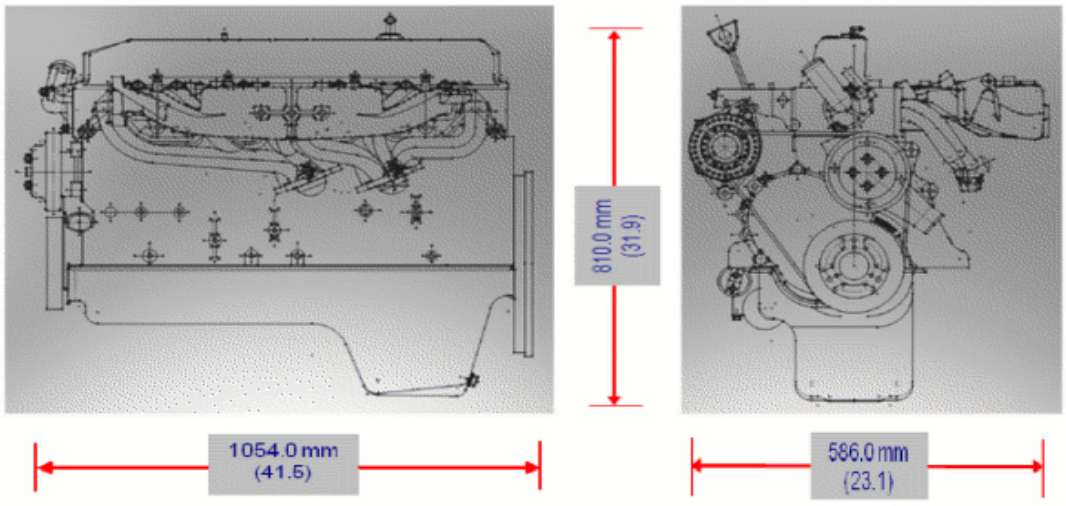
| Fuel System | |
|---|---|
| Gasoline Multi-port | |
| LPG / NG | Mixer Type |
| Fuel Pressure (gasoline) | 3 bar |
| Fuel Pressure LPG / NG | <5 in |
| Fuel Requirement | unleaded gasoline |
| Fuel Pump | Electric |
| Electronic Governor | ZEEMS III |

| Physical Data | |
|---|---|
| Length | 41.5 in / 1054.0 mm |
| Width | 23.1 in / 586.0 mm |
| Height | 31.9 in / 810.0 mm |
| Weight | 470 lb / 214.0 kg |
| Oil Capacity | 6.0 qt / 5.7 L |

| Electrical | |
|---|---|
| Starter Motor | 12 V - 1.4 Kw |
| Alternator | 12 V - 55 A w/ built in regulator |
| DIS Ignition | Computer Controlled |
| Distributor with coil - Non-certified applications | |
| Hall effect dist. w/ coil - Certified applications | |

| Cooling | |
|---|---|
| Thermostat | 180°F / 82 °C |

back to top >



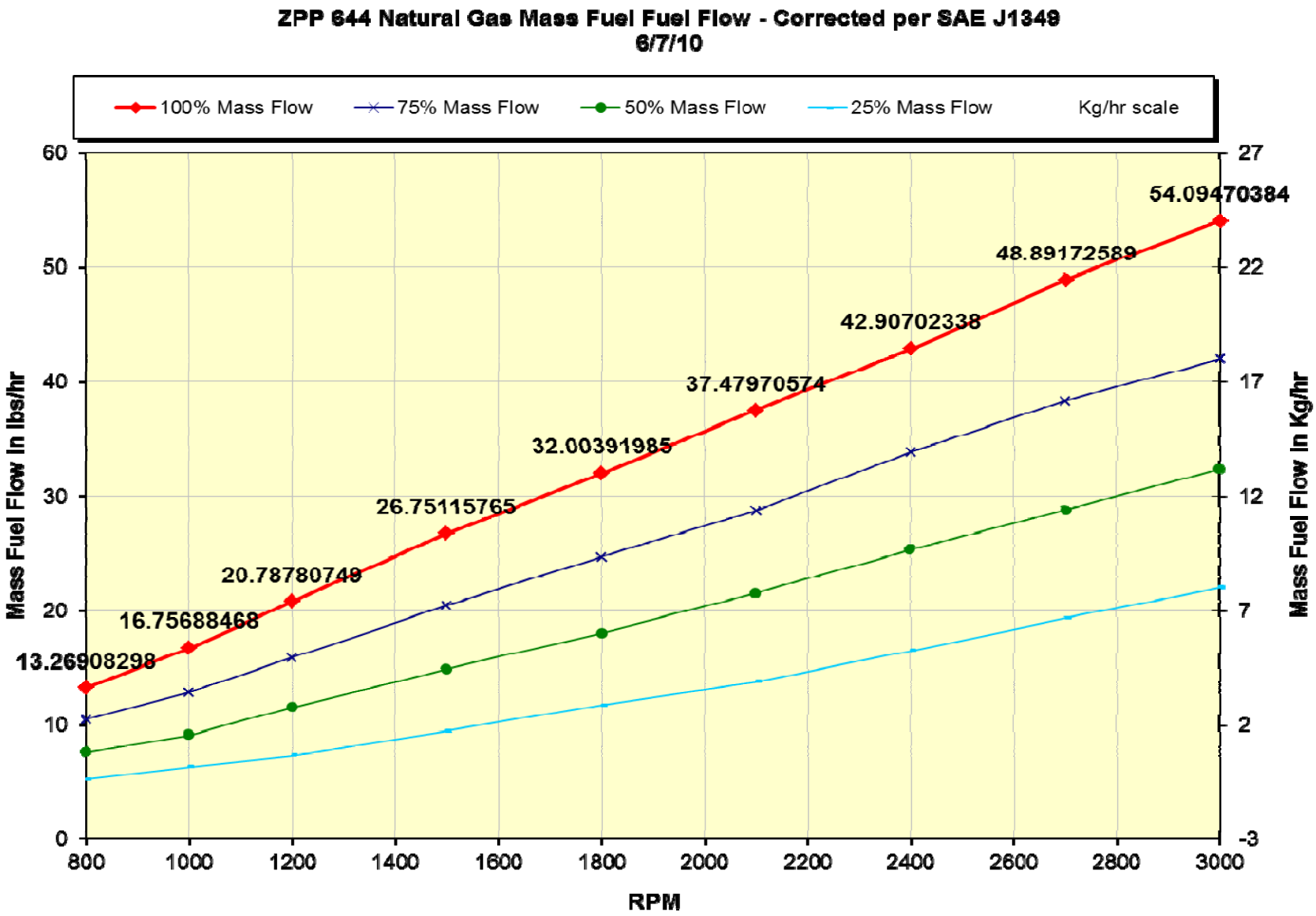

DESIGN AND SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE

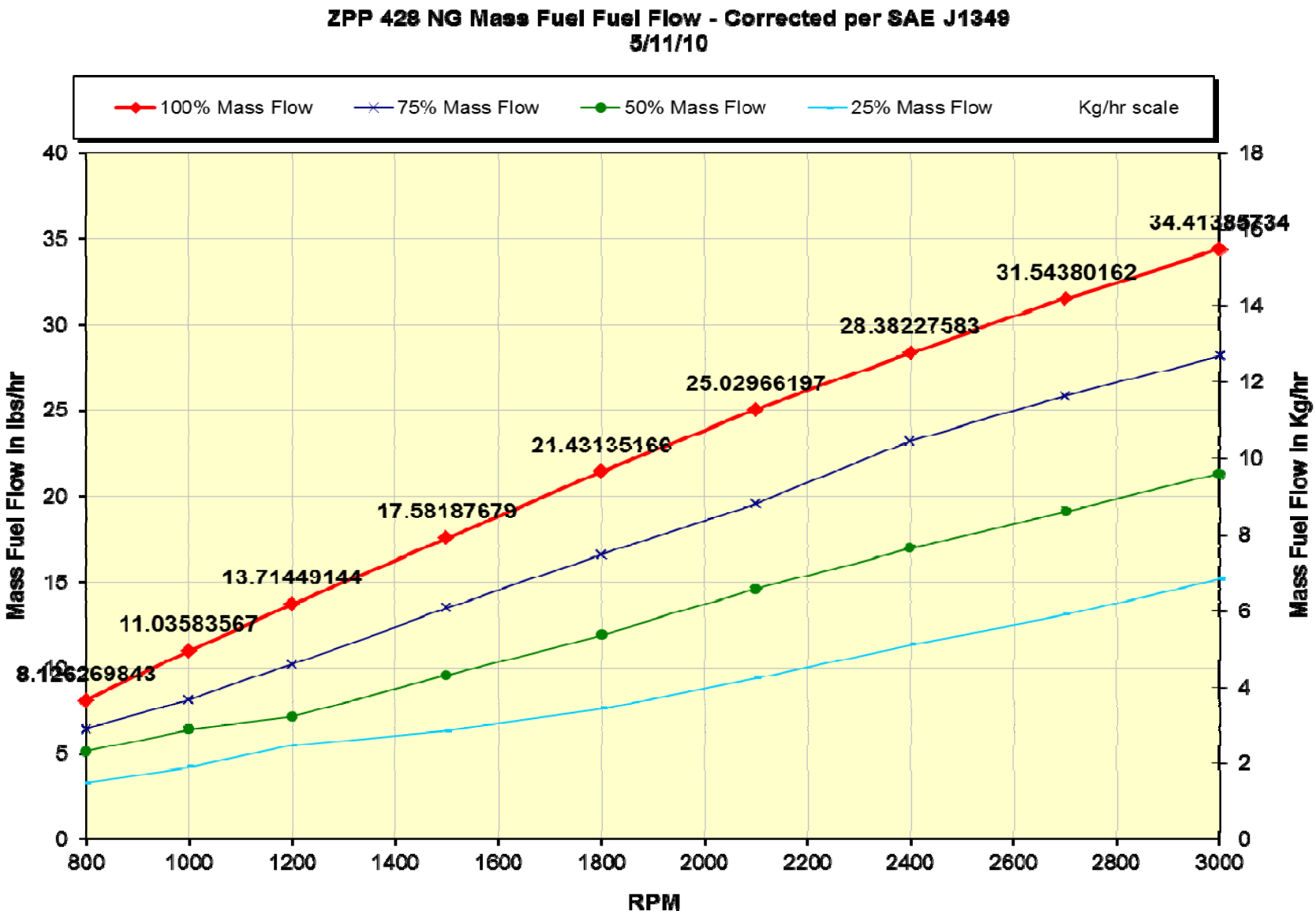
back to top >

# HY-BON/EDI VRU Packages w/ HP Ratings

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

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


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


ZPP 428 NG Mass Fuel Fuel Flow - Corrected per SAE J1349
5/11/10
100% Mass Flow
75% Mass Flow
50% Mass Flow
25% Mass Flow
Kg/hr scale
Mass Fuel Flow In lbs/hr
Mass Fuel Flow In Kg/hr
RPM
8.126269843
11.03583567
13.71449144
17.58187679
21.43135166
25.02966197
28.38227583
31.54380162
34.41385734
0
5
10
15
20
25
30
35
40
0
2
4
6
8
10
12
14
16
18
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000

**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY**
**2014 MODEL YEAR**
**CERTIFICATE OF CONFORMITY**
**WITH THE CLEAN AIR ACT OF 1990**

**OFFICE OF TRANSPORTATION**
**AND AIR QUALITY**
**ANN ARBOR, MICHIGAN 48105**

**Certificate Issued To:** **Zenith Power Products**
(U.S. Manufacturer or Importer)

**Certificate Number: EZPPB04.4P44-005**

**Effective Date:** 02/10/2014

**Expiration Date:** 12/31/2014

**Byron J. Bunker, Division Director**
**Compliance Division**

**Issue Date:** 02/10/2014

**Revision Date:** N/A

**Manufacturer:** Zenith Power Products
**Engine Family:** EZPPB04.4P44
**Certification Type:** Mobile and Stationary
**Fuel :** Natural Gas (CNG/LNG)
LPG/Propane
Gasoline (up to and including 10% Ethanol)
**Emission Standards :** CO ( g/kW-hr ) : 4.4
NMHC + NOx ( g/kW-hr ) : 2.7
HC + NOx ( g/kW-hr ) : 2.7CO ( g/kW-hr ) : 4.4
NMHC + NOx ( g/kW-hr ) : 2.7
HC + NOx ( g/kW-hr ) : 2.7
**Emergency Use Only :** N

611

Pursuant to Section 213 of the Clean Air Act (42 U.S.C. section 7547) and 40 CFR Part 1048, 40 CFR Part 60, 1065, 1068, and 60 ( stationary only and combined stationary and mobile ) and subject to the terms and conditions prescribed in those provisions, this certificate of conformity is hereby issued with respect to the test engines which have been found to conform to applicable requirements and which represent the following nonroad engines, by engine family, more fully described in the documentation required by 40 CFR Part 1048, 40 CFR Part 60 and produced in the stated model year.

This certificate of conformity covers only those new nonroad spark-ignition engines which conform in all material respects to the design specifications that applied to those engines described in the documentation required by 40 CFR Part 1048, 40 CFR Part 60 and which are produced during the model year stated on this certificate of the said manufacturer, as defined in 40 CFR Part 1048, 40 CFR Part 60. This certificate of conformity does not cover nonroad engines imported prior to the effective date of the certificate.

It is a term of this certificate that the manufacturer shall consent to all inspections described in 40 CFR 1068.20 and authorized in a warrant or court order. Failure to comply with the requirements of such a warrant or court order may lead to revocation or suspension of this certificate for reasons specified in 40 CFR Part 1048, 40 CFR Part 60. It is also a term of this certificate that this certificate may be revoked or suspended or rendered void *ab initio* for other reasons specified in 40 CFR Part 1048, 40 CFR Part 60.

This certificate does not cover large nonroad engines sold, offered for sale, or introduced, or delivered for introduction, into commerce in the U.S. prior to the effective date of the certificate.

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 ($\mu$m) 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/$10^6$scf.

[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 $\mu$m 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.

# ATTACHMENT O: TANKER TRUCK LOADING DATA SHEET

## ATTACHMENT O – TANKER TRUCK/RAIL CAR LOADING DATA SHEET

Complete this data sheet for each new or modified bulk liquid transfer area or loading rack at the facility. This is to be used for bulk liquid transfer operations to tanker trucks/rail cars. Use extra pages if necessary.

***Truck/Rail Car Loadout Collection Efficiencies***

The following applicable capture efficiencies of a truck/rail car loadout are allowed:

- For tanker trucks/rail cars passing the MACT level annual leak test – 99.2%
- For tanker trucks/rail cars passing the NSPS level annual leak test – 98.7%
- For tanker trucks/rail cars not passing one of the annual leak tests listed above – 70%

Compliance with this requirement shall be demonstrated by keeping records of the applicable MACT or NSPS Annual Leak Test certification for ***every*** truck and railcar loaded/unloaded. This requirement can be satisfied if the trucking/rail car company provided certification that its entire fleet was compliant. This certification must be submitted in writing to the Director of the DAQ. These additional requirements must be noted in the Registration Application.

| | | |
|---|---|---|
| Emission Unit ID#:<br>EU-LOAD-COND | Emission Point ID#:<br>EP-LOAD-COND/APC-COMB | Year Installed/Modified: TBD |
| Emission Unit Description: Condensate Truck Loading Emissions | | |
| **Loading Area Data** | | |
| Number of Pumps: 1 | Number of Liquids Loaded: 1 | Max number of trucks/rail cars loading at one (1) time: 1 |
| Are tanker trucks/rail cars pressure tested for leaks at this or any other location? ☐ Yes ☒ No ☐ Not Required<br>If Yes, Please describe: | | |
| Provide description of closed vent system and any bypasses. Vapors are collected and routed to a vapor combustor. | | |
| Are any of the following truck/rail car loadout systems utilized?<br>☐ Closed System to tanker truck/rail car passing a MACT level annual leak test?<br>☐ Closed System to tanker truck/rail car passing a NSPS level annual leak test?<br>☐ Closed System to tanker truck/rail car not passing an annual leak test and has vapor return? | | |

**Projected Maximum Operating Schedule (for rack or transfer point as a whole)**

| Time | Jan – Mar | Apr - Jun | Jul – Sept | Oct - Dec |
|---|---|---|---|---|
| Hours/day | 24 | 24 | 24 | 24 |
| Days/week | 5 | 5 | 5 | 5 |

**Bulk Liquid Data (use extra pages as necessary)**

| | | | |
|---|---|---|---|
| Liquid Name | Condensate | | |
| Max. Daily Throughput (1000 gal/day) | 16.8 | | |
| Max. Annual Throughput (1000 gal/yr) | 6,132.00 | | |
| Loading Method[1] | SUB | | |
| Max. Fill Rate (gal/min) | 125 | | |
| Average Fill Time (min/loading) | Approx. 60 | | |
| Max. Bulk Liquid Temperature (°F) | Refer to ProMax | | |
| True Vapor Pressure[2] | Refer to ProMax | | |
| Cargo Vessel Condition[3] | U | | |
| Control Equipment or Method[4] | O = Vapor Return/ Combustion Controls | | |
| Max. Collection Efficiency (%) | 70% | | |

| | | | | |
|---|---|---|---|---|
| Max. Control Efficiency (%) | | 98% | | |
| Max.VOC Emission Rate | Loading (lb/hr) | 10.10 | | |
| | Annual (ton/yr) | 6.65 | | |
| Max.HAP Emission Rate | Loading (lb/hr) | 0.82 | | |
| | Annual (ton/yr) | 0.54 | | |
| Estimation Method[5] | | O = ProMax process simulation | | |

| Emission Unit ID#: EU-LOAD-PW | Emission Point ID#: EP-LOAD-PW/APC-COMB | Year Installed/Modified: TBD |
|---|---|---|
| Emission Unit Description: Produced Water Truck Loading Emissions | | |
| **Loading Area Data** | | |
| Number of Pumps: 1 | Number of Liquids Loaded: 1 | Max number of trucks/rail cars loading at one (1) time: 1 |
| Are tanker trucks/rail cars pressure tested for leaks at this or any other location? ☐ Yes ☒ No ☐ Not Required<br>If Yes, Please describe: | | |
| Provide description of closed vent system and any bypasses. Vapors are collected and routed to a vapor combustor. | | |
| Are any of the following truck/rail car loadout systems utilized?<br>☐ Closed System to tanker truck/rail car passing a MACT level annual leak test?<br>☐ Closed System to tanker truck/rail car passing a NSPS level annual leak test?<br>☐ Closed System to tanker truck/rail car not passing an annual leak test and has vapor return? | | |

**Projected Maximum Operating Schedule (for rack or transfer point as a whole)**

| Time | Jan – Mar | Apr - Jun | Jul – Sept | Oct - Dec |
|---|---|---|---|---|
| Hours/day | 24 | 24 | 24 | 24 |
| Days/week | 5 | 5 | 5 | 5 |

**Bulk Liquid Data (use extra pages as necessary)**

| Liquid Name | | Produced Water | | |
|---|---|---|---|---|
| Max. Daily Throughput (1000 gal/day) | | 14.70 | | |
| Max. Annual Throughput (1000 gal/yr) | | 5,365.50 | | |
| Loading Method[1] | | SUB | | |
| Max. Fill Rate (gal/min) | | 125 | | |
| Average Fill Time (min/loading) | | Approx. 60 | | |
| Max. Bulk Liquid Temperature (°F) | | Refer to ProMax | | |
| True Vapor Pressure[2] | | Refer to ProMax | | |
| Cargo Vessel Condition[3] | | U | | |
| Control Equipment or Method[4] | | O = Vapor Return/ Combustion Controls | | |
| Max. Collection Efficiency (%) | | 70% | | |
| Max. Control Efficiency (%) | | 98% | | |
| Max.VOC Emission Rate | Loading (lb/hr) | 0.05 | | |
| | Annual (ton/yr) | 0.02 | | |
| Max.HAP Emission Rate | Loading (lb/hr) | <0.01 | | |
| | Annual (ton/yr) | <0.01 | | |
| Estimation Method[5] | | O = ProMax process simulation | | |

1 BF Bottom Fill SP Splash Fill SUB Submerged Fill
2 At maximum bulk liquid temperature
3 B Ballasted Vessel C Cleaned U Uncleaned (dedicated service)
O Other (describe)
4 List as many as apply (complete and submit appropriate Air Pollution Control Device Sheets)
CA Carbon Adsorption VB Dedicated Vapor Balance (closed system)
ECD Enclosed Combustion Device F Flare
TO Thermal Oxidization or Incineration
5 EPA EPA Emission Factor in AP-42 MB Material Balance
TM Test Measurement based upon test data submittal O Other (describe)

# ATTACHMENT P: GLYCOL DEHYDRATION UNIT DATA SHEET

GRI-GLYCALC REPORTS

EXTENDED ANALYSIS

# ATTACHMENT P – GLYCOL DEHYDRATION UNIT DATA SHEET

Complete this data sheet for each Glycol Dehydration Unit, Reboiler, Flash Tank and/or Regenerator at the facility. Include gas sample analysis and GRI- GLYCalc™ input and aggregate report. Use extra pages if necessary.

| | |
|---|---|
| Manufacturer: N/A | Model: N/A |
| Max. Dry Gas Flow Rate: 24.0 mmscf/day | Reboiler Design Heat Input: 0.75 MMBTU/hr |
| Design Type: ☒ TEG ☐ DEG ☐ EG | Source Status[1]: NS |
| Date Installed/Modified/Removed[2]: TBD | Regenerator Still Vent APCD/ERD[3]: CC |
| Control Device/ERD ID#[3]: APC-COND/EP-RB1 | Fuel HV (BTU/scf): 905 |
| $H_2S$ Content (gr/100 scf): Negligible | Operation (hours/year): 8,760 |
| Pump Rate (gpm): 7.50 | |
| Water Content (wt %) in: Wet Gas: Dry Gas: | |

Is the glycol dehydration unit exempt from 40CFR63 Section 764(d)? ☒ Yes ☐ No: If Yes, answer the following:

The actual annual average flowrate of natural gas to the glycol dehydration unit is less than 85 thousand standard cubic meters per day, as determined by the procedures specified in §63.772(b)(1) of this subpart. ☐ Yes ☒ No

The actual average emissions of benzene from the glycol dehydration unit process vent to the atmosphere are less than 0.90 megagram per year (1 ton per year), as determined by the procedures specified in §63.772(b)(2) of this subpart. ☒ Yes ☐ No

Is the glycol dehydration unit located within an Urbanized Area (UA) or Urban Cluster (UC)? ☐ Yes ☒ No

Is a lean glycol pump optimization plan being utilized? ☐ Yes ☒ No

Recycling the glycol dehydration unit back to the flame zone of the reboiler.
☐ Yes ☒ No

Recycling the glycol dehydration unit back to the flame zone of the reboiler and mixed with fuel.
☒ Yes ☐ No

What happens when temperature controller shuts off fuel to the reboiler?
☒ Still vent emissions to the atmosphere.
☐ Still vent emissions stopped with valve.
☐ Still vent emissions to glow plug.

Please indicate if the following equipment is present.
☒ Flash Tank
☐ Burner management system that continuously burns condenser or flash tank vapors

**Control Device Technical Data**

| Pollutants Controlled | Manufacturer's Guaranteed Control Efficiency (%) |
|---|---|
| See GlyCalc | |
| | |
| | |
| | |

Emissions Data

| Emission Unit ID / Emission Point ID[4] | Description | Calculation Methodology[5] | PTE[6] | Controlled Maximum Hourly Emissions (lb/hr) | Controlled Maximum Annual Emissions (tpy) |
|---|---|---|---|---|---|
| EU-RB1/EPRB1 | Reboiler Vent | AP | $NO_x$ | 0.08 | 0.36 |
| | | AP | CO | 0.07 | 0.30 |
| | | AP | VOC | <0.01 | 0.02 |
| | | AP | $SO_2$ | <0.01 | <0.01 |
| | | AP | $PM_{10}$ | <0.01 | 0.02 |
| | | AP | GHG ($CO_2e$) | 87.82 | 384.67 |

| | | | | | |
|---|---|---|---|---|---|
| EU-DEHY1/EP-RB1 | Glycol Regenerator Still Vent | GRI-GlyCalc™ | VOC | 2.99 | 13.09 |
| | | GRI-GlyCalc™ | Benzene | 0.11 | 0.49 |
| | | GRI-GlyCalc™ | Toluene | 0.18 | 0.77 |
| | | GRI-GlyCalc™ | Ethylbenzene | 0.00 | 0.00 |
| | | GRI-GlyCalc™ | Xylenes | 0.05 | 0.24 |
| | | GRI-GlyCalc™ | n-Hexane | 0.12 | 0.51 |
| EU-DEHY1/APC-COMB | Glycol Flash Tank | GRI-GlyCalc™ | VOC | 1.57 | 6.88 |
| | | GRI-GlyCalc™ | Benzene | <0.01 | 0.01 |
| | | GRI-GlyCalc™ | Toluene | <0.01 | 0.02 |
| | | GRI-GlyCalc™ | Ethylbenzene | 0.00 | 0.00 |
| | | GRI-GlyCalc™ | Xylenes | <0.01 | 0.01 |
| | | GRI-GlyCalc™ | n-Hexane | 0.04 | 0.16 |

*Note: Glycol Regenerator Still Vent and Flash Tank emissions include a 20% safety factor.*

1 Enter the Source Status using the following codes:
NS Construction of New Source ES Existing Source
MS Modification of Existing Source

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

3 Enter the Air Pollution Control Device (APCD)/Emission Reduction Device (ERD) type designation using the following codes and the device ID number:
NA None CD Condenser FL Flare
CC Condenser/Combustion Combination TO Thermal Oxidizer O Other (please list)

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

5 Enter the Potential Emissions Data Reference designation using the following codes:
MD Manufacturer's Data AP AP-42
GR GRI-GLYCalc™ OT Other (please list)

6 Enter the Reboiler Vent and Glycol Regenerator Still Vent Potential to Emit (PTE) for the listed regulated pollutants in lbs per hour and tons per year. The Glycol Regenerator Still Vent potential emissions may be determined using the most recent version of the thermodynamic software model GRI-GLYCalc™ (Radian International LLC & Gas Research Institute). **Attach all referenced Potential Emissions Data (or calculations) and the GRI-GLYCalc™ Aggregate Calculations Report (shall include emissions reports, equipment reports, and stream reports) to this Glycol Dehydration Emission Unit Data Sheet(s). Backup pumps do not have to be considered as operating for purposes of PTE.** This PTE data shall be incorporated in the Emissions Summary Sheet.

GRI-GLYCalc VERSION 4.0 - SUMMARY OF INPUT VALUES

Case Name: Ruth Keller 24 MMSCFD TEG Dehydration Unit
File Name: C:\Users\hmoseley\Dropbox\Flatrock OKC - Hillary\Southwestern\Ruth Keller\Ruth Keller GLYCalc.ddf
Date: April 06, 2017

DESCRIPTION:

Description: George Gantzer No. 8H PVT analysis temp = 70F, pressure = 900 psig. Kimray 45015 PV (7.5 gpm) glycol pump. Flash tank recylced to heater treater/reboiler fuel. Still vent emissions to BTEX Skid w/ overheads to reboiler (glow plug).

Annual Hours of Operation: 8760.0 hours/yr

WET GAS:

Temperature: 70.00 deg. F
Pressure: 900.00 psig
Wet Gas Water Content: Saturated

| Component | Conc. (vol %) |
|---|---|
| Carbon Dioxide | 0.1490 |
| Nitrogen | 0.5130 |
| Methane | 71.4270 |
| Ethane | 17.4910 |
| Propane | 6.8020 |
| Isobutane | 0.6680 |
| n-Butane | 1.8280 |
| Isopentane | 0.3270 |
| n-Pentane | 0.4400 |
| n-Hexane | 0.1070 |
| Cyclohexane | 0.0100 |
| Other Hexanes | 0.1250 |
| Heptanes | 0.0678 |
| Methylcyclohexane | 0.0110 |
| Benzene | 0.0010 |
| Toluene | 0.0020 |
| Xylenes | 0.0010 |
| C8+ Heavies | 0.0310 |

DRY GAS:

Flow Rate: 24.0 MMSCF/day
Water Content: 7.0 lbs. H2O/MMSCF

LEAN GLYCOL:

Glycol Type: TEG
Water Content: 1.5 wt% H2O
Flow Rate: 7.5 gpm

PUMP:

---

Glycol Pump Type: Gas Injection
Gas Injection Pump Volume Ratio: 0.080 acfm gas/gpm glycol

FLASH TANK:

---

Flash Control: Combustion device
Flash Control Efficiency: 98.00 %
Temperature: 150.0 deg. F
Pressure: 50.0 psig

REGENERATOR OVERHEADS CONTROL DEVICE:

---

Control Device: Condenser
Temperature: 100.0 deg. F
Pressure: 14.0 psia

Control Device: Combustion Device
Destruction Efficiency: 50.0 %
Excess Oxygen: 5.0 %
Ambient Air Temperature: 50.0 deg. F

GRI-GLYCalc VERSION 4.0 - AGGREGATE CALCULATIONS REPORT

Case Name: Ruth Keller 24 MMSCFD TEG Dehydration Unit
File Name: C:\Users\hmoseley\Dropbox\Flatrock OKC - Hillary\Southwestern\Ruth Keller\Ruth Keller GLYCalc.ddf
Date: April 06, 2017

DESCRIPTION:

Description: George Gantzer No. 8H PVT analysis temp = 70F, pressure = 900 psig. Kimray 45015 PV (7.5 gpm) glycol pump. Flash tank recylced to heater treater/reboiler fuel. Still vent emissions to BTEX Skid w/ overheads to reboiler (glow plug).

Annual Hours of Operation: 8760.0 hours/yr

EMISSIONS REPORTS:

CONTROLLED REGENERATOR EMISSIONS

| Component | lbs/hr | lbs/day | tons/yr |
|---|---|---|---|
| Methane | 0.3393 | 8.143 | 1.4861 |
| Ethane | 0.6193 | 14.862 | 2.7124 |
| Propane | 0.7419 | 17.806 | 3.2495 |
| Isobutane | 0.1477 | 3.545 | 0.6469 |
| n-Butane | 0.5625 | 13.499 | 2.4637 |
| Isopentane | 0.1187 | 2.849 | 0.5200 |
| n-Pentane | 0.2124 | 5.097 | 0.9303 |
| n-Hexane | 0.0966 | 2.319 | 0.4231 |
| Cyclohexane | 0.0690 | 1.656 | 0.3022 |
| Other Hexanes | 0.0859 | 2.061 | 0.3762 |
| Heptanes | 0.1015 | 2.437 | 0.4447 |
| Methylcyclohexane | 0.0669 | 1.605 | 0.2929 |
| Benzene | 0.0940 | 2.256 | 0.4117 |
| Toluene | 0.1475 | 3.539 | 0.6458 |
| Xylenes | 0.0454 | 1.089 | 0.1987 |
| C8+ Heavies | 0.0010 | 0.024 | 0.0043 |
| Total Emissions | 3.4494 | 82.786 | 15.1085 |
| Total Hydrocarbon Emissions | 3.4494 | 82.786 | 15.1085 |
| Total VOC Emissions | 2.4909 | 59.781 | 10.9100 |
| Total HAP Emissions | 0.3834 | 9.202 | 1.6793 |
| Total BTEX Emissions | 0.2868 | 6.883 | 1.2562 |

UNCONTROLLED REGENERATOR EMISSIONS

| Component | lbs/hr | lbs/day | tons/yr |
|---|---|---|---|
| Methane | 0.6792 | 16.301 | 2.9750 |
| Ethane | 1.2443 | 29.864 | 5.4502 |
| Propane | 1.5191 | 36.457 | 6.6535 |
| Isobutane | 0.3101 | 7.442 | 1.3582 |
| n-Butane | 1.2045 | 28.908 | 5.2757 |
| Isopentane | 0.2833 | 6.798 | 1.2407 |
| n-Pentane | 0.5223 | 12.535 | 2.2876 |

| Component | lbs/hr | lbs/day | tons/yr |
|---|---|---|---|
| n-Hexane | 0.3096 | 7.432 | 1.3563 |
| Cyclohexane | 0.2547 | 6.112 | 1.1155 |
| Other Hexanes | 0.2458 | 5.899 | 1.0767 |
| Heptanes | 0.5663 | 13.590 | 2.4802 |
| Methylcyclohexane | 0.3714 | 8.913 | 1.6267 |
| Benzene | 0.3718 | 8.923 | 1.6284 |
| Toluene | 1.1826 | 28.382 | 5.1796 |
| Xylenes | 1.0998 | 26.396 | 4.8173 |
| C8+ Heavies | 1.1223 | 26.936 | 4.9158 |
| Total Emissions | 11.2871 | 270.890 | 49.4374 |
| Total Hydrocarbon Emissions | 11.2871 | 270.890 | 49.4374 |
| Total VOC Emissions | 9.3635 | 224.724 | 41.0122 |
| Total HAP Emissions | 2.9638 | 71.132 | 12.9816 |
| Total BTEX Emissions | 2.6542 | 63.700 | 11.6253 |

FLASH GAS EMISSIONS

| Component | lbs/hr | lbs/day | tons/yr |
|---|---|---|---|
| Methane | 1.9727 | 47.346 | 8.6406 |
| Ethane | 1.0676 | 25.622 | 4.6761 |
| Propane | 0.6639 | 15.934 | 2.9079 |
| Isobutane | 0.0931 | 2.234 | 0.4078 |
| n-Butane | 0.2826 | 6.782 | 1.2378 |
| Isopentane | 0.0605 | 1.453 | 0.2652 |
| n-Pentane | 0.0907 | 2.177 | 0.3973 |
| n-Hexane | 0.0308 | 0.740 | 0.1350 |
| Cyclohexane | 0.0063 | 0.150 | 0.0274 |
| Other Hexanes | 0.0321 | 0.771 | 0.1408 |
| Heptanes | 0.0284 | 0.681 | 0.1242 |
| Methylcyclohexane | 0.0074 | 0.177 | 0.0322 |
| Benzene | 0.0015 | 0.035 | 0.0065 |
| Toluene | 0.0031 | 0.075 | 0.0137 |
| Xylenes | 0.0012 | 0.030 | 0.0054 |
| C8+ Heavies | 0.0080 | 0.191 | 0.0348 |
| Total Emissions | 4.3499 | 104.399 | 19.0528 |
| Total Hydrocarbon Emissions | 4.3499 | 104.399 | 19.0528 |
| Total VOC Emissions | 1.3096 | 31.431 | 5.7361 |
| Total HAP Emissions | 0.0367 | 0.880 | 0.1606 |
| Total BTEX Emissions | 0.0058 | 0.140 | 0.0256 |

FLASH TANK OFF GAS

| Component | lbs/hr | lbs/day | tons/yr |
|---|---|---|---|
| Methane | 98.6369 | 2367.286 | 432.0296 |
| Ethane | 53.3801 | 1281.121 | 233.8046 |
| Propane | 33.1949 | 796.677 | 145.3935 |
| Isobutane | 4.6551 | 111.724 | 20.3895 |
| n-Butane | 14.1299 | 339.118 | 61.8890 |
| Isopentane | 3.0274 | 72.657 | 13.2599 |
| n-Pentane | 4.5358 | 108.860 | 19.8669 |
| n-Hexane | 1.5416 | 36.999 | 6.7524 |
| Cyclohexane | 0.3132 | 7.516 | 1.3718 |
| Other Hexanes | 1.6070 | 38.568 | 7.0387 |

| | | | |
|---|---|---|---|
| Heptanes | 1.4178 | 34.027 | 6.2100 |
| Methylcyclohexane | 0.3678 | 8.826 | 1.6108 |
| Benzene | 0.0737 | 1.768 | 0.3226 |
| Toluene | 0.1564 | 3.754 | 0.6851 |
| Xylenes | 0.0622 | 1.492 | 0.2723 |
| C8+ Heavies | 0.3977 | 9.545 | 1.7420 |
| Total Emissions | 217.4974 | 5219.939 | 952.6388 |
| Total Hydrocarbon Emissions | 217.4974 | 5219.939 | 952.6388 |
| Total VOC Emissions | 65.4805 | 1571.532 | 286.8045 |
| Total HAP Emissions | 1.8339 | 44.013 | 8.0324 |
| Total BTEX Emissions | 0.2923 | 7.014 | 1.2801 |

COMBINED REGENERATOR VENT/FLASH GAS EMISSIONS

| Component | lbs/hr | lbs/day | tons/yr |
|---|---|---|---|
| Methane | 2.3120 | 55.489 | 10.1267 |
| Ethane | 1.6869 | 40.485 | 7.3885 |
| Propane | 1.4058 | 33.739 | 6.1574 |
| Isobutane | 0.2408 | 5.779 | 1.0547 |
| n-Butane | 0.8451 | 20.282 | 3.7014 |
| Isopentane | 0.1793 | 4.303 | 0.7852 |
| n-Pentane | 0.3031 | 7.275 | 1.3276 |
| n-Hexane | 0.1274 | 3.059 | 0.5582 |
| Cyclohexane | 0.0753 | 1.806 | 0.3296 |
| Other Hexanes | 0.1180 | 2.833 | 0.5169 |
| Heptanes | 0.1299 | 3.117 | 0.5689 |
| Methylcyclohexane | 0.0742 | 1.781 | 0.3251 |
| Benzene | 0.0955 | 2.291 | 0.4181 |
| Toluene | 0.1506 | 3.614 | 0.6595 |
| Xylenes | 0.0466 | 1.118 | 0.2041 |
| C8+ Heavies | 0.0089 | 0.215 | 0.0392 |
| Total Emissions | 7.7994 | 187.185 | 34.1613 |
| Total Hydrocarbon Emissions | 7.7994 | 187.185 | 34.1613 |
| Total VOC Emissions | 3.8005 | 91.212 | 16.6461 |
| Total HAP Emissions | 0.4201 | 10.082 | 1.8400 |
| Total BTEX Emissions | 0.2926 | 7.023 | 1.2818 |

COMBINED REGENERATOR VENT/FLASH GAS EMISSION CONTROL REPORT:

| Component | Uncontrolled tons/yr | Controlled tons/yr | % Reduction |
|---|---|---|---|
| Methane | 435.0046 | 10.1267 | 97.67 |
| Ethane | 239.2549 | 7.3885 | 96.91 |
| Propane | 152.0470 | 6.1574 | 95.95 |
| Isobutane | 21.7477 | 1.0547 | 95.15 |
| n-Butane | 67.1647 | 3.7014 | 94.49 |
| Isopentane | 14.5005 | 0.7852 | 94.58 |
| n-Pentane | 22.1545 | 1.3276 | 94.01 |
| n-Hexane | 8.1086 | 0.5582 | 93.12 |
| Cyclohexane | 2.4873 | 0.3296 | 86.75 |
| Other Hexanes | 8.1154 | 0.5169 | 93.63 |
| Heptanes | 8.6902 | 0.5689 | 93.45 |

| | | | |
|---|---|---|---|
| Methylcyclohexane | 3.2375 | 0.3251 | 89.96 |
| Benzene | 1.9511 | 0.4181 | 78.57 |
| Toluene | 5.8647 | 0.6595 | 88.75 |
| Xylenes | 5.0896 | 0.2041 | 95.99 |
| C8+ Heavies | 6.6579 | 0.0392 | 99.41 |
| Total Emissions | 1002.0762 | 34.1613 | 96.59 |
| Total Hydrocarbon Emissions | 1002.0762 | 34.1613 | 96.59 |
| Total VOC Emissions | 327.8167 | 16.6461 | 94.92 |
| Total HAP Emissions | 21.0140 | 1.8400 | 91.24 |
| Total BTEX Emissions | 12.9054 | 1.2818 | 90.07 |

EQUIPMENT REPORTS:

CONDENSER AND COMBUSTION DEVICE

| | |
|---|---|
| Condenser Outlet Temperature: | 100.00 deg. F |
| Condenser Pressure: | 14.00 psia |
| Condenser Duty: | 1.75e-002 MM BTU/hr |
| Hydrocarbon Recovery: | 0.35 bbls/day |
| Produced Water: | 1.63 bbls/day |
| Ambient Temperature: | 50.00 deg. F |
| Excess Oxygen: | 5.00 % |
| Combustion Efficiency: | 50.00 % |
| Supplemental Fuel Requirement: | 1.75e-002 MM BTU/hr |

| Component | Emitted | Destroyed |
|---|---|---|
| Methane | 49.95% | 50.05% |
| Ethane | 49.77% | 50.23% |
| Propane | 48.84% | 51.16% |
| Isobutane | 47.63% | 52.37% |
| n-Butane | 46.70% | 53.30% |
| Isopentane | 41.91% | 58.09% |
| n-Pentane | 40.67% | 59.33% |
| n-Hexane | 31.20% | 68.80% |
| Cyclohexane | 27.09% | 72.91% |
| Other Hexanes | 34.94% | 65.06% |
| Heptanes | 17.93% | 82.07% |
| Methylcyclohexane | 18.01% | 81.99% |
| Benzene | 25.28% | 74.72% |
| Toluene | 12.47% | 87.53% |
| Xylenes | 4.12% | 95.88% |
| C8+ Heavies | 0.09% | 99.91% |

ABSORBER

NOTE: Because the Calculated Absorber Stages was below the minimum allowed, GRI-GLYCalc has set the number of Absorber Stages to 1.25 and has calculated a revised Dry Gas Dew Point.

| | |
|---|---|
| Calculated Absorber Stages: | 1.25 |
| Calculated Dry Gas Dew Point: | 0.87 lbs. H2O/MMSCF |

| | |
|---|---|
| Temperature: | 70.0 deg. F |
| Pressure: | 900.0 psig |
| Dry Gas Flow Rate: | 24.0000 MMSCF/day |
| Glycol Losses with Dry Gas: | 0.2073 lb/hr |
| Wet Gas Water Content: | Saturated |
| Calculated Wet Gas Water Content: | 25.30 lbs. H2O/MMSCF |
| Calculated Lean Glycol Recirc. Ratio: | 18.42 gal/lb H2O |

| Component | Remaining in Dry Gas | Absorbed in Glycol |
|---|---|---|
| Water | 3.43% | 96.57% |
| Carbon Dioxide | 99.49% | 0.51% |
| Nitrogen | 99.96% | 0.04% |
| Methane | 99.97% | 0.03% |
| Ethane | 99.90% | 0.10% |
| Propane | 99.86% | 0.14% |
| Isobutane | 99.81% | 0.19% |
| n-Butane | 99.75% | 0.25% |
| Isopentane | 99.76% | 0.24% |
| n-Pentane | 99.69% | 0.31% |
| n-Hexane | 99.53% | 0.47% |
| Cyclohexane | 97.74% | 2.26% |
| Other Hexanes | 99.64% | 0.36% |
| Heptanes | 99.19% | 0.81% |
| Methylcyclohexane | 97.70% | 2.30% |
| Benzene | 78.67% | 21.33% |
| Toluene | 72.74% | 27.26% |
| Xylenes | 58.79% | 41.21% |
| C8+ Heavies | 99.20% | 0.80% |

FLASH TANK

| | |
|---|---|
| Flash Control: | Combustion device |
| Flash Control Efficiency: | 98.00 % |
| Flash Temperature: | 150.0 deg. F |
| Flash Pressure: | 50.0 psig |

| Component | Left in Glycol | Removed in Flash Gas |
|---|---|---|
| Water | 99.45% | 0.55% |
| Carbon Dioxide | 6.45% | 93.55% |
| Nitrogen | 0.67% | 99.33% |
| Methane | 0.68% | 99.32% |
| Ethane | 2.28% | 97.72% |
| Propane | 4.38% | 95.62% |
| Isobutane | 6.25% | 93.75% |
| n-Butane | 7.85% | 92.15% |
| Isopentane | 8.76% | 91.24% |
| n-Pentane | 10.56% | 89.44% |
| n-Hexane | 16.98% | 83.02% |
| Cyclohexane | 46.42% | 53.58% |
| Other Hexanes | 13.74% | 86.26% |
| Heptanes | 28.80% | 71.20% |
| Methylcyclohexane | 52.02% | 47.98% |
| Benzene | 84.28% | 15.72% |
| Toluene | 89.23% | 10.77% |
| Xylenes | 95.34% | 4.66% |
| C8+ Heavies | 76.20% | 23.80% |

REGENERATOR

No Stripping Gas used in regenerator.

| Component | Remaining in Glycol | Distilled Overhead |
|---|---|---|
| Water | 72.48% | 27.52% |
| Carbon Dioxide | 0.00% | 100.00% |
| Nitrogen | 0.00% | 100.00% |
| Methane | 0.00% | 100.00% |
| Ethane | 0.00% | 100.00% |
| Propane | 0.00% | 100.00% |
| Isobutane | 0.00% | 100.00% |
| n-Butane | 0.00% | 100.00% |
| Isopentane | 2.55% | 97.45% |
| n-Pentane | 2.43% | 97.57% |
| n-Hexane | 1.81% | 98.19% |
| Cyclohexane | 6.12% | 93.88% |
| Other Hexanes | 4.00% | 96.00% |
| Heptanes | 1.27% | 98.73% |
| Methylcyclohexane | 6.84% | 93.16% |
| Benzene | 5.86% | 94.14% |
| Toluene | 8.77% | 91.23% |
| Xylenes | 13.46% | 86.54% |
| C8+ Heavies | 11.88% | 88.12% |

STREAM REPORTS:

WET GAS STREAM

Temperature: 70.00 deg. F
Pressure: 914.70 psia
Flow Rate: 1.00e+006 scfh

| Component | Conc. (vol%) | Loading (lb/hr) |
|---|---|---|
| Water | 5.33e-002 | 2.53e+001 |
| Carbon Dioxide | 1.49e-001 | 1.73e+002 |
| Nitrogen | 5.13e-001 | 3.79e+002 |
| Methane | 7.14e+001 | 3.02e+004 |
| Ethane | 1.75e+001 | 1.39e+004 |
| Propane | 6.80e+000 | 7.91e+003 |
| Isobutane | 6.68e-001 | 1.02e+003 |
| n-Butane | 1.83e+000 | 2.80e+003 |
| Isopentane | 3.27e-001 | 6.22e+002 |
| n-Pentane | 4.40e-001 | 8.37e+002 |
| n-Hexane | 1.07e-001 | 2.43e+002 |
| Cyclohexane | 9.99e-003 | 2.22e+001 |
| Other Hexanes | 1.25e-001 | 2.84e+002 |
| Heptanes | 6.78e-002 | 1.79e+002 |
| Methylcyclohexane | 1.10e-002 | 2.85e+001 |
| Benzene | 9.99e-004 | 2.06e+000 |
| Toluene | 2.00e-003 | 4.86e+000 |

| | | |
|---|---|---|
| Xylenes | 9.99e-004 | 2.80e+000 |
| C8+ Heavies | 3.10e-002 | 1.39e+002 |
| Total Components | 100.00 | 5.88e+004 |

DRY GAS STREAM

Temperature: 70.00 deg. F
Pressure: 914.70 psia
Flow Rate: 1.00e+006 scfh

| Component | Conc. (vol%) | Loading (lb/hr) |
|---|---|---|
| Water | 1.83e-003 | 8.70e-001 |
| Carbon Dioxide | 1.48e-001 | 1.72e+002 |
| Nitrogen | 5.13e-001 | 3.79e+002 |
| Methane | 7.14e+001 | 3.02e+004 |
| Ethane | 1.75e+001 | 1.39e+004 |
| Propane | 6.80e+000 | 7.90e+003 |
| Isobutane | 6.67e-001 | 1.02e+003 |
| n-Butane | 1.82e+000 | 2.79e+003 |
| Isopentane | 3.26e-001 | 6.21e+002 |
| n-Pentane | 4.39e-001 | 8.35e+002 |
| n-Hexane | 1.07e-001 | 2.42e+002 |
| Cyclohexane | 9.78e-003 | 2.17e+001 |
| Other Hexanes | 1.25e-001 | 2.83e+002 |
| Heptanes | 6.73e-002 | 1.78e+002 |
| Methylcyclohexane | 1.08e-002 | 2.78e+001 |
| Benzene | 7.87e-004 | 1.62e+000 |
| Toluene | 1.46e-003 | 3.54e+000 |
| Xylenes | 5.88e-004 | 1.65e+000 |
| C8+ Heavies | 3.08e-002 | 1.38e+002 |
| Total Components | 100.00 | 5.87e+004 |

LEAN GLYCOL STREAM

Temperature: 70.00 deg. F
Flow Rate: 7.50e+000 gpm

| Component | Conc. (wt%) | Loading (lb/hr) |
|---|---|---|
| TEG | 9.85e+001 | 4.16e+003 |
| Water | 1.50e+000 | 6.33e+001 |
| Carbon Dioxide | 2.10e-012 | 8.86e-011 |
| Nitrogen | 3.67e-013 | 1.55e-011 |
| Methane | 8.08e-018 | 3.41e-016 |
| Ethane | 1.53e-007 | 6.46e-006 |
| Propane | 1.10e-008 | 4.63e-007 |
| Isobutane | 1.38e-009 | 5.83e-008 |
| n-Butane | 4.15e-009 | 1.75e-007 |
| Isopentane | 1.75e-004 | 7.41e-003 |
| n-Pentane | 3.08e-004 | 1.30e-002 |
| n-Hexane | 1.35e-004 | 5.69e-003 |
| Cyclohexane | 3.93e-004 | 1.66e-002 |
| Other Hexanes | 2.43e-004 | 1.02e-002 |
| Heptanes | 1.73e-004 | 7.31e-003 |
| Methylcyclohexane | 6.46e-004 | 2.73e-002 |

| | | |
|---|---|---|
| Benzene | 5.48e-004 | 2.31e-002 |
| Toluene | 2.69e-003 | 1.14e-001 |
| Xylenes | 4.05e-003 | 1.71e-001 |
| C8+ Heavies | 3.58e-003 | 1.51e-001 |
| Total Components | 100.00 | 4.22e+003 |

RICH GLYCOL AND PUMP GAS STREAM

Temperature: 70.00 deg. F
Pressure: 914.70 psia
Flow Rate: 8.06e+000 gpm
NOTE: Stream has more than one phase.

| Component | Conc. (wt%) | Loading (lb/hr) |
|---|---|---|
| TEG | 9.29e+001 | 4.16e+003 |
| Water | 1.96e+000 | 8.79e+001 |
| Carbon Dioxide | 3.12e-002 | 1.40e+000 |
| Nitrogen | 2.85e-002 | 1.27e+000 |
| Methane | 2.22e+000 | 9.93e+001 |
| Ethane | 1.22e+000 | 5.46e+001 |
| Propane | 7.75e-001 | 3.47e+001 |
| Isobutane | 1.11e-001 | 4.97e+000 |
| n-Butane | 3.42e-001 | 1.53e+001 |
| Isopentane | 7.41e-002 | 3.32e+000 |
| n-Pentane | 1.13e-001 | 5.07e+000 |
| n-Hexane | 4.15e-002 | 1.86e+000 |
| Cyclohexane | 1.31e-002 | 5.84e-001 |
| Other Hexanes | 4.16e-002 | 1.86e+000 |
| Heptanes | 4.45e-002 | 1.99e+000 |
| Methylcyclohexane | 1.71e-002 | 7.66e-001 |
| Benzene | 1.05e-002 | 4.69e-001 |
| Toluene | 3.24e-002 | 1.45e+000 |
| Xylenes | 2.98e-002 | 1.33e+000 |
| C8+ Heavies | 3.73e-002 | 1.67e+000 |
| Total Components | 100.00 | 4.48e+003 |

FLASH TANK OFF GAS STREAM

Temperature: 150.00 deg. F
Pressure: 64.70 psia
Flow Rate: 3.52e+003 scfh

| Component | Conc. (vol%) | Loading (lb/hr) |
|---|---|---|
| Water | 2.89e-001 | 4.82e-001 |
| Carbon Dioxide | 3.20e-001 | 1.31e+000 |
| Nitrogen | 4.87e-001 | 1.27e+000 |
| Methane | 6.63e+001 | 9.86e+001 |
| Ethane | 1.91e+001 | 5.34e+001 |
| Propane | 8.12e+000 | 3.32e+001 |
| Isobutane | 8.64e-001 | 4.66e+000 |
| n-Butane | 2.62e+000 | 1.41e+001 |
| Isopentane | 4.53e-001 | 3.03e+000 |
| n-Pentane | 6.78e-001 | 4.54e+000 |
| n-Hexane | 1.93e-001 | 1.54e+000 |
| Cyclohexane | 4.01e-002 | 3.13e-001 |

| | | |
|---|---|---|
| Other Hexanes | 2.01e-001 | 1.61e+000 |
| Heptanes | 1.53e-001 | 1.42e+000 |
| Methylcyclohexane | 4.04e-002 | 3.68e-001 |
| Benzene | 1.02e-002 | 7.37e-002 |
| Toluene | 1.83e-002 | 1.56e-001 |
| Xylenes | 6.32e-003 | 6.22e-002 |
| C8+ Heavies | 2.52e-002 | 3.98e-001 |
| Total Components | 100.00 | 2.21e+002 |

FLASH TANK GLYCOL STREAM

Temperature: 150.00 deg. F
Flow Rate: 7.57e+000 gpm

| Component | Conc. (wt%) | Loading (lb/hr) |
|---|---|---|
| TEG | 9.77e+001 | 4.16e+003 |
| Water | 2.05e+000 | 8.74e+001 |
| Carbon Dioxide | 2.12e-003 | 9.01e-002 |
| Nitrogen | 2.01e-004 | 8.57e-003 |
| Methane | 1.60e-002 | 6.79e-001 |
| Ethane | 2.92e-002 | 1.24e+000 |
| Propane | 3.57e-002 | 1.52e+000 |
| Isobutane | 7.28e-003 | 3.10e-001 |
| n-Butane | 2.83e-002 | 1.20e+000 |
| Isopentane | 6.83e-003 | 2.91e-001 |
| n-Pentane | 1.26e-002 | 5.35e-001 |
| n-Hexane | 7.41e-003 | 3.15e-001 |
| Cyclohexane | 6.37e-003 | 2.71e-001 |
| Other Hexanes | 6.01e-003 | 2.56e-001 |
| Heptanes | 1.35e-002 | 5.74e-001 |
| Methylcyclohexane | 9.36e-003 | 3.99e-001 |
| Benzene | 9.28e-003 | 3.95e-001 |
| Toluene | 3.04e-002 | 1.30e+000 |
| Xylenes | 2.99e-002 | 1.27e+000 |
| C8+ Heavies | 2.99e-002 | 1.27e+000 |
| Total Components | 100.00 | 4.26e+003 |

FLASH GAS EMISSIONS

Flow Rate: 1.41e+004 scfh
Control Method: Combustion Device
Control Efficiency: 98.00

| Component | Conc. (vol%) | Loading (lb/hr) |
|---|---|---|
| Water | 6.18e+001 | 4.12e+002 |
| Carbon Dioxide | 3.76e+001 | 6.13e+002 |
| Nitrogen | 1.22e-001 | 1.27e+000 |
| Methane | 3.32e-001 | 1.97e+000 |
| Ethane | 9.58e-002 | 1.07e+000 |
| Propane | 4.06e-002 | 6.64e-001 |
| Isobutane | 4.32e-003 | 9.31e-002 |
| n-Butane | 1.31e-002 | 2.83e-001 |
| Isopentane | 2.26e-003 | 6.05e-002 |
| n-Pentane | 3.39e-003 | 9.07e-002 |

| | | |
|---|---|---|
| n-Hexane | 9.65e-004 | 3.08e-002 |
| Cyclohexane | 2.01e-004 | 6.26e-003 |
| Other Hexanes | 1.01e-003 | 3.21e-002 |
| Heptanes | 7.63e-004 | 2.84e-002 |
| Methylcyclohexane | 2.02e-004 | 7.36e-003 |
| Benzene | 5.09e-005 | 1.47e-003 |
| Toluene | 9.16e-005 | 3.13e-003 |
| Xylenes | 3.16e-005 | 1.24e-003 |
| C8+ Heavies | 1.26e-004 | 7.95e-003 |
| Total Components | 100.00 | 1.03e+003 |

REGENERATOR OVERHEADS STREAM

Temperature: 212.00 deg. F
Pressure: 14.70 psia
Flow Rate: 5.87e+002 scfh

| Component | Conc. (vol%) | Loading (lb/hr) |
|---|---|---|
| Water | 8.63e+001 | 2.41e+001 |
| Carbon Dioxide | 1.32e-001 | 9.01e-002 |
| Nitrogen | 1.98e-002 | 8.57e-003 |
| Methane | 2.74e+000 | 6.79e-001 |
| Ethane | 2.68e+000 | 1.24e+000 |
| Propane | 2.23e+000 | 1.52e+000 |
| Isobutane | 3.45e-001 | 3.10e-001 |
| n-Butane | 1.34e+000 | 1.20e+000 |
| Isopentane | 2.54e-001 | 2.83e-001 |
| n-Pentane | 4.68e-001 | 5.22e-001 |
| n-Hexane | 2.32e-001 | 3.10e-001 |
| Cyclohexane | 1.96e-001 | 2.55e-001 |
| Other Hexanes | 1.84e-001 | 2.46e-001 |
| Heptanes | 3.65e-001 | 5.66e-001 |
| Methylcyclohexane | 2.45e-001 | 3.71e-001 |
| Benzene | 3.08e-001 | 3.72e-001 |
| Toluene | 8.30e-001 | 1.18e+000 |
| Xylenes | 6.70e-001 | 1.10e+000 |
| C8+ Heavies | 4.26e-001 | 1.12e+000 |
| Total Components | 100.00 | 3.54e+001 |

CONDENSER PRODUCED WATER STREAM

Temperature: 100.00 deg. F
Flow Rate: 4.76e-002 gpm

| Component | Conc. (wt%) | Loading (lb/hr) | (ppm) |
|---|---|---|---|
| Water | 1.00e+002 | 2.38e+001 | 999628. |
| Carbon Dioxide | 1.17e-003 | 2.79e-004 | 12. |
| Nitrogen | 2.54e-006 | 6.07e-007 | 0. |
| Methane | 4.08e-004 | 9.72e-005 | 4. |
| Ethane | 8.95e-004 | 2.13e-004 | 9. |
| Propane | 9.32e-004 | 2.22e-004 | 9. |
| Isobutane | 1.03e-004 | 2.47e-005 | 1. |
| n-Butane | 5.35e-004 | 1.28e-004 | 5. |
| Isopentane | 8.20e-005 | 1.95e-005 | 1. |
| n-Pentane | 1.60e-004 | 3.81e-005 | 2. |

| | | | |
|---|---|---|---|
| n-Hexane | 6.27e-005 | 1.49e-005 | 1. |
| Cyclohexane | 2.71e-004 | 6.46e-005 | 3. |
| Other Hexanes | 4.42e-005 | 1.05e-005 | 0. |
| Heptanes | 3.75e-005 | 8.94e-006 | 0. |
| Methylcyclohexane | 1.27e-004 | 3.04e-005 | 1. |
| Benzene | 1.16e-002 | 2.76e-003 | 116. |
| Toluene | 1.55e-002 | 3.69e-003 | 155. |
| Xylenes | 5.27e-003 | 1.26e-003 | 53. |
| C8+ Heavies | 2.03e-007 | 4.84e-008 | 0. |
| Total Components | 100.00 | 2.38e+001 | 1000000. |

CONDENSER RECOVERED OIL STREAM

Temperature: 100.00 deg. F
Flow Rate: 1.03e-002 gpm

| Component | Conc. (wt%) | Loading (lb/hr) |
|---|---|---|
| Water | 3.24e-002 | 1.42e-003 |
| Carbon Dioxide | 4.44e-003 | 1.94e-004 |
| Nitrogen | 1.33e-004 | 5.83e-006 |
| Methane | 1.22e-002 | 5.34e-004 |
| Ethane | 1.28e-001 | 5.61e-003 |
| Propane | 8.00e-001 | 3.50e-002 |
| Isobutane | 3.35e-001 | 1.47e-002 |
| n-Butane | 1.81e+000 | 7.94e-002 |
| Isopentane | 1.05e+000 | 4.58e-002 |
| n-Pentane | 2.22e+000 | 9.75e-002 |
| n-Hexane | 2.66e+000 | 1.16e-001 |
| Cyclohexane | 2.66e+000 | 1.17e-001 |
| Other Hexanes | 1.69e+000 | 7.40e-002 |
| Heptanes | 8.29e+000 | 3.63e-001 |
| Methylcyclohexane | 5.42e+000 | 2.38e-001 |
| Benzene | 4.13e+000 | 1.81e-001 |
| Toluene | 2.02e+001 | 8.84e-001 |
| Xylenes | 2.30e+001 | 1.01e+000 |
| C8+ Heavies | 2.56e+001 | 1.12e+000 |
| Total Components | 100.00 | 4.38e+000 |

CONDENSER VENT STREAM

Temperature: 100.00 deg. F
Pressure: 14.00 psia
Flow Rate: 6.88e+001 scfh

| Component | Conc. (vol%) | Loading (lb/hr) |
|---|---|---|
| Water | 6.85e+000 | 2.24e-001 |
| Carbon Dioxide | 1.12e+000 | 8.96e-002 |
| Nitrogen | 1.69e-001 | 8.56e-003 |
| Methane | 2.33e+001 | 6.79e-001 |
| Ethane | 2.27e+001 | 1.24e+000 |
| Propane | 1.86e+001 | 1.48e+000 |
| Isobutane | 2.80e+000 | 2.95e-001 |
| n-Butane | 1.07e+001 | 1.12e+000 |
| Isopentane | 1.82e+000 | 2.37e-001 |

| | | |
|---|---|---|
| n-Pentane | 3.25e+000 | 4.25e-001 |
| n-Hexane | 1.24e+000 | 1.93e-001 |
| Cyclohexane | 9.05e-001 | 1.38e-001 |
| Other Hexanes | 1.10e+000 | 1.72e-001 |
| Heptanes | 1.12e+000 | 2.03e-001 |
| Methylcyclohexane | 7.52e-001 | 1.34e-001 |
| Benzene | 1.33e+000 | 1.88e-001 |
| Toluene | 1.77e+000 | 2.95e-001 |
| Xylenes | 4.71e-001 | 9.07e-002 |
| C8+ Heavies | 6.39e-003 | 1.97e-003 |
| Total Components | 100.00 | 7.22e+000 |

COMBUSTION DEVICE OFF GAS STREAM

Temperature: 1000.00 deg. F
Pressure: 14.70 psia
Flow Rate: 3.16e+001 scfh

| Component | Conc. (vol%) | Loading (lb/hr) |
|---|---|---|
| Methane | 2.54e+001 | 3.39e-001 |
| Ethane | 2.47e+001 | 6.19e-001 |
| Propane | 2.02e+001 | 7.42e-001 |
| Isobutane | 3.05e+000 | 1.48e-001 |
| n-Butane | 1.16e+001 | 5.62e-001 |
| Isopentane | 1.98e+000 | 1.19e-001 |
| n-Pentane | 3.54e+000 | 2.12e-001 |
| n-Hexane | 1.35e+000 | 9.66e-002 |
| Cyclohexane | 9.85e-001 | 6.90e-002 |
| Other Hexanes | 1.20e+000 | 8.59e-002 |
| Heptanes | 1.22e+000 | 1.02e-001 |
| Methylcyclohexane | 8.18e-001 | 6.69e-002 |
| Benzene | 1.45e+000 | 9.40e-002 |
| Toluene | 1.92e+000 | 1.47e-001 |
| Xylenes | 5.13e-001 | 4.54e-002 |
| C8+ Heavies | 6.96e-003 | 9.87e-004 |
| Total Components | 100.00 | 3.45e+000 |

CONDENSER CONTROL CURVE DATA REPORT:

CONDENSER CONTROL EFFICIENCY CURVES

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

| Temp(F) | BTEX | Total HAP | VOC |
|---|---|---|---|
| 40.0 | 97.06 | 95.85 | 67.53 |
| 45.0 | 96.44 | 95.02 | 66.07 |
| 50.0 | 95.71 | 94.06 | 64.58 |
| 55.0 | 94.85 | 92.96 | 63.06 |
| 60.0 | 93.86 | 91.70 | 61.51 |
| 65.0 | 92.72 | 90.28 | 59.91 |
| 70.0 | 91.40 | 88.67 | 58.26 |
| 75.0 | 89.90 | 86.88 | 56.57 |
| 80.0 | 88.04 | 84.70 | 54.65 |

| | | | |
|---|---|---|---|
| 85.0 | 86.04 | 82.43 | 52.80 |
| 90.0 | 83.78 | 79.91 | 50.86 |
| 95.0 | 81.21 | 77.12 | 48.85 |
| 100.0 | 78.31 | 74.05 | 46.74 |
| 105.0 | 75.06 | 70.66 | 44.54 |
| 110.0 | 71.42 | 66.96 | 42.26 |
| 115.0 | 67.37 | 62.91 | 39.90 |
| 120.0 | 62.90 | 58.52 | 37.45 |
| 125.0 | 58.02 | 53.79 | 34.95 |
| 130.0 | 52.73 | 48.74 | 32.40 |
| 135.0 | 47.09 | 43.41 | 29.83 |
| 140.0 | 41.19 | 37.89 | 27.25 |
| 145.0 | 35.17 | 32.29 | 24.70 |
| 150.0 | 29.19 | 26.76 | 22.20 |
| 155.0 | 23.45 | 21.47 | 19.75 |
| 160.0 | 18.10 | 16.56 | 17.29 |
| 165.0 | 13.19 | 12.07 | 14.63 |
| 170.0 | 8.98 | 8.22 | 11.61 |

---

ANNUAL AIR-COOLED CONDENSER PERFORMANCE:

---

ANNUAL AIR-COOLED CONDENSER PERFORMANCE

Nearest Site for Air Temperature Data: Pittsburgh, PA

| Ambient Air Dry Bulb Temperature (deg. F) | Frequency (%) | Condenser Outlet Temperature (deg. F) |
|---|---|---|
| <=50 | 47.54 | <=70 |
| 51-55 | 7.60 | 71-75 |
| 56-60 | 8.16 | 76-80 |
| 61-65 | 9.24 | 81-85 |
| 66-70 | 9.63 | 86-90 |
| 71-75 | 7.80 | 91-95 |
| 76-80 | 5.39 | 96-100 |
| 81-85 | 3.24 | 101-105 |
| 86-90 | 1.11 | 106-110 |
| 91-95 | 0.27 | 111-115 |
| 96-100 | 0.03 | 116-120 |
| >100 | 0.00 | >120 |

Condenser outlet temperature approach to ambient: 20.00 deg. F

---

Annual air-cooled condenser emissions and control efficiency:

| | Uncontrolled emissions tons/year | Controlled emissions tons/year | % Control |
|---|---|---|---|
| Benzene | 1.628 | 0.541 | 66.75 |
| BTEX | 11.625 | 1.458 | 87.46 |
| Total HAP | 12.982 | 2.051 | 84.20 |
| VOC | 41.012 | 18.624 | 54.59 |

# ATTACHMENT Q: PNEUMATIC CONTROLLERS DATA SHEET

## ATTACHMENT Q – PNEUMATIC CONTROLLERS DATA SHEET

**Are there any continuous bleed natural gas driven pneumatic controllers at this facility that commenced construction, modification or reconstruction after August 23, 2011, and on or before September 18, 2015?**

☐ Yes ☒ No

Please list approximate number.

**Are there any continuous bleed natural gas driven pneumatic controllers at this facility that commenced construction, modification or reconstruction after September 18, 2015?**

☐ Yes ☒ No

Please list approximate number.

**Are there any continuous bleed natural gas driven pneumatic controllers at this facility with a bleed rate greater than 6 standard cubic feet per hour that are required based on functional needs, including but not limited to response time, safety and positive actuation that commenced construction, modification or reconstruction after August 23, 2011, and on or before September 18, 2015?**

☐ Yes ☒ No

Please list approximate number.

**Are there any continuous bleed natural gas driven pneumatic controllers at this facility with a bleed rate greater than 6 standard cubic feet per hour that are required based on functional needs, including but not limited to response time, safety and positive actuation that commenced construction, modification or reconstruction after September 18, 2015?**

☐ Yes ☒ No

Please list approximate number.

# ATTACHMENT R: PNEUMATIC PUMP DATA SHEET

## ATTACHMENT R – PNEUMATIC PUMP DATA SHEET

**Are there any natural gas-driven diaphragm pumps located at a well site that commenced construction, modification or reconstruction after September 18, 2015?**

☐ Yes ☒ No

Please list.

| Source ID # | Date | Pump Make/Model | Pump Size |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

# ATTACHMENT S: AIR POLLUTION CONTROL DEVICE/EMISSION REDUCTION DEVICES SHEETS

VAPOR COMBUSTION

AP-42 EMISSION FACTORS

## ATTACHMENT S – AIR POLLUTION CONTROL DEVICE / EMISSION REDUCTION DEVICE SHEETS

Complete the applicable air pollution control device sheets for each flare, vapor combustor, thermal oxidizer, condenser, adsorption system, vapor recovery unit, BTEX Eliminator, Reboiler with and without Glow Plug, etc. at the facility. Use extra pages if necessary.

Emissions calculations must be performed using the most conservative control device efficiency.

| *The following five (5) rows are only to be completed if registering an alternative air pollution control device.* | |
|---|---|
| Emission Unit ID: | Make/Model: |
| Primary Control Device ID: | Make/Model: |
| Control Efficiency (%): | APCD/ERD Data Sheet Completed: ☐ Yes ☐ No |
| Secondary Control Device ID: | Make/Model: |
| Control Efficiency (%): | APCD/ERD Data Sheet Completed: ☐ Yes ☐ No |

# VAPOR COMBUSTION
# (Including Enclosed Combustors)

**General Information**

| | | |
|---|---|---|
| Control Device ID#: APC-COMB | Installation Date: TBD<br>☒ New ☐ Modified ☐ Relocated | |
| Maximum Rated Total Flow Capacity<br>6,125 scfh 147,000 scfd | Maximum Design Heat Input (from mfg. spec sheet)<br>15 MMBTU/hr | Design Heat Content<br>2,450 BTU/scf |

**Control Device Information**

Type of Vapor Combustion Control?

☒ Enclosed Combustion Device ☐ Elevated Flare ☐ Ground Flare
☐ Thermal Oxidizer

| | |
|---|---|
| Manufacturer: MRW Technologies<br>Model: TBF-5.5-30-147000 | Hours of operation per year? 8,760 |

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

| Emission Unit ID# | Emission Source Description | Emission Unit ID# | Emission Source Description |
|---|---|---|---|
| EU-TANKS-COND | Condensate Tanks | EU-LOAD-COND | Condensate Truck Loading |
| EU-TANKS-PW | Produced Water Tanks | EU-LOAD-PW | Produced Water Truck Loading |
| | | | |

*If this vapor combustor controls emissions from more than six (6) emission units, please attach additional pages.*

| Assist Type (Flares only) | Flare Height | Tip Diameter | Was the design per §60.18? |
|---|---|---|---|
| ☐ Steam ☐ Air<br>☐ Pressure ☒ Non | 30 feet | 5.5 feet | ☐ Yes ☒ No<br>Provide determination. |

**Waste Gas Information**

| Maximum Waste Gas Flow Rate | Heat Value of Waste Gas Stream | Exit Velocity of the Emissions Stream |
|---|---|---|
| 102.08 (scfm) | 2,450 BTU/ft$^3$ | (ft/s) |

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

**Pilot Gas Information**

| Number of Pilot Lights | Fuel Flow Rate to Pilot Flame per Pilot | Heat Input per Pilot | Will automatic re-ignition be used? |
|---|---|---|---|
| 1 | 50 scfh | 45,250 BTU/hr | ☒ Yes ☐ No |

If automatic re-ignition is used, please 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 remote alarm signal will be generated to indicate loss of pilot flame.

| | |
|---|---|
| Is pilot flame equipped with a monitor to detect the presence of the flame? ☒ Yes ☐ No | If Yes, what type? ☐ Thermocouple ☐ Infrared<br>☐ Ultraviolet ☐ Camera ☒ Other: flame rod |

Describe all operating ranges and maintenance procedures required by the manufacturer to maintain the warranty. *(If unavailable, please indicate).*

Additional information attached? ☒ Yes ☐ No
Please attach copies of manufacturer's data sheets, drawings, flame demonstration per §60.18 or §63.11(b) and performance testing.

| CONDENSER | | |
|---|---|---|
| **General Information** | | |
| Control Device ID#: APC-COND | Installation Date: TBD<br>☒ New ☐ Modified ☐ Relocated | |
| Manufacturer:<br>Jatco | Model: | Control Device Name:<br>Still Column Condenser |
| Control Efficiency (%): Varies by Pollutant | | |
| Manufacturer's required temperature range for control efficiency. ºF | | |
| Describe the warning and/or alarm system that protects against operation when unit is not meeting the design requirements: | | |
| Describe all operating ranges and maintenance procedures required by the manufacturer to maintain the warranty. | | |
| Additional information attached? ☐ Yes ☒ No<br>Please attach copies of manufacturer's data sheets. | | |
| Is condenser routed to a secondary APCD or ERD?<br>☒ Yes ☐ No | | |

**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<br>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.

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.

# ATTACHMENT T: EMISSIONS CALCULATIONS

**SWN Production Company, LLC**
**Ruth Keller Pad**
**Summary of Criteria Air Pollutant Emissions**

| Equipment | Unit ID | Emission Point ID | NOx | | CO | | Total VOC[1] | | $SO_2$ | | PM Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | lb/hr | TPY | lb/hr | TPY | lb/hr | TPY | lb/hr | TPY | lb/hr | TPY |
| 145-hp Caterpillar G3306 NA Engine | EU-ENG1 | EP-ENG1 | 0.32 | 1.40 | 0.64 | 2.80 | 0.31 | 1.36 | <0.01 | <0.01 | 0.02 | 0.11 |
| 145-hp Caterpillar G3306 NA Engine | EU-ENG2 | EP-ENG2 | 0.32 | 1.40 | 0.64 | 2.80 | 0.31 | 1.36 | <0.01 | <0.01 | 0.02 | 0.11 |
| 103.3-hp Zenith ZPP-644 4.4 L Engine | EU-ENG3 | EP-ENG3 | 0.46 | 2.01 | 0.75 | 3.27 | 0.46 | 2.01 | <0.01 | <0.01 | 0.01 | 0.05 |
| 1.0-mmBtu/hr GPU Burner | EU-GPU1 | EP-GPU1 | 0.11 | 0.48 | 0.09 | 0.41 | 0.01 | 0.03 | <0.01 | <0.01 | 0.01 | 0.04 |
| 0.5-mmBtu/hr Heater Treater | EU-HT1 | EP-HT1 | 0.06 | 0.24 | 0.05 | 0.20 | <0.01 | 0.01 | <0.01 | <0.01 | <0.01 | 0.02 |
| 24.0-MMSCFD TEG Dehydration Unit | EU-DEHY1 | EP-RB1 | - | - | - | - | 2.99 | 13.09 | - | - | - | - |
| 0.75-mmBtu/hr TEG Reboiler | EU-RB1 | EP-RB1 | 0.08 | 0.36 | 0.07 | 0.30 | <0.01 | 0.02 | <0.01 | <0.01 | 0.01 | 0.03 |
| Two (2) 400-bbl Condensate Tanks Routed to Vapor Combustor | EU-TANKS-COND | APC-COMB | - | - | - | - | - | - | - | - | - | - |
| Two (2) 400-bbl Produced Water Tanks Routed to Vapor Combustor | EU-TANKS-PW | APC-COMB | - | - | - | - | - | - | - | - | - | - |
| Condensate Truck Loading w/ Vapor Return Routed to Combustor | EU-LOAD-COND | APC-COMB | - | - | - | - | 1.52 | 6.65 | - | - | - | - |
| Produced Water Truck Loading w/ Vapor Return Routed to Combustor | EU-LOAD-PW | APC-COMB | - | - | - | - | 0.01 | 0.02 | - | - | - | - |
| 15.0-mmBtu/hr Vapor Combustor | APC-COMB | APC-COMB | 2.07 | 9.07 | 4.13 | 18.10 | 0.98 | 4.27 | - | - | 0.05 | 0.20 |
| Vapor Combustor Pilot | EU-PILOT | APC-COMB | <0.01 | 0.02 | <0.01 | 0.02 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Fugitive Emissions | EU-FUG | EP-FUG | - | - | - | - | 0.68 | 2.98 | - | - | - | - |
| Fugitive Haul Road Emissions | EU-HR | EP-HR | - | - | - | - | - | - | - | - | 0.26 | 0.86 |
| | | **Total =** | **3.42** | **14.99** | **6.37** | **27.91** | **7.26** | **31.81** | **<0.01** | **0.01** | **0.39** | **1.41** |

Notes:
[1] Total VOC includes all constituents heavier than Propane (C3+), including hazardous air pollutants (HAP). Speciated HAP presented in following table.

**SWN Production Company, LLC**
**Ruth Keller 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 | EU-ENG1 | <0.01 | <0.01 | <0.01 | <0.01 | 0.09 | <0.01 | - | <0.01 | <0.01 | 0.10 |
| 145-hp Caterpillar G3306 NA Engine | EU-ENG2 | <0.01 | <0.01 | <0.01 | <0.01 | 0.09 | <0.01 | - | <0.01 | <0.01 | 0.10 |
| 103.3-hp Zenith ZPP-644 4.4 L Engine | EU-ENG3 | <0.01 | <0.01 | <0.01 | <0.01 | 0.05 | <0.01 | - | <0.01 | <0.01 | 0.05 |
| 1.0-mmBtu/hr GPU Burner | EU-GPU1 | - | - | <0.01 | - | <0.01 | - | <0.01 | <0.01 | - | <0.01 |
| 0.5-mmBtu/hr Heater Treater | EU-HT1 | - | - | <0.01 | - | <0.01 | - | <0.01 | <0.01 | - | <0.01 |
| 24.0-MMSCFD TEG Dehydration Unit | EU-DEHY1 | - | - | 0.11 | 0.00 | - | - | 0.12 | 0.18 | 0.05 | 0.46 |
| 0.75-mmBtu/hr TEG Reboiler | EU-RB1 | - | - | <0.01 | - | <0.01 | - | <0.01 | <0.01 | - | <0.01 |
| Two (2) 400-bbl Condensate Tanks Routed to Vapor Combustor | EU-TANKS-COND | - | - | - | - | - | - | - | - | - | - |
| Two (2) 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 | - | - | 0.09 | 0.01 | 0.02 | 0.12 |
| 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 |
| 15.0-mmBtu/hr Vapor Combustor | APC-COMB | - | - | <0.01 | <0.01 | - | - | 0.06 | <0.01 | 0.01 | 0.08 |
| Vapor Combustor Pilot | EU-PILOT | - | - | <0.01 | - | <0.01 | - | <0.01 | <0.01 | - | <0.01 |
| Fugitive Emissions | EU-FUG | - | - | <0.01 | <0.01 | - | - | 0.03 | <0.01 | 0.01 | 0.04 |
| Fugitive Haul Road Emissions | EU-HR | - | - | - | - | - | - | - | - | - | - |
| | **Total =** | **0.01** | **0.01** | **0.12** | **0.01** | **0.22** | **0.01** | **0.29** | **0.19** | **0.10** | **0.96** |

*Continued on Next Page*

**SWN Production Company, LLC**
**Ruth Keller 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 | EU-ENG1 | 0.02 | 0.01 | 0.01 | <0.01 | 0.38 | 0.02 | - | <0.01 | <0.01 | 0.44 |
| 145-hp Caterpillar G3306 NA Engine | EU-ENG2 | 0.02 | 0.01 | 0.01 | <0.01 | 0.38 | 0.02 | - | <0.01 | <0.01 | 0.44 |
| 103.3-hp Zenith ZPP-644 4.4 L Engine | EU-ENG3 | 0.01 | 0.01 | <0.01 | <0.01 | 0.20 | 0.01 | - | <0.01 | <0.01 | 0.23 |
| 1.0-mmBtu/hr GPU Burner | EU-GPU1 | - | - | <0.01 | - | <0.01 | - | 0.01 | <0.01 | - | 0.01 |
| 0.5-mmBtu/hr Heater Treater | EU-HT1 | - | - | <0.01 | - | <0.01 | - | <0.01 | <0.01 | - | <0.01 |
| 24.0-MMSCFD TEG Dehydration Unit | EU-DEHY1 | - | - | 0.49 | 0.00 | - | - | 0.51 | 0.77 | 0.24 | 2.02 |
| 0.75-mmBtu/hr TEG Reboiler | EU-RB1 | - | - | <0.01 | - | <0.01 | - | 0.01 | <0.01 | - | 0.01 |
| Two (2) 400-bbl Condensate Tanks Routed to Vapor Combustor | EU-TANKS-COND | - | - | - | - | - | - | - | - | - | - |
| Two (2) 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 | 0.03 | - | - | 0.38 | 0.03 | 0.10 | 0.54 |
| 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 |
| 15.0-mmBtu/hr Vapor Combustor | APC-COMB | - | - | <0.01 | 0.02 | - | - | 0.25 | 0.02 | 0.06 | 0.35 |
| Vapor Combustor Pilot | EU-PILOT | - | - | <0.01 | - | <0.01 | - | <0.01 | <0.01 | - | <0.01 |
| Fugitive Emissions | EU-FUG | - | - | <0.01 | 0.01 | - | - | 0.12 | 0.01 | 0.02 | 0.16 |
| Fugitive Haul Road Emissions | EU-HR | - | - | - | - | - | - | - | - | - | - |
| **Total =** | | **0.04** | **0.04** | **0.52** | **0.05** | **0.96** | **0.04** | **1.29** | **0.83** | **0.42** | **4.20** |

**SWN Production Company, LLC**
**Ruth Keller Pad**
**Summary of Greenhouse Gas Emissions - Metric Tons per Year (Tonnes)**

| Equipment | Unit ID | Carbon Dioxide ($CO_2$) | | Methane ($CH_4$) | | Methane ($CH_4$) as $CO_{2\ Eq.}$ | | Nitrous Oxide ($N_2O$) | | Nitrous Oxide ($N_2O$) as $CO_{2\ Eq.}$ | | Total $CO_2$ + $CO_{2\ Eq.}$ [1] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | lb/hr | tonnes/yr | lb/hr | tonnes/yr | lb/hr | tonnes/yr | lb/hr | tonnes/yr | lb/hr | tonnes/yr | lb/hr | tonnes/yr |
| 145-hp Caterpillar G3306 NA Engine | EU-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 | 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 |
| 103.3-hp Zenith ZPP-644 4.4 L Engine | EU-ENG3 | 74.89 | 297.56 | 0.37 | 1.45 | 9.13 | 36.29 | <0.01 | <0.01 | 0.04 | 0.17 | 84.06 | 334.01 |
| 1.0-mmBtu/hr GPU Burner | EU-GPU1 | 116.98 | 464.80 | <0.01 | 0.01 | 0.06 | 0.22 | <0.01 | <0.01 | 0.07 | 0.26 | 117.10 | 465.28 |
| 0.5-mmBtu/hr Heater Treater | EU-HT1 | 58.49 | 232.40 | <0.01 | <0.01 | 0.03 | 0.11 | <0.01 | <0.01 | 0.03 | 0.13 | 58.55 | 232.64 |
| 24.0-MMSCFD TEG Dehydration Unit | EU-DEHY1 | <0.01 | <0.01 | 0.41 | 1.62 | 10.18 | 40.45 | - | - | - | - | 10.18 | 40.45 |
| 0.75-mmBtu/hr TEG Reboiler | EU-RB1 | 87.73 | 348.60 | <0.01 | 0.01 | 0.04 | 0.16 | <0.01 | <0.01 | 0.05 | 0.20 | 87.82 | 348.96 |
| Two (2) 400-bbl Condensate Tanks Routed to Vapor Combustor | EU-TANKS-COND | - | - | - | - | - | - | - | - | - | - | - | - |
| Two (2) 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 | 0.22 | 0.86 | 5.42 | 21.54 | - | - | - | - | 5.42 | 21.55 |
| Produced Water Truck Loading w/ Vapor Return Routed to Combustor | EU-LOAD-PW | <0.01 | <0.01 | 0.19 | 0.75 | 4.74 | 18.85 | - | - | - | - | 4.75 | 18.86 |
| 15.0-mmBtu/hr Vapor Combustor | APC-COMB | 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 | 0.68 | 2.72 | 17.10 | 67.95 | - | - | - | - | 17.11 | 67.97 |
| Fugitive Haul Road Emissions | EU-HR | - | - | - | - | - | - | - | - | - | - | - | - |
| **Total =** | | **2,466.61** | **9,800.97** | **1.91** | **7.58** | **47.70** | **189.53** | **<0.01** | **0.02** | **1.38** | **5.47** | **2,515.68** | **9,995.96** |

Notes:
[1] $CO_2$ Equivalent = Pollutant times GWP multiplier. 40 CFR 98 Table A-1, Global Warming Potential (GWP) multiplier (100-Year Time Horizon): $CO_2$ = 1, $CH_4$ = 25, $N_2O$ = 298
[2] Per API Compendium (2009) Chapter 5: Because most of the $CH_4$ and $CO_2$ emissions from storage tanks occur as a result of flashing (which is controlled by the vapor combustor in this case), working and breathing loss emissions of these gases are very small in production and virtually non-existent in the downstream segments. Vapors from the tanks are routed to the vapor combustor at this site. Therefore, GHG emissions from the condensate and produced water tanks are assumed to be negligible.

**SWN Production Company, LLC**
**Ruth Keller Pad**
**Summary of Greenhouse Gas Emissions - Short Tons per Year (Tons)**

| Equipment | Unit ID | Carbon Dioxide ($CO_2$) | | Methane ($CH_4$) | | Methane ($CH_4$) as $CO_{2\ Eq.}$ | | Nitrous Oxide ($N_2O$) | | Nitrous Oxide ($N_2O$) as $CO_{2\ Eq.}$ | | Total $CO_2$ + $CO_{2\ Eq.}$[1] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | lb/hr | tons/yr[2] | lb/hr | tons/yr[2] | lb/hr | tons/yr | lb/hr | tons/yr[2] | lb/hr | tons/yr | lb/hr | tons/yr |
| 145-hp Caterpillar G3306 NA Engine | EU-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 | 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 |
| 103.3-hp Zenith ZPP-644 4.4 L Engine | EU-ENG3 | 74.89 | 328.00 | 0.37 | 1.60 | 9.13 | 40.00 | <0.01 | <0.01 | 0.04 | 0.18 | 84.06 | 368.19 |
| 1.0-mmBtu/hr GPU Burner | EU-GPU1 | 116.98 | 512.36 | <0.01 | 0.01 | 0.06 | 0.24 | <0.01 | <0.01 | 0.07 | 0.29 | 117.10 | 512.89 |
| 0.5-mmBtu/hr Heater Treater | EU-HT1 | 58.49 | 256.18 | <0.01 | <0.01 | 0.03 | 0.12 | <0.01 | <0.01 | 0.03 | 0.14 | 58.55 | 256.44 |
| 24.0-MMSCFD TEG Dehydration Unit | EU-DEHY1 | <0.01 | 0.01 | 0.41 | 1.78 | 10.18 | 44.58 | - | - | - | - | 10.18 | 44.59 |
| 0.75-mmBtu/hr TEG Reboiler | EU-RB1 | 87.73 | 384.27 | <0.01 | 0.01 | 0.04 | 0.18 | <0.01 | <0.01 | 0.05 | 0.22 | 87.82 | 384.67 |
| Two (2) 400-bbl Condensate Tanks Routed to Vapor Combustor | EU-TANKS-COND | - | - | - | - | - | - | - | - | - | - | - | - |
| Two (2) 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 | 0.22 | 0.95 | 5.42 | 23.75 | - | - | - | - | 5.42 | 23.75 |
| Produced Water Truck Loading w/ Vapor Return Routed to Combustor | EU-LOAD-PW | <0.01 | <0.01 | 0.19 | 0.83 | 4.74 | 20.78 | - | - | - | - | 4.75 | 20.78 |
| 15.0-mmBtu/hr Vapor Combustor | APC-COMB | 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 | 0.68 | 3.00 | 17.10 | 74.91 | - | - | - | - | 17.11 | 74.92 |
| Fugitive Haul Road Emissions | EU-HR | - | - | - | - | - | - | - | - | - | - | - | - |
| | **Total =** | **2,466.61** | **10,803.72** | **1.91** | **8.36** | **47.70** | **208.92** | **<0.01** | **0.02** | **1.38** | **6.02** | **2,515.68** | **11,018.67** |

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

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

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

**SWN Production Company, LLC**
**Ruth Keller Pad**
**Engine Emissions Calculations - Criteria Air Pollutants**

**Equipment Information**

| Unit ID: | EU-ENG1 | EU-ENG2 | EU-ENG3 |
|---|---|---|---|
| Emission Point ID: | EP-ENG1 | EP-ENG2 | EP-ENG3 |
| Make: | Caterpillar | Caterpillar | Zenith |
| Model: | G3306 NA | G3306 NA | ZPP-644 4.4 L |
| Design Class: | 4S-RB | 4S-RB | 4S-RB |
| Controls: | NSCR | NSCR | NSCR |
| Horsepower (hp): | 145 | 145.0 | 103.3 |
| Capacity (kW): | NA | NA | 77.0 |
| Fuel Use (Btu/hp-hr): | 8,625 | 8,625 | NA |
| Fuel Use (Btu/kW-hr): | NA | NA | 8,314 |
| Fuel Use (scfh): | 1,382 | 1,382 | 707 |
| Annual Fuel Use (mmscf): | 12.11 | 12.11 | 6.20 |
| Fuel Use (mmBtu/hr): | 1.25 | 1.25 | 0.64 |
| Exhaust Flow (acfm): | 678 | 678 | NA |
| Exhaust Temp (°F): | 1,101 | 1,101 | NA |
| Manufacture Date: | after 1/1/2011 | after 1/1/2011 | after 1/1/2011 |
| Operating Hours: | 8,760 | 8,760 | 8,760 |
| Fuel Heating Value (Btu/scf): | 905 | 905 | 905 |
| **Uncontrolled Manufacturer Emission Factors [1]** | | | |
| NOx (g/hp-hr): | 13.47 | 13.47 | NA |
| CO (g/hp-hr): | 13.47 | 13.47 | NA |
| NMNEHC/VOC (g/hp-hr): | 0.22 | 0.22 | NA |
| Total VOC = NMNEHC + HCHO (g/hp-hr): | 0.49 | 0.22 | NA |
| NMHC + NOx as NOx (g/kW-hr): | NA | NA | 2.70 |
| CO (g/kW-hr): | NA | NA | 4.40 |
| NMHC + NOx as VOC (g/kW-hr): | NA | NA | 2.70 |
| **Post-Catalyst Emission Factors** | | | |
| NOx Control Eff. % | 92.58% | 92.58% | NA |
| CO Control Eff. % | 85.15% | 85.15% | NA |
| NOx (g/hp-hr): | 1.00 | 1.00 | NA |
| CO (g/hp-hr): | 2.00 | 2.00 | NA |
| NMNEHC/VOC (g/hp-hr): | 0.70 | 0.70 | NA |
| Total VOC = NMNEHC + HCHO (g/hp-hr): | 0.97 | 0.97 | NA |
| NMHC + NOx as NOx (g/kW-hr): | NA | NA | 2.70 |
| CO (g/kW-hr): | NA | NA | 4.40 |
| NMHC + NOx as VOC (g/kW-hr): | NA | NA | 2.70 |

**Uncontrolled Criteria Air Pollutant Emissions**

| Unit ID: | EU-ENG1 | | EU-ENG2 | | EU-ENG3 | |
|---|---|---|---|---|---|---|
| **Pollutant** | **lb/hr** | **TPY** | **lb/hr** | **TPY** | **lb/hr** | **TPY** |
| NOx | 4.31 | 18.86 | 4.31 | 18.86 | NA | NA |
| NMHC + NOx as NOx | NA | NA | NA | NA | 0.46 | 2.01 |
| CO | 4.31 | 18.86 | 4.31 | 18.86 | 0.75 | 3.27 |
| NMNEHC/VOC (does not include HCHO) | 0.07 | 0.31 | 0.07 | 0.31 | NA | NA |
| Total VOC (includes HCHO) | 0.16 | 0.69 | 0.07 | 0.31 | NA | NA |
| NMHC + NOx as VOC | NA | NA | NA | NA | 0.46 | 2.01 |
| $SO_2$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| $PM_{10/2.5}$ | 0.01 | 0.05 | 0.01 | 0.05 | 0.01 | 0.03 |
| $PM_{COND}$ | 0.01 | 0.05 | 0.01 | 0.05 | 0.01 | 0.03 |
| $PM_{TOT}$ | 0.02 | 0.11 | 0.02 | 0.11 | 0.01 | 0.05 |

**SWN Production Company, LLC**
**Ruth Keller Pad**
**Engine Emissions Calculations - Criteria Air Pollutants (Continued)**

**Proposed Criteria Air Pollutant Emissions[2, 3]**

| Pollutant | lb/hr | TPY | lb/hr | TPY | lb/hr | TPY |
|---|---|---|---|---|---|---|
| NOx | 0.32 | 1.40 | 0.32 | 1.40 | NA | NA |
| NMHC + NOx as NOx | NA | NA | NA | NA | 0.46 | 2.01 |
| CO | 0.64 | 2.80 | 0.64 | 2.80 | 0.75 | 3.27 |
| NMNEHC/VOC (does not include HCHO) | 0.22 | 0.98 | 0.22 | 0.98 | NA | NA |
| Total VOC (includes HCHO) | 0.31 | 1.36 | 0.31 | 1.36 | NA | NA |
| NMHC + NOx as VOC | NA | NA | NA | NA | 0.46 | 2.01 |
| $SO_2$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| $PM_{10/2.5}$ | 0.01 | 0.05 | 0.01 | 0.05 | 0.01 | 0.03 |
| $PM_{COND}$ | 0.01 | 0.05 | 0.01 | 0.05 | 0.01 | 0.03 |
| $PM_{TOT}$ | 0.02 | 0.11 | 0.02 | 0.11 | 0.01 | 0.05 |

**AP-42 Emission Factors (lb/mmBtu)[4]**

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

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

[3] Zenith engine is certified to meet EPA emissions standards of 2.7 g/kW-hr NMHC+NOx and 4.4 g/kW-hr CO. Total NMHC+NOx factor used to conservatively estimate emissions of NOx and VOC, respectively. All other pollutants calculated using AP-42.

[4] 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**
**Ruth Keller Pad**
**Engine Emissions Calculations - Hazardous Air Pollutants**

**Equipment Information**

| Unit ID: | EU-ENG1 | EU-ENG2 | EU-ENG3 |
|---|---|---|---|
| Emission Point ID: | EP-ENG1 | EP-ENG2 | EP-ENG3 |
| Make: | Caterpillar | Caterpillar | Zenith |
| Model: | G3306 NA | G3306 NA | ZPP-644 4.4 L |
| Design Class: | 4S-RB | 4S-RB | 4S-RB |
| Controls: | NSCR | NSCR | NSCR |
| Horsepower (hp): | 145 | 145 | 103 |
| Capacity (kW): | NA | NA | 77.0 |
| Fuel Use (Btu/hp-hr): | 8,625 | 8,625 | NA |
| Fuel Use (Btu/kW-hr): | NA | NA | 8,314 |
| Fuel Use (scfh): | 1,382 | 1,382 | 707 |
| Annual Fuel Use (mmscf): | 12.11 | 12.11 | 6.20 |
| Fuel Use (mmBtu/hr): | 1.25 | 1.25 | 0.64 |
| Exhaust Flow (acfm): | 678 | 678 | NA |
| Exhaust Temp (°F): | 1,101 | 1,101 | NA |
| Operating Hours: | 8,760 | 8,760 | 8,760 |

**Proposed HAP Emissions[1,2]**

| Unit ID: | EU-ENG1 | | EU-ENG2 | | EU-ENG3 | |
|---|---|---|---|---|---|---|
| **Pollutant** | **lb/hr** | **TPY** | **lb/hr** | **TPY** | **lb/hr** | **TPY** |
| Acetaldehyde | <0.01 | 0.02 | <0.01 | 0.02 | <0.01 | 0.01 |
| Acrolein | <0.01 | 0.01 | <0.01 | 0.01 | <0.01 | 0.01 |
| Benzene | <0.01 | 0.01 | <0.01 | 0.01 | <0.01 | <0.01 |
| Ethylbenzene | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Formaldehyde | 0.09 | 0.38 | 0.09 | 0.38 | 0.05 | 0.20 |
| Methanol | <0.01 | 0.02 | <0.01 | 0.02 | <0.01 | 0.01 |
| Toluene | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Xylenes | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| **Total HAP =** | **0.10** | **0.44** | **0.10** | **0.44** | **0.05** | **0.23** |

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

Notes:

[1] Manuf. data for uncontrolled Caterpillar G3306 HCHO emissions (g/hp-hr): 0.27

[2] For conservative estimate, no reduction taken for any HAP .

**SWN Production Company, LLC**
**Ruth Keller Pad**
**Engine Emissions Calculations - Greenhouse Gases**

**Equipment Information**

| Unit ID: | EU-ENG1 | EU-ENG2 | EU-ENG3 |
|---|---|---|---|
| Emission Point ID: | EP-ENG1 | EP-ENG2 | EP-ENG3 |
| Make: | Caterpillar | Caterpillar | Zenith |
| Model: | G3306 NA | G3306 NA | ZPP-644 4.4 L |
| Design Class: | 4S-RB | 4S-RB | 4S-RB |
| Horsepower (hp): | 145 | 145 | 103 |
| Capacity (kW): | NA | NA | 77.0 |
| Fuel Use (Btu/hp-hr): | 8,625 | 8,625 | NA |
| Fuel Use (Btu/kW-hr): | NA | NA | 8,314 |
| Fuel Use (scfh): | 1,382 | 1,382 | 707 |
| Fuel Use (mmBtu/hr): | 1.25 | 1.25 | 0.64 |
| Exhaust Flow (acfm): | 678 | 678 | NA |
| Exhaust Temp (°F): | 1,101 | 1,101 | NA |
| Operating Hours: | 8,760 | 8,760 | 8,760 |

**Manufacturer Emission Factors (g/hp-hr)[1]**

| | | | |
|---|---|---|---|
| $CO_2$ = | 485 | NA | 685 |

**Greenhouse Gas (GHG) Emissions[1]**

| Pollutant | lb/hr | tonnes/yr | lb/hr | tonnes/yr | lb/hr | tonnes/yr |
|---|---|---|---|---|---|---|
| $CO_2$ | 155.04 | 616.04 | 155.04 | 616.04 | 74.89 | 297.56 |
| $CH_4$ | <0.01 | 0.01 | <0.01 | 0.01 | 0.37 | 1.45 |
| $N_2O$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| $CH_4$ as $CO_2e$ | 0.07 | 0.27 | 0.07 | 0.27 | 9.13 | 36.29 |
| $N_2O$ as $CO_2e$ | 0.08 | 0.33 | 0.08 | 0.33 | 0.04 | 0.17 |
| **Total $CO_2$ + $CO_2e$ =** | **155.19** | **616.64** | **155.19** | **616.64** | **84.06** | **334.01** |

**40 CFR 98 Tables ENG-1 and ENG-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] Manufacturer data used to estimate $CO_2$ emissions for the Caterpillar engines. All other emissions estimated using EPA data. 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**
**Ruth Keller Pad**
**Gas Production Unit Burner Emissions Calculations - Criteria Air Pollutants**

**Equipment Information**

| | |
|---|---|
| Unit ID: | **EU-GPU1** |
| Emission Point ID: | EP-GPU1 |
| Description: | Gas Production Unit Burner |
| Number of Units: | 1 |
| 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**

| Pollutant | lb/hr | TPY |
|---|---|---|
| NOx | 0.11 | 0.48 |
| CO | 0.09 | 0.41 |
| VOC | 0.01 | 0.03 |
| $SO_2$ | <0.01 | <0.01 |
| $PM_{10/2.5}$ | 0.01 | 0.03 |
| $PM_{COND}$ | <0.01 | 0.01 |
| $PM_{TOT}$ | 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**
**Ruth Keller Pad**
**Gas Production Unit Burner Emissions Calculations - Hazardous Air Pollutants**

**Equipment Information**

| | |
|---|---|
| Unit ID: | **EU-GPU1** |
| Emission Point ID: | EP-GPU1 |
| Description: | Gas Production Unit Burner |
| Number of Units: | 1 |
| 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**

| Pollutant | lb/hr | TPY |
|---|---|---|
| n-Hexane | <0.01 | 0.01 |
| Formaldehyde | <0.01 | <0.01 |
| Benzene | <0.01 | <0.01 |
| Toluene | <0.01 | <0.01 |
| **Total HAP =** | **<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**
**Ruth Keller Pad**
**Gas Production Unit Burner Emissions Calculations - Greenhouse Gases**

**Equipment Information**

| | |
|---|---|
| Unit ID: | **EU-GPU1** |
| Emission Point ID: | EP-GPU1 |
| Description: | Gas Production Unit Burner |
| Number of Units: | 1 |
| 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**

| Pollutant | lb/hr | tonnes/yr |
|---|---|---|
| $CO_2$ | 116.98 | 464.80 |
| $CH_4$ | <0.01 | 0.01 |
| $N_2O$ | <0.01 | <0.01 |
| $CH_4$ as $CO_2e$ | 0.06 | 0.22 |
| $N_2O$ as $CO_2e$ | 0.07 | 0.26 |
| **Total $CO_2$ + $CO_2e$ =** | **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**
**Ruth Keller Pad**
**Heater Treater Emissions Calculations - Criteria Air Pollutants**

**Equipment Information**

| | |
|---|---|
| Unit ID: | **EU-HT1** |
| Emission Point ID: | EP-HT1 |
| Description: | Heater Treater |
| Number of Units: | 1 |
| 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**

| Pollutant | lb/hr | TPY |
|---|---|---|
| NOx | 0.06 | 0.24 |
| CO | 0.05 | 0.20 |
| VOC | <0.01 | 0.01 |
| $SO_2$ | <0.01 | <0.01 |
| $PM_{10/2.5}$ | <0.01 | 0.01 |
| $PM_{COND}$ | <0.01 | <0.01 |
| $PM_{TOT}$ | <0.01 | 0.02 |

**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**
**Ruth Keller Pad**
**Heater Treater Emissions Calculations - Hazardous Air Pollutants**

**Equipment Information**

| | |
|---|---|
| Unit ID: | **EU-HT1** |
| Emission Point ID: | EP-HT1 |
| Description: | Heater Treater |
| Number of Units: | 1 |
| 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**

| Pollutant | lb/hr | TPY |
|---|---|---|
| n-Hexane | <0.01 | <0.01 |
| Formaldehyde | <0.01 | <0.01 |
| Benzene | <0.01 | <0.01 |
| Toluene | <0.01 | <0.01 |
| **Total HAP =** | **<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**
**Ruth Keller Pad**
**Heater Treater Emissions Calculations - Greenhouse Gases**

**Equipment Information**

| | |
|---|---|
| Unit ID: | **EU-HT1** |
| Emission Point ID: | EP-HT1 |
| Description: | Heater Treater |
| Number of Units: | 1 |
| 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**

| Pollutant | lb/hr | tonnes/yr |
|---|---|---|
| $CO_2$ | 58.49 | 232.40 |
| $CH_4$ | <0.01 | <0.01 |
| $N_2O$ | <0.01 | <0.01 |
| $CH_4$ as $CO_2e$ | 0.03 | 0.11 |
| $N_2O$ as $CO_2e$ | 0.03 | 0.13 |
| **Total $CO_2$ + $CO_2e$ =** | **58.55** | **232.64** |

**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**
**Ruth Keller Pad**
**Glycol Dehydration Unit Emissions - Criteria and Hazardous Air Pollutants**

**Equipment Information**

| Parameter | Units | Value |
|---|---|---|
| Unit ID | - | EU-DEHY1 |
| Emission Point ID: | - | EP-RB1 |
| Maximum Throughput | MMSCFD | 24.0 |
| Operating Hours | Hours/Year | 8,760 |
| Wet Gas Temperature | °F | 70 |
| Wet Gas Pressure | psig | 900 |
| Pump Make | - | Kimray |
| Pump Model | - | 45015 PV |
| Pump Type | Electric/Gas | Gas |
| Lean Glycol Flow Rate[1] | gpm | 7.50 |
| Flash Tank Temperature | °F | 150 |
| Flash Tank Pressure | psig | 50 |
| Flash Tank Controls[2] | - | Combustion |
| Regenerator Still Vent Controls[3] | - | Condenser/ Combustion |
| Flash Tank Control Efficiency | % | 98% |
| Condenser Temperature | °F | 100 |
| Condenser Pressure | psia | 14.00 |
| Safety factor | % | 20% |

**Proposed Emissions[4]**

Unit ID: **EU-DEHY1**

| Pollutant | lb/hr | TPY |
|---|---|---|
| n-Hexane | 0.12 | 0.51 |
| Benzene | 0.11 | 0.49 |
| Toluene | 0.18 | 0.77 |
| Ethylbenzene | <0.01 | <0.01 |
| Xylenes | 0.05 | 0.24 |
| **Total HAPs =** | **0.46** | **2.02** |
| **Total VOCs =** | **2.99** | **13.09** |

**SWN Production Company, LLC**
**Ruth Keller Pad**
**Glycol Dehydration Unit Emissions - Criteria and Hazardous Air Pollutants (Continued)**

**GRI-GLYCalc Results - Controlled (For Reference Only)[5]**

| | STILL VENT | | FLASH TANK | | TOTAL (EU-DEHY1) | |
|---|---|---|---|---|---|---|
| **Pollutant** | **lb/hr** | **TPY** | **lb/hr** | **TPY** | **lb/hr** | **TPY** |
| n-Hexane | 0.0966 | 0.4231 | 0.0308 | 0.1350 | 0.1274 | 0.5581 |
| Benzene | 0.0940 | 0.4117 | 0.0015 | 0.0065 | 0.0955 | 0.4182 |
| Toluene | 0.1475 | 0.6458 | 0.0031 | 0.0137 | 0.1506 | 0.6595 |
| Ethylbenzene | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Xylenes | 0.0454 | 0.1987 | 0.0012 | 0.0054 | 0.0466 | 0.2041 |
| **Total HAP =** | **0.3835** | **1.6793** | **0.0366** | **0.1606** | **0.4201** | **1.8399** |
| **Total VOCs =** | **2.4909** | **10.9100** | **1.3096** | **5.7361** | **3.8005** | **16.6461** |

**GRI-GLYCalc Results - Uncontrolled (For Reference Only)[5]**

| | STILL VENT | | FLASH TANK | | TOTAL (EU-DEHY1) | |
|---|---|---|---|---|---|---|
| **Pollutant** | **lb/hr** | **TPY** | **lb/hr** | **TPY** | **lb/hr** | **TPY** |
| n-Hexane | 0.3096 | 1.3563 | 1.5416 | 6.7524 | 1.8512 | 8.1087 |
| Benzene | 0.3718 | 1.6284 | 0.0737 | 0.3226 | 0.4455 | 1.9510 |
| Toluene | 1.1826 | 5.1796 | 0.1564 | 0.6851 | 1.3390 | 5.8647 |
| Ethylbenzene | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Xylenes | 1.0998 | 4.8173 | 0.0622 | 0.2723 | 1.1620 | 5.0896 |
| **Total HAP =** | **2.9638** | **12.9816** | **1.8339** | **8.0324** | **4.7977** | **21.0140** |
| **Total VOCs =** | **9.3635** | **41.0122** | **65.4805** | **286.8045** | **74.8440** | **327.8167** |

Notes:

[1] Dehydration unit is equipped with two (2) 7.5 gpm Kimray 45015 gas injection pumps. One is a backup; only one pump will be in use at one time.

[2] Flash tank off gas is recycled to the heater treater then recompressed. Flash tank off-gases can also be used as supplemental fuel for the reboiler; therefore, a capture efficiency of 100% and a destruction efficiency of 98% were used in in GRI-GLYCalc™.

[3] Regenerator still vent emissions are controlled by condenser, with non-condensables routed to the reboiler for destruction. 50% combustion control efficiency taken in GRI-GLYCalc™.

[4] 20% safety factor added to controlled GRI-GLYCalc™ results to account for potential fluctuations in gas composition. Note that proposed emissions include still vent emissions only.

[5] GRI-GLYCalc™ report attached.

**SWN Production Company, LLC**
**Ruth Keller Pad**
**Glycol Dehydration Unit Emissions - Greenhouse Gas Emissions**

| | |
|---|---|
| $CH_4$ mol% from gas analysis = | 71.427% |
| $CO_2$ mol% from gas analysis = | 0.149% |

**Proposed Emissions [1]**

Unit ID: **EU-DEHY1**

| Pollutant | lb/hr | tons/yr |
|---|---|---|
| $CO_2$ = | <0.01 | 0.01 |
| $CH_4$ = | 0.41 | 1.78 |
| $CH_4$ as $CO_2e$ = | 10.18 | 44.58 |
| **Total $CO_2$ + $CO_2e$ =** | **10.18** | **44.59** |

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

| Unit ID: | STILL VENT | | FLASH TANK | | TOTAL (EU-DEHY1) | |
|---|---|---|---|---|---|---|
| **Pollutant** | **lb/hr** | **tons/yr** | **lb/hr** | **tons/yr** | **lb/hr** | **tons/yr** |
| $CO_2$ = | 0.0019 | 0.0085 | 0.0113 | 0.0496 | 0.0133 | 0.0581 |
| $CH_4$ from GLYCalc = | 0.3393 | 1.4861 | 1.9727 | 8.6406 | 2.3120 | 10.1267 |
| $CH_4$ as $CO_2e$ = | 8.4825 | 37.1525 | 49.3175 | 216.0150 | 57.8000 | 253.1675 |
| **Total $CO_2$ + $CO_2e$ =** | **8.4844** | **37.1610** | **49.3288** | **216.0646** | **57.8133** | **253.2256** |

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

| Unit ID: | STILL VENT | | FLASH TANK | | TOTAL (EU-DEHY1) | |
|---|---|---|---|---|---|---|
| **Pollutant** | **lb/hr** | **tons/yr** | **lb/hr** | **tons/yr** | **lb/hr** | **tons/yr** |
| $CO_2$ = | 0.0039 | 0.0171 | 0.5658 | 2.4784 | 0.5697 | 2.4955 |
| $CH_4$ from GLYCalc = | 0.6792 | 2.9750 | 98.6369 | 432.0296 | 99.3161 | 435.0046 |
| $CH_4$ as $CO_2e$ = | 16.9800 | 74.3750 | 2,465.9225 | 10,800.7400 | 2,482.9025 | 10,875.1150 |
| **Total $CO_2$ + $CO_2e$ =** | **16.9839** | **74.3921** | **2,466.4883** | **10,803.2184** | **2,483.4722** | **10,877.6105** |

Notes:

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

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

**SWN Production Company, LLC**
**Ruth Keller Pad**
**Reboiler Emissions Calculations - Criteria Air Pollutants**

**Equipment Information**

| | |
|---|---|
| Unit ID: | **EU-RB1** |
| Emission Point ID: | EP-RB1 |
| Description: | TEG Reboiler |
| Number of Units: | 1 |
| Burner Design (mmBtu/hr): | 0.75 |
| Fuel HHV (Btu/scf): | 905 |
| Annual Fuel Use (mmscf): | 7.26 |
| Annual Operating Hours: | 8,760 |

**Criteria Air Pollutant Emissions**

Unit ID: **EU-RB1**

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

**AP-42 Emission Factors for Units <100 mmBtu/hr (lb/mmscf)[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**
**Ruth Keller Pad**
**Reboiler Emissions Calculations - Hazardous Air Pollutants**

**Equipment Information**

| | |
|---|---|
| Unit ID: | **EU-RB1** |
| Emission Point ID: | EP-RB1 |
| Description: | TEG Reboiler |
| Number of Units: | 1 |
| Burner Design (mmBtu/hr): | 0.75 |
| Fuel HHV (Btu/scf): | 905 |
| Annual Fuel Use (mmscf): | 7.26 |
| Annual Operating Hours: | 8,760 |

**Hazardous Air Pollutant Emissions**

Unit ID: **EU-RB1**

| Pollutant | lb/hr | TPY |
|---|---|---|
| n-Hexane | <0.01 | 0.01 |
| Formaldehyde | <0.01 | <0.01 |
| Benzene | <0.01 | <0.01 |
| Toluene | <0.01 | <0.01 |
| **Total HAP =** | **<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**
**Ruth Keller Pad**
**Reboiler Emissions Calculations - Greenhouse Gases**

**Equipment Information**

| | |
|---|---|
| Unit ID: | **EU-RB1** |
| Emission Point ID: | EP-RB1 |
| Description: | TEG Reboiler |
| Number of Units: | 1 |
| Burner Design (mmBtu/hr): | 0.75 |
| Fuel HHV (Btu/scf): | 905 |
| Annual Fuel Use (mmscf): | 7.26 |
| Annual Operating Hours: | 8,760 |

**Greenhouse Gas (GHG) Emissions[1]**

Unit ID: **EU-RB1**

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

**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**
**Ruth Keller Pad**
**Storage Tank Emissions - Criteria Air Pollutants**

**Tank Information**

| Unit ID: | EU-TANKS-COND | EU-TANKS-PW |
|---|---|---|
| Emission Point ID: | APC-COMB | APC-COMB |
| Contents: [1,3] | Condensate | Produced Water |
| Number of Tanks: | 2 | 2 |
| Capacity (bbl) - Per Tank: | 400 | 400 |
| Capacity (gal) - Per Tank: | 16,800 | 16,800 |
| **Total:** | | |
| Total Throughput (bbl/yr): | 146,000 | 127,750 |
| Total Throughput (gal/yr): | 6,132,000 | 5,365,500 |
| Total Throughput (bbl/d): | 400 | 350 |
| **Per Tank:** | | |
| Throughput (bbl/yr): | 73,000 | 63,875 |
| Throughput (gal/yr): | 3,066,000 | 2,682,750 |
| Throughput (bbl/d): | 200 | 175 |
| Turnovers: | 365.00 | 319.38 |
| 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 | 2.56 | 11.20 | 0.01 | 0.04 |
| Breathing Losses | 1.47 | 6.42 | <0.01 | 0.01 |
| Flashing Losses[2] | 40.48 | 177.30 | 0.71 | 3.10 |
| **Total VOC =** | **44.50** | **194.92** | **0.72** | **3.16** |

**Controlled Storage Tank Emissions[3]**

| Unit ID: | EU-TANKS-COND | | EU-TANKS-PW | |
|---|---|---|---|---|
| **Emissions** | **lb/hr** | **TPY** | **lb/hr** | **TPY** |
| Working Losses | 0.05 | 0.22 | <0.01 | <0.01 |
| Breathing Losses | 0.03 | 0.13 | <0.01 | <0.01 |
| Flashing Losses | 0.81 | 3.55 | 0.01 | 0.06 |
| **Total VOC =** | **0.89** | **3.90** | **0.01** | **0.06** |
| **Per Tank =** | **0.45** | **1.95** | **0.01** | **0.03** |

Notes:

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

[2] Flashing calculated using Promax process simulation. Reports located in Attachment L. Uncontrolled tank working/breathing/flashing emissions are routed to a vapor combustor with 100% capture efficiency.

[3] Controlled tank emissions are shown for reference only.

**SWN Production Company, LLC**
**Ruth Keller 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 = [1,2]** | **44.50** | **194.92** | **0.72** | **3.16** |
| n-Hexane | 2.57 | 11.27 | 0.04 | 0.18 |
| Benzene | 0.03 | 0.14 | <0.01 | <0.01 |
| Toluene | 0.17 | 0.76 | <0.01 | 0.01 |
| Ethylbenzene | 0.19 | 0.82 | <0.01 | 0.01 |
| Xylenes | 0.64 | 2.79 | 0.01 | 0.05 |
| **Total HAP =** | **3.60** | **15.78** | **0.06** | **0.26** |

**Controlled Storage Tank Emissions [3]**

| Unit ID: | EU-TANKS-COND | | EU-TANKS-PW | |
|---|---|---|---|---|
| **Pollutant** | **lb/hr** | **TPY** | **lb/hr** | **TPY** |
| **Total VOC = [1]** | **0.89** | **3.90** | **0.01** | **0.06** |
| n-Hexane | 0.05 | 0.23 | <0.01 | <0.01 |
| Benzene | <0.01 | <0.01 | <0.01 | <0.01 |
| Toluene | <0.01 | 0.02 | <0.01 | <0.01 |
| Ethylbenzene | <0.01 | 0.02 | <0.01 | <0.01 |
| Xylenes | 0.01 | 0.06 | <0.01 | <0.01 |
| **Total HAP =** | **0.07** | **0.32** | **<0.01** | **0.01** |

**Estimated HAP Composition (% by Weight)[4]**

| 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] Controlled tank emissions are shown for reference only.

[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.

**SWN Production Company, LLC**
**Ruth Keller Pad**
**Condensate Truck Loading Emissions - Criteria and Hazardous Air Pollutants**

**Loading Information**

| | |
|---|---|
| Unit ID: | **EU-LOAD-COND** |
| Emission Point ID: | APC-COMB |
| Fill Method: | Submerged |
| Type of Service: | Dedicated |
| Mode of Operation: | Normal |
| Saturation Factor: | 0.6 |
| Throughput (1000 gal): | 6,132.00 |
| Control Type: | Vapor Return/Combustion |
| Vapor Capture Efficiency: [1] | 70% |
| Average Fill Rate (gal/hr): | 7,500 |
| Captured Vapors Routed to: | Vapor Combustor |

**Uncontrolled Loading Emissions[2]**

| Pollutant | Max. lb/hr | Avg. lb/hr | TPY |
|---|---|---|---|
| **VOC =** | **33.66** | **5.06** | **22.18** |
| n-Hexane | 1.95 | 0.29 | 1.28 |
| Benzene | 0.02 | <0.01 | 0.02 |
| Toluene | 0.13 | 0.02 | 0.09 |
| Ethylbenzene | 0.14 | 0.02 | 0.09 |
| Xylenes | 0.48 | 0.07 | 0.32 |
| **Total HAP =** | **2.72** | **0.41** | **1.80** |

**Uncaptured Loading Emissions[2]**

| Pollutant | Max. lb/hr | Avg. lb/hr | TPY |
|---|---|---|---|
| **VOC =** | **10.10** | **1.52** | **6.65** |
| n-Hexane | 0.58 | 0.09 | 0.38 |
| Benzene | 0.01 | <0.01 | <0.01 |
| Toluene | 0.04 | 0.01 | 0.03 |
| Ethylbenzene | 0.04 | 0.01 | 0.03 |
| Xylenes | 0.14 | 0.02 | 0.10 |
| **Total HAP =** | **0.82** | **0.12** | **0.54** |

**SWN Production Company, LLC**
**Ruth Keller Pad**
**Condensate Truck Loading Emissions - Criteria and Hazardous Air Pollutants (Continued)**

**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] 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.

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

[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**
**Ruth Keller Pad**
**Condensate Truck Loading Emissions - Greenhouse Gases**

**Loading Information**

| | |
|---|---|
| Unit ID: | **EU-LOAD-COND** |
| Emission Point ID: | APC-COMB |
| 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): | 6.13200 |
| Control Type: | Vapor Return/Combustion |
| Vapor Capture Efficiency: [2] | 70.00% |
| Average Fill Rate (gal/hr): | 7,500 |
| Captured Vapors Routed to: | Vapor Combustor |

| | |
|---|---|
| Analysis $CH_4$ wt% = | 51.47913% |
| Analysis $CO_2$ wt% = | 0.29461% |

**Uncontrolled Loading Emissions[3, 4]**

| Pollutant | Max. lb/hr | Avg. lb/hr | tonnes/yr | tons/yr |
|---|---|---|---|---|
| $CH_4$ | 7.75 | 0.72 | 2.87 | 3.17 |
| $CH_4$ as $CO_2e$ | 193.65 | 18.07 | 71.81 | 79.16 |
| $CO_2$ | 0.04 | <0.01 | 0.02 | 0.02 |
| **Total $CO_2$ + $CO_2e$ =** | **193.69** | **18.08** | **71.83** | **79.18** |

**Uncaptured Loading Emissions[3, 4]**

| Pollutant | Max. lb/hr | Avg. lb/hr | tonnes/yr | tons/yr |
|---|---|---|---|---|
| $CH_4$ | 2.32 | 0.22 | 0.86 | 0.95 |
| $CH_4$ as $CO_2e$ | 58.09 | 5.42 | 21.54 | 23.75 |
| $CO_2$ | 0.01 | <0.01 | <0.01 | 0.01 |
| **Total $CO_2$ + $CO_2e$ =** | **58.11** | **5.42** | **21.55** | **23.75** |

**SWN Production Company, LLC**
**Ruth Keller Pad**
**Condensate Truck Loading Emissions - Greenhouse Gases (Continued)**

**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**
**Ruth Keller Pad**
**Produced Water Truck Loading Emissions - Criteria and Hazardous Air Pollutants**

**Loading Information**

| | |
|---|---|
| Unit ID: | **EU-LOAD-PW** |
| Emission Point ID: | APC-COMB |
| Fill Method: | Submerged |
| Type of Service: | Dedicated |
| Mode of Operation: | Normal |
| Saturation Factor: | 0.6 |
| Throughput (1000 gal): | 5,365.50 |
| Control Type: | Vapor Return/Combustion |
| Vapor Capture Efficiency: [1] | 70% |
| Average Fill Rate (gal/hr): | 7,500 |
| Captured Vapors Routed to: | Vapor Combustor |

**Uncontrolled Loading Emissions[2]**

| Pollutant | Max. lb/hr | Avg. lb/hr | TPY |
|---|---|---|---|
| **VOC =** | **0.16** | **0.02** | **0.08** |
| 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 =** | **0.01** | **<0.01** | **0.01** |

**Uncaptured Loading Emissions[2]**

| Pollutant | Max. lb/hr | Avg. lb/hr | TPY |
|---|---|---|---|
| **VOC =** | **0.05** | **0.01** | **0.02** |
| 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 =** | **<0.01** | **<0.01** | **<0.01** |

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

**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] 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.

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

[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**
**Ruth Keller Pad**
**Produced Water Truck Loading Emissions - Greenhouse Gases**

**Loading Information**

| | |
|---|---|
| Unit ID: | **EU-LOAD-PW** |
| Emission Point ID: | APC-COMB |
| 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): | 5.3655 |
| Control Type: | Vapor Return/Combustion |
| Vapor Capture Efficiency: [2] | 70.00% |
| Average Fill Rate (gal/hr): | 7,500 |
| Captured Vapors Routed to: | Vapor Combustor |

| | |
|---|---|
| Analysis $CH_4$ wt% = | 51.47913% |
| Analysis $CO_2$ wt% = | 0.29461% |

**Uncontrolled Loading Emissions[3, 4]**

| Pollutant | Max. lb/hr | Avg. lb/hr | tonnes/yr | tons/yr |
|---|---|---|---|---|
| $CH_4$ | 7.75 | 0.63 | 2.51 | 2.77 |
| $CH_4$ as $CO_2e$ | 193.65 | 15.81 | 62.84 | 69.27 |
| $CO_2$ | 0.04 | <0.01 | 0.01 | 0.02 |
| **Total $CO_2$ + $CO_2e$ =** | **193.69** | **15.82** | **62.85** | **69.28** |

**Uncaptured Loading Emissions[3, 4]**

| Pollutant | Max. lb/hr | Avg. lb/hr | tonnes/yr | tons/yr |
|---|---|---|---|---|
| $CH_4$ | 2.32 | 0.19 | 0.75 | 0.83 |
| $CH_4$ as $CO_2e$ | 58.09 | 4.74 | 18.85 | 20.78 |
| $CO_2$ | 0.01 | <0.01 | <0.01 | <0.01 |
| **Total $CO_2$ + $CO_2e$ =** | **58.11** | **4.75** | **18.86** | **20.78** |

**SWN Production Company, LLC**
**Ruth Keller Pad**
**Produced Water Truck Loading Emissions - Greenhouse Gases (Continued)**

**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**
**Ruth Keller Pad**
**Vapor Combustor Emissions Calculations - Criteria and Hazardous Air Pollutants**

**Criteria and Hazardous Air Pollutant Emissions**

| Unit ID | Pollutant | Emission Factors[1] | Total Captured Emissions[2] | | Combustor Destruction Efficiency | Total Controlled Emissions (Post-Capture and Combustion) | |
|---|---|---|---|---|---|---|---|
| | | | lb/hr | TPY | % | lb/hr | TPY |
| APC-COMB | NOx | 0.138 | - | - | - | 2.07 | 9.07 |
| | CO | 0.2755 | - | | - | 4.13 | 18.10 |
| | PM | 7.6 | - | | - | 0.05 | 0.20 |
| | VOC | Mass Balance | 48.78 | 213.65 | 98.00% | 0.98 | 4.27 |
| | n-Hexane | Mass Balance | 2.82 | 12.36 | 98.00% | 0.06 | 0.25 |
| | Benzene | Mass Balance | 0.03 | 0.15 | 98.00% | <0.01 | <0.01 |
| | Toluene | Mass Balance | 0.19 | 0.83 | 98.00% | <0.01 | 0.02 |
| | Ethylbenzene | Mass Balance | 0.21 | 0.90 | 98.00% | <0.01 | 0.02 |
| | Xylenes | Mass Balance | 0.70 | 3.06 | 98.00% | 0.01 | 0.06 |

Notes:

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

| | | |
|---|---|---|
| | Hours per Year: | 8,760 |
| | Number of Combustors: | 1 |
| NOx and CO emission factors (lb/mmBtu): *TCEQ Air Permit Technical Guidance for Chemical Sources: Flares and Vapor Oxidizers:* High Btu waste streams (>1,000 Btu/scf) based on heat input to each combustor = | 15.0 | mmBtu/hr per Combustor |
| | 15.0 | 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. Captured emissions from sources controlled by VOC combustor shown in following tables.

**SWN Production Company, LLC**
**Ruth Keller Pad**
**Vapor Combustor Emissions Calculations - Criteria and Hazardous Air Pollutants (Continued)**

| Source | Captured VOC Emissions | |
|---|---|---|
| | lb/hr | TPY |
| Condensate Storage Tanks | 44.50 | 194.92 |
| Produced Water Storage Tanks | 0.72 | 3.16 |
| Condensate Truck Loading | 3.54 | 15.52 |
| Produced Water Truck Loading | 0.01 | 0.05 |
| **Total VOC =** | **48.78** | **213.65** |

| Source | Captured HAP Emissions (lb/hr) | | | | |
|---|---|---|---|---|---|
| | n-Hexane | Benzene | Toluene | Ethylbenzene | Xylenes |
| Condensate Storage Tanks | 2.57 | 0.03 | 0.17 | 0.19 | 0.64 |
| Produced Water Storage Tanks | 0.04 | <0.01 | <0.01 | <0.01 | 0.01 |
| Condensate Truck Loading | 0.20 | <0.01 | 0.01 | 0.01 | 0.05 |
| Produced Water Truck Loading | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| **Total HAP =** | **2.82** | **0.03** | **0.19** | **0.21** | **0.70** |

| Source | Captured HAP Emissions (TPY) | | | | |
|---|---|---|---|---|---|
| | n-Hexane | Benzene | Toluene | Ethylbenzene | Xylenes |
| Condensate Storage Tanks | 11.27 | 0.14 | 0.76 | 0.82 | 2.79 |
| Produced Water Storage Tanks | 0.18 | <0.01 | 0.01 | 0.01 | 0.05 |
| Condensate Truck Loading | 0.90 | 0.01 | 0.06 | 0.07 | 0.22 |
| Produced Water Truck Loading | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| **Total HAP =** | **12.36** | **0.15** | **0.83** | **0.90** | **3.06** |

**SWN Production Company, LLC**
**Ruth Keller Pad**
**Vapor Combustor Emissions Calculations - Greenhouse Gases**

**Equipment Information**

| | |
|---|---|
| Unit ID: | **APC-COMB** |
| Description: | Vapor Combustor |
| Number of Combustors: | 1 |
| Burner Design Capacity (mmBtu/hr): | 15.0 |
| Stream HHV (Btu/scf): | 2,450 |
| Annual Throughput (mmscf): | 53.63 |
| 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**
**Ruth Keller Pad**
**Vapor Combustor Pilot Emissions Calculations - Criteria Air Pollutants**

**Criteria Air Pollutant Emissions**

| Unit ID | Pollutant | Emission Factors [1] (lb/mmscf) | Emissions lb/hr | Emissions TPY |
|---|---|---|---|---|
| EU-PILOT APC-COMB | NOx | 100 | <0.01 | 0.02 |
| | 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 | Total 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**
**Ruth Keller Pad**
**Vapor Combustor Pilot Emissions Calculations - Hazardous Air Pollutants**

**Hazardous Air Pollutant Emissions**

| Unit ID | Pollutant | Emission Factors [1] (lb/mmscf) | Emissions lb/hr | Emissions TPY |
|---|---|---|---|---|
| EU-PILOT APC-COMB | 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 HAP =** | **<0.01** | **<0.01** |

| | |
|---|---|
| 905 | Pilot Stream Heat Content (Btu/SCF) |
| 8,760 | Pilot Hours/Yr |
| 50 | Total 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**
**Ruth Keller 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 |
| APC-COMB | $CH_4$ | <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 | Total 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**
**Ruth Keller 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 | 61 | 9.92E-03 | 0.00% | 0.61 | 2.65 | 24.18% |
| Flanges - Gas | 282 | 8.60E-04 | 0.00% | 0.24 | 1.06 | 24.18% |
| Compressor Seals - Gas | 9 | 1.94E-02 | 0.00% | 0.17 | 0.76 | 24.18% |
| Relief Valves - Gas | 14 | 1.94E-02 | 0.00% | 0.27 | 1.19 | 24.18% |
| Open-Ended Lines - Gas | 2 | 4.41E-03 | 0.00% | 0.01 | 0.04 | 24.18% |
| **Total TOC (Gas Components) =** | | | | **1.30** | **5.71** | - |
| Valves - Light Oil | 53 | 5.51E-03 | 0.00% | 0.29 | 1.28 | 94.29% |
| Connectors - Light Oil | 206 | 4.63E-04 | 0.00% | 0.10 | 0.42 | 94.29% |
| **Total TOC (Liquid Components) =** | | | | **0.39** | **1.70** | - |

**VOC and Greenhouse Gas Emissions**

| Source Type/Service | VOC | | $CH_4$ | | $CO_2$ | |
|---|---|---|---|---|---|---|
| | lb/hr | TPY | lb/hr | TPY | lb/hr | TPY |
| Valves - Gas | 0.15 | 0.64 | 0.31 | 1.38 | <0.01 | 0.01 |
| Flanges - Gas | 0.06 | 0.26 | 0.13 | 0.55 | <0.01 | <0.01 |
| Compressor Seals - Gas | 0.04 | 0.18 | 0.09 | 0.40 | <0.01 | <0.01 |
| Relief Valves - Gas | 0.07 | 0.29 | 0.14 | 0.62 | <0.01 | <0.01 |
| Open-Ended Lines - Gas | <0.01 | 0.01 | <0.01 | 0.02 | <0.01 | <0.01 |
| **Components in Gas Service =** | **0.31** | **1.38** | **0.68** | **2.97** | **<0.01** | **0.02** |
| Valves - Light Oil | 0.28 | 1.21 | 0.01 | 0.02 | <0.01 | <0.01 |
| Connectors - Light Oil | 0.09 | 0.39 | <0.01 | 0.01 | <0.01 | <0.01 |
| **Components in Liquid Service =** | **0.37** | **1.60** | **0.01** | **0.03** | **<0.01** | **<0.01** |
| **Total (Gas + Liquid Components) =** | **0.68** | **2.98** | **0.68** | **3.00** | **<0.01** | **0.02** |

**SWN Production Company, LLC**
**Ruth Keller 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 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.00 | <0.01 |
| **Components in Gas Service =** | **0.01** | **<0.01** | **<0.01** | **<0.01** | **<0.01** | **0.00** | **0.01** |
| Valves - Light Oil | 0.02 | <0.01 | <0.01 | <0.01 | <0.01 | 0.00 | 0.02 |
| Connectors - Light Oil | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.00 | 0.01 |
| **Components in Liquid Service =** | **0.02** | **<0.01** | **<0.01** | **<0.01** | **0.01** | **0.00** | **0.03** |
| **Total (Gas + Liquid Components) =** | **0.03** | **<0.01** | **<0.01** | **<0.01** | **0.01** | **0.00** | **0.04** |

**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 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.00 | <0.01 |
| **Components in Gas Service =** | **0.02** | **<0.01** | **<0.01** | **<0.01** | **<0.01** | **0.00** | **0.02** |
| Valves - Light Oil | 0.07 | <0.01 | <0.01 | 0.01 | 0.02 | 0.00 | 0.10 |
| Connectors - Light Oil | 0.02 | <0.01 | <0.01 | <0.01 | 0.01 | 0.00 | 0.03 |
| **Components in Liquid Service =** | **0.10** | **<0.01** | **0.01** | **0.01** | **0.02** | **0.00** | **0.14** |
| **Total (Gas + Liquid Components) =** | **0.12** | **<0.01** | **0.01** | **0.01** | **0.02** | **0.00** | **0.16** |

**SWN Production Company, LLC**
**Ruth Keller Pad**
**Fugitive Emissions Calculations (Continued)**

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

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

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

**SWN Production Company, LLC**
**Ruth Keller 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 | 0.04 |
| Methane | 16.042 | 71.427% | 11.458 | 51.479% | 51.968% | 0.68 | 2.97 |
| Ethane | 30.069 | 17.491% | 5.259 | 23.629% | 23.853% | 0.31 | 1.36 |
| Propane | 44.096 | 6.802% | 2.999 | 13.476% | 13.603% | 0.18 | 0.78 |
| i-Butane | 58.122 | 0.668% | 0.388 | 1.744% | 1.761% | 0.02 | 0.10 |
| n-Butane | 58.122 | 1.828% | 1.062 | 4.773% | 4.819% | 0.06 | 0.27 |
| i-Pentane | 72.149 | 0.327% | 0.236 | 1.060% | 1.070% | 0.01 | 0.06 |
| n-Pentane | 72.149 | 0.440% | 0.317 | 1.426% | 1.440% | 0.02 | 0.08 |
| n-Hexane | 86.175 | 0.107% | 0.092 | 0.414% | 0.418% | 0.01 | 0.02 |
| Other Hexanes | 86.175 | 0.135% | 0.116 | 0.523% | 0.528% | 0.01 | 0.03 |
| Heptanes (as n-Heptane) | 100.202 | 0.078% | 0.078 | 0.351% | 0.354% | <0.01 | 0.02 |
| 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%** | **1.31** | **5.76** |
| | | **TOTAL HC =** | **22.05** | **TOTAL VOC =** | **24.18%** | **0.31** | **1.38** |
| | | | | **TOTAL HAP =** | **0.44%** | **0.01** | **0.02** |

**SWN Production Company, LLC**
**Ruth Keller 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 | 0.03 |
| Ethane | 30.069 | 9.965% | 2.996 | 3.870% | 3.871% | 0.01 | 0.07 |
| Propane | 44.096 | 11.708% | 5.163 | 6.668% | 6.669% | 0.03 | 0.11 |
| i-Butane | 58.122 | 2.480% | 1.441 | 1.862% | 1.862% | 0.01 | 0.03 |
| n-Butane | 58.122 | 9.597% | 5.578 | 7.204% | 7.206% | 0.03 | 0.12 |
| i-Pentane | 72.149 | 3.683% | 2.657 | 3.432% | 3.433% | 0.01 | 0.06 |
| n-Pentane | 72.149 | 6.541% | 4.719 | 6.095% | 6.096% | 0.02 | 0.10 |
| n-Hexane | 86.175 | 5.195% | 4.477 | 5.782% | 5.783% | 0.02 | 0.10 |
| Other Hexanes | 86.175 | 5.393% | 4.647 | 6.002% | 6.003% | 0.02 | 0.10 |
| Heptanes (as n-Heptane) | 100.202 | 10.008% | 10.028 | 12.952% | 12.954% | 0.05 | 0.22 |
| 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 | 0.02 |
| 2,2,4-Trimethylpentane | 114.230 | 0.000% | 0.000 | 0.000% | 0.000% | 0.00 | 0.00 |
| Octanes (as n-Octane) | 114.229 | 7.566% | 8.643 | 11.162% | 11.164% | 0.04 | 0.19 |
| Nonanes (as n-Nonane) | 128.255 | 4.597% | 5.896 | 7.615% | 7.616% | 0.03 | 0.13 |
| Decanes (as n-Decane) | 142.282 | 12.619% | 17.955 | 23.190% | 23.193% | 0.09 | 0.39 |
| **TOTAL =** | | **100.00%** | **77.43** | **100.00%** | **100.00%** | **0.39** | **1.70** |
| | | **TOTAL HC =** | **77.41** | **TOTAL VOC =** | **94.29%** | **0.37** | **1.60** |
| | | | | **TOTAL HAP =** | **8.10%** | **0.03** | **0.14** |

Notes:

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

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

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

[4] Gas and liquids analyses located in Attachment L.

**SWN Production Company, LLC**
**Ruth Keller Pad**
**Fugitive Haul Road Emissions**

***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 | 2 | 1 | 4 |
| Distance per round trip (miles/trip) | 0.24 | 0.24 | 0.24 |
| Vehicle miles travelled (miles/day) | 0.48 | 0.24 | 0.96 |
| Number of days operational (days/yr) | 365 | 365 | 365 |
| Vehicle miles travelled VMT (miles/yr) | 175 | 87 | 349 |
| Average vehicle speed S (mph) | 10 | 10 | 10 |
| Average number of round trips/hour/vehicle type | 0.11 | 0.05 | 0.22 |
| Average number of round trips/year/vehicle type | 720 | 360 | 1,441 |
| Estimated maximum number of round trips/hour/vehicle type | 3 | 3 | 2 |
| Estimated maximum number of round trips/day/vehicle type | 6 | 4 | 6 |
| Estimated maximum number of round trips/year/vehicle type | 2,300 | 1,533 | 2,279 |

| | |
|---|---|
| 190 | Average Tanker Volume (bbl) |
| 7,980 | Gallons Tanker Volume |
| 350 | bwpd |
| 400 | bopd |
| 3.95 | Tanker Trucks per Day |
| 225 | Length Leased Access Road (ft) |
| 415 | Longest Pad Side (ft) |
| 1,280 | 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) | 0.09 | VMT/hr | |
| Total annual fleet vehicle miles travelled (miles/yr)[3] | 611.24 | VMT/yr | |
| Average wheels[4] | 13 | | |
| Average vehicle weight of the fleet (W)[5] | 16.1 | 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

**SWN Production Company, LLC**
**Ruth Keller Pad**
**Fugitive Haul Road Emissions (Continued)**

| Vehicle Type | Emission Factors | | | Control Efficiency | Total Vehicle Miles Travelled | | Emission Rates | | | Emission Rates | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PM | $PM_{10}$ | $PM_{2.5}$ | | | | Total PM | Total $PM_{10}$ | $PM_{2.5}$ | Total PM | Total $PM_{10}$ | $PM_{2.5}$ |
| | (lbs/VMT) | (lbs/VMT) | (lbs/VMT) | (%) | (VMT/hr) | (VMT/yr) | (lb/hr) | (lb/hr) | (lb/hr) | (tons/yr) | (tons/yr) | (tons/yr) |
| Light Vehicles | 2.80 | 0.69 | 0.07 | 0.00 | 0.03 | 174.64 | 0.07 | 0.02 | <0.01 | 0.24 | 0.06 | 0.01 |
| Medium Trucks | 2.80 | 0.69 | 0.07 | 0.00 | 0.01 | 87.32 | 0.04 | 0.01 | <0.01 | 0.12 | 0.03 | <0.01 |
| Heavy Trucks | 2.80 | 0.69 | 0.07 | 0.00 | 0.05 | 349.28 | 0.15 | 0.04 | <0.01 | 0.49 | 0.12 | 0.01 |
| | | | **Total =** | **0.00** | **0.09** | **611.24** | **0.26** | **0.06** | **0.01** | **0.86** | **0.21** | **0.02** |

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 U: FACILITY-WIDE EMISSION SUMMARY SHEETS

## ATTACHMENT U – FACILITY-WIDE CONTROLLED EMISSIONS SUMMARY SHEET

List all sources of emissions in this table. Use extra pages if necessary.

| Emission Point ID # | $NO_X$ | | CO | | VOC | | $SO_2$ | | $PM_{10}$ | | $PM_{2.5}$ | | CH4 | | GHG ($CO_2e$) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | lb/hr | tpy | lb/hr | tpy | lb/hr | tpy | lb/hr | tpy | lb/hr | tpy | lb/hr | tpy | lb/hr | tpy | lb/hr | tpy |
| EP-ENG1 | 0.32 | 1.40 | 0.64 | 2.80 | 0.31 | 1.36 | <0.01 | <0.01 | 0.02 | 0.11 | 0.02 | 0.11 | <0.01 | 0.01 | 155.19 | 679.73 |
| EP-ENG2 | 0.32 | 1.40 | 0.64 | 2.80 | 0.31 | 1.36 | <0.01 | <0.01 | 0.02 | 0.11 | 0.02 | 0.11 | <0.01 | 0.01 | 155.19 | 679.73 |
| EP-ENG3 | 0.46 | 2.01 | 0.75 | 3.27 | 0.46 | 2.01 | <0.01 | <0.01 | 0.01 | 0.05 | 0.01 | 0.05 | 0.37 | 1.60 | 84.06 | 368.19 |
| EP-GPU1 | 0.11 | 0.48 | 0.09 | 0.41 | 0.01 | 0.03 | <0.01 | <0.01 | 0.01 | 0.04 | 0.01 | 0.04 | <0.01 | 0.01 | 117.10 | 512.89 |
| EP-HT1 | 0.06 | 0.24 | 0.05 | 0.20 | <0.01 | 0.01 | <0.01 | <0.01 | <0.01 | 0.02 | <0.01 | 0.02 | <0.01 | <0.01 | 58.55 | 256.44 |
| EP-RB1 | - | - | - | - | 2.99 | 13.09 | - | - | - | - | - | - | 0.41 | 1.78 | 10.18 | 44.59 |
| EP-RB1 | 0.08 | 0.36 | 0.07 | 0.30 | <0.01 | 0.02 | <0.01 | <0.01 | 0.01 | 0.03 | 0.01 | 0.03 | <0.01 | 0.01 | 87.82 | 384.67 |
| EP-LOAD-COND | - | - | - | - | 1.52 | 6.65 | - | - | - | - | - | - | 0.22 | 0.95 | 5.42 | 23.75 |
| EP-LOAD-PW | - | - | - | - | 0.01 | 0.02 | - | - | - | - | - | - | 0.19 | 0.83 | 4.75 | 20.78 |
| APC-COMB | 2.08 | 9.09 | 4.14 | 18.12 | 0.98 | 4.27 | <0.01 | <0.01 | 0.05 | 0.21 | 0.05 | 0.21 | 0.03 | 0.15 | 1,761.77 | 7,716.54 |
| | | | | | | | | | | | | | | | | |
| **TOTAL** | 3.42 | 14.99 | 6.37 | 27.91 | 6.58 | 28.83 | <0.01 | 0.01 | 0.13 | 0.56 | 0.13 | 0.56 | 1.22 | 5.36 | 2,498.58 | 10,943.75 |

Annual emissions shall be based on 8,760 hours per year of operation for all emission units except emergency generators.

According to 45CSR14 Section 2.43.e, fugitive emissions are not included in the major source determination because it is not listed as one of the source categories in Table 1. Therefore, fugitive emissions shall not be included in the PTE above.

*Note that the emissions from the APC-COMB includes uncombusted emissions from the uncombusted emissions from the tanks and loading operations, as well as combustor pilot emissions.*

| ATTACHMENT U – FACILITY-WIDE HAP CONTROLLED EMISSIONS SUMMARY SHEET | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| List all sources of emissions in this table. Use extra pages if necessary. | | | | | | | | | | | | | | |
| Emission Point ID # | Formaldehyde | | Benzene | | Toluene | | Ethylbenzene | | Xylenes | | Hexane | | Total HAPs | |
| | lb/hr | tpy | lb/hr | tpy | lb/hr | tpy | lb/hr | tpy | lb/hr | tpy | lb/hr | tpy | lb/hr | tpy |
| EP-ENG1 | 0.09 | 0.38 | <0.01 | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | - | - | 0.10 | 0.44 |
| EP-ENG2 | 0.09 | 0.38 | <0.01 | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | - | - | 0.10 | 0.44 |
| EP-ENG3 | 0.05 | 0.20 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | - | - | 0.05 | 0.23 |
| EP-GPU1 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | - | - | - | - | <0.01 | 0.01 | <0.01 | 0.01 |
| EP-HT1 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | - | - | - | - | <0.01 | <0.01 | <0.01 | <0.01 |
| EP-RB1 | - | - | 0.11 | 0.49 | 0.18 | 0.77 | 0.00 | 0.00 | 0.05 | 0.24 | 0.12 | 0.51 | 0.46 | 2.02 |
| EP-RB1 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | - | - | - | - | <0.01 | 0.01 | <0.01 | 0.01 |
| EP-LOAD-COND | - | - | <0.01 | <0.01 | 0.01 | 0.03 | 0.01 | 0.03 | 0.02 | 0.10 | 0.09 | 0.38 | 0.12 | 0.54 |
| EP-LOAD-PW | - | - | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| APC-COMB | <0.01 | <0.01 | <0.01 | 0.01 | 0.01 | 0.04 | 0.01 | 0.05 | 0.04 | 0.16 | 0.14 | 0.63 | 0.20 | 0.89 |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| **TOTAL** | 0.22 | 0.96 | 0.12 | 0.52 | 0.19 | 0.83 | 0.01 | 0.05 | 0.09 | 0.40 | 0.27 | 1.17 | 0.92 | 4.03 |

Annual emissions shall be based on 8,760 hours per year of operation for all emission units except emergency generators.

According to 45CSR14 Section 2.43.e, fugitive emissions are not included in the major source determination because it is not listed as one of the source categories in Table 1. Therefore, fugitive emissions shall not be included in the PTE above.

*Note that the emissions from the APC-COMB includes uncombusted emissions from the uncombusted emissions from the tanks and loading operations, as well as combustor pilot emissions.*

# ATTACHMENT V: LEGAL ADVERTISEMENT

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

**AIR QUALITY PERMIT NOTICE**
**Notice of Application**

Notice is given that SWN Production Company, LLC has applied to the West Virginia Department of Environmental Protection, Division of Air Quality, for a G70-D General Permit Registration for a natural gas production facility (Ruth Keller Pad) located in Marshall County, West Virginia. From I-470 east take exit 2 and turn right, (or 470 west, turn left), on CR-91/1 south, (Spruce St), for 0.46 miles to intersection of CR-91/1 and SR-88 (Ridgecrest Road). Turn right on SR-88 south and travel 4.15 miles to junction of SR-88 and SR-86, (Grandview Road), and turn right on SR-86. Travel SR-86 for 1.2 miles with access road on left. Latitude/longitude coordinates are: 39.98601, -80.69714.

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

| | |
|---|---|
| Nitrogen Oxides (NOx) | 13.59 tons/yr |
| Carbon Monoxide (CO) | 25.11 tons/yr |
| Volatile Organic Compounds (VOC) | 30.19 tons/yr |
| Sulfur Dioxide ($SO_2$) | 0.01 tons/yr |
| Particulate Matter (PM) | 1.31 tons/yr |
| Acetaldehyde | 0.02 tons/yr |
| Acrolein | 0.02 tons/yr |
| Benzene | 0.52 tons/yr |
| Ethylbenzene | 0.05 tons/yr |
| Formaldehyde | 0.44 tons/yr |
| Methanol | 0.03 tons/yr |
| n-Hexane | 1.28 tons/yr |
| Toluene | 0.83 tons/yr |
| Xylenes | 0.42 tons/yr |
| Carbon Dioxide | 10,124.66 tons/yr |
| Methane | 6.39 tons/yr |
| Nitrous Oxide | 0.02 tons/yr |
| $CO_2$ Equivalent | 10,290.19 tons/yr |

Operations is planned to begin on or about June 15, 2017. Written comments will be received by the West Virginia Department of Environmental Protection, Division of Air Quality, 601 57th Street, SE, Charleston, WV 25304, for at least 30 calendar days from the date of publication of this notice. Any questions regarding this permit application should be directed to the DAQ at (304) 926-0499, extension 1250, during normal business hours.

Dated this the XXth of April 2017

By: SWN Production Company, LLC
Carla Suszkowski, P.E.
Regulatory Manager – West Virginia Division
10000 Energy Drive
Spring, TX 77389