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TEL: (412) 395-3654

Mark A. Sowa
Senior Environmental Coordinator

CERTIFIED MAIL # 7017 1070 0000 4379 0741

September 18, 2018

William F. Durham, Director
WVDEP, Division of Air Quality
601 57th Street SE
Charleston, WV 25304

Re: EQM Gathering Opco, LLC – Janus Compressor Station
Facility ID No: 017-00158
Initial Title V Permit Application

Dear Mr. Durham:

EQM Gathering Opco, LLC (EQM) is submitting this initial Title V Operating Permit (TVOP) application to the West Virginia Department of Environmental Protection (WVDEP) for the continued operation of its existing compressor station located in Doddridge County, West Virginia. The Station currently operates under Permit No. R13-3269B.

Please contact me at 412-395-3654 or via email at msowa@eqt.com for payment of the application fee by credit card or if you have any questions regarding this application

Sincerely,

Mark A. Sowa
Senior Environmental Coordinator

PROJECT REPORT

EQM Gathering Opco, LLC > Janus Compressor Station

Initial Title V Operating Permit Application

TRINITY CONSULTANTS
4500 Brooktree Drive
Suite 103
Wexford, PA 15090
(724) 935-2611

September 2018

Trinity Consultants

Environmental solutions delivered uncommonly well

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EQM Gathering Opco, LLC (EQM) is submitting this initial Title V Operating Permit (TVOP) application to the West Virginia Department of Environmental Protection (WVDEP) for the continued operation of its existing compressor station located in Doddridge County, West Virginia (Janus Compressor Station). The Station currently operates under R13 Permit No. R13-3269B.

1.1. FACILITY AND PROJECT DESCRIPTION

The Janus Compressor Station is an existing natural gas gathering facility. Natural gas and liquids (mostly produced water) from nearby wells undergoes compression and dehydration before it is transported to a gas gathering line.

The station currently consists of the following equipment:

- Four (4) Caterpillar G3616 compressor engines, each rated at 5,350 bhp and equipped with oxidation catalysts;
- Five (5) C200 Capstone microturbines, each rated at 200 kW;
- Two (2) fuel gas heaters (rated at 1.15 MMBtu/hr and 0.77 MMBtu/hr);
- Two (2) triethylene glycol (TEG) dehydration units rated at 152 million standard cubic feet per day (MMSCFD) with associated reboilers (rated at 2.31 MMBtu/hr heat input) and controlled by enclosed flares (each rated at 7.0 MMBtu/hr);
- Two (2) produced fluid tanks (210 bbl each) controlled by a tank enclosed flare (rated at 41 MMBtu/hr);
- Miscellaneous storage tanks; and
- Associated piping components.

A process flow diagram is included as Attachment C.

1.2. SOURCE STATUS

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

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

Other additional pollutant emitting facilities should be aggregated with the Janus Compressor Station for air permitting purposes if and only if all three elements of the "stationary source" definition above are fulfilled. The Janus Compressor Station has previously been determined to be a separate stationary source with respect to permitting programs, including Title V and Prevention of Significant Deterioration, and has not been aggregated with other sources. No changes have been made since the last determination.

The Janus Compressor Station's site-wide potential to emit currently exceeds the Title V major source thresholds for several pollutants. Refer to Section 3 for detailed discussion regarding applicable requirements and compliance demonstration methodology.

1.3. TITLE V APPLICATION ORGANIZATION

This West Virginia Initial Title V permit application is organized as follows:

- Section 2: Sample Emission Source Calculations;
- Section 3: Regulatory Discussion;
- Section 4: Title V Application Form;
- Attachment A: Area Map;
- Attachment B: Plot Plan;
- Attachment C: Process Flow Diagram;
- Attachment D: Equipment Table;
- Attachment E: Emission Unit Forms;
- Attachment F: Schedule of Compliance Forms *(Not applicable)*;
- Attachment G: Air Pollution Control Device Forms;
- Attachment H: Compliance Assurance Monitoring Forms *(Not applicable)*;
- Attachment I: Emission Calculations; and
- Application Fee.

2. SAMPLE EMISSION SOURCE CALCULATIONS

The characteristics of air emissions from the Janus Compressor Station, along with the methodology for calculating emissions, are briefly described in this section of the application. Detailed emission calculations are presented in Attachment I of this application. Emissions from the facility result from combustion of natural gas in the compressor engines, microturbines, heaters, combustion of gases in the enclosed flares, and reboilers. Emissions also result from the storage of produced fluids, operation of the dehydrator units, and fugitive emissions from component leaks. The methods by which emissions from each of these source types is calculated are summarized below. Note that in some instances, R13 permit limits were used in the facility-wide summary.

- **Compressor Engines:** Potential emissions of nitrogen oxides (NO_x), carbon monoxide (CO), volatile organic compounds (VOC), formaldehyde, and greenhouse gases (GHGs) are calculated using factors provided by the engine manufacturer and the oxidation catalyst manufacturer where available. Potential emissions of other criteria pollutants and all other hazardous air pollutants (HAPs) are calculated using U.S. EPA's AP-42 factors for natural gas-fired engines.[1] When needed, calculations assume a site-specific heat content of natural gas.

- **Fuel Gas Heaters and Reboilers:** Potential emissions of criteria pollutants and HAPs are calculated using U.S. EPA's AP-42 factors for natural gas external combustion.[2] These calculations assume a site-specific heat content of natural gas. Greenhouse gas emissions are calculated according to 40 CFR 98 Subpart C.[3]

- **Microturbine Generators:** Potential emissions of NO_x, CO, VOC, and CO_2 are calculated using manufacturer's emission data. Emissions of all other criteria pollutants and HAPs are calculated using U.S. EPA's AP-42 factors for stationary gas turbines.[4] These calculations use a site specific heat content. Emissions of CH_4 and N_2O are calculated according to 40 CFR 98 Subpart C.

- **TEG Dehydration Units:** Potential emissions of HAPs, VOC, and methane from the dehydration unit are calculated using GRI-GLYCalc v4.0.

- **Enclosed Flares:** Potential emissions from the enclosed flares for all criteria pollutants and HAPs are calculated using U.S. EPA's AP-42 factors for natural gas combustion equipment. These calculations assume a site-specific heat content of natural gas. Greenhouse gas emissions are calculated according to 40 CFR 98 Subpart C.

- **Produced Fluid Tanks:** Potential emissions from the storage tanks are calculated using Bryan Research Engineering ProMax Software. The condensate throughput used in the program is assumed to be to 10% of the total throughput of produced fluids through the storage tank.

- **Miscellaneous Storage Tanks:** Working and breathing losses from the small storage tanks were calculated using EPA Tanks 4.0.9d.

- **Fugitive Emissions:** Emissions from fugitive equipment leaks are calculated using published EPA emission factors and 40 CFR Part 98, Subpart W emission factors. Emissions from blowdown events are calculated using emissions from blowdown events are calculated using engineering estimates of the amount of gas vented during each event. Site specific gas analyses were used to speciate VOC, HAP, and GHG emissions.

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[1] U.S. EPA, AP 42, Fifth Edition, Volume I, Chapter 3.2, *Natural Gas-Fired Reciprocating Engine*, July 2000.
[2] U.S. EPA, AP 42, Fifth Edition, Volume I, Chapter 1.4, Natural Gas Combustion, Supplement D, July 1998.
[3] 40 CFR 98 Subpart C, *General Stationary Fuel combustion Sources*, Tables C-1 and C-2.
[4] U.S. EPA, AP-42, Fifth Edition, Volume 1, Chapter 3.1, Stationary Gas Turbines, April 2000.

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

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

This review is presented to supplement and/or add clarification to the information provided in the Title V operating permit application forms, which fulfill the requirement to include citations and descriptions of applicable statutory and administrative code requirements.

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

3.1. PSD AND NNSR SOURCE CLASSIFICATION

Federal construction permitting programs regulate new and modified sources of attainment pollutants under Prevention of Significant Deterioration and new and modified sources of non-attainment pollutants under Non-Attainment New Source Review.

PSD regulations apply when a new source is constructed in which emissions exceed major source thresholds, an existing minor source undergoes a modification in which emission increases exceed PSD major source thresholds, or an existing major source undergoes a modification in which emission increases exceed PSD significant emission rates. The Janus Station is considered an existing minor source with respect to PSD.

NNSR regulations only apply in areas designated as non-attainment. The Janus Station is located in Doddridge County, which is designated as attainment/unclassifiable for all criteria pollutants.[5] Therefore, NNSR regulations do not apply to the Janus Station.

3.2. TITLE V OPERATING PERMIT PROGRAM

Title 40 of the Code of Federal Regulations Part 70 (40 CFR 70) establishes the federal Title V operating permit program. West Virginia has incorporated the provisions of this federal program in its Title V operating permit program in West Virginia Code of State Regulations (CSR) 45-30. The major source thresholds with respect to the West Virginia Title V operating permit program regulations are 10 tons per year (tpy) of a single HAP, 25 tpy of any

[5] U.S. EPA Greenbook, http://www.epa.gov/airquality/greenbook/anayo_wv.html, as of June 20, 2017.

combination of HAP, and 100 tpy of all other regulated pollutants. Potential emissions of NO_X exceed the major source thresholds. Therefore, the Janus Compressor Station is a major source with respect to the Title V Program. EQM is submitting this Title V operating permit application in accordance with 40 CFR 70.5(a)(1) and 45 CSR 30 4.1.a.2 within 12 months of start-up of the authorized equipment under the current R13 permit.

3.3. COMPLIANCE ASSURANCE MONITORING

Under 40 CFR 64 (CAM), facilities are required to prepare and submit monitoring plans for certain emissions units with the initial or renewal Title V operating permit application. CAM Plans are intended to provide an on-going and reasonable assurance of compliance with emission limits for sources that utilize active control devices. As there are no units with post-control potential emissions greater than the major source thresholds, the regulatory requirement for addressing CAM is to do so at the time of the first Title V Operating Permit renewal, per 64.5(b). Since this application is an initial application for a Title V Operating Permit, CAM is not required to be addressed. CAM for the Janus station will be addressed accordingly during the facility's first Title V Operating Permit renewal.

3.4. NEW SOURCE PERFORMANCE STANDARDS

New Source Performance Standards, located in 40 CFR 60, require new, modified, or reconstructed sources to control emissions to the level achievable by the best demonstrated technology as specified in the applicable provisions. Moreover, any source subject to an NSPS is also subject to the general provisions of NSPS Subpart A, except where expressly noted. The following is a summary of applicability and non-applicability determinations for NSPS regulations of relevance to the facility.

3.4.1. NSPS Subparts D, Da, Db, and Dc - Steam Generating Units

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

3.4.2. NSPS Subpart GG - Stationary Gas Turbines

This subpart applies to stationary gas turbines with a heat input at peak load equal to or greater than 10 MMBtu/hr, based on the lower heating value of the fuel, commencing construction after October 3, 1977. The microturbines at the station have a heat input rating less than 10 MMbtu/hr, therefore the requirements of this subpart do not apply.

3.4.3. NSPS Subpart IIII - Stationary Compression Ignition Internal Combustion Engines

This subpart applies to manufacturers, owners, and operators of stationary compression ignition internal combustion engines (CI ICE) that have been constructed, reconstructed, or modified after various dates, the earliest of which is July 11, 2005. The compressor engines at the Janus Compressor Station are spark-ignition internal combustion engines. Therefore the requirements of this subpart do not apply.

3.4.4. NSPS Subpart JJJJ - Stationary Spark Ignition Internal Combustion Engines

New Source Performance Standards 40 CFR Part 60 Subpart JJJJ affects owners and operators of stationary spark ignition internal combustion engines (SI ICE) that commence construction, reconstruction or modification after June 12, 2006. Applicability dates are based on the date the engine was ordered by the operator. The engines at the Janus Compressor Station are 4-stroke, lean burn spark ignition RICE (each rated at >500 hp) manufactured after July 1, 2007. The engines are equipped with oxidation catalysts reduce CO, formaldehyde and VOC emissions. The engines are subject to the emission standards per Table 1 of NSPS JJJJ non-emergency use engines and will be in compliance with the NSPS JJJJ limits.

EQM will continue to demonstrate compliance with this subpart for all non-certified engines at the Janus Compressor Station in accordance with 40 CFR 60.4243(b)(2)(ii) which requires EQM to keep a maintenance plan and records of conducted maintenance and to maintain and operate the engines, to the extent practicable, in a manner consistent with good air pollution control practices for minimizing emissions. Additionally, EQM is required to conduct compliance testing every 8,760 hours or three years, whichever comes first, to demonstrate continued compliance. Testing will be conducted in accordance with 40 CFR §60.4244.

Records of all notifications submitted to comply with this subpart, maintenance conducted on the engines, and performance testing will be maintained in accordance with 40 CFR §60.4245(a). Performance testing results will be reported as required in 40 CFR §60.4245(d).

3.4.5. NSPS Subparts K, Ka, and Kb - Storage Vessels

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

3.4.6. NSPS Subpart OOOO – Crude Oil and Natural Gas Production, Transmission, and Distribution

Subpart OOOO, Standards of Performance for Crude Oil and Natural Gas Production, Transmission, and Distribution, applies to affected facilities that commenced construction, reconstruction, or modification after August 23, 2011 and or before September 18, 2015. This NSPS was published in the Federal Register on August 16, 2012, and subsequently amended. The Janus compressor station commenced construction after the applicability date of this subpart, and as such the affected source categories under NSPS Subpart OOOO will not subject to this subpart.

3.4.7. NSPS Subpart OOOOa – Crude Oil and Natural Gas Facilities

Subpart OOOOa, Standards of Performance for Crude Oil and Natural Gas Facilities, applies to affected facilities that commenced construction, reconstruction, or modification after September 18, 2015. The regulation was published final in the Federal Register on June 3, 2016. The rule includes provisions for the following facilities:

- Hydraulically fractured wells;
- Centrifugal compressors located between the wellhead and the point of custody transfer to the natural gas distribution segment;
- Reciprocating compressors located between the wellhead and the point of custody transfer to the natural gas distribution segment;
- Continuous bleed natural gas-driven pneumatic controllers with a bleed rate of > 6 scfh located in the production, gathering, processing, or transmission and storage segments (excluding natural gas processing plants);
- Continuous bleed natural gas-driven pneumatic controllers located at natural gas processing plants;
- Pneumatic pumps located in the production, gathering, processing, or transmission and storage segments;
- Storage vessels located in the production, gathering, processing, or transmission and storage segments;
- The collection of fugitive emissions components at a well site;
- The collection of fugitive emissions components at a compressor station; and
- Sweetening units located onshore that process natural gas produced from s

The Janus Compressor Station is not a gas wellhead, nor is it a natural gas processing plant. Therefore, the only potentially applicable requirements for the equipment at the station are those for storage vessels, reciprocating

compressors, fugitive components and pneumatic controllers, where construction commenced after September 18, 2015.

Storage vessel affected facilities under Subpart OOOOa are those with VOC emissions equal to or greater than 6 tpy. The storage vessels at the facility each have potential VOC emissions limited to less than 6 tpy by a permit limit and, therefore, are not storage vessel affected facilities under the rule.

The reciprocating compressors at the facility are subject to the rule per §60.5385a, and must change the rod packing prior to operating 26,000 hours or prior to 36 months of the last packing change (or start up). EQM will continue to comply with the requirements of this rule.

Pneumatic controller affected facilities under Subpart OOOOa are those with a continuous natural gas bleed rate greater than 6 standard cubic feet per hour. All pneumatics at the facility are either intermittent bleed, air powered or low bleed (less than 6 scf per hour). As such, they are not pneumatic controller affected facilities under the rule.

The collection of fugitive components at the compressor station is an affected facility (subject to leak detection and repair or 'LDAR') based on commence construction date. Therefore, EQM will be required to monitor all fugitive emission components (ex. connectors, flanges, etc.) with an optical gas imaging (OGI) device, and repair all sources of fugitive emissions in accordance with the rule. EQM must also develop a monitoring plan, and conduct surveys on a quarterly basis. EQM is also subject to the applicable recordkeeping and reporting requirements of the rule.

3.4.8. Non-Applicability of All Other NSPS

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

3.5. NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS

Part 63 NESHAP allowable emission limits are established on the basis of a maximum achievable control technology (MACT) determination for a particular major source. A HAP major source is defined as having potential emissions in excess of 25 tpy for total HAP and/or potential emissions in excess of 10 tpy for any individual HAP. The Janus Compressor Station is an Area (minor) source of HAP since its potential emissions of HAP are less than the 10/25 major source thresholds. NESHAP apply to sources in specifically regulated industrial source categories (Clean Air Act Section 112(d)) or on a case-by-case basis (Section 112(g)) for facilities not regulated as a specific industrial source type. The potential applicability of specific MACT standards to the Janus Compressor Station is discussed below.

3.5.1. NESHAP Subpart HH - Oil and Natural Gas Production Facilities

This MACT standard contains requirements for both major and area sources of HAP. The benzene emissions from the existing glycol dehydrator vents are less than 0.90 megagrams per year (1 tpy) each, therefore, the Janus Compressor Station is exempt from the requirements of NESHAP Subpart HH pursuant to 40 CFR §63.764(e)(1)(ii), except for the requirement to keep records of the actual average natural gas flow rate or actual average benzene emissions from the dehydrator, per 40 CFR §63.774(d)(1). EQM will continue to comply with the requirements of Subpart HH as outlined in the current R13 permit.

3.5.2. NESHAP Subpart HHH - Natural Gas Transmission and Storage Facilities

Glycol dehydration units are potentially subject to Subpart HHH, NESHAP from Natural Gas Transmission and Storage Facilities. This standard applies to such units at natural gas transmission and storage facilities that are major sources of HAP emissions located downstream of the point of custody transfer (after processing and/or treatment in the

production sector), but upstream of the distribution sector. The Janus Station is a gathering station and is not a transmission or storage facility. As such, the requirements of this subpart do not apply to the station.

3.5.3. NESHAP Subpart ZZZZ - Stationary Reciprocating Internal Combustion Engines

This MACT subpart applies to stationary reciprocating combustion engines (RICE) at major and area sources of HAP. The Caterpillar G3616 compressor engines at the Janus Compressor Station are classified as new spark ignition engines at an area (minor) source of HAP. 40 CFR §63.6590(c) states that a new or reconstructed stationary reciprocating internal combustion engines (RICE) located at an area HAP source must meet the requirements of NESHAP Subpart ZZZZ by meeting the requirements of NSPS Subpart JJJJ. No further requirements apply for such engines under NESHAP Subpart ZZZZ. EQM will be in compliance with applicable requirements of 40 CFR 63 Subpart ZZZZ by meeting the applicable requirements of 40 CFR 60 Subpart JJJJ

3.5.4. NESHAP Subpart JJJJJJ - Industrial, Commercial, and Institutional Boilers

This MACT standard applies to industrial, commercial, and institutional boilers of various sizes and fuel types at area sources of HAP. The reboilers and fuel gas heaters at the Janus Station are natural gas-fired and are specifically exempt from this subpart. Therefore, no sources at the Janus Station are subject to any requirements under 40 CFR 63 Subpart JJJJJJ.

3.6. WEST VIRGINIA SIP REGULATIONS

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

3.6.1. 45 CSR 2: To Prevent and Control Particulate Air Pollution from Combustion of Fuel in Indirect Heat Exchangers

45 CSR 2 applies to fuel burning units, defined as equipment burning fuel "for the primary purpose of producing heat or power by indirect heat transfer". The reboilers and fuel gas heaters are fuel burning units and therefore must comply with this regulation. Per 45 CSR 2-3, opacity of emissions from units shall not exceed 10 percent, based on a six-minute block average. Per 45 CSR 2-4, PM emissions from the units will not exceed a level measured in lb/hr of 0.09 multiplied by the heat design inputs in MMBtu/hr.

3.6.2. 45 CSR 4: To Prevent and Control the Discharge of Air Pollutants into the Air Which Causes or Contributes to an Objectionable Odor

According to 45 CSR 4-3:

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

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

3.6.3. 45 CSR 6: Control of Air Pollution from the Combustion of Refuse

45 CSR 6 applies to activities involving incineration of refuse, defined as "the destruction of combustible refuse by burning in a furnace designed for that purpose. For the purposes of this rule, the destruction of any combustible liquid or gaseous material by burning in a flare or flare stack, thermal oxidizer or thermal catalytic oxidizer stack shall

be considered incineration." The enclosed flares are incinerators and therefore must comply with this regulation. Per 45 CSR 6-4.3, opacity of emissions from these units shall not exceed 20 percent, except as provided by 4.4. PM emissions from this unit will not exceed the levels calculated in accordance with 6-4.1.

3.6.4. 45 CSR 10: To Prevent and Control Air Pollution from the Emission of Sulfur Oxides

This rule potentially applies to fuel burning units, including glycol dehydration unit reboilers and fuel gas heaters. Per 45 CSR 10-10.1, units rated less than 10 MMBtu/hr are exempt from the SO_2 emission limitations and testing, monitoring, recordkeeping, and reporting requirements of this rule. The reboilers and fuel gas heaters at the station are each rated less than 10 MMBtu/hr and as such are exempt from this rule.

3.6.5. 45 CSR 16: Standards of Performance for New Stationary Sources

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

3.6.6. 45 CSR 17: To Prevent and Control Particulate Matter Air Pollution from Materials Handling, Preparation, Storage and Other Sources of Fugitive Particulate Matter

According to 45 CSR 17-3.1:

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

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

3.6.7. 45 CSR 21-28: Petroleum Liquid Storage in Fixed Roof Tanks

45 CSR 21-28 applies to any fixed roof petroleum liquid storage tank with a capacity greater than 40,000 gallons located in Putnam County, Kanawha County, Cabell County, Wayne County, and Wood County. The capacity of each storage tank at Janus is less than 40,000 gallons and the facility is not located in a listed county. Therefore, 45 CSR 21-28 does not apply to the storage tanks at this station.

3.6.8. 45 CSR 34: Emissions Standards for Hazardous Air Pollutants

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

3.6.9. Non-Applicability of Other SIP Rules

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

4. TITLE V APPLICATION FORMS

The WVDEP permit application forms contained in this application include all applicable Title V application forms including the required attachments.

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

INITIAL/RENEWAL TITLE V PERMIT APPLICATION - GENERAL FORMS

Section 1: General Information

1. **Name of Applicant (As registered with the WV Secretary of State's Office):** EQM Gathering Opco, LLC	2. **Facility Name or Location:** Janus Compressor Station
3. **DAQ Plant ID No.:** 017-00158	4. **Federal Employer ID No. (FEIN):** 32-0422322

5. **Permit Application Type:**

☒ Initial Permit **(Initial Title V)** When did operations commence? 2016
☐ Permit Renewal What is the expiration date of the existing permit?
☐ Update to Initial/Renewal Permit Application

6. **Type of Business Entity:** ☐ Corporation ☐ Governmental Agency ☒ LLC ☐ Partnership ☐ Limited Partnership	7. **Is the Applicant the:** ☐ Owner ☐ Operator ☒ Both If the Applicant is not both the owner and operator, please provide the name and address of the other party. _____ _____ _____
8. **Number of onsite employees:** 0	

9. **Governmental Code:**

☒ Privately owned and operated; 0
☐ Federally owned and operated; 1
☐ State government owned and operated; 2
☐ County government owned and operated; 3
☐ Municipality government owned and operated; 4
☐ District government owned and operated; 5

10. **Business Confidentiality Claims**

Does this application include confidential information (per 45CSR31)? ☐ Yes ☒ No

If yes, identify each segment of information on each page that is submitted as confidential, and provide justification for each segment claimed confidential, including the criteria under 45CSR§31-4.1, and in accordance with the DAQ's *"PRECAUTIONARY NOTICE-CLAIMS OF CONFIDENTIALITY"* guidance.

11. Mailing Address		
Street or P.O. Box: 625 Liberty Avenue, Suite 1700		
City: Pittsburgh	**State:** PA	**Zip:** 15222
Telephone Number: (412) 395-3654	**Fax Number:** ( ) -	

12. Facility Location		
Street: Arnold's Creek Road	**City:** West Union	**County:** Doddridge
UTM Easting: 516.776 km	**UTM Northing:** 4,345.401 km	**Zone:** ☒ 17 or ☐ 18
Directions: Turn south off of RT 50 at MM 50.5 onto Arnolds Creek Rd. (Rt 11). Bear left in 0.7 miles onto Left Fork Run Rd. (RT 11/4). Turn right in 0.9 miles onto station road and proceed 0.9 miles up the hill to the Janus Station..		
Portable Source? ☐ Yes ☒ No		
Is facility located within a nonattainment area? ☐ Yes ☒ No		**If yes, for what air pollutants?**
Is facility located within 50 miles of another state? ☒ Yes ☐ No		**If yes, name the affected state(s).** Ohio Pennsylvania
Is facility located within 100 km of a Class I Area[1]? ☐ Yes ☒ No **If no, do emissions impact a Class I Area[1]?** ☐ Yes ☒ No		**If yes, name the area(s).**
[1] *Class I areas include Dolly Sods and Otter Creek Wilderness Areas in West Virginia, and Shenandoah National Park and James River Face Wilderness Area in Virginia.*		

13. Contact Information		
Responsible Official: Clifford W. Baker		**Title:** Sr. Vice President
Street or P.O. Box: 625 Liberty Avenue, Suite 1700		
City: Pittsburgh	**State:** PA	**Zip:** 15222
Telephone Number: ( ) -	**Fax Number:** ( ) -	
E-mail address: cbaker@eqt.com		
Environmental Contact: Mark A. Sowa		**Title:** Sr. Environmental Coordinator
Street or P.O. Box: 625 Liberty Avenue, Suite 1700		
City: Pittsburgh	**State:** PA	**Zip:** 15222
Telephone Number: (412) 395-3654	**Fax Number:** ( ) -	
E-mail address: msowa@eqt.com		
Application Preparer: Tom Muscenti		**Title:** Principal Consultant
Company: Trinity Consultants		
Street or P.O. Box: 4500 Brooktree Road, Suite 103		
City: Wexford	**State:** PA	**Zip:** 15090
Telephone Number: (724) 935-2611	**Fax Number:** ( ) -	
E-mail address: tmuscenti@trinityconsultants.com		

14. Facility Description

List all processes, products, NAICS and SIC codes for normal operation, in order of priority. Also list any process, products, NAICS and SIC codes associated with any alternative operating scenarios if different from those listed for normal operation.

Process	Products	NAICS	SIC
Natural Gas Gathering Facility	Natural Gas	211111	

Provide a general description of operations. The Janus Compressor Station is an existing natural gas gathering facility. Natural gas and liquids (mostly produced water) from nearby wells undergo compression and dehydration before it is transported to a gas gathering line.
15. Provide an **Area Map** showing plant location as **ATTACHMENT A.**
16. Provide a **Plot Plan(s)**, e.g. scaled map(s) and/or sketch(es) showing the location of the property on which the stationary source(s) is located as **ATTACHMENT B.** For instructions, refer to "Plot Plan - Guidelines."
17. Provide a detailed **Process Flow Diagram(s)** showing each process or emissions unit as **ATTACHMENT C.** Process Flow Diagrams should show all emission units, control equipment, emission points, and their relationships.

Section 2: Applicable Requirements

18. Applicable Requirements Summary	
Instructions: Mark all applicable requirements.	
☒ SIP	☐ FIP
☒ Minor source NSR (45CSR13)	☐ PSD (45CSR14)
☒ NESHAP (45CSR34)	☐ Nonattainment NSR (45CSR19)
☒ Section 111 NSPS – Subparts OOOOa, Subpart JJJJ	☒ Section 112(d) MACT standards – Subpart ZZZZ, Subpart HH
☐ Section 112(g) Case-by-case MACT	☐ 112(r) RMP
☐ Section 112(i) Early reduction of HAP	☐ Consumer/commercial prod. reqts., section 183(e)
☐ Section 129 Standards/Reqts.	☐ Stratospheric ozone (Title VI)
☐ Tank vessel reqt., section 183(f)	☐ Emissions cap 45CSR§30-2.6.1
☐ NAAQS, increments or visibility (temp. sources)	☐ 45CSR27 State enforceable only rule
☐ 45CSR4 State enforceable only rule	☐ Acid Rain (Title IV, 45CSR33)
☐ Emissions Trading and Banking (45CSR28)	☐ Compliance Assurance Monitoring (40CFR64)
☐ CAIR NO_x Annual Trading Program (45CSR39)	☐ CAIR NO_x Ozone Season Trading Program (45CSR40)
☐ CAIR SO_2 Trading Program (45CSR41)	

19. Non Applicability Determinations

List all requirements which the source has determined not applicable and for which a permit shield is requested. The listing shall also include the rule citation and the reason why the shield applies.

- 40 CFR part 60 Subpart Dc – the boilers at the facility are below 10 MMBtu/hr
- 40 CFR part 60 Subpart GG and KKKK – there are no turbines greater than 10 MMbtu/hr at the facility
- 40 CFR part 60 Subparts K, Ka – all tanks at the facility are less than 40,000 gallons in capacity.
- 40 CFR part 60 Subpart KKK – the facility is not engaged in the extraction of natural gas liquids from field gas or in the fractionation of mixed natural gas liquids to natural gas products
- 40 CFR part 60 Subpart LLL – there are no sweetening units at the facility
- 40 CFR part 60 Subpart IIII – the engines at the facility are not stationary compression ignition (CI) internal combustion engines (ICE).
- 40 CFR part 60 Subpart OOOO – this subpart applies to affected facilities that have been constructed, reconstructed, or modified after August 23, 2011 and on or before September 18, 2015. All emission units at the facility were constructed in 2016 and have not been modified or reconstructed, and therefore the requirements of this subpart do not apply
- 40 CFR part 60 Subpart DDDDD – this MACT standard applies to industrial, commercial, and institutional boilers and process heaters of various sizes and fuel types at major sources of HAP emissions. The facility is an area source of HAP emissions. Therefore, this subpart is not applicable.
- 40 CFR part 63 Subpart JJJJJJ – this MACT standard applies to industrial, commercial, and institutional boilers at area sources of HAP. All boilers at the facility fire natural gas exclusively. Natural gas fired boilers are exempt from the rule per 40 C.F.R. §63.11195(e). Therefore, this rule is not applicable.
- 45 CSR 21 – the facility is not located in Cabell, Kanawha, Putnam, Wayne, nor Wood counties.
- 45 CSR 27 – natural gas is included as a petroleum product and contains less than 5% benzene by weight.
- 45 CSR §27-2.4 – exempts equipment "used in the production and distribution of petroleum products providing that such equipment does not produce or contact materials containing more than 5% benzene by weight."

☒ Permit Shield

20. Facility-Wide Applicable Requirements

List all facility-wide applicable requirements. For each applicable requirement, include the underlying rule/regulation citation and/or construction permit with the condition number. (*Note: Title V permit condition numbers alone are not the underlying applicable requirements*).

45CSR§6-3.1 Open Burning, R13 Permit Condition 3.1.1.

45CSR§6-3.2 Open Burning Exemptions R13 Permit Condition 3.1.2.

45CSR§61.145(b) and 45CSR§34 Asbestos, R13 Permit Condition 3.1.3.

45CSR§4-3.1 Odor, R13 Permit Condition 3.1.4.

45CSR§13-10.5 Permanent Shutdown, R13 Permit Condition 3.1.5.

45CSR§11-5.2 Standby Plan for Reducing Emissions, R13 Permit Condition 3.1.6.

45CSR§17-3-1 Particulate Matter Emissions

☒ Permit Shield

For all facility-wide applicable requirements listed above, provide monitoring/testing / recordkeeping / reporting which shall be used to demonstrate compliance. If the method is based on a permit or rule, include the condition number and/or citation. (Note: Each requirement listed above must have an associated method of demonstrating compliance. If there is not already a required method in place, then a method must be proposed.)

WV Code §22-5-4(a)(14-15) and 45CSR13 Stack Testing, R13 Permit Condition 3.3.

Retention of Records, R13 Permit Condition 3.4.1.

45CSR§4 Odors, R13 Permit Condition 3.4.2.

Reporting Requirements, R13 Permit Condition 3.5.

Are you in compliance with all facility-wide applicable requirements? ☒ Yes ☐ No

If no, complete the **Schedule of Compliance Form** as **ATTACHMENT F**.

21. Active Permits/Consent Orders		
Permit or Consent Order Number	Date of Issuance MM/DD/YYYY	List any Permit Determinations that Affect the Permit *(if any)*
R13-3269B	08/21/2018	NA
	/ /	
	/ /	
	/ /	

22. Inactive Permits/Obsolete Permit Conditions		
Permit Number	Date of Issuance	Permit Condition Number
R13-3269	02/12/2016	NA – Inactive Permit
R13-3269A	01/18/2017	NA
	/ /	
	/ /	
	/ /	
	/ /	

Section 3: Facility-Wide Emissions

23. Facility-Wide Emissions Summary [Tons per Year]	
Criteria Pollutants	Potential Emissions
Carbon Monoxide (CO)	59.11
Nitrogen Oxides (NO_X)	127.17
Lead (Pb)	<0.01
Particulate Matter ($PM_{2.5}$)[1]	8.92
Particulate Matter (PM_{10})[1]	9.19
Sulfur Dioxide (SO_2)	0.71
Volatile Organic Compounds (VOC)	146.46
Hazardous Air Pollutants[2]	Potential Emissions
Formaldehyde (HCHO)	4.17
Total HAPs	22.52
Regulated Pollutants other than Criteria and HAP	Potential Emissions

[1] $PM_{2.5}$ and PM_{10} are components of TSP.
[2] For HAPs that are also considered PM or VOCs, emissions should be included in both the HAPs section and the Criteria Pollutants section.

Section 4: Insignificant Activities

24. Insignificant Activities (Check all that apply)		
☒	1.	Air compressors and pneumatically operated equipment, including hand tools.
☐	2.	Air contaminant detectors or recorders, combustion controllers or shutoffs.
☒	3.	Any consumer product used in the same manner as in normal consumer use, provided the use results in a duration and frequency of exposure which are not greater than those experienced by consumer, and which may include, but not be limited to, personal use items; janitorial cleaning supplies, office supplies and supplies to maintain copying equipment.
☒	4.	Bathroom/toilet vent emissions.
☒	5.	Batteries and battery charging stations, except at battery manufacturing plants.
☐	6.	Bench-scale laboratory equipment used for physical or chemical analysis, but not lab fume hoods or vents. Many lab fume hoods or vents might qualify for treatment as insignificant (depending on the applicable SIP) or be grouped together for purposes of description.
☐	7.	Blacksmith forges.
☒	8.	Boiler water treatment operations, not including cooling towers.
☒	9.	Brazing, soldering or welding equipment used as an auxiliary to the principal equipment at the source.
☐	10.	CO_2 lasers, used only on metals and other materials which do not emit HAP in the process.
☒	11.	Combustion emissions from propulsion of mobile sources, except for vessel emissions from Outer Continental Shelf sources.
☒	12.	Combustion units designed and used exclusively for comfort heating that use liquid petroleum gas or natural gas as fuel.
☒	13.	Comfort air conditioning or ventilation systems not used to remove air contaminants generated by or released from specific units of equipment.
☐	14.	Demineralized water tanks and demineralizer vents.
☐	15.	Drop hammers or hydraulic presses for forging or metalworking.
☐	16.	Electric or steam-heated drying ovens and autoclaves, but not the emissions from the articles or substances being processed in the ovens or autoclaves or the boilers delivering the steam.
☐	17.	Emergency (backup) electrical generators at residential locations.
☐	18.	Emergency road flares.
☒	19.	Emission units which do not have any applicable requirements and which emit criteria pollutants (CO, NO_x, SO_2, VOC and PM) into the atmosphere at a rate of less than 1 pound per hour and less than 10,000 pounds per year aggregate total for each criteria pollutant from all emission units. Please specify all emission units for which this exemption applies along with the quantity of criteria pollutants emitted on an hourly and annual basis: **Four (4) Engine Oil Tanks (each rated at 300 gallons)** **Five (4) Compressor Oil Tanks (each rated at 300 gallons)** **One (1) 2,000 gallons New TEG Tank** **One (1) 2,000 gallons Used TEG Tank** **One (1) 2,000 gallons Engine Lube Oil Tank** **One (1) 2,000 gallons Compressor Lube Oil Tank** **One (1) 2,000 gallons New MEG Storage Tank** **One (1) 2,000 gallons Used MEG Storage Tank** **One (1) 4,200 gallons Used Oil Storage Tank** **One (1) 2,000 gallons Methanol Storage Tank**

24. Insignificant Activities (Check all that apply)		
☐	20.	Emission units which do not have any applicable requirements and which emit hazardous air pollutants into the atmosphere at a rate of less than 0.1 pounds per hour and less than 1,000 pounds per year aggregate total for all HAPs from all emission sources. This limitation cannot be used for any source which emits dioxin/furans nor for toxic air pollutants as per 45CSR27. Please specify all emission units for which this exemption applies along with the quantity of hazardous air pollutants emitted on an hourly and annual basis: _____
☐	21.	Environmental chambers not using hazardous air pollutant (HAP) gases.
☐	22.	Equipment on the premises of industrial and manufacturing operations used solely for the purpose of preparing food for human consumption.
☐	23.	Equipment used exclusively to slaughter animals, but not including other equipment at slaughterhouses, such as rendering cookers, boilers, heating plants, incinerators, and electrical power generating equipment.
☒	24.	Equipment used for quality control/assurance or inspection purposes, including sampling equipment used to withdraw materials for analysis.
☐	25.	Equipment used for surface coating, painting, dipping or spray operations, except those that will emit VOC or HAP.
☒	26.	Fire suppression systems.
☐	27.	Firefighting equipment and the equipment used to train firefighters.
☐	28.	Flares used solely to indicate danger to the public.
☒	29.	Fugitive emission related to movement of passenger vehicle provided the emissions are not counted for applicability purposes and any required fugitive dust control plan or its equivalent is submitted.
☐	30.	Hand-held applicator equipment for hot melt adhesives with no VOC in the adhesive formulation.
☒	31.	Hand-held equipment for buffing, polishing, cutting, drilling, sawing, grinding, turning or machining wood, metal or plastic.
☐	32.	Humidity chambers.
☐	33.	Hydraulic and hydrostatic testing equipment.
☐	34.	Indoor or outdoor kerosene heaters.
☒	35.	Internal combustion engines used for landscaping purposes.
☐	36.	Laser trimmers using dust collection to prevent fugitive emissions.
☐	37.	Laundry activities, except for dry-cleaning and steam boilers.
☒	38.	Natural gas pressure regulator vents, excluding venting at oil and gas production facilities.
☐	39.	Oxygen scavenging (de-aeration) of water.
☐	40.	Ozone generators.
☒	41.	Plant maintenance and upkeep activities (e.g., grounds-keeping, general repairs, cleaning, painting, welding, plumbing, re-tarring roofs, installing insulation, and paving parking lots) provided these activities are not conducted as part of a manufacturing process, are not related to the source's primary business activity, and not otherwise triggering a permit modification. (Cleaning and painting activities qualify if they are not subject to VOC or HAP control requirements. Asphalt batch plant owners/operators must still get a permit if otherwise requested.)
☒	42.	Portable electrical generators that can be moved by hand from one location to another. "Moved by Hand" means that it can be moved without the assistance of any motorized or non-motorized vehicle, conveyance, or device.

24. Insignificant Activities (Check all that apply)		
☐	43.	Process water filtration systems and demineralizers.
☒	44.	Repair or maintenance shop activities not related to the source's primary business activity, not including emissions from surface coating or de-greasing (solvent metal cleaning) activities, and not otherwise triggering a permit modification.
☒	45.	Repairs or maintenance where no structural repairs are made and where no new air pollutant emitting facilities are installed or modified.
☒	46.	Routing calibration and maintenance of laboratory equipment or other analytical instruments.
☐	47.	Salt baths using nonvolatile salts that do not result in emissions of any regulated air pollutants. Shock chambers.
☐	48.	Shock chambers.
☐	49.	Solar simulators.
☐	50.	Space heaters operating by direct heat transfer.
☐	51.	Steam cleaning operations.
☐	52.	Steam leaks.
☐	53.	Steam sterilizers.
☐	54.	Steam vents and safety relief valves.
☐	55.	Storage tanks, reservoirs, and pumping and handling equipment of any size containing soaps, vegetable oil, grease, animal fat, and nonvolatile aqueous salt solutions, provided appropriate lids and covers are utilized.
☒	56.	Storage tanks, vessels, and containers holding or storing liquid substances that will not emit any VOC or HAP. Exemptions for storage tanks containing petroleum liquids or other volatile organic liquids should be based on size limits such as storage tank capacity and vapor pressure of liquids stored and are not appropriate for this list.
☐	57.	Such other sources or activities as the Director may determine.
☐	58.	Tobacco smoking rooms and areas.
☒	59.	Vents from continuous emissions monitors and other analyzers.

Section 5: Emission Units, Control Devices, and Emission Points

25. Equipment Table
Fill out the **Title V Equipment Table** and provide it as **ATTACHMENT D.**
26. Emission Units
For each emission unit listed in the **Title V Equipment Table**, fill out and provide an **Emission Unit Form** as **ATTACHMENT E.**
For each emission unit not in compliance with an applicable requirement, fill out a **Schedule of Compliance Form** as **ATTACHMENT F.**
27. Control Devices
For each control device listed in the **Title V Equipment Table**, fill out and provide an **Air Pollution Control Device Form** as **ATTACHMENT G.**
For any control device that is required on an emission unit in order to meet a standard or limitation for which the potential pre-control device emissions of an applicable regulated air pollutant is greater than or equal to the Title V Major Source Threshold Level, refer to the **Compliance Assurance Monitoring (CAM) Form(s)** for CAM applicability. Fill out and provide these forms, if applicable, for each Pollutant Specific Emission Unit (PSEU) as **ATTACHMENT H.**

Section 6: Certification of Information

28. Certification of Truth, Accuracy and Completeness and Certification of Compliance

*Note: This Certification must be signed by a responsible official. The **original**, signed in **blue ink**, must be submitted with the application. Applications without an **original** signed certification will be considered as incomplete.*

a. Certification of Truth, Accuracy and Completeness

I certify that I am a responsible official (as defined at 45CSR§30-2.38) and am accordingly authorized to make this submission on behalf of the owners or operators of the source described in this document and its attachments. I certify under penalty of law that I have personally examined and am familiar with the statements and information submitted in this document and all its attachments. Based on my inquiry of those individuals with primary responsibility for obtaining the information, I certify that the statements and information are to the best of my knowledge and belief true, accurate, and complete. I am aware that there are significant penalties for submitting false statements and information or omitting required statements and information, including the possibility of fine and/or imprisonment.

b. Compliance Certification

Except for requirements identified in the Title V Application for which compliance is not achieved, I, the undersigned hereby certify that, based on information and belief formed after reasonable inquiry, all air contaminant sources identified in this application are in compliance with all applicable requirements.

Responsible official (type or print)	
Name: Clifford W. Baker	Title: Sr. Vice President

Responsible official's signature:

Signature: Clifford W. Baker Signature Date: 9-18-18

(Must be signed and dated in blue ink)

Note: Please check all applicable attachments included with this permit application:	
☒	ATTACHMENT A: Area Map
☒	ATTACHMENT B: Plot Plan(s)
☒	ATTACHMENT C: Process Flow Diagram(s)
☒	ATTACHMENT D: Equipment Table
☒	ATTACHMENT E: Emission Unit Form(s)
☐	ATTACHMENT F: Schedule of Compliance Form(s) *(Not Applicable)*
☒	ATTACHMENT G: Air Pollution Control Device Form(s)
☐	ATTACHMENT H: Compliance Assurance Monitoring (CAM) Form(s) *(Not Applicable)*

All of the required forms and additional information can be found and downloaded from, the DEP website at www.dep.wv.gov/daq, requested by phone (304) 926-0475, and/or obtained through the mail.

ATTACHMENT A

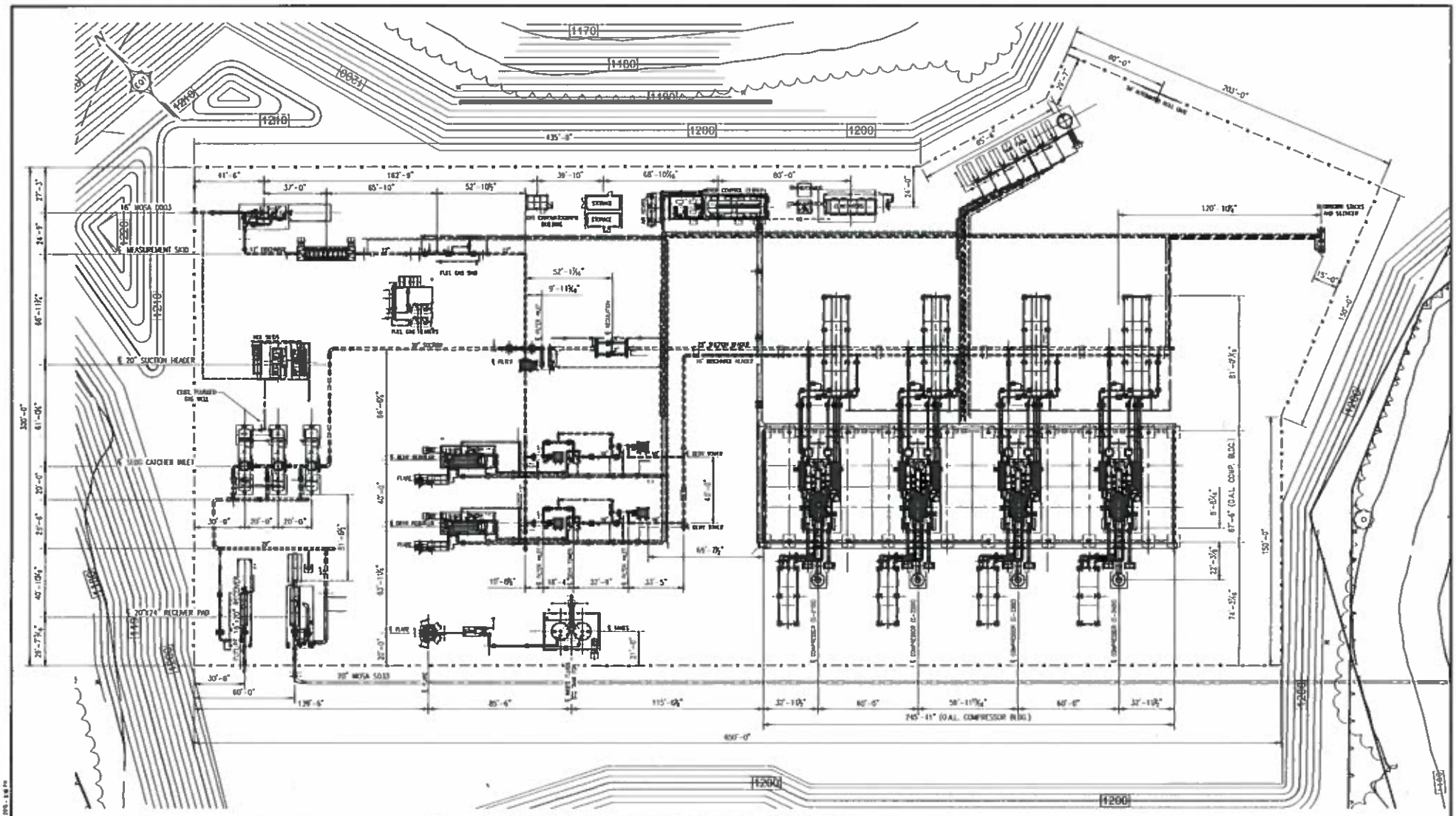
Area Map

Figure 1 - Map of Janus Station

UTM Northing (KM):	4,345.401
UTM Easting (KM):	516.776
Elevation:	1,200 ft

ATTACHMENT B

Plot Plan



DRAWING NUMBER	DRAWING TITLE	NO	DATE	REVISION	BY	CHK	APPD
		P	6/16/15	ISSUED FOR 30% REVIEW			

TO THE BEST OF MY KNOWLEDGE ALL COMPONENTS OF THIS DRAWING ARE DESIGNED IN ACCORDANCE WITH APPLICABLE GUIDELINES AND SPECIFICATIONS

MECHANICAL DESIGN ENGINEER — DATE

ELECTRICAL DESIGN ENGINEER — DATE

NOTE: ANY CHANGES TO THE DESIGN SHOWN ON THIS DRAWING MUST BE APPROVED BY THE DESIGN ENGINEER

EQT

DESIGN ENGINEER (EOR)

PROJECT #

DRAWING SCALE: 1"=25'-0"

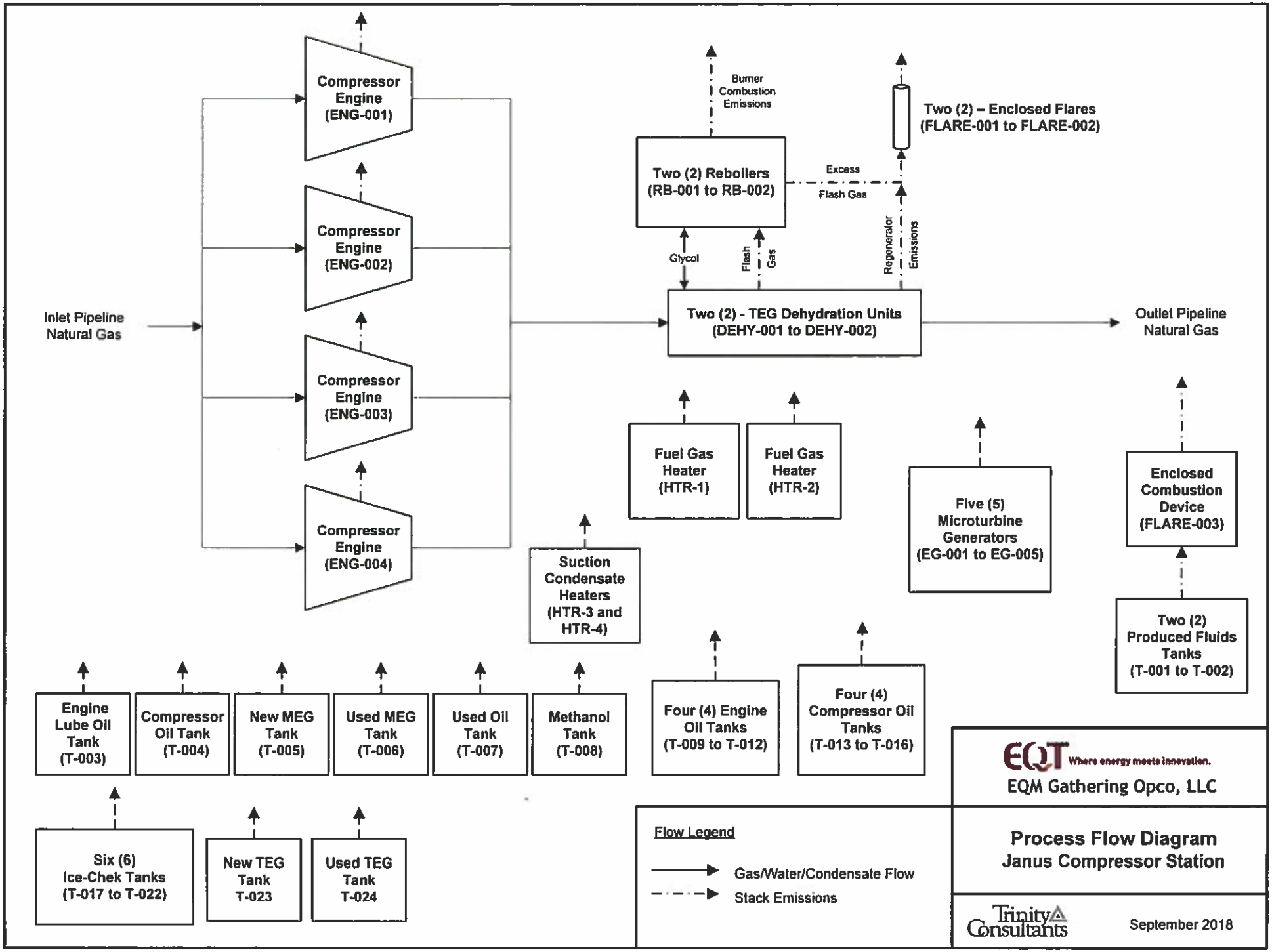
DRAWING TITLE:

JANUS COMPRESSOR STATION
2016 COMPRESSOR AND DEHY INSTALLATION
PIPING
PLOT PLAN

FACILITY	STATE	IDENTIFICATION	SERIES	SHEET	REVISION
C	W	JAN01	1100	02	P

ATTACHMENT C

Process Flow Diagram


Compressor Engine (ENG-001)
Compressor Engine (ENG-002)
Compressor Engine (ENG-003)
Compressor Engine (ENG-004)
Inlet Pipeline Natural Gas
Burner Combustion Emissions
Two (2) Reboilers (RB-001 to RB-002)
Two (2) – Enclosed Flares (FLARE-001 to FLARE-002)
Excess Flash Gas
Glycol
Flash Gas
Regenerator Emissions
Two (2) - TEG Dehydration Units (DEHY-001 to DEHY-002)
Outlet Pipeline Natural Gas
Fuel Gas Heater (HTR-1)
Fuel Gas Heater (HTR-2)
Five (5) Microturbine Generators (EG-001 to EG-005)
Enclosed Combustion Device (FLARE-003)
Suction Condensate Heaters (HTR-3 and HTR-4)
Two (2) Produced Fluids Tanks (T-001 to T-002)
Engine Lube Oil Tank (T-003)
Compressor Oil Tank (T-004)
New MEG Tank (T-005)
Used MEG Tank (T-006)
Used Oil Tank (T-007)
Methanol Tank (T-008)
Four (4) Engine Oil Tanks (T-009 to T-012)
Four (4) Compressor Oil Tanks (T-013 to T-016)
Six (6) Ice-Chek Tanks (T-017 to T-022)
New TEG Tank T-023
Used TEG Tank T-024
Flow Legend
Gas/Water/Condensate Flow
Stack Emissions
EQT Where energy meets innovation.
EQM Gathering Opco, LLC
Process Flow Diagram
Janus Compressor Station
Trinity Consultants
September 2018

ATTACHMENT D

Equipment Table

ATTACHMENT D - Title V Equipment Table

(includes all emission units at the facility except those designated as insignificant activities in Section 4, Item 24 of the General Forms)

Emission Point ID[1]	Control Device[1]	Emission Unit ID[1]	Emission Unit Description	Design Capacity	Year Installed/ Modified
ENG-001	C1 Oxidation Catalyst	ENG-001	Caterpillar G3616 4SLB Compressor Engine	5,350 hp	2016
ENG-002	C2 Oxidation Catalyst	ENG-002	Caterpillar G3616 4SLB Compressor Engine	5,350 hp	2016
ENG-003	C3 Oxidation Catalyst	ENG-003	Caterpillar G3616 4SLB Compressor Engine	5,350 hp	2017
ENG-004	C4 Oxidation Catalyst	ENG-004	Caterpillar G3616 4SLB Compressor Engine	5,350 hp	2017
FLARE-001	FLARE-001	DEHY-001	Glycol Dehydration Unit Flash Tank and Still Column	152 MMSCFD	2016
FLARE-002	FLARE-002	DEHY-002	Glycol Dehydration Unit Flash Tank and Still Column	152 MMSCFD	2017
FLARE-003	FLARE-003	T-001	Produced Fluids Vessel T-8110	210 BBL	2016
FLARE-003	FLARE-003	T-002	Produced Fluids Vessel T-8120	210 BBL	2016
L1	None	L1	Liquid Loading	420,000 gal/yr	2016
RB-001	None	RB-001	Glycol Dehydration Unit Reboiler	2.31 MMBtu/hr	2016
RB-002	None	RB-002	Glycol Dehydration Unit Reboiler	2.31 MMBtu/hr	2017
HTR-1	None	HTR-1	Fuel Gas Heater	1.15 MMbtu/hr	2016
HTR-2	None	HTR-2	Fuel Gas Heater	0.77 MMbtu/hr	2016
HTR-3	None	HTR-3	#1 Suction Condensate Heater	6.0 Mbtu/hr	2016
HTR-4	None	HTR-4	#2 Suction Condensate Heater	6.0 Mbtu/hr	2016
EG-001	None	EG-001	Capstone C200 Microturbine	200 KW	2016
EG-002	None	EG-002	Capstone C200 Microturbine	200 KW	2016
EG-003	None	EG-003	Capstone C200 Microturbine	200 KW	2016

EG-004	None	EG-004	Capstone C200 Microturbine	200 KW	2016
EG-005	None	EG-005	Capstone C200 Microturbine	200 KW	2016
T-003	None	T-003	Engine Lube Oil Tank	2,000 gallons	2016
T-004	None	T-004	Compressor Lube Oil Tank	2,000 gallons	2016
T-005	None	T-005	New MEG Storage Tank	2,000 gallons	2016
T-006	None	T-006	Used MEG Storage Tank	2,000 gallons	2016
T-007	None	T-007	Used Oil Storage Tank	4,200 gallons	2016
T-008	None	T-008	Methanol Storage Tank	2,000 gallons	2016
T-009	None	T-009	Engine Oil Storage Tank	300 gallons	2016
T-010	None	T-010	Engine Oil Storage Tank	300 gallons	2016
T-011	None	T-011	Engine Oil Storage Tank	300 gallons	2016
T-012	None	T-012	Engine Oil Storage Tank	300 gallons	2016
T-013	None	T-013	Compressor Oil Storage Tank	300 gallons	2016
T-014	None	T-014	Compressor Oil Storage Tank	300 gallons	2016
T-015	None	T-015	Compressor Oil Storage Tank	300 gallons	2016
T-016	None	T-016	Compressor Oil Storage Tank	300 gallons	2016
T-023	None	T-023	New TEG Storage Tank	2,000 gallons	2016
T-024	None	T-024	Used TEG Storage Tank	2,000 gallons	2016

[1]For 45CSR13 permitted sources, the numbering system used for the emission points, control devices, and emission units should be consistent with the numbering system used in the 45CSR13 permit. For grandfathered sources, the numbering system should be consistent with registrations or emissions inventory previously submitted to DAQ. For emission points, control devices, and emissions units which have not been previously labeled, use the following 45CSR13 numbering system: 1S, 2S, 3S,... or other appropriate description for emission units; 1C, 2C, 3C,... or other appropriate designation for control devices; 1E, 2E, 3E, ... or other appropriate designation for emission points.

ATTACHMENT E

Emission Unit Forms

ATTACHMENT E - Emission Unit Form

Emission Unit Description

Emission unit ID number:	**Emission unit name:**	**List any control devices associated with this emission unit:**
ENG-001 to ENG-004	Caterpillar G3616 Compressor Engines	C1 to C4 (Oxidation Catalysts)

Provide a description of the emission unit (type, method of operation, design parameters, etc.):
Four (4) natural gas-fired 5,350 horsepower (hp) reciprocating internal combustion engines that drive compressors for the compression of natural gas.

Manufacturer:	**Model number:**	**Serial number:**
Caterpillar	G3616	
Construction date:	**Installation date:**	**Modification date(s):**
2016	2016	

Design Capacity (examples: furnaces - tons/hr, tanks - gallons):
5,350 HP (each)

Maximum Hourly Throughput:	**Maximum Annual Throughput:**	**Maximum Operating Schedule:**
~32,160 scf/hr (each)	~281.7 MMscf/year (each)	8,760 hours (each)

Fuel Usage Data **(fill out all applicable fields)**

Does this emission unit combust fuel? _X__Yes ___ No	**If yes, is it? N/A (RICE Engine)** ___ Indirect Fired ___Direct Fired
Maximum design heat input and/or maximum horsepower rating: 5,350 HP (each) 39.43 MMBtu/hr (each)	**Type and Btu/hr rating of burners:** 39.43 MMBtu/hr (each)

List the primary fuel type(s) and if applicable, the secondary fuel type(s). For each fuel type listed, provide the maximum hourly and annual fuel usage for each.

Natural Gas – 32,160 scf/hr (each), ~281.7 MMscf/year (each)

Describe each fuel expected to be used during the term of the permit.

Fuel Type	Max. Sulfur Content	Max. Ash Content	BTU Value
Natural Gas	Negl.	Negl.	~1,226 BTU/scf

Emissions Data

Criteria Pollutants	Potential Emissions *(Each Unit)*	
	PPH	TPY
Carbon Monoxide (CO)	2.04	8.93
Nitrogen Oxides (NO_X)	5.90	25.83
Lead (Pb)	--	--
Particulate Matter ($PM_{2.5}$)	0.39	1.73

Particulate Matter (PM_{10})	0.39	1.73
Total Particulate Matter (TSP)	0.39	1.73
Sulfur Dioxide (SO_2)	0.02	0.10
Volatile Organic Compounds (VOC)[1]	3.93	17.23
Hazardous Air Pollutants	Potential Emissions *(Each Unit)*	
	PPH	TPY
Formaldehyde (HCHO)	0.24	1.03
Total HAP	0.84	3.66
Regulated Pollutants other than Criteria and HAP	Potential Emissions *(Each Unit)*	
	PPH	TPY
CO2e	5,741	25,144

List the method(s) used to calculate the potential emissions (include dates of any stack tests conducted, versions of software used, source and dates of emission factors, etc.).

SO_2, PM, and HAP emission factors from AP-42 Section 3.2, Table 3.2-2 "Uncontrolled Emission Factors for 4-Stroke Lean-Burn Engines," Supplement F, August 2000. Uncontrolled acrolein emission factor is based on SDAPCD emissions testing factors (assuming controlled values as tested are reduced by 99%) and assuming 1020 Btu/scf. NO_X, VOC, CO and Formaldehyde emission factors are based on manufacturer's guarantees for the oxidation catalyst. Greenhouse gas emission factors are based on 40 CFR Part 98, Subpart C, Tables C-1 and C-2 for natural gas combustion.

Applicable Requirements

List all applicable requirements for this emission unit. For each applicable requirement, include the underlying rule/regulation citation and/or construction permit with the condition number. (*Note: Title V permit condition numbers alone are not the underlying applicable requirements*). If an emission limit is calculated based on the type of source and design capacity or if a standard is based on a design parameter, this information should also be included.

No change from existing R13-3269B requirements (Conditions 4.1.1, 4.1.2, 4.1.2,4.1.3, 4.1.4)

____ Permit Shield

For all applicable requirements listed above, provide monitoring/testing/recordkeeping/reporting which shall be used to demonstrate compliance. If the method is based on a permit or rule, include the condition number or citation. (Note: Each requirement listed above must have an associated method of demonstrating compliance. If there is not already a required method in place, then a method must be proposed.)

No change from existing R13-3269B requirements (Conditions 4.2.1, 4.3.1, 4.4.1,4.4.2,4.4.3, 4.4.4, 4.4.5,4.5.1)

Are you in compliance with all applicable requirements for this emission unit? _X_ Yes ___No

If no, complete the **Schedule of Compliance Form** as **ATTACHMENT F.**

[1] VOC is non-methane, non-ethane hydrocarbons plus formaldehyde.

ATTACHMENT E - Emission Unit Form

Emission Unit Description

Emission unit ID number:	**Emission unit name:**	**List any control devices associated with this emission unit:** None
EG-001 to EG-005	Microturbines	

Provide a description of the emission unit (type, method of operation, design parameters, etc.):
Five (5) Capstone microturbines (each rated 200 kW) for generating electricity.

Manufacturer:	**Model number:**	**Serial number:**
Capstone	C200	
Construction date:	**Installation date:**	**Modification date(s):**
2016	2016	N/A

Design Capacity (examples: furnaces - tons/hr, tanks - gallons):
200 kW (each)

Maximum Hourly Throughput:	**Maximum Annual Throughput:**	**Maximum Operating Schedule:**
1,859 scf/hr (each)	16.29 MMscf/year (each)	8,760 hours (each)

Fuel Usage Data **(fill out all applicable fields)**

Does this emission unit combust fuel? _X__Yes ___ No	**If yes, is it? (N/A – turbine engine)** ___ Indirect Fired ___Direct Fired
Maximum design heat input and/or maximum horsepower rating: 2.28 MMbtu/hr (each)	**Type and Btu/hr rating of burners:** 2.28 MMbtu/hr (each)

List the primary fuel type(s) and if applicable, the secondary fuel type(s). For each fuel type listed, provide the maximum hourly and annual fuel usage for each.

Natural Gas – 1,859 scf/hr (each); 16.29 MMscf/year (each)

Describe each fuel expected to be used during the term of the permit.

Fuel Type	Max. Sulfur Content	Max. Ash Content	BTU Value
Natural Gas	Negl.	Negl.	1,226 BTU/scf

Emissions Data

Criteria Pollutants	Potential Emissions *(Each Unit)*	
	PPH	TPY
Carbon Monoxide (CO)	0.22	0.96
Nitrogen Oxides (NO_X)	0.08	0.35
Lead (Pb)	--	--
Particulate Matter ($PM_{2.5}$)	0.02	0.07
Particulate Matter (PM_{10})	0.02	0.07
Total Particulate Matter (TSP)	0.02	0.07

Sulfur Dioxide (SO_2)	0.01	0.03
Volatile Organic Compounds (VOC)	0.02	0.09
Hazardous Air Pollutants	Potential Emissions *(Each Unit)*	
	PPH	TPY
Total HAP	2.34E-03	0.01
Regulated Pollutants other than Criteria and HAP	Potential Emissions *(Each Unit)*	
	PPH	TPY
CO2e	267	1,166

List the method(s) used to calculate the potential emissions (include dates of any stack tests conducted, versions of software used, source and dates of emission factors, etc.).

Emission factors from AP-42 Section 3.1, Tables 3.1-2a and 3.1-3.
VOC, NO_X, and CO, and CO_2 emission factors from Table 1 and Table 5 (CO_2) of Capstone MicroTurbine Systems Emissions sheet. CH_4 and N_2O emission factors from Tables C-1 and C-2, 40 CFR 98, Subpart C.

Applicable Requirements

List all applicable requirements for this emission unit. For each applicable requirement, include the underlying rule/regulation citation and/or construction permit with the condition number. (*Note: Title V permit condition numbers alone are not the underlying applicable requirements*). If an emission limit is calculated based on the type of source and design capacity or if a standard is based on a design parameter, this information should also be included.

No change from current R13-3269B permit conditions. (Conditions 6.1.2)

____ Permit Shield

For all applicable requirements listed above, provide monitoring/testing/recordkeeping/reporting which shall be used to demonstrate compliance. If the method is based on a permit or rule, include the condition number or citation. (Note: Each requirement listed above must have an associated method of demonstrating compliance. If there is not already a required method in place, then a method must be proposed.)

No change from current R13-3269B permit conditions

Are you in compliance with all applicable requirements for this emission unit? _X__Yes ___No

If no, complete the **Schedule of Compliance Form** as **ATTACHMENT F**.

ATTACHMENT E - Emission Unit Form

Emission Unit Description

Emission unit ID number:	**Emission unit name:**	**List any control devices associated with this emission unit:**
HTR-1	Fuel Gas Heater	None

Provide a description of the emission unit (type, method of operation, design parameters, etc.):
One (1) 1.15 MMBtu/hr natural gas-fired fuel gas heater.

Manufacturer:	**Model number:**	**Serial number:**

Construction date:	**Installation date:**	**Modification date(s):**
2016	2016	N/A

Design Capacity (examples: furnaces - tons/hr, tanks - gallons):
1.15 MMBtu/hr

Maximum Hourly Throughput:	**Maximum Annual Throughput:**	**Maximum Operating Schedule:**
938 scf/hr	8.22 MMscf/yr	8,760 hours (each)

Fuel Usage Data **(fill out all applicable fields)**

Does this emission unit combust fuel? _X_ Yes ___ No	**If yes, is it?** _X_ Indirect Fired ___ Direct Fired
Maximum design heat input and/or maximum horsepower rating: 1.15 MMBtu/hr	**Type and Btu/hr rating of burners:** 1.15 MMBtu/hr

List the primary fuel type(s) and if applicable, the secondary fuel type(s). For each fuel type listed, provide the maximum hourly and annual fuel usage for each.

Natural Gas – 938 scf/hr

Describe each fuel expected to be used during the term of the permit.

Fuel Type	Max. Sulfur Content	Max. Ash Content	BTU Value
Natural Gas	Negl.	Negl.	1,226 BTU/scf

Emissions Data

Criteria Pollutants	Potential Emissions	
	PPH	TPY
Carbon Monoxide (CO)	0.08	0.35
Nitrogen Oxides (NO_X)	0.09	0.41
Lead (Pb)	4.69E-07	2.05E-06
Particulate Matter ($PM_{2.5}$)	0.01	0.03
Particulate Matter (PM_{10})	0.01	0.03
Total Particulate Matter (TSP)	0.01	0.03

Sulfur Dioxide (SO_2)	5.63E-04	2.46E-03
Volatile Organic Compounds (VOC)	0.01	0.02
Hazardous Air Pollutants	Potential Emissions *(Each Unit)*	
	PPH	TPY
Total HAP	1.77E-03	7.76E-03
Regulated Pollutants other than Criteria and HAP	Potential Emissions *(Each Unit)*	
	PPH	TPY
CO2e	135	590

List the method(s) used to calculate the potential emissions (include dates of any stack tests conducted, versions of software used, source and dates of emission factors, etc.).

Criteria pollutant and HAP emission factors from AP-42 Section 1.4 "Natural Gas Combustion" Tables 1.4-1, 1.4-2, & 1.4-3. Greenhouse gas emission factors from 40 CFR Part 98 Tables C-1 and C-2.

Applicable Requirements

List all applicable requirements for this emission unit. For each applicable requirement, include the underlying rule/regulation citation and/or construction permit with the condition number. (*Note: Title V permit condition numbers alone are not the underlying applicable requirements*). If an emission limit is calculated based on the type of source and design capacity or if a standard is based on a design parameter, this information should also be included.

No change from existing R13-3296B requirements. (Condition 6.1.1)

____ Permit Shield

For all applicable requirements listed above, provide monitoring/testing/recordkeeping/reporting which shall be used to demonstrate compliance. If the method is based on a permit or rule, include the condition number or citation. (Note: Each requirement listed above must have an associated method of demonstrating compliance. If there is not already a required method in place, then a method must be proposed.)

No change from existing R13-3296B requirements. (Condition 6.1.1)

Are you in compliance with all applicable requirements for this emission unit? _X__Yes ___No

If no, complete the **Schedule of Compliance Form** as **ATTACHMENT F**.

ATTACHMENT E - Emission Unit Form

Emission Unit Description

Emission unit ID number:	**Emission unit name:**	**List any control devices associated with this emission unit:**
HTR-2	Fuel Gas Heater	None

Provide a description of the emission unit (type, method of operation, design parameters, etc.):
One (1) 0.77 MMBtu/hr natural gas-fired fuel gas heater.

Manufacturer:	**Model number:**	**Serial number:**

Construction date:	**Installation date:**	**Modification date(s):**
2016	2016	N/A

Design Capacity (examples: furnaces - tons/hr, tanks - gallons):
0.77 MMBtu/hr

Maximum Hourly Throughput:	**Maximum Annual Throughput:**	**Maximum Operating Schedule:**
628 scf/hr	5.50 MMscf/yr	8,760 hours

Fuel Usage Data **(fill out all applicable fields)**

Does this emission unit combust fuel? _X_ Yes ___ No	**If yes, is it?** _X_ Indirect Fired ___ Direct Fired
Maximum design heat input and/or maximum horsepower rating: 0.77` MMBtu/hr	**Type and Btu/hr rating of burners:** 0.77 MMBtu/hr

List the primary fuel type(s) and if applicable, the secondary fuel type(s). For each fuel type listed, provide the maximum hourly and annual fuel usage for each.

Natural Gas – 628 scf/hr

Describe each fuel expected to be used during the term of the permit.

Fuel Type	Max. Sulfur Content	Max. Ash Content	BTU Value
Natural Gas	Negl.	Negl.	1,226 BTU/scf

Emissions Data

Criteria Pollutants	Potential Emissions	
	PPH	TPY
Carbon Monoxide (CO)	0.05	0.23
Nitrogen Oxides (NO_X)	0.06	0.28
Lead (Pb)	3.14E-07	1.36E-06
Particulate Matter ($PM_{2.5}$)	4.77E-03	0.02
Particulate Matter (PM_{10})	4.77E-03	0.02
Total Particulate Matter (TSP)	4.77E-03	0.02

Sulfur Dioxide (SO_2)	3.77E-04	1.65E-03
Volatile Organic Compounds (VOC)	3.45E-03	0.02
Hazardous Air Pollutants	Potential Emissions *(Each Unit)*	
	PPH	TPY
Total HAP	1.19E-03	5.19E-03
Regulated Pollutants other than Criteria and HAP	Potential Emissions *(Each Unit)*	
	PPH	TPY
CO2e	90	395

List the method(s) used to calculate the potential emissions (include dates of any stack tests conducted, versions of software used, source and dates of emission factors, etc.).

Criteria pollutant and HAP emission factors from AP-42 Section 1.4 "Natural Gas Combustion" Tables 1.4-1, 1.4-2, & 1.4-3. Greenhouse gas emission factors from 40 CFR Part 98 Tables C-1 and C-2.

Applicable Requirements

List all applicable requirements for this emission unit. For each applicable requirement, include the underlying rule/regulation citation and/or construction permit with the condition number. (*Note: Title V permit condition numbers alone are not the underlying applicable requirements*). If an emission limit is calculated based on the type of source and design capacity or if a standard is based on a design parameter, this information should also be included.

No change from existing R13-3296B requirements. (Condition 6.1.1)

____ Permit Shield

For all applicable requirements listed above, provide monitoring/testing/recordkeeping/reporting which shall be used to demonstrate compliance. If the method is based on a permit or rule, include the condition number or citation. (Note: Each requirement listed above must have an associated method of demonstrating compliance. If there is not already a required method in place, then a method must be proposed.)

No change from existing R13-3296B requirements. (Condition 6.1.1)

Are you in compliance with all applicable requirements for this emission unit? _X__Yes ___No

If no, complete the **Schedule of Compliance Form** as **ATTACHMENT F.**

ATTACHMENT E - Emission Unit Form

Emission Unit Description

Emission unit ID number:	**Emission unit name:**	**List any control devices associated with this emission unit:**
HTR-3, HTR-4	Suction Condensate Heaters	None

Provide a description of the emission unit (type, method of operation, design parameters, etc.):
Two (2) 6.0 MBtu/hr natural gas-fired heaters.

Manufacturer:	**Model number:**	**Serial number:**

Construction date:	**Installation date:**	**Modification date(s):**
2016	2016	N/A

Design Capacity (examples: furnaces - tons/hr, tanks - gallons):
6.0 MBtu/hr each

Maximum Hourly Throughput:	**Maximum Annual Throughput:**	**Maximum Operating Schedule:**
5 scf/hr each	0.04 MMscf/yr each	8,760 hours (each)

Fuel Usage Data **(fill out all applicable fields)**

Does this emission unit combust fuel? _X_ Yes ___ No	**If yes, is it?** _X_ Indirect Fired ___Direct Fired
Maximum design heat input and/or maximum horsepower rating: 6.0 MBtu/hr each	**Type and Btu/hr rating of burners:** 6.0 MBtu/hr each

List the primary fuel type(s) and if applicable, the secondary fuel type(s). For each fuel type listed, provide the maximum hourly and annual fuel usage for each.

Natural Gas – 5 scf/hr each

Describe each fuel expected to be used during the term of the permit.

Fuel Type	Max. Sulfur Content	Max. Ash Content	BTU Value
Natural Gas	Negl.	Negl.	1,226 BTU/scf

Emissions Data

Criteria Pollutants	Potential Emissions *(Each Unit)*	
	PPH	TPY
Carbon Monoxide (CO)	< 0.01	< 0.01
Nitrogen Oxides (NO_X)	< 0.01	< 0.01
Lead (Pb)	< 0.01	< 0.01
Particulate Matter ($PM_{2.5}$)	< 0.01	< 0.01
Particulate Matter (PM_{10})	< 0.01	< 0.01
Total Particulate Matter (TSP)	< 0.01	< 0.01

Sulfur Dioxide (SO_2)	< 0.01	< 0.01
Volatile Organic Compounds (VOC)	< 0.01	< 0.01
Hazardous Air Pollutants	Potential Emissions *(Each Unit)*	
	PPH	TPY
Total HAP	< 0.01	< 0.01
Regulated Pollutants other than Criteria and HAP	Potential Emissions *(Each Unit)*	
	PPH	TPY
CO2e	1	3

List the method(s) used to calculate the potential emissions (include dates of any stack tests conducted, versions of software used, source and dates of emission factors, etc.).

Criteria pollutant and HAP emission factors from AP-42 Section 1.4 "Natural Gas Combustion" Tables 1.4-1, 1.4-2, & 1.4-3. Greenhouse gas emission factors from 40 CFR Part 98 Tables C-1 and C-2.

Applicable Requirements

List all applicable requirements for this emission unit. For each applicable requirement, include the underlying rule/regulation citation and/or construction permit with the condition number. (*Note: Title V permit condition numbers alone are not the underlying applicable requirements*). If an emission limit is calculated based on the type of source and design capacity or if a standard is based on a design parameter, this information should also be included.

NA

____ Permit Shield

For all applicable requirements listed above, provide monitoring/testing/recordkeeping/reporting which shall be used to demonstrate compliance. If the method is based on a permit or rule, include the condition number or citation. (Note: Each requirement listed above must have an associated method of demonstrating compliance. If there is not already a required method in place, then a method must be proposed.)

NA

Are you in compliance with all applicable requirements for this emission unit? _X__Yes ___No

If no, complete the **Schedule of Compliance Form** as **ATTACHMENT F**.

ATTACHMENT E - Emission Unit Form

Emission Unit Description

Emission unit ID number:	**Emission unit name:**	**List any control devices associated with this emission unit:**
DEHY-001 to DEHY-002	TEG Dehydration Units	FLARE-001 to FLARE-002

Provide a description of the emission unit (type, method of operation, design parameters, etc.):
Triethylene Glycol dehydration unit for removing water from natural gas.

Manufacturer:	**Model number:**	**Serial number:**

Construction date:	**Installation date:**	**Modification date(s):**
2016	2016	2017

Design Capacity (examples: furnaces - tons/hr, tanks - gallons):

152 million standard cubic feet per day MMscfd (each)

Maximum Hourly Throughput:	**Maximum Annual Throughput:**	**Maximum Operating Schedule:**
6.33 MMScf/hr (each)	55,480 MMscf/year (each)	8,760 hours (each)

Fuel Usage Data **(fill out all applicable fields)**

Does this emission unit combust fuel? ___Yes __X_ No	**If yes, is it? N/A** ___ Indirect Fired ___Direct Fired
Maximum design heat input and/or maximum horsepower rating: NA	**Type and Btu/hr rating of burners:** NA

List the primary fuel type(s) and if applicable, the secondary fuel type(s). For each fuel type listed, provide the maximum hourly and annual fuel usage for each.

NA

Describe each fuel expected to be used during the term of the permit.

Fuel Type	Max. Sulfur Content	Max. Ash Content	BTU Value
NA			

Emissions Data

Criteria Pollutants	Potential Emissions *(Each Unit)*	
	PPH	TPY
Carbon Monoxide (CO)	--	--
Nitrogen Oxides (NO_X)	--	--

Lead (Pb)	--	--
Particulate Matter ($PM_{2.5}$)	--	--
Particulate Matter (PM_{10})	--	--
Total Particulate Matter (TSP)	--	--
Sulfur Dioxide (SO_2)	--	--
Volatile Organic Compounds (VOC)	1.55	6.80
Hazardous Air Pollutants	Potential Emissions *(Each Unit)*	
	PPH	TPY
Benzene	0.08	0.36
n-hexane	0.04	0.18
Total HAP	0.68	2.96
Regulated Pollutants other than Criteria and HAP	Potential Emissions *(Each Unit)*	
	PPH	TPY
CO2e	21	92

List the method(s) used to calculate the potential emissions (include dates of any stack tests conducted, versions of software used, source and dates of emission factors, etc.).

GRI-GLYCalc 4.0

Applicable Requirements

List all applicable requirements for this emission unit. For each applicable requirement, include the underlying rule/regulation citation and/or construction permit with the condition number. (*Note: Title V permit condition numbers alone are not the underlying applicable requirements*). If an emission limit is calculated based on the type of source and design capacity or if a standard is based on a design parameter, this information should also be included.

No change from current R1#-3269B permit conditions (Conditions 5.1.1,5.1.2, 5.1.3, 5.1.4)

____ Permit Shield

For all applicable requirements listed above, provide monitoring/testing/recordkeeping/reporting which shall be used to demonstrate compliance. If the method is based on a permit or rule, include the condition number or citation. (Note: Each requirement listed above must have an associated method of demonstrating compliance. If there is not already a required method in place, then a method must be proposed.)

No change from current R1#-3269B permit conditions (Conditions 5.2.1,5.2.2, 5.2.3,5.4.1,5.4.2,5.4.3,5.4.4, 5.4.5, 5.5.1)

Are you in compliance with all applicable requirements for this emission unit? _X__Yes ___No

If no, complete the **Schedule of Compliance Form** as **ATTACHMENT F.**

ATTACHMENT E - Emission Unit Form

Emission Unit Description

Emission unit ID number:	**Emission unit name:**	**List any control devices associated with this emission unit:**
RB-001 to RB-002	Dehydrator Reboilers	None

Provide a description of the emission unit (type, method of operation, design parameters, etc.):
Two (2) 2.31 MMBtu/hr natural gas fired reboilers associated with dehydration units (DEHY-001 to DEHY-002)

Manufacturer:	**Model number:**	**Serial number:**

Construction date:	**Installation date:**	**Modification date(s):**
2016	2016	N/A

Design Capacity (examples: furnaces - tons/hr, tanks - gallons):
2.31 MMBtu/hr (each)

Maximum Hourly Throughput:	**Maximum Annual Throughput:**	**Maximum Operating Schedule:**
1,884 scf/hr (each)	16.50 MMscf/year (each)	8,760 hours

Fuel Usage Data **(fill out all applicable fields)**

Does this emission unit combust fuel? _X__Yes ___ No	**If yes, is it?** _X_ Indirect Fired ___Direct Fired
Maximum design heat input and/or maximum horsepower rating: 2.31 MMbtu/hr (each)	**Type and Btu/hr rating of burners:** 2.31 MMbtu/hr (each)

List the primary fuel type(s) and if applicable, the secondary fuel type(s). For each fuel type listed, provide the maximum hourly and annual fuel usage for each.

Natural Gas – 1,884 scf/hr (each); 16.50 MMscf/year (each)

Describe each fuel expected to be used during the term of the permit.

Fuel Type	Max. Sulfur Content	Max. Ash Content	BTU Value
Natural Gas	Negl.	Negl.	1,226 BTU/scf

Emissions Data

Criteria Pollutants	Potential Emissions	
	PPH	TPY
Carbon Monoxide (CO)	0.16	0.69
Nitrogen Oxides (NO_X)	0.19	0.83
Lead (Pb)	--	--
Particulate Matter ($PM_{2.5}$)	0.01	0.06
Particulate Matter (PM_{10})	0.01	0.06
Total Particulate Matter (TSP)	0.01	0.06

Sulfur Dioxide (SO_2)	1.13E-03	4.95E-03
Volatile Organic Compounds (VOC)	0.01	0.05
Hazardous Air Pollutants	Potential Emissions	
	PPH	TPY
Total HAP	3.56E-03	0.02
Regulated Pollutants other than Criteria and HAP	Potential Emissions	
	PPH	TPY
CO2e	271	1,185

List the method(s) used to calculate the potential emissions (include dates of any stack tests conducted, versions of software used, source and dates of emission factors, etc.).

Criteria pollutants and HAP emission factors from AP-42 Section 1.4 "Natural Gas Combustion" Tables 1.4-1, 1.4-2, & 1.4-3. Greenhouse gas emission factors from 40 CFR Part 98 Tables C-1 and C-2.

Applicable Requirements

List all applicable requirements for this emission unit. For each applicable requirement, include the underlying rule/regulation citation and/or construction permit with the condition number. (*Note: Title V permit condition numbers alone are not the underlying applicable requirements*). If an emission limit is calculated based on the type of source and design capacity or if a standard is based on a design parameter, this information should also be included.

No change from existing R13-3296B requirements. (Condition 5.1.3.)

____ Permit Shield

For all applicable requirements listed above, provide monitoring/testing/recordkeeping/reporting which shall be used to demonstrate compliance. If the method is based on a permit or rule, include the condition number or citation. (Note: Each requirement listed above must have an associated method of demonstrating compliance. If there is not already a required method in place, then a method must be proposed.)

No change from existing R13-3296B requirements. (Condition 5.2.1,5.4.1)

Are you in compliance with all applicable requirements for this emission unit? _X__Yes ___No

If no, complete the **Schedule of Compliance Form** as **ATTACHMENT F**.

ATTACHMENT E - Emission Unit Form

Emission Unit Description

Emission unit ID number:	**Emission unit name:**	**List any control devices associated with this emission unit:**
T-001 to T-002	Produced Fluids Tanks	FLARE-003

Provide a description of the emission unit (type, method of operation, design parameters, etc.):
Two (2) 8,820 gallon storage tanks for produced fluids.

Manufacturer:	**Model number:**	**Serial number:**
Construction date: 2016	**Installation date:** 2016	**Modification date(s):** 2017

Design Capacity (examples: furnaces - tons/hr, tanks - gallons):
8,820 gallons (each)

Maximum Hourly Throughput:	**Maximum Annual Throughput:** 210,000 gal/yr (each)	**Maximum Operating Schedule:** 8,760 hours (each)

Fuel Usage Data **(fill out all applicable fields)**

Does this emission unit combust fuel? ___Yes _X__ No	**If yes, is it?** ___ Indirect Fired ___Direct Fired
Maximum design heat input and/or maximum horsepower rating: NA	**Type and Btu/hr rating of burners:** NA

List the primary fuel type(s) and if applicable, the secondary fuel type(s). For each fuel type listed, provide the maximum hourly and annual fuel usage for each.

NA

Describe each fuel expected to be used during the term of the permit.

Fuel Type	Max. Sulfur Content	Max. Ash Content	BTU Value
NA			

Emissions Data

Criteria Pollutants	Potential Emissions *(Each Unit)*	
	PPH	TPY
Carbon Monoxide (CO)	--	--
Nitrogen Oxides (NO_X)	--	--
Lead (Pb)	--	--
Particulate Matter ($PM_{2.5}$)	--	--
Particulate Matter (PM_{10})	--	--

Total Particulate Matter (TSP)	--	--
Sulfur Dioxide (SO_2)	--	--
Volatile Organic Compounds (VOC)	1.16	5.09
Hazardous Air Pollutants	Potential Emissions *(Each Unit)*	
	PPH	TPY
Formaldehyde (HCHO)	--	--
Total HAP	0.12	0.53
Regulated Pollutants other than Criteria and HAP	Potential Emissions *(Each Unit)*	
	PPH	TPY
CO2e	--	--

List the method(s) used to calculate the potential emissions (include dates of any stack tests conducted, versions of software used, source and dates of emission factors, etc.).

ProMax

Applicable Requirements

List all applicable requirements for this emission unit. For each applicable requirement, include the underlying rule/regulation citation and/or construction permit with the condition number. (*Note: Title V permit condition numbers alone are not the underlying applicable requirements*). If an emission limit is calculated based on the type of source and design capacity or if a standard is based on a design parameter, this information should also be included.

No change from existing R13-3296B requirements. (Condition 7.1.1, 7.1.2)

____ Permit Shield

For all applicable requirements listed above, provide monitoring/testing/recordkeeping/reporting which shall be used to demonstrate compliance. If the method is based on a permit or rule, include the condition number or citation. (Note: Each requirement listed above must have an associated method of demonstrating compliance. If there is not already a required method in place, then a method must be proposed.)

No change from existing R13-3296B requirements. (Condition 7.2.1,7.2.2,7.3.1)

Are you in compliance with all applicable requirements for this emission unit? _X__Yes ___No

If no, complete the **Schedule of Compliance Form** as **ATTACHMENT F**.

ATTACHMENT G

Air Pollution Control Device Forms

ATTACHMENT G - Air Pollution Control Device Form

Control device ID number: FLARE-001 to FLARE-002	**List all emission units associated with this control device.** DEHY-001 to DEHY-002	
Manufacturer: Envirotherm	**Model number:** ETI-DVC-36-20	**Installation date:** 2016

Type of Air Pollution Control Device:

___ Baghouse/Fabric Filter	___ Venturi Scrubber	___ Multiclone
___ Carbon Bed Adsorber	___ Packed Tower Scrubber	___ Single Cyclone
___ Carbon Drum(s)	___ Other Wet Scrubber	___ Cyclone Bank
___ Catalytic Incinerator	___ Condenser	___ Settling Chamber
___ Thermal Incinerator	___ Flare	_X_ Other (describe) Enclosed Flare
___ Wet Plate Electrostatic Precipitator		___ Dry Plate Electrostatic Precipitator

List the pollutants for which this device is intended to control and the capture and control efficiencies.

Pollutant	Capture Efficiency	Control Efficiency
VOC	100%	98%
HAP	100%	98%

Explain the characteristic design parameters of this control device (flow rates, pressure drops, number of bags, size, temperatures, etc.).

Flare Rating – 7 MMBtu/hr
Pilot Rating – 0.09 MMBtu/hr

Is this device subject to the CAM requirements of 40 C.F.R. 64? ___ Yes _X__ No

If Yes, **Complete ATTACHMENT H**

If No, **Provide justification.**

Initial Title V application

Describe the parameters monitored and/or methods used to indicate performance of this control device.

Pilot flame is equipped with a thermocouple.

ATTACHMENT G - Air Pollution Control Device Form

Control device ID number:	List all emission units associated with this control device.	
FLARE-003	T-001 to T-002	
Manufacturer:	**Model number:**	**Installation date:**
Envirotherm	EF-96-30	2016

Type of Air Pollution Control Device:

___ Baghouse/Fabric Filter	___ Venturi Scrubber	___ Multiclone
___ Carbon Bed Adsorber	___ Packed Tower Scrubber	___ Single Cyclone
___ Carbon Drum(s)	___ Other Wet Scrubber	___ Cyclone Bank
___ Catalytic Incinerator	___ Condenser	___ Settling Chamber
___ Thermal Incinerator	___ Flare	_X_ Other (describe) Enclosed Flare
___ Wet Plate Electrostatic Precipitator		___ Dry Plate Electrostatic Precipitator

List the pollutants for which this device is intended to control and the capture and control efficiencies.

Pollutant	Capture Efficiency	Control Efficiency
VOC	100%	95%
HAP	100%	95%

Explain the characteristic design parameters of this control device (flow rates, pressure drops, number of bags, size, temperatures, etc.).

Flare Rating – 41 MMBtu/hr
Pilot Rating – 0.12 MMBtu/hr

Is this device subject to the CAM requirements of 40 C.F.R. 64? ___ Yes _X__ No

If Yes, **Complete ATTACHMENT H**

If No, **Provide justification.**

Initial Title V application

Describe the parameters monitored and/or methods used to indicate performance of this control device.

Pilot flame is equipped with a thermocouple.

ATTACHMENT I

Emission Calculations

EQM Gathering Opco, LLC - Janus Station
Facility-Wide Emissions Summary

	Site-wide Emissions														Janus Station TOTAL	
	CAT G3616 Compressor Engines	Capstone Microturbine	Fuel Gas Heaters		Suction Condensate Heaters	Dehydrator Enclosed Flares	Dehydration Units	Reboilers	Tank Enclosed Flare	Haul Roads	Miscellaneous Storage Tanks	Produced Fluids Storage Tanks	Liquid Loading Operations	Station Fugitives Blowdowns & Component Leaks		
Emission Unit ID	ENG-001 to ENG-004	EG-001 to EG-005	HTR-1	HTR-2	HTR-3 to HTR-4	DEHY-001 to DEHY-002	DEHY-001 to DEHY-002	RB-001 to RB-002	FLARE-003	NA	T003 to T024	T-001 to T002	L1	NA		
Emission Point ID	ENG-001 to ENG-004	EG-001 to EG-005	HTR-1	HTR-2	HTR-3 to HTR-4	FLARE-001 to FLARE-002	FLARE-001 to FLARE-002	RB-001 to RB-002	FLARE-003	NA	NA	FLARE-003	L1	NA		
Equipment Count	4	5	1	1	2	2	2	2	1	NA	22	2	NA	NA		
Equipment Status	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing		
Fuel Type	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	—	Natural Gas	Natural Gas	NA	NA	NA	NA	NA		
Capacity	5,350	1.0	1.15	0.77	0.01	7	125	2.31	41		4,200 or less	210				
Unit	bhp	MW	MMBtu/hr	MMBtu/hr	MMBtu/hr	MMBtu/hr	MMSCFD	MMBtu/hr	MMBtu/hr		gallon	bbl				
Hours per Year	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760		
Pollutant	tpy	tpy	tpy	tpy	tpy	tpy	tpy	tpy	tpy	tpy	tpy	tpy	tpy	tpy	lb/hr	tpy
PM_{10}	6.90	0.33	0.03	0.02	<0.01	0.38	—	0.13	1.12	0.28	—	—	—	—	2.10	9.19
$PM_{2.5}$	6.90	0.33	0.03	0.02	<0.01	0.38	—	0.13	1.12	0.01	—	—	—	—	2.04	8.92
SO_x	0.41	0.17	<0.01	<0.01	<0.01	0.03	—	0.01	0.09	—	—	—	—	—	0.16	0.71
CO	35.73	4.82	0.35	0.23	<0.01	4.25	—	1.39	12.34	—	—	—	—	—	13.49	59.11
NO_x	103.32	1.75	0.41	0.28	<0.01	5.07	—	1.65	14.69	—	—	—	—	—	29.03	127.17
VOC (incl. HCHO)	68.91	0.44	0.02	0.02	<0.01	—	13.60	0.09	11.38	—	0.00	—	0.01	51.99	33.44	146.46
CO_2	89,682	5,825	589	395	6	7,267	7,295	2,368	21073	—	—	—	—	0.53	30,707.83	134,580.31
CH_4	433.94	0.11	0.01	0.01	<0.01	0.14	6.32	0.04	0.40	—	—	—	—	81.45	119.27	522.42
N_2O	0.15	0.01	<0.01	<0.01	<0.01	0.01	—	0.00	0.04	—	—	—	—	—	0.05	0.22
CO_2e	100,576	5,831	590	395	6	7,274	7,453	2,370	21095	—	—	—	—	2,037	33,704.85	147,627.24
Formaldehyde	4.13	0.04	<0.01	<0.01	<0.01	—	—	<0.01	—	—	—	—	—	—	0.95	4.17
Total HAPs (including HCHO)	14.66	0.05	0.01	0.01	<0.01	—	5.92	0.03	0.05	—	—	—	0.00	1.79	5.14	22.52

1. VOC and HAP emissions from the produced fluids tanks are consolidated in the enclosed combustor emissions.

Compressor Engines (Per Engine)

Source Designation:	
Manufacturer:	Caterpillar
Model No.:	3616
Stroke Cycle:	4-stroke
Type of Burn:	Lean Burn
Year Installed/Date Manufactured	TBD
Fuel Used:	Natural Gas
Fuel High Heating Value (HHV) (Btu/scf):	1,226
Rated Horsepower (bhp):	5,350
Specific Fuel Consumption (Btu/bhp-hr):	7,338
Maximum Fuel Consumption at 100% Load (scf/hr):	32,160
Heat Input (MMBtu/hr)	39.43
Control Device:	Oxidation Catalyst
Operational Details:	
Potential Annual Hours of Operation (hr/yr):	8,760
Potential Fuel Consumption (MMscf/yr):	281.7

Criteria and Manufacturer Specific Pollutant Emission Factors:

Pollutant	Emission Factors[1]	Units	Estimation Basis / Emission Factor Source
NOx	0.50	g/bhp-hr	CAT GERP Vendor Spec Sheet
CO	0.17	g/bhp-hr	Catalyst Vendor Spec Sheet
SO_2	5.88E-04	lb/MMBtu	AP-42, Table 3.2-2 (Jul-2000)
PM_{10} (Filterable)	7.71E-05	lb/MMBtu	AP-42, Table 3.2-2 (Jul-2000)
$PM_{2.5}$ (Filterable)	7.71E-05	lb/MMBtu	AP-42, Table 3.2-2 (Jul-2000)
PM Condensable	9.91E-03	lb/MMBtu	AP-42, Table 3.2-2 (Jul-2000)
PM Total	9.99E-03	lb/MMBtu	AP-42, Table 3.2-2 (Jul-2000)
NMNEHC	0.31	g/bhp-hr	Catalyst Vendor Spec Sheet
VOC (Includes HCHO)	0.33	g/bhp-hr	Catalyst Vendor Spec Sheet
Formaldehyde (HCHO)	0.02	g/bhp-hr	Catalyst Vendor Spec Sheet
CO_2	434.0	g/bhp-hr	CAT GERP Vendor Spec Sheet
CH_4	2.10	g/bhp-hr	Vendor Spec Sheet (=THC-NMHC)
N_2O	1.00E-04	kg/MMBtu	40 CFR 98, Table C-2

Criteria and Manufacturer Specific Pollutant Emission Rates:

Pollutant	Potential Emissions (lb/hr)[2]	Potential Emissions (tons/yr)[3]
NO_x	5.90	25.83
CO	2.04	8.93
SO_2	0.02	0.10
PM_{10} (Filterable)	0.003	0.01
$PM_{2.5}$ (Filterable)	0.003	0.01
PM Condensable	0.39	1.71
PM Total	0.39	1.73
NMNEHC	3.70	16.20
VOC (incl HCHO)	3.93	17.23
Formaldehyde (HCHO)	0.24	1.03
CO_2	5,119	22,420
CH_4	24.77	108.49
N_2O	0.01	0.04

Compressor Engines (Per Engine)

Hazardous Air Pollutant (HAP) Potential Emissions:

Pollutant	Emission Factor (lb/MMBtu)[1]	Potential Emissions (lb/hr)[2]	Potential Emissions (tons/yr)[3]
HAPs:			
Acenaphthene	1.25E-06	4.93E-05	2.16E-04
Acenaphthylene	5.53E-06	2.18E-04	9.55E-04
Acetaldehyde	8.36E-03	3.30E-01	1.44E+00
Acrolein	9.80E-04	3.87E-02	1.69E-01
Benzene	4.40E-04	1.74E-02	7.60E-02
Benzo(b)fluoranthene	1.66E-07	6.55E-06	2.87E-05
Benzo(e)pyrene	4.15E-07	1.64E-05	7.17E-05
Benzo(g,h,i)perlyene	4.14E-07	1.63E-05	7.15E-05
Biphenyl	2.12E-04	8.36E-03	3.66E-02
1,3-Butadiene	2.67E-04	1.05E-02	4.61E-02
Carbon Tetrachloride	3.67E-05	1.45E-03	6.34E-03
Chlorobenzene	3.04E-05	1.20E-03	5.25E-03
Chloroform	2.85E-05	1.12E-03	4.92E-03
Chrysene	6.93E-07	2.73E-05	1.20E-04
1,3-Dichloropropene	2.64E-05	1.04E-03	4.56E-03
Ethylbenzene	3.97E-05	1.57E-03	6.86E-03
Ethylene Dibromide	4.43E-05	1.75E-03	7.65E-03
Fluoranthene	1.11E-06	4.38E-05	1.92E-04
Fluorene	5.67E-06	2.24E-04	9.79E-04
Methanol	2.50E-03	9.86E-02	4.32E-01
Methylene Chloride	2.00E-05	7.89E-04	3.45E-03
n-Hexane	1.11E-03	4.38E-02	1.92E-01
Phenanthrene	1.04E-05	4.10E-04	1.80E-03
Phenol	2.40E-05	9.46E-04	4.15E-03
Pyrene	1.36E-06	5.36E-05	2.35E-04
Styrene	2.36E-05	9.31E-04	4.08E-03
Toluene	4.08E-04	1.61E-02	7.05E-02
1,1,2,2-Tetrachloroethane	4.00E-05	1.58E-03	6.91E-03
Tetrachloroethane	2.48E-06	9.78E-05	4.28E-04
1,1,2-Trichloroethane	3.18E-05	1.25E-03	5.49E-03
2,2,4-Trimethylpentane	2.50E-04	9.86E-03	4.32E-02
Vinyl Chloride	1.49E-05	5.88E-04	2.57E-03
Xylene	1.84E-04	7.26E-03	3.18E-02
Polycyclic Organic Matter:			
Naphthalene	7.44E-05	2.93E-03	1.29E-02
2-Methylnaphthalene	3.32E-05	1.31E-03	5.73E-03
PAH	2.69E-05	1.06E-03	4.65E-03
Total HAP		**0.84**	**3.66**

Notes:

1. SO_2, PM, and HAP emission factors from AP-42 Section 3.2, Table 3.2-2 "Uncontrolled Emission Factors for 4-Stroke Lean-Burn Engines," Supplement F, August 2000. Uncontrolled acrolein emission factor is based on SDAPCD emissions testing factors (assuming controlled values as tested are reduced by 99%) and assuming 1020 Btu/scf (http://www.sdapcd.org/content/dam/sdc/apcd/PDF/Misc/EFT/Gas_Combustion/APCD_Engine_Natural_Gas_Fired_4_Stroke_Lean_Burn_with_Catalytic_Oxidation.pdf). NO_X, VOC, CO, CO_2, and CH_4 (=THC-NMHC) and formaldehyde emission factors are based on manufacturer's data. Greenhouse gas emission factors (N_2O) are based on 40 CFR Part 98, Subpart C, Table C-2 for natural gas combustion.

2. Emission Rate (lb/hr) = Rated Capacity (MMBtu/hr or bhp) × Emission Factor (lb/MMBtu or gr/bhp-hr).

3. Annual Emissions (tons/yr)$_{Potential}$ = (lb/hr)$_{Emissions}$ × (Maximum Allowable Operating Hours, 8,760 hr/yr) × (1 ton/2000 lb).

Microturbines

Microturbine Unit Information:

Manufacturer:	Capstone
Model No.:	C200
Projected Startup Date:	Upon Approval
Number of Units:	5

Notes:
1. The unit is comprised of 5 identical C200 units.

Microturbine Fuel Information:

	Per C1000 Unit
Fuel Type:	Natural Gas
Higher Heating Value (Btu/Scf)	1,226
Rated Electrical Power Output (kW):	1,000
Rated Electrical Power Output (MW):	1.000
Rated Horsepower (bhp):	1,341
Heat Input (MMBtu/hr)	11.40
Potential Fuel Consumption (scf/hr):	9,297
Potential Fuel Consumption (MMBtu/yr):	99,864
Max. Annual Hours of Operation (hr/yr):	8,760

Microturbine Emissions Data:

Pollutant	Emission Factors	Units	Maximum Potential Emissions		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
NO_X	0.40	lb/MWhe	0.40	1.75	Manufacturer's Specifications
VOC	0.10	lb/MWhe	0.10	0.44	Manufacturer's Specifications
CO	1.10	lb/MWhe	1.10	4.82	Manufacturer's Specifications
SO_X	0.0034	lb/MMBtu	0.04	0.17	AP-42, Table 3.1-2a (Apr-2000)
PM_{10}	0.0066	lb/MMBtu	0.08	0.33	AP-42, Table 3.1-2a (Apr-2000)
$PM_{2.5}$	0.0066	lb/MMBtu	0.08	0.33	AP-42, Table 3.1-2a (Apr-2000)
GHG (CO_2e)	See Table Below		1,331	5,831	Manuf. Specs / 40 CFR 98, Table C-2
Other (Total HAP)	See Table Below		0.01	0.05	AP-42, Table 3.1-3 (Apr-2000)

Notes:
1. NMNEHC is non-methane, non-ethane hydrocarbon excluding formaldehyde (HCHO).
2. PM_{10} and $PM_{2.5}$ are total values (filterable + condensable).
3. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CO_2 (GWP = 1) + CH_4 (GWP = 25) + N_2O (GWP = 298).
4. Total HAP is the summation of all hazardous air pollutants for which there is a published emission factor for this engine type, including HCHO.

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

Pollutant	Emission Factor	Units	Maximum Potential Emissions		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
GHGs:					
CO_2	1,330	lb/MWhe	1,330	5,825	Manufacturer's Specifications
CH_4	0.001	kg/MMBtu	0.03	0.11	40 CFR 98, Table C-2
N_2O	0.0001	kg/MMBtu	0.00	0.01	40 CFR 98, Table C-2
GHG (CO_2e)			**1,331**	**5,831**	
HAPs:					
1,3-Butadiene	4.3E-07	lb/MMBtu	4.90E-06	2.15E-05	AP-42, Table 3.1-3 (Apr-2000)
Acetaldehyde	4.0E-05	lb/MMBtu	4.56E-04	2.00E-03	AP-42, Table 3.1-3 (Apr-2000)
Acrolein	6.4E-06	lb/MMBtu	7.30E-05	3.20E-04	AP-42, Table 3.1-3 (Apr-2000)
Benzene	1.2E-05	lb/MMBtu	1.37E-04	5.99E-04	AP-42, Table 3.1-3 (Apr-2000)
Ethylbenzene	3.2E-05	lb/MMBtu	3.65E-04	1.60E-03	AP-42, Table 3.1-3 (Apr-2000)
Formaldehyde	7.1E-04	lb/MMBtu	8.09E-03	3.55E-02	AP-42, Table 3.1-3 (Apr-2000)
Naphthalene	1.3E-06	lb/MMBtu	1.48E-05	6.49E-05	AP-42, Table 3.1-3 (Apr-2000)
PAH	2.2E-06	lb/MMBtu	2.51E-05	1.10E-04	AP-42, Table 3.1-3 (Apr-2000)
Propylene oxide	2.9E-05	lb/MMBtu	3.31E-04	1.45E-03	AP-42, Table 3.1-3 (Apr-2000)
Toluene	1.3E-04	lb/MMBtu	1.48E-03	6.49E-03	AP-42, Table 3.1-3 (Apr-2000)
Xylene	6.4E-05	lb/MMBtu	7.30E-04	3.20E-03	AP-42, Table 3.1-3 (Apr-2000)
Total HAP			**0.012**	**0.051**	

Dehydration Unit & Combustor Emissions

GRI-GLYCalc Version 4.0 - EMISSIONS SUMMARY
Controlled Regenerator Emissions

Pollutant	(lbs/hr)	(lbs/day)	(tons/yr)
Carbon dioxide	0.91	21 8	3 99
Methane	0 0234	0 563	0 103
Ethane	0 0623	1 495	0 273
Propane	0 0620	1 488	0 272
Isobutane	0 0178	0 427	0 078
n-Butane	0 0511	1 227	0 224
Isopentane	0 0168	0 403	0 074
n-Pentane	0 0232	0 558	0 102
n-Hexane*	0 0222	0 534	0 097
Cyclohexane	0 0288	0 692	0 126
Other Hexanes	0 0221	0 530	0 097
Heptanes	0 0689	1 655	0 302
2,2,4-Trimethylpentane*	0 0145	0 349	0 064
Benzene*	0 0799	1 918	0 350
Toluene*	0 2164	5 193	0 948
Ethylbenzene*	0 0387	0 929	0 170
Xylenes*	0 2660	6 385	1 165
C8+ Heavier Hydrocarbons	0 0664	1 594	0 291
Total Emissions	1 0808	25 938	4 734
Total Hydrocarbon Emissions	1 0808	25 938	4 734
Total VOC Emissions	0 9951	23 881	4 358
Total HAP Emissions	0 6378	15 308	2.794

GRI-GLYCalc Version 4.0 - EMISSIONS SUMMARY
Flash Gas Emissions

Pollutant	(lbs/hr)	(lbs/day)	(tons/yr)
Carbon dioxide	2	57	10
Methane	0 6821	16 371	2 988
Ethane	0 5151	12 362	2 256
Propane	0 2467	5 921	1 081
Isobutane	0 0471	1 131	0 206
n-Butane	0 1040	2 496	0 456
Isopentane	0 0299	0 718	0 131
n-Pentane	0 0334	0 800	0 146
n-Hexane*	0 0177	0 426	0 078
Cyclohexane	0 0057	0 136	0 025
Other Hexanes	0 0232	0 556	0 101
Heptanes	0 0268	0 644	0 118
2,2,4-Trimethylpentane*	0 0112	0 268	0 049
Benzene*	0 0023	0 056	0 010
Toluene*	0 0041	0 098	0 018
Ethylbenzene*	0 0004	0 010	0 002
Xylenes*	0 0020	0 049	0 009
C8+ Heavier Hydrocarbons	0 0025	0 060	0 011
Total Emissions	1 7543	42 103	7 684
Total Hydrocarbon Emissions	1 7543	42 103	7 684
Total VOC Emissions	0 5571	13 370	2 440
Total HAP Emissions	0 0378	0 907	0 166

GRI-GLYCalc Version 4.0 - EMISSIONS SUMMARY [1]
Combined Regenerator and Flash Gas Emissions

Pollutant	(lbs/hr)	(lbs/day)	(tons/yr)
Carbon dioxide	3 2800	78 7200	14 3664
Methane	0 7055	16 934	3 0904
Ethane	0 5774	13 857	2 5288
Propane	0 3087	7 409	1 3521
Isobutane	0 0649	1 558	0 2843
n-Butane	0 1551	3 723	0 6795
Isopentane	0 0467	1.121	0 2045
n-Pentane	0 0566	1 358	0 2479
n-Hexane*	0 0399	0 960	0 1751
Cyclohexane	0 0345	0 828	0 1511
Other Hexanes	0 0453	1 086	0 1981
Heptanes	0 0957	2 299	0 4196
2,2,4-Trimethylpentane*	0 0257	0 617	0 1126
Benzene*	0 0822	1 974	0 3604
Toluene*	0 2205	5 291	0 9656
Ethylbenzene*	0 0391	0 939	0 1714
Xylenes*	0 2680	6 434	1 1743
C8+ Heavier Hydrocarbons	0 0689	1.654	0 3019
Total Emissions	2 8351	68 041	12 4175
Total Hydrocarbon Emissions	2 8351	68 041	12 4175
Total VOC Emissions	1 5522	37 251	6 7983
Total HAP Emissions	0 6756	16 215	2 9593

*HAPs

[1] Based on GRI GLYCalc 4 0 run at dry gas flowrate of 125 MMSCFD and T and P of 75°F and 1200 psig, respectively (note that emissions from this scenario are more conservative than the maximum 152 MMscfd and 1400 psig) Still emissions are controlled by the enclosed flare at a destruction efficiency of 98% Flash tank emissions will be routed to the reboiler for use as fuel, with the flare as backup for excess This is expected to achieve 98% destruction efficiency

Enclosed Flare (FLARE-1 & FLARE-2) Emissions Calculations:

Combustor Rating	7 0 MMbtu/hr
Pilot Rating	0 09 MMbtu/hr
Higher Heating Value (HHV)	1,226 btu/scf

Pollutant	Emission Factors [1] (lb/MMBtu)	Combustor Potential Emissions (lb/hr)	Combustor Potential Emissions (tpy)	Pilot Potential Emissions (lb/hr)	Pilot Potential Emissions (tpy)
NO_x	0 082	0 571	2 500	0 007	0 032
CO	0 069	0 480	2 100	0 006	0 027
PM/PM_{10}	0 006	0 043	0 190	0 0006	0 002
SO_2	0 000	0 003	0 015	4 40E-05	1 93E-04
CO_2 [2] (Natural Gas Firing)	116 997	818 981	3,587 137	10 530	46 120
CH_4 [2] (Natural Gas Firing)	0 002	0 015	0 068	1 98E-04	8 69E-04
N_2O [2] (Natural Gas Firing)	0 000	0 002	0 007	1 98E-05	8 69E-05

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

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

Reboilers (Per Unit)

Source Designation:	
Fuel Used:	Natural Gas
Higher Heating Value (HHV) (Btu/scf)	1,226
Heat Input (MMBtu/hr)	2 31
Fuel Consumption (MMscf/hr)	1 88E-03
Potential Annual Hours of Operation (hr/yr)	8,760

Criteria and Manufacturer Specific Pollutant Emission Rates:

Pollutant	Emission Factor (lb/MMscf)[1]	Potential Emissions (lb/hr)[2]	Potential Emissions (tons/yr)[3]
NO_x	100	1 88E-01	8 25E-01
CO	84	1 58E-01	6 93E-01
SO_2	0 6	1 13E-03	4 95E-03
PM Total	7 6	1 43E-02	6 27E-02
PM Condensable	5 7	1 07E-02	4 70E-02
PM_{10} (Filterable)	1 9	3 58E-03	1 57E-02
$PM_{2.5}$ (Filterable)	1 9	3 58E-03	1 57E-02
VOC	5 5	1 04E-02	4 54E-02
CO_2[4] (Natural Gas Firing)	143,462	270 26	1183 76
CH_4[4] (Natural Gas Firing)	2 7	5 09E-03	2 23E-02
N_2O[4] (Natural Gas Firing)	0 27	5 09E-04	2 23E-03

Hazardous Air Pollutant (HAP) Potential Emissions:

Pollutant	Emission Factor (lb/MMscf)[1]	Potential Emissions (lb/hr)[2]	Potential Emissions (tons/yr)[3]
HAPs:			
3-Methylchloranthrene	1 8E-06	3 39E-09	1 49E-08
7,12-Dimethylbenz(a)anthracene	1 6E-05	3 01E-08	1 32E-07
Acenaphthene	1 8E-06	3 39E-09	1 49E-08
Acenaphthylene	1 8E-06	3 39E-09	1 49E-08
Anthracene	2 4E-06	4 52E-09	1 98E-08
Benz(a)anthracene	1 8E-06	3 39E-09	1 49E-08
Benzene	2 1E-03	3 96E-06	1 73E-05
Benzo(a)pyrene	1 2E-06	2 26E-09	9 90E-09
Benzo(b)fluoranthene	1 8E-06	3 39E-09	1 49E-08
Benzo(g,h,i)perylene	1 2E-06	2 26E-09	9 90E-09
Benzo(k)fluoranthene	1 8E-06	3 39E-09	1 49E-08
Chrysene	1 8E-06	3 39E-09	1 49E-08
Dibenzo(a,h) anthracene	1 2E-06	2 26E-09	9 90E-09
Dichlorobenzene	1 2E-03	2 26E-06	9 90E-06
Fluoranthene	3 0E-06	5 65E-09	2 48E-08
Fluorene	2 8E-06	5 27E-09	2 31E-08
Formaldehyde	7 5E-02	1 41E-04	6 19E-04
Hexane	1 8E+00	3 39E-03	1 49E-02
Indo(1,2,3-cd)pyrene	1 8E-06	3 39E-09	1 49E-08
Phenanthrene	1 7E-05	3 20E-08	1 40E-07
Pyrene	5 0E-06	9 42E-09	4 13E-08
Toluene	3 4E-03	6 41E-06	2 81E-05
Arsenic	2 0E-04	3 77E-07	1 65E-06
Beryllium	1.2E-05	2 26E-08	9 90E-08
Cadmium	1 1E-03	2 07E-06	9 08E-06
Chromium	1 4E-03	2 64E-06	1 16E-05
Cobalt	8 4E-05	1 58E-07	6 93E-07
Lead	5 0E-04	9 42E-07	4 13E-06
Manganese	3 8E-04	7 16E-07	3 14E-06
Mercury	2 6E-04	4 90E-07	2 15E-06
Nickel	2 1E-03	3 96E-06	1 73E-05
Selenium	2 4E-05	4 52E-08	1 98E-07
Polycyclic Organic Matter:			
Methylnaphthalene (2-)	2 4E-05	4 52E-08	1 98E-07
Naphthalene	6 1E-04	1 15E-06	5 03E-06
Total HAP		**3.56E-03**	**1.56E-02**

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

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

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

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

Fuel Gas Heater 1

Source Designation:	
Fuel Used	Natural Gas
Higher Heating Value (HHV) (Btu/scf)	1,226
Heat Input (MMBtu/hr)	1 15
Fuel Consumption (MMscf/hr)	9 38E-04
Potential Annual Hours of Operation (hr/yr)	8,760

Criteria and Manufacturer Specific Pollutant Emission Rates:

Pollutant	Emission Factor (lb/MMscf)[1]	Potential Emissions (lb/hr)[2]	Potential Emissions (tons/yr)[3]
NO_x	100	0 09	0 41
CO	84	0 08	0 35
SO_2	0 6	5 63E-04	2 46E-03
PM Total	7 6	0 01	0 03
PM Condensable	5 7	0 01	0 02
PM_{10} (Filterable)	1 9	1 78E-03	7 80E-03
$PM_{2.5}$ (Filterable)	1 9	1 78E-03	7 80E-03
VOC	5 5	0 01	0 02
CO_2[4] (Natural Gas Firing)	143,462	134 55	589 32
CH_4[4] (Natural Gas Firing)	2 7	2 54E-03	1 11E-02
N_2O[4] (Natural Gas Firing)	0 27	2 54E-04	1 11E-03

Hazardous Air Pollutant (HAP) Potential Emissions:

Pollutant	Emission Factor (lb/MMscf)[1]	Potential Emissions (lb/hr)[2]	Potential Emissions (tons/yr)[3]
HAPs:			
3-Methylchloranthrene	1 8E-06	1 69E-09	7 39E-09
7,12-Dimethylbenz(a)anthracene	1 6E-05	1 50E-08	6 57E-08
Acenaphthene	1 8E-06	1 69E-09	7 39E-09
Acenaphthylene	1 8E-06	1 69E-09	7 39E-09
Anthracene	2 4E-06	2 25E-09	9 86E-09
Benz(a)anthracene	1 8E-06	1 69E-09	7 39E-09
Benzene	2 1E-03	1 97E-06	8 63E-06
Benzo(a)pyrene	1 2E-06	1 13E-09	4 93E-09
Benzo(b)fluoranthene	1 8E-06	1 69E-09	7 39E-09
Benzo(g,h,i)perylene	1 2E-06	1 13E-09	4 93E-09
Benzo(k)fluoranthene	1 8E-06	1 69E-09	7 39E-09
Chrysene	1 8E-06	1 69E-09	7 39E-09
Dibenzo(a,h) anthracene	1 2E-06	1 13E-09	4 93E-09
Dichlorobenzene	1 2E-03	1 13E-06	4 93E-06
Fluoranthene	3 0E-06	2 81E-09	1 23E-08
Fluorene	2 8E-06	2 63E-09	1 15E-08
Formaldehyde	7 5E-02	7 03E-05	3 08E-04
Hexane	1 8E+00	1 69E-03	7 39E-03
Indo(1,2,3-cd)pyrene	1 8E-06	1 69E-09	7 39E-09
Phenanthrene	1 7E-05	1 59E-08	6 98E-08
Pyrene	5 0E-06	4 69E-09	2 05E-08
Toluene	3 4E-03	3 19E-06	1 40E-05
Arsenic	2 0E-04	1 88E-07	8 22E-07
Beryllium	1 2E-05	1 13E-08	4 93E-08
Cadmium	1 1E-03	1 03E-06	4 52E-06
Chromium	1 4E-03	1 31E-06	5 75E-06
Cobalt	8 4E-05	7 88E-08	3 45E-07
Lead	5 0E-04	4 69E-07	2 05E-06
Manganese	3 8E-04	3 56E-07	1 56E-06
Mercury	2 6E-04	2 44E-07	1 07E-06
Nickel	2 1E-03	1 97E-06	8 63E-06
Selenium	2 4E-05	2 25E-08	9 86E-08
Polycyclic Organic Matter:			
Methylnaphthalene (2-)	2 4E-05	2 25E-08	9 86E-08
Naphthalene	6 1E-04	5 72E-07	2 51E-06
Total HAP		**1.77E-03**	**7.76E-03**

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

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

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

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

Fuel Gas Heater 2

Source Designation:	
Fuel Used	Natural Gas
Higher Heating Value (HHV) (Btu/scf)	1,226
Heat Input (MMBtu/hr)	0 77
Fuel Consumption (MMscf/hr)	6 28E-04
Potential Annual Hours of Operation (hr/yr)	8,760

Criteria and Manufacturer Specific Pollutant Emission Rates:

Pollutant	Emission Factor (lb/MMscf)[1]	Potential Emissions (lb/hr)[2]	Potential Emissions (tons/yr)[3]
NO_x	100	0 06	0 28
CO	84	0 05	0 23
SO_2	0 6	3 77E-04	1 65E-03
PM Total	7 6	4 77E-03	2 09E-02
PM Condensable	5 7	3 58E-03	1 57E-02
PM_{10} (Filterable)	1 9	1 19E-03	5 23E-03
$PM_{2.5}$ (Filterable)	1 9	1 19E-03	5 23E-03
VOC	5 5	3 45E-03	1 51E-02
CO_2[4] (Natural Gas Firing)	143,462	90 09	394 59
CH_4[4] (Natural Gas Firing)	2 7	1 70E-03	7 44E-03
N_2O[4] (Natural Gas Firing)	0 27	1 70E-04	7 44E-04

Hazardous Air Pollutant (HAP) Potential Emissions:

Pollutant	Emission Factor (lb/MMscf)[1]	Potential Emissions (lb/hr)[2]	Potential Emissions (tons/yr)[3]
HAPs:			
3-Methylchloranthrene	1 8E-06	1 13E-09	4 95E-09
7,12-Dimethylbenz(a)anthracene	1 6E-05	1 00E-08	4 40E-08
Acenaphthene	1 8E-06	1 13E-09	4 95E-09
Acenaphthylene	1 8E-06	1 13E-09	4 95E-09
Anthracene	2 4E-06	1 51E-09	6 60E-09
Benz(a)anthracene	1 8E-06	1 13E-09	4 95E-09
Benzene	2 1E-03	1 32E-06	5 78E-06
Benzo(a)pyrene	1 2E-06	7 54E-10	3 30E-09
Benzo(b)fluoranthene	1 8E-06	1 13E-09	4 95E-09
Benzo(g,h,i)perylene	1 2E-06	7 54E-10	3 30E-09
Benzo(k)fluoranthene	1 8E-06	1 13E-09	4 95E-09
Chrysene	1 8E-06	1 13E-09	4 95E-09
Dibenzo(a,h) anthracene	1 2E-06	7 54E-10	3 30E-09
Dichlorobenzene	1 2E-03	7 54E-07	3 30E-06
Fluoranthene	3 0E-06	1 88E-09	8 25E-09
Fluorene	2 8E-06	1 76E-09	7 70E-09
Formaldehyde	7 5E-02	4 71E-05	2 06E-04
Hexane	1 8E+00	1 13E-03	4 95E-03
Indo(1,2,3-cd)pyrene	1 8E-06	1 13E-09	4 95E-09
Phenanthrene	1 7E-05	1 07E-08	4 68E-08
Pyrene	5 0E-06	3 14E-09	1 38E-08
Toluene	3 4E-03	2.14E-06	9 35E-06
Arsenic	2 0E-04	1 26E-07	5 50E-07
Beryllium	1 2E-05	7 54E-09	3 30E-08
Cadmium	1.1E-03	6 91E-07	3 03E-06
Chromium	1 4E-03	8 79E-07	3 85E-06
Cobalt	8 4E-05	5 27E-08	2 31E-07
Lead	5 0E-04	3 14E-07	1 38E-06
Manganese	3 8E-04	2 39E-07	1 05E-06
Mercury	2 6E-04	1 63E-07	7 15E-07
Nickel	2 1E-03	1 32E-06	5 78E-06
Selenium	2 4E-05	1 51E-08	6 60E-08
Polycyclic Organic Matter:			
Methylnaphthalene (2-)	2 4E-05	1 51E-08	6 60E-08
Naphthalene	6 1E-04	3 83E-07	1 68E-06
Total HAP		**1.19E-03**	**5.19E-03**

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

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

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

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

Fuel Gas Heater 3 and 4

Source Designation:	
Fuel Used	Natural Gas
Higher Heating Value (HHV) (Btu/scf)	1,226
Heat Input (MMBtu/hr)	0 01
Fuel Consumption (MMscf/hr)	4 89E-06
Potential Annual Hours of Operation (hr/yr)	8,760

Criteria and Manufacturer Specific Pollutant Emission Rates:

Pollutant	Emission Factor (lb/MMscf)[1]	Potential Emissions (lb/hr)[2]	Potential Emissions (tons/yr)[3]
NO_x	100	0 00	0 00
CO	84	0 00	0 00
SO_2	0 6	2 94E-06	1 29E-05
PM Total	7 6	3 72E-05	1 63E-04
PM Condensable	5 7	2 79E-05	1 22E-04
PM_{10} (Filterable)	1 9	9 30E-06	4 07E-05
$PM_{2.5}$ (Filterable)	1 9	9 30E-06	4 07E-05
VOC	5 5	2 69E-05	1 18E-04
CO_2[4] (Natural Gas Firing)	143,462	0 70	3 07
CH_4[4] (Natural Gas Firing)	2 7	1 32E-05	5 79E-05
N_2O[4] (Natural Gas Firing)	0 27	1 32E-06	5 79E-06

Hazardous Air Pollutant (HAP) Potential Emissions:

Pollutant	Emission Factor (lb/MMscf)[1]	Potential Emissions (lb/hr)[2]	Potential Emissions (tons/yr)[3]
HAPs:			
3-Methylchloranthrene	1 8E-06	8 81E-12	3 86E-11
7,12-Dimethylbenz(a)anthracene	1 6E-05	7 83E-11	3 43E-10
Acenaphthene	1 8E-06	8 81E-12	3 86E-11
Acenaphthylene	1 8E-06	8 81E-12	3 86E-11
Anthracene	2 4E-06	1 17E-11	5 14E-11
Benz(a)anthracene	1 8E-06	8 81E-12	3 86E-11
Benzene	2 1E-03	1 03E-08	4 50E-08
Benzo(a)pyrene	1 2E-06	5 87E-12	2 57E-11
Benzo(b)fluoranthene	1 8E-06	8 81E-12	3 86E-11
Benzo(g,h,i)perylene	1 2E-06	5 87E-12	2 57E-11
Benzo(k)fluoranthene	1 8E-06	8 81E-12	3 86E-11
Chrysene	1 8E-06	8 81E-12	3 86E-11
Dibenzo(a,h) anthracene	1 2E-06	5 87E-12	2 57E-11
Dichlorobenzene	1 2E-03	5 87E-09	2 57E-08
Fluoranthene	3 0E-06	1 47E-11	6 43E-11
Fluorene	2 8E-06	1 37E-11	6 00E-11
Formaldehyde	7 5E-02	3 67E-07	1 61E-06
Hexane	1 8E+00	8 81E-06	3 86E-05
Indo(1,2,3-cd)pyrene	1 8E-06	8 81E-12	3 86E-11
Phenanthrene	1 7E-05	8 32E-11	3 64E-10
Pyrene	5 0E-06	2 45E-11	1 07E-10
Toluene	3 4E-03	1 66E-08	7 29E-08
Arsenic	2 0E-04	9 79E-10	4 29E-09
Beryllium	1 2E-05	5 87E-11	2 57E-10
Cadmium	1 1E-03	5 38E-09	2 36E-08
Chromium	1 4E-03	6 85E-09	3 00E-08
Cobalt	8 4E-05	4 11E-10	1 80E-09
Lead	5 0E-04	2 45E-09	1 07E-08
Manganese	3 8E-04	1 86E-09	8 14E-09
Mercury	2 6E-04	1 27E-09	5 57E-09
Nickel	2 1E-03	1 03E-08	4 50E-08
Selenium	2 4E-05	1 17E-10	5 14E-10
Polycyclic Organic Matter:			
Methylnaphthalene (2-)	2 4E-05	1 17E-10	5 14E-10
Naphthalene	6 1E-04	2 98E-09	1 31E-08
Total HAP		**9,24E-06**	**4.05E-05**

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

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

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

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

Storage Tank Emissions

Tank Description	Tank Contents	Tank ID Number	Number of Tanks	Tank Capacity (gal)	Tank Diameter (ft)	Tank Length (ft)	Turnovers Per Year	Annual Throughput (gal)	VOC Emissions Per Tank (lb/yr)	Total VOC Emissions (tpy)	HAP Emissions Per Tank (lb/yr)	Total HAP Emissions (tpy)
Produced Fluids Tank	Produced Water	T-001	1	8,820	10	15 0	24	210,000	509 15	0 255	53 07	0 03
Produced Fluids Tank	Produced Water	T-002	1	8,820	10	15 0	24	210,000	509 15	0.255	53 07	0 03
Engine Lube Oil Tank	Engine Lube Oil	T-003	1	2,000	5 33	12 0	2	4,200	0 65	0.000	<0 01	<0 01
Compressor Lube Oil Tank	Compressor Oil	T-004	1	2,000	5 33	12 0	4	7,266	0.70	3 50E-04	<0 01	<0 01
New MEG Tank	New MEG	T-005	1	2,000	5 33	12 0	1	1,050	0 04	2 00E-05	<0 01	<0 01
Used MEG Tank	Used MEG	T-006	1	2,000	5 33	12 0	1	1,050	0 04	2 00E-05	<0 01	<0 01
Used Oil Tank	Used Oil	T-007	1	4,200	5 33	25 1	1	4,200	1 27	6 35E-04	<0 01	<0 01
Methanol Tank	Methanol	T-008	1	3,998	5 33	23 9	5	21,000	0 11	5 50E-05	<0 01	<0 01
Engine Lube Oil Tank	Engine Oil	T-009	1	302	3 2	5 1	3	1,050	0 11	5 50E-05	<0 01	<0 01
Engine Lube Oil Tank	Engine Oil	T-010	1	302	3 2	5 1	3	1,050	0 11	5 50E-05	<0 01	<0 01
Engine Lube Oil Tank	Engine Oil	T-011	1	302	3 2	5 1	3	1,050	0 11	5 50E-05	<0 01	<0 01
Engine Lube Oil Tank	Engine Oil	T-012	1	302	3 2	5 1	3	1,050	0 11	5 50E-05	<0 01	<0 01
Compressor Lube Oil Tank	Compressor Oil	T-013	1	302	3 2	5 1	6	1,806	0 11	5 50E-05	<0 01	<0 01
Compressor Lube Oil Tank	Compressor Oil	T-014	1	302	3 2	5 1	6	1,806	0 11	5 50E-05	<0 01	<0 01
Compressor Lube Oil Tank	Compressor Oil	T-015	1	302	3 2	5 1	6	1,806	0 11	5 50E-05	<0 01	<0 01
Compressor Lube Oil Tank	Compressor Oil	T-016	1	302	3 2	5 1	6	1,806	0 11	5 50E-05	<0 01	<0 01
Ice-chek Tank	Ice-chek	T-017	1	550	4 2	5 4	6	3,486	0 02	1 00E-05	<0 01	<0 01
Ice-chek Tank	Ice-chek	T-018	1	550	4 2	5 4	6	3,486	0 02	1 00E-05	<0 01	<0 01
Ice-chek Tank	Ice-chek	T-019	1	550	4 2	5 4	6	3,486	0 20	1 0E-04	<0 01	<0 01
Ice-chek Tank	Ice-chek	T-020	1	550	4 2	5 4	6	3,486	0 06	3 0E-05	<0 01	<0 01
Ice-chek Tank	Ice-chek	T-021	1	550	4 2	5 4	6	3,486	0 06	3 0E-05	<0 01	<0 01
Ice-chek Tank	Ice-chek	T-022	1	550	4 2	5 4	6	3,486	0 06	3 0E-05	<0 01	<0 01
New TEG Tank	New TEG	T-023	1	2,000	5 3	12 0	2	4,200	0 05	2 5E-05	<0 01	<0 01
Used TEG Tank	Used TEG	T-024	1	2,000	5 3	12 0	2	4,200	0 05	2 5E-05	<0 01	<0 01
Total Potential Emissions (excluding pipeline fluids tanks)									**4.21**	**0.00**	**0.000**	**0.00**

1 Ice-Chek contains ethylene glycol

Produced Fluids Tank (210 bbl) - T001 & T002

Operational Hours	8,760 hrs/yr
Control Efficiency	95%
Annual Fluid Throughput (per tank)	210,000 gal/yr

Description	Potential Throughput[1] (gal/yr)
Produced Water (per tank)	189,000
Condensate (per tank)	21,000

[1] Based on engineering estimate of total produced fluids for the station Produced Fluids comprises of 90% water and 10% condensate

Storage Tank (210 bbl, each) - Emissions (Each Tank)

Constituent	Uncontrolled Total Emissions[1] lb/hr	Uncontrolled Total Emissions[1] tpy	Controlled Total Emissions[1] lb/hr	Controlled Total Emissions[1] tpy
Propane	0 363	1 589	0 018	0 079
Isobutane	0.104	0 454	0 005	0 023
n-Butane	0 228	0 998	0 011	0 050
Isopentane	0.102	0 447	0 005	0 022
n-Pentane	0.100	0 438	0 005	0 022
Isohexane	0 076	0 333	0 004	0 017
n-Hexane	0 052	0 227	0 003	0 011
Benzene	0 002	0 009	0 000	0 000
Cyclohexane	0 009	0 039	0 000	0 002
i-Heptane	0 044	0 193	0 002	0 010
Toluene	0 020	0 089	0 001	0 004
i-Octane	0 045	0 196	0 002	0 010
n-Octane	0 007	0 029	0 000	0 001
Ethylbenzene	0 000	0 002	0 000	0 000
m-Xylene	0 002	0 008	0 000	0 000
Isononane	0 005	0 022	0 000	0 001
n-Nonane	0 001	0 005	0 000	0 000
Decane	0 003	0 014	0 000	0 001
Total VOC Emissions:	1.162	5 091	0 058	0 255
Total HAP Emissions:	0 121	0 531	0 006	0 027

[1] Uncontrolled emissions calculations using ProMax (sum of produced water and condensate) and based on 210,000 gallons per year Permit limit is 6 0 tpy

Tank Enclosed Flare

Enclosed Ground Flare Calculations:

Combustor Rating	41.0	MMbtu/hr
Hours Of Operation	8760	hrs
Pilot Rating	0.12	MMbtu/hr
Higher Heating Value (HHV)	1,226	btu/scf

Pollutant	Emission Factors [1] (lb/MMBtu)	Combustor Potential Emissions (lb/hr)	Combustor Potential Emissions (tpy)	Pilot Potential Emissions (lb/hr)	Pilot Potential Emissions (tpy)
NO_x	0.082	3.34	14.65	0.01	0.04
CO	0.069	2.81	12.30	0.01	0.04
PM/PM_{10}	0.006	0.25	1.11	7.60E-04	3.33E-03
SO_2	0.000	0.02	0.09	6.00E-05	2.63E-04
VOC[2]		2.60	11.38		
HAP[2]		0.01	0.05		
CO_2 [3] (Natural Gas Firing)	116.997	4796.89	21010.38	14.35	62.84
CH_4 [3] (Natural Gas Firing)	0.002	0.09	0.40	2.70E-04	1.18E-03
N_2O [3] (Natural Gas Firing)	0.000	0.01	0.04	2.70E-05	1.18E-04

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

[2] Permit Limit R13-3269B condition 7.1.2.a and b.

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

Fugitive Emissions

Fugitive Component Information:

Component Type	Estimated Component Count	Gas Leak Emission Factor (lb/hr/component)	Factor Source	Average Gas Leak Rate (lb/hr)	Max Gas Leak Rate (tpy)	Potential VOC Emissions (tpy)	Benzene Emissions (tpy)	Toluene Emissions (tpy)	Ethylbenzene Emissions (tpy)	Xylene Emissions (tpy)	n-Hexane Emissions (tpy)	2,2,4-TMP Emissions (tpy)	Potential HAP Emissions (tpy)
Connectors	650	0 0004	EPA Protocol, Table 2-4	0 29	1 51	0 23	0 00	0 00	0 00	0 00	0 01	0 01	0 01
Flanges	250	0 001	EPA Protocol, Table 2-4	0 21	1 13	0 17	0 00	0 00	0 00	0 00	0 00	0 00	0 01
Open-Ended Lines	12	0 004	EPA Protocol, Table 2-4	0 05	0 28	0 04	0 00	0 00	0 00	0 00	0 00	0 00	0 00
Valves	700	0 010	EPA Protocol, Table 2-4	6 94	36 50	5 65	0 01	0 01	0 00	0 01	0 14	0 14	0 31
Total				**7.50**	**39.41**	**6.10**	**0.01**	**0.01**	**0.00**	**0.01**	**0.15**	**0.15**	**0.33**

Notes:

1. The component type "Other" includes any equipment type other than connectors, flanges, open-ended lines, pumps and valves that have fugitive emissions.
2. The component count is a preliminary estimate based on the proposed design of the station
3. *Table 2-4 :Oil & Gas Production Operations Average Emission Factors* , Protocol for Equipment Leak Emission Estimates, EPA 453/R-95-
4. Assumes maximum leak rate 20% greater than measured average leak rate.

GHG Fugitive Emissions from Component Leaks:

Component Type	Estimated Component Count	GHG Emission Factor (scf/hr/component)	Factor Source	CH_4 Emissions (tpy)	CO_2 Emissions (tpy)	CO_2e Emissions (tpy)
Connectors	650	0 003	40 CFR 98, Table W-1A	0 29	1 9E-03	7 29
Flanges	250	0 003	40 CFR 98, Table W-1A	0 11	7.2E-04	2 80
Open-Ended Lines	12	0 061	40 CFR 98, Table W-1A	0 11	7 1E-04	2 74
Valves	700	0 027	40 CFR 98, Table W-1A	2 83	1 8E-02	70 66
Total				**3.34**	**0.02**	**83.49**

Notes:

1. The component count is a preliminary estimate based on the proposed design of the station
2. *Table W-1 of Subpart W - Default Whole Gas Emission Factors for Onshore Production* , 40 CFR 98, Subpart W
3. Calculated in accordance with Equations W-32a, W-35, and W-36 in Subpart W of 40 CFR 98
4. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CO2 (GWP = 1) + CH4 (GWP = 25) + N2O (GWP = 298)

Rod Packing Emissions

Number of Compressors	Number of Rods Per Compressor	Leak Rate (scf/hr/rod)	Total Volume NG Emitted (scf/yr)	Potential VOC Emissions (tpy)	Benzene Emissions (tpy)	Toluene Emissions (tpy)	Ethylbenzene Emissions (tpy)	Xylene Emissions (tpy)	n-Hexane Emissions (tpy)	2,2,4-TMP Emissions (tpy)	Potential HAP Emissions (tpy)	Potential CO_2 Emissions (tpy)	Potential CH_4 Emissions (tpy)	Potential CO_2e Emissions (tpy)
4	6	11	2,312,640	8 94	0 01	0 02	0 00	0 02	0 22	0 23	0 49	0 25	39 47	987 03
Total				**8.94**	**0.01**	**0.02**	**0.00**	**0.02**	**0.22**	**0.23**	**0.49**	**0.25**	**39.47**	**987.03**

Notes:

1. Density of natural gas: 0 05 lb/ft3 @ STP and wt% are used for VOC and HAP emission calculations.
2. Leak rate from https //www3 epa gov/gasstar/documents/ll_rodpack pdf

Fugitive Emissions

VOC/GHG Fugitive Emissions from Blowdowns:

Blowdown Type	Number of Events	Gas Volume (scf/event)	Gas Volume (scf/yr)	VOC Emissions (tpy)	Benzene Emissions (tpy)	Toluene Emissions (tpy)	Ethylbenzene Emissions (tpy)	Xylene Emissions (tpy)	n-Hexane Emissions (tpy)	2,2,4-TMP Emissions (tpy)	HAP Emissions (tpy)	CH_4 Emissions (tpy)	CO_2 Emissions (tpy)	CO_2e Emissions (tpy)
Station ESD	5	358,000	1,790,000	6.92	0.01	0.01	0.00	0.01	0.17	0.18	0.38	30.55	0.20	763.97
Pigging Operations	500	2,000	1,000,000	23.12	0.00	0.01	0.00	0.01	0.09	0.10	0.21	17.07	0.11	426.80
Filter Maintenance	15	13,500	202,500	0.78	0.00	0.00	0.00	0.00	0.02	0.02	0.04	3.46	0.02	86.43
Compressor	36	44,000	1,584,000	6.13	0.01	0.01	0.00	0.01	0.15	0.15	0.34	27.03	0.17	676.05
Total			**4,576,500**	**36.95**	**0.02**	**0.04**	**0.01**	**0.03**	**0.43**	**0.45**	**0.97**	**78.11**	**0.50**	**1,953.24**

Notes:

1. CH_4 and CO_2 emissions are based on fractions of these pollutants in the site-specific gas analysis.
2. GHG Emissions are calculated in accordance with Equations W-35 and W-36 in Subpart W of 40 CFR 98.
3. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CO_2 (GWP = 1) + CH_4 (GWP = 25) + N_2O (GWP = 298).
4. Density of natural gas: 0.05 lb/ft3 @ STP and wt% are used for VOC and HAP emission calculations. VOC emissions from pigging are equal to R13-3269B permit limit (Condition 8.1.3.c).

Fugitive Component Emissions Data:

Pollutant	Atmospheric Emissions		Emissions Estimation Method
	lbs/hr	tpy	
VOC	11.87	51.99	EPA Protocol, Table 2-4 and Site-Specific Gas Analysis
Benzene	0.01	0.03	EPA Protocol, Table 2-4 and Site-Specific Gas Analysis
Toluene	0.02	0.07	EPA Protocol, Table 2-4 and Site-Specific Gas Analysis
Ethylbenzene	0.00	0.01	EPA Protocol, Table 2-4 and Site-Specific Gas Analysis
Xylene	0.01	0.06	EPA Protocol, Table 2-4 and Site-Specific Gas Analysis
n-hexane	0.18	0.80	EPA Protocol, Table 2-4 and Site-Specific Gas Analysis
2,2,4-TMP	0.19	0.83	EPA Protocol, Table 2-4 and Site-Specific Gas Analysis
Total HAP	0.41	1.79	EPA Protocol, Table 2-4 and Site-Specific Gas Analysis
GHG (CO_2e)	690	3024	40 CFR 98, Table W-1A and Site-Specific Gas Analysis

Liquid Loading

Liquid Loading Emissions

Description	Maximum Throughput (gal)	VOC Emissions (tpy)	HAP Emissions (tpy)
Produced Water	420,000	0 013	0 001

1 Based on ProMax Calculations for the Janus Station

Haul Roads

Estimated Potential Road Fugitive Emissions

Unpaved Road Emissions

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

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

Description	Weight of Empty Truck (tons)	Weight of Truck w/ Max Load (tons)	Mean Vehicle Weight (tons)	Length of Unpaved Road Traveled (mile/trip)	Trips Per Year	Mileage Per Year	Control (%)	Emissions (tpy) PM	PM_{10}	$PM_{2.5}$
Liquids Hauling	20	40	30	0.75	105	79	0	0.17	0.04	0.004
Employee Vehicles	3	3	3	0.75	200	150	0	0.11	0.03	0.003
Total Potential Emissions								**0.28**	**0.07**	**0.01**

Gas Analysis

Higher Heating Value 1,226 btu/scf

Constituent	Concentration (Vol %)	Molecular Weight	Molar Weight	Average Weight Fraction	Stream Speciation (Wt. %)
Carbon Dioxide	0.190%	44.01	0.08	0.00	0.42
Nitrogen	0.466%	28.014	0.13	0.01	0.65
Methane	80.644%	16.04	12.94	0.64	64.22
Ethane	12.891%	30.07	3.88	0.19	19.25
Propane	3.575%	44.10	1.58	0.08	7.83
Isobutane	0.455%	58.12	0.26	0.01	1.31
n-Butane	0.834%	58.12	0.48	0.02	2.41
Isopentane	0.230%	72.15	0.17	0.01	0.82
n-Pentane	0.214%	72.15	0.15	0.01	0.77
n-Hexane*	0.088%	86.18	0.08	0.00	0.38
Cyclohexane	0.016%	84.16	0.01	0.00	0.07
Other Hexanes	0.128%	86.18	0.11	0.01	0.55
Heptanes	0.112%	100.20	0.11	0.01	0.56
2,2,4-Trimethylpentane*	0.069%	114.23	0.08	0.00	0.39
Benzene*	0.004%	78.11	0.00	0.00	0.02
Toluene*	0.007%	92.14	0.01	0.00	0.03
Ethylbenzene*	0.001%	106.17	0.00	0.00	0.01
Xylenes*	0.005%	106.16	0.01	0.00	0.03
C8+ Heavies	0.055%	114.23	0.06	0.00	0.31
Totals	99.98%		20.14	1.00	100.00

*HAPs

TOC (Total)	99.33%		98.94
VOC (Total)	5.79%		15.47
HAP (Total)	0.17%		0.85

GRI-GLYCalc VERSION 4.0 - AGGREGATE CALCULATIONS REPORT

Case Name: EQT - Janus Compressor Station Dehys 1 & 2
File Name: Z:\Client\EQT Corporation\West Virginia\Janus\153901.0106 R13 Application\04 Draft\Dehy Changes\2017-0609_EQT_Janus_R13_Dehys1&2_v1.0.ddf
Date: June 09, 2017

DESCRIPTION:

Description: Revised PTE Calculations

Annual Hours of Operation: 8760.0 hours/yr

EMISSIONS REPORTS:

CONTROLLED REGENERATOR EMISSIONS

Component	lbs/hr	lbs/day	tons/yr
Methane	0.0242	0.580	0.1059
Ethane	0.0589	1.415	0.2582
Propane	0.0545	1.307	0.2385
Isobutane	0.0148	0.355	0.0648
n-Butane	0.0420	1.009	0.1841
Isopentane	0.0130	0.311	0.0568
n-Pentane	0.0180	0.431	0.0786
n-Hexane	0.0163	0.390	0.0713
Cyclohexane	0.0217	0.521	0.0952
Other Hexanes	0.0163	0.391	0.0714
Heptanes	0.0477	1.145	0.2090
2,2,4-Trimethylpentane	0.0097	0.233	0.0426
Benzene	0.0624	1.498	0.2733
Toluene	0.1618	3.882	0.7085
Ethylbenzene	0.0264	0.634	0.1157
Xylenes	0.1834	4.401	0.8032
C8+ Heavies	0.0402	0.966	0.1762
Total Emissions	0.8112	19.470	3.5532
Total Hydrocarbon Emissions	0.8112	19.470	3.5532
Total VOC Emissions	0.7281	17.475	3.1892
Total HAP Emissions	0.4599	11.038	2.0145
Total BTEX Emissions	0.4339	10.415	1.9007

UNCONTROLLED REGENERATOR EMISSIONS

Component	lbs/hr	lbs/day	tons/yr
Methane	1.2084	29.002	5.2928
Ethane	2.9475	70.739	12.9098
Propane	2.7226	65.343	11.9250
Isobutane	0.7402	17.765	3.2421
n-Butane	2.1013	50.431	9.2037
Isopentane	0.6487	15.569	2.8413
n-Pentane	0.8977	21.544	3.9319
n-Hexane	0.8135	19.523	3.5630
Cyclohexane	1.0862	26.069	4.7576
Other Hexanes	0.8156	19.573	3.5722

Component	lbs/hr	lbs/day	tons/yr
Heptanes	2.3854	57.250	10.4481
2,2,4-Trimethylpentane	0.4863	11.671	2.1299
Benzene	3.1199	74.877	13.6650
Toluene	8.0883	194.118	35.4266
Ethylbenzene	1.3204	31.689	5.7832
Xylenes	9.1685	220.045	40.1581
C8+ Heavies	2.0117	48.280	8.8110
Total Emissions	40.5619	973.487	177.6613
Total Hydrocarbon Emissions	40.5619	973.487	177.6613
Total VOC Emissions	36.4061	873.746	159.4586
Total HAP Emissions	22.9968	551.922	100.7258
Total BTEX Emissions	21.6970	520.729	95.0330

FLASH GAS EMISSIONS

Component	lbs/hr	lbs/day	tons/yr
Methane	0.7719	18.525	3.3808
Ethane	0.5398	12.956	2.3645
Propane	0.2364	5.673	1.0354
Isobutane	0.0429	1.029	0.1879
n-Butane	0.0936	2.246	0.4098
Isopentane	0.0254	0.610	0.1113
n-Pentane	0.0283	0.679	0.1239
n-Hexane	0.0143	0.343	0.0626
Cyclohexane	0.0047	0.114	0.0208
Other Hexanes	0.0189	0.452	0.0826
Heptanes	0.0205	0.493	0.0900
2,2,4-Trimethylpentane	0.0083	0.199	0.0363
Benzene	0.0020	0.048	0.0088
Toluene	0.0034	0.081	0.0147
Ethylbenzene	0.0003	0.008	0.0014
Xylenes	0.0015	0.037	0.0068
C8+ Heavies	0.0017	0.041	0.0075
Total Emissions	1.8139	43.533	7.9448
Total Hydrocarbon Emissions	1.8139	43.533	7.9448
Total VOC Emissions	0.5022	12.052	2.1995
Total HAP Emissions	0.0298	0.715	0.1304
Total BTEX Emissions	0.0072	0.173	0.0316

FLASH TANK OFF GAS

Component	lbs/hr	lbs/day	tons/yr
Methane	38.5937	926.248	169.0402
Ethane	26.9922	647.813	118.2259
Propane	11.8192	283.661	51.7681
Isobutane	2.1446	51.470	9.3932
n-Butane	4.6784	112.281	20.4913
Isopentane	1.2707	30.496	5.5656
n-Pentane	1.4138	33.932	6.1926
n-Hexane	0.7142	17.140	3.1280
Cyclohexane	0.2372	5.692	1.0388
Other Hexanes	0.9425	22.621	4.1283
Heptanes	1.0273	24.655	4.4995
2,2,4-Trimethylpentane	0.4140	9.936	1.8134

Benzene	0.1000	2.400	0.4381
Toluene	0.1678	4.028	0.7351
Ethylbenzene	0.0159	0.382	0.0696
Xylenes	0.0771	1.851	0.3379
C8+ Heavies	0.0856	2.054	0.3748
Total Emissions	90.6942	2176.660	397.2405
Total Hydrocarbon Emissions	90.6942	2176.660	397.2405
Total VOC Emissions	25.1083	602.599	109.9744
Total HAP Emissions	1.4891	35.737	6.5221
Total BTEX Emissions	0.3609	8.662	1.5807

EQUIPMENT REPORTS:

COMBUSTION DEVICE

Ambient Temperature: 70.00 deg. F
Excess Oxygen: 10.00 %
Combustion Efficiency: 98.00 %
Supplemental Fuel Requirement: 2.27e-001 MM BTU/hr

Component	Emitted	Destroyed
Methane	2.00%	98.00%
Ethane	2.00%	98.00%
Propane	2.00%	98.00%
Isobutane	2.00%	98.00%
n-Butane	2.00%	98.00%
Isopentane	2.00%	98.00%
n-Pentane	2.00%	98.00%
n-Hexane	2.00%	98.00%
Cyclohexane	2.00%	98.00%
Other Hexanes	2.00%	98.00%
Heptanes	2.00%	98.00%
2,2,4-Trimethylpentane	2.00%	98.00%
Benzene	2.00%	98.00%
Toluene	2.00%	98.00%
Ethylbenzene	2.00%	98.00%
Xylenes	2.00%	98.00%
C8+ Heavies	2.00%	98.00%

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: 1.19 lbs. H2O/MMSCF

Temperature: 80.0 deg. F
Pressure: 1400.0 psig
Dry Gas Flow Rate: 152.0000 MMSCF/day
Glycol Losses with Dry Gas: 6.2856 lb/hr

Wet Gas Water Content: Saturated
Calculated Wet Gas Water Content: 26.52 lbs. H2O/MMSCF
Calculated Lean Glycol Recirc. Ratio: 7.03 gal/lb H2O

Component	Remaining in Dry Gas	Absorbed in Glycol
Water	4.47%	95.53%
Carbon Dioxide	99.75%	0.25%
Nitrogen	99.98%	0.02%
Methane	99.98%	0.02%
Ethane	99.95%	0.05%
Propane	99.94%	0.06%
Isobutane	99.93%	0.07%
n-Butane	99.92%	0.08%
Isopentane	99.93%	0.07%
n-Pentane	99.91%	0.09%
n-Hexane	99.88%	0.12%
Cyclohexane	99.41%	0.59%
Other Hexanes	99.90%	0.10%
Heptanes	99.82%	0.18%
2,2,4-Trimethylpentane	99.93%	0.07%
Benzene	93.83%	6.17%
Toluene	92.33%	7.67%
Ethylbenzene	92.46%	7.54%
Xylenes	89.57%	10.43%
C8+ Heavies	99.87%	0.13%

FLASH TANK

Flash Control: Combustion device
Flash Control Efficiency: 98.00 %
Flash Temperature: 135.0 deg. F
Flash Pressure: 35.0 psig

Component	Left in Glycol	Removed in Flash Gas
Water	99.92%	0.08%
Carbon Dioxide	26.04%	73.96%
Nitrogen	2.95%	97.05%
Methane	3.04%	96.96%
Ethane	9.84%	90.16%
Propane	18.72%	81.28%
Isobutane	25.66%	74.34%
n-Butane	30.99%	69.01%
Isopentane	34.13%	65.87%
n-Pentane	39.14%	60.86%
n-Hexane	53.48%	46.52%
Cyclohexane	82.65%	17.35%
Other Hexanes	46.92%	53.08%
Heptanes	70.05%	29.95%
2,2,4-Trimethylpentane	54.70%	45.30%
Benzene	97.05%	2.95%
Toluene	98.13%	1.87%
Ethylbenzene	98.93%	1.07%
Xylenes	99.27%	0.73%
C8+ Heavies	96.41%	3.59%

REGENERATOR

No Stripping Gas used in regenerator.

Component	Remaining in Glycol	Distilled Overhead
Water	49.74%	50.26%
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	1.46%	98.54%
n-Pentane	1.28%	98.72%
n-Hexane	0.93%	99.07%
Cyclohexane	3.87%	96.13%
Other Hexanes	2.13%	97.87%
Heptanes	0.71%	99.29%
2,2,4-Trimethylpentane	2.74%	97.26%
Benzene	5.15%	94.85%
Toluene	8.05%	91.95%
Ethylbenzene	10.52%	89.48%
Xylenes	13.03%	86.97%
C8+ Heavies	12.45%	87.55%

STREAM REPORTS:

WET GAS STREAM

Temperature: 80.00 deg. F
Pressure: 1414.70 psia
Flow Rate: 6.34e+006 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	5.59e-002	1.68e+002
Carbon Dioxide	1.90e-001	1.40e+003
Nitrogen	4.66e-001	2.18e+003
Methane	8.06e+001	2.16e+005
Ethane	1.29e+001	6.47e+004
Propane	3.57e+000	2.63e+004
Isobutane	4.55e-001	4.42e+003
n-Butane	8.34e-001	8.09e+003
Isopentane	2.30e-001	2.77e+003
n-Pentane	2.14e-001	2.58e+003
n-Hexane	8.80e-002	1.27e+003
Cyclohexane	1.60e-002	2.25e+002
Other Hexanes	1.28e-001	1.84e+003
Heptanes	1.12e-001	1.87e+003
2,2,4-Trimethylpentane	6.90e-002	1.32e+003
Benzene	4.00e-003	5.22e+001
Toluene	7.00e-003	1.08e+002
Ethylbenzene	1.00e-003	1.77e+001

Xylenes	5.00e-003	8.86e+001
C8+ Heavies	5.50e-002	1.56e+003
Total Components	100.00	3.37e+005

DRY GAS STREAM

Temperature: 80.00 deg. F
Pressure: 1414.70 psia
Flow Rate: 6.33e+006 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	2.50e-003	7.51e+000
Carbon Dioxide	1.90e-001	1.39e+003
Nitrogen	4.66e-001	2.18e+003
Methane	8.07e+001	2.16e+005
Ethane	1.29e+001	6.47e+004
Propane	3.57e+000	2.63e+004
Isobutane	4.55e-001	4.41e+003
n-Butane	8.34e-001	8.09e+003
Isopentane	2.30e-001	2.77e+003
n-Pentane	2.14e-001	2.58e+003
n-Hexane	8.79e-002	1.26e+003
Cyclohexane	1.59e-002	2.24e+002
Other Hexanes	1.28e-001	1.84e+003
Heptanes	1.12e-001	1.87e+003
2,2,4-Trimethylpentane	6.90e-002	1.32e+003
Benzene	3.75e-003	4.90e+001
Toluene	6.47e-003	9.94e+001
Ethylbenzene	9.25e-004	1.64e+001
Xylenes	4.48e-003	7.94e+001
C8+ Heavies	5.49e-002	1.56e+003
Total Components	100.00	3.37e+005

LEAN GLYCOL STREAM

Temperature: 80.00 deg. F
Flow Rate: 1.88e+001 gpm

Component	Conc. (wt%)	Loading (lb/hr)
TEG	9.85e+001	1.04e+004
Water	1.50e+000	1.59e+002
Carbon Dioxide	3.28e-012	3.47e-010
Nitrogen	5.00e-013	5.29e-011
Methane	1.26e-017	1.34e-015
Ethane	1.34e-007	1.41e-005
Propane	5.59e-009	5.92e-007
Isobutane	8.18e-010	8.65e-008
n-Butane	1.59e-009	1.68e-007
Isopentane	9.12e-005	9.64e-003
n-Pentane	1.10e-004	1.16e-002
n-Hexane	7.25e-005	7.68e-003
Cyclohexane	4.13e-004	4.37e-002
Other Hexanes	1.68e-004	1.78e-002
Heptanes	1.62e-004	1.71e-002

2,2,4-Trimethylpentane	1.30e-004	1.37e-002
Benzene	1.60e-003	1.69e-001
Toluene	6.70e-003	7.08e-001
Ethylbenzene	1.47e-003	1.55e-001
Xylenes	1.30e-002	1.37e+000
C8+ Heavies	2.70e-003	2.86e-001
Total Components	100.00	1.06e+004

RICH GLYCOL STREAM

Temperature: 80.00 deg. F
Pressure: 1414.70 psia
Flow Rate: 1.94e+001 gpm
NOTE: Stream has more than one phase.

Component	Conc. (wt%)	Loading (lb/hr)
TEG	9.58e+001	1.04e+004
Water	2.94e+000	3.19e+002
Carbon Dioxide	3.19e-002	3.47e+000
Nitrogen	4.87e-003	5.30e-001
Methane	3.66e-001	3.98e+001
Ethane	2.75e-001	2.99e+001
Propane	1.34e-001	1.45e+001
Isobutane	2.65e-002	2.88e+000
n-Butane	6.23e-002	6.78e+000
Isopentane	1.77e-002	1.93e+000
n-Pentane	2.14e-002	2.32e+000
n-Hexane	1.41e-002	1.54e+000
Cyclohexane	1.26e-002	1.37e+000
Other Hexanes	1.63e-002	1.78e+000
Heptanes	3.15e-002	3.43e+000
2,2,4-Trimethylpentane	8.41e-003	9.14e-001
Benzene	3.12e-002	3.39e+000
Toluene	8.24e-002	8.96e+000
Ethylbenzene	1.37e-002	1.49e+000
Xylenes	9.77e-002	1.06e+001
C8+ Heavies	2.19e-002	2.38e+000
Total Components	100.00	1.09e+004

FLASH TANK OFF GAS STREAM

Temperature: 135.00 deg. F
Pressure: 49.70 psia
Flow Rate: 1.46e+003 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	3.65e-001	2.53e-001
Carbon Dioxide	1.51e+000	2.56e+000
Nitrogen	4.76e-001	5.14e-001
Methane	6.24e+001	3.86e+001
Ethane	2.33e+001	2.70e+001
Propane	6.95e+000	1.18e+001
Isobutane	9.57e-001	2.14e+000
n-Butane	2.09e+000	4.68e+000

Isopentane	4.57e-001	1.27e+000
n-Pentane	5.08e-001	1.41e+000
n-Hexane	2.15e-001	7.14e-001
Cyclohexane	7.31e-002	2.37e-001
Other Hexanes	2.84e-001	9.43e-001
Heptanes	2.66e-001	1.03e+000
2,2,4-Trimethylpentane	9.40e-002	4.14e-001
Benzene	3.32e-002	1.00e-001
Toluene	4.72e-002	1.68e-001
Ethylbenzene	3.88e-003	1.59e-002
Xylenes	1.88e-002	7.71e-002
C8+ Heavies	1.30e-002	8.56e-002
Total Components	100.00	9.40e+001

FLASH TANK GLYCOL STREAM

Temperature: 135.00 deg. F
Flow Rate: 1.92e+001 gpm

Component	Conc. (wt%)	Loading (lb/hr)
TEG	9.66e+001	1.04e+004
Water	2.96e+000	3.19e+002
Carbon Dioxide	8.37e-003	9.03e-001
Nitrogen	1.45e-004	1.57e-002
Methane	1.12e-002	1.21e+000
Ethane	2.73e-002	2.95e+000
Propane	2.53e-002	2.72e+000
Isobutane	6.87e-003	7.40e-001
n-Butane	1.95e-002	2.10e+000
Isopentane	6.11e-003	6.58e-001
n-Pentane	8.43e-003	9.09e-001
n-Hexane	7.62e-003	8.21e-001
Cyclohexane	1.05e-002	1.13e+000
Other Hexanes	7.73e-003	8.33e-001
Heptanes	2.23e-002	2.40e+000
2,2,4-Trimethylpentane	4.64e-003	5.00e-001
Benzene	3.05e-002	3.29e+000
Toluene	8.16e-002	8.80e+000
Ethylbenzene	1.37e-002	1.48e+000
Xylenes	9.78e-002	1.05e+001
C8+ Heavies	2.13e-002	2.30e+000
Total Components	100.00	1.08e+004

FLASH GAS EMISSIONS

Flow Rate: 5.86e+003 scfh
Control Method: Combustion Device
Control Efficiency: 98.00

Component	Conc. (vol%)	Loading (lb/hr)
Water	6.14e+001	1.71e+002
Carbon Dioxide	3.80e+001	2.58e+002
Nitrogen	1.19e-001	5.14e-001
Methane	3.11e-001	7.72e-001

Ethane	1.16e-001	5.40e-001
Propane	3.47e-002	2.36e-001
Isobutane	4.77e-003	4.29e-002
n-Butane	1.04e-002	9.36e-002
Isopentane	2.28e-003	2.54e-002
n-Pentane	2.54e-003	2.83e-002
n-Hexane	1.07e-003	1.43e-002
Cyclohexane	3.65e-004	4.74e-003
Other Hexanes	1.42e-003	1.89e-002
Heptanes	1.33e-003	2.05e-002
2,2,4-Trimethylpentane	4.69e-004	8.28e-003
Benzene	1.66e-004	2.00e-003
Toluene	2.36e-004	3.36e-003
Ethylbenzene	1.94e-005	3.18e-004
Xylenes	9.40e-005	1.54e-003
C8+ Heavies	6.50e-005	1.71e-003
Total Components	100.00	4.32e+002

REGENERATOR OVERHEADS STREAM

Temperature: 212.00 deg. F
Pressure: 14.70 psia
Flow Rate: 3.62e+003 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	9.34e+001	1.60e+002
Carbon Dioxide	2.15e-001	9.03e-001
Nitrogen	5.86e-003	1.57e-002
Methane	7.91e-001	1.21e+000
Ethane	1.03e+000	2.95e+000
Propane	6.48e-001	2.72e+000
Isobutane	1.34e-001	7.40e-001
n-Butane	3.79e-001	2.10e+000
Isopentane	9.44e-002	6.49e-001
n-Pentane	1.31e-001	8.98e-001
n-Hexane	9.91e-002	8.13e-001
Cyclohexane	1.35e-001	1.09e+000
Other Hexanes	9.93e-002	8.16e-001
Heptanes	2.50e-001	2.39e+000
2,2,4-Trimethylpentane	4.47e-002	4.86e-001
Benzene	4.19e-001	3.12e+000
Toluene	9.21e-001	8.09e+000
Ethylbenzene	1.31e-001	1.32e+000
Xylenes	9.06e-001	9.17e+000
C8+ Heavies	1.24e-001	2.01e+000
Total Components	100.00	2.02e+002

COMBUSTION DEVICE OFF GAS STREAM

Temperature: 1000.00 deg. F
Pressure: 14.70 psia
Flow Rate: 4.58e+000 scfh

Component	Conc. (vol%)	Loading (lb/hr)

Methane	1.25e+001	2.42e-002
Ethane	1.62e+001	5.89e-002
Propane	1.02e+001	5.45e-002
Isobutane	2.11e+000	1.48e-002
n-Butane	5.99e+000	4.20e-002
Isopentane	1.49e+000	1.30e-002
n-Pentane	2.06e+000	1.80e-002
n-Hexane	1.56e+000	1.63e-002
Cyclohexane	2.14e+000	2.17e-002
Other Hexanes	1.57e+000	1.63e-002
Heptanes	3.94e+000	4.77e-002
2,2,4-Trimethylpentane	7.05e-001	9.73e-003
Benzene	6.62e+000	6.24e-002
Toluene	1.45e+001	1.62e-001
Ethylbenzene	2.06e+000	2.64e-002
Xylenes	1.43e+001	1.83e-001
C8+ Heavies	1.96e+000	4.02e-002
Total Components	100.00	8.11e-001

CERTIFICATE OF ANALYSIS

Number : 2012100194-001A

LAFAYETTE AREA LABORATORY
4790 N.E. EVANGELINE THRUWAY
CARENCRO, LA 70520
PHONE (337) 896-3055
FAX (337) 896-3077

Gas Analytical Services
Chuck Honaker
PO Box 1028

Bridgeport, WV 26330

Field:	EQT Midstream	**Report Date:**	10/23/12
Station:	Main Suction after Recycle	**Sample Of:**	Gas
Station No.:		**Sample Date:**	10/10/2012
Sample Point:		**Sample Conditions:**	236 psi ,N.G.° F
Cylinder # :	GAS	**PO / Ref. No.:**	

Comments:

ANALYTICAL DATA

Components	Mol %	Wt%	GPM at 14.730 psia	Method	Lab Tech.	Date Analyzed
				GPA-2286	CC	10/23/12
Nitrogen	0.466	0.649	0.051	(MC10)		
Methane	80.644	64.134	13.668			
Carbon Dioxide	0.190	0.416	0.032			
Ethane	12.891	19.215	3.447			
Propane	3.575	7.813	0.985			
iso Butane	0.455	1.309	0.149			
n-Butane	0.834	2.404	0.263			
iso Pentane	0.230	0.823	0.084			
n-Pentane	0.214	0.763	0.078			
i-Hexanes	0.128	0.543	0.052			
n-Hexane	0.088	0.373	0.036			
Benzene	0.004	0.014	0.001			
Cyclohexane	0.016	0.068	0.006			
i-Heptanes	0.072	0.358	0.032			
n-Heptane	0.040	0.200	0.018			
Toluene	0.007	0.031	0.002			
i-Octanes	0.069	0.360	0.031			
n-Octane	0.016	0.089	0.008			
*e-Benzene	0.001	0.003	NIL			
*m,o,&p-Xylene	0.005	0.026	0.002			
i-Nonanes	0.017	0.102	0.008			
n-Nonane	0.005	0.032	0.003			
i-Decanes	0.004	0.039	0.003			
n-Decane Plus	0.002	0.015	0.001			
i-Undecanes	0.027	0.221	0.019			
Totals	100.000	100.000	18.980			

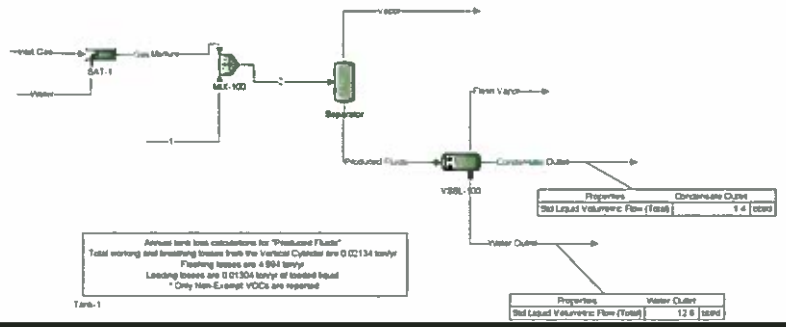
Calculated Values	TOTAL	C10+
Molecular Weight	20.172	159.200
Real Dry BTU @ 14.73 psia, 60 °F	1226.2	8681.3
Real Wet BTU @ 14.73 psia, 60 °F	1205.7	8531.1
Relative Density	0.6982	5.5140
	TOTAL	
GPM's at 14.73 psia, 60 °F	18.980	
Compressibility Factor	0.9967	

Brian Hasfurd
Data Reviewer

Janus Station
Plant Schematic

Client Name:	Janus	Job:
Location:	Storage Tank Calculations	
Flowsheet:	Janus Station	

Janus Station



Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Janus	Job:	
Location:	Storage Tank Calculations		
Flowsheet:	Janus Station		

Connections

	Condensate Outlet	Flash Vapor	Gas Mixture	Inlet Gas	Produced Fluids
From Block	VSSL-100	VSSL-100	SAT-1	--	Separator
To Block	--	--	MIX-100	SAT-1	VSSL-100

Stream Composition

Mole Fraction	Condensate Outlet %	Flash Vapor %	Gas Mixture %	Inlet Gas %	Produced Fluids %
Nitrogen	0.000108447	0.0714252	0.465311	0.466033 *	0.00029598
Methane	0.186611	34.8844	80.5248	80.6496 *	0.146761
Carbon Dioxide	0.00703106	0.458597	0.189719	0.190013 *	0.00221967
Ethane	0.817019	24.1657	12.8719	12.8919 *	0.110996
Propane	2.22235	17.3549	3.56971	3.57525 *	0.10092
Isobutane	1.17312	3.59413	0.454327	0.455032 *	0.0302023
n-Butane	3.66837	7.63481	0.832767	0.834058 *	0.0795915
Isopentane	3.23649	2.5322	0.22966	0.230016 *	0.0528134
n-Pentane	4.07551	2.43163	0.213684	0.214015 *	0.0633502
Isohexane	6.16779	1.46341	0.127811	0.128009 *	0.0867479
n-Hexane	6.0191	0.97288	0.0878699	0.0880062 *	0.0827756
Benzene	0.285289	0.0443705	0.00399409	0.00400028 *	0.00408361
Cyclohexane	1.39968	0.173206	0.0159763	0.0160011 *	0.0190465
i-Heptane	9.41339	0.697439	0.0718936	0.072005 *	0.126064
Toluene	7.91916	0.345975	0.0399409	0.0400028 *	0.106035
i-Octane	11.5214	0.614392	0.068898	0.0690048 *	0.153308
n-Octane	5.86782	0.0866647	0.0159763	0.0160011 *	0.0771474
Ethylbenzene	0.397855	0.00508019	0.000998522	0.00100007 *	0.00524068
m-Xylene	2.06043	0.024285	0.00499261	0.00500035 *	0.0271036
Isononane	8.56908	0.0565757	0.0169749	0.0170012 *	0.112374
n-Nonane	2.81021	0.0124451	0.00499261	0.00500035 *	0.0368278
Decane	22.1335	0.0312	0.0329512	0.0330023 *	0.289785
Water	0.0486887	2.34427	0.154827	0 *	98.2863

Molar Flow	Condensate Outlet lbmol/h	Flash Vapor lbmol/h	Gas Mixture lbmol/h	Inlet Gas lbmol/h	Produced Fluids lbmol/h
Nitrogen	1.47335E-07	3.04878E-05	0.475374	0.475374 *	3.07268E-05
Methane	0.000253528	0.0148904	82.2663	82.2663 *	0.0152359
Carbon Dioxide	9.55234E-06	0.000195752	0.193822	0.193822 *	0.000230433
Ethane	0.00110999	0.0103151	13.1503	13.1503 *	0.0115229
Propane	0.00301926	0.00740792	3.64692	3.64692 *	0.010477
Isobutane	0.00159378	0.00153415	0.464153	0.464153 *	0.00313542
n-Butane	0.00498382	0.00325891	0.850777	0.850777 *	0.0082627
Isopentane	0.00439707	0.00108087	0.234627	0.234627 *	0.00548276
n-Pentane	0.00553696	0.00103794	0.218305	0.218305 *	0.00657663
Isohexane	0.0083795	0.000624656	0.130575	0.130575 *	0.00900564
n-Hexane	0.0081775	0.000415273	0.0897703	0.0897703 *	0.00859326
Benzene	0.000387591	1.89395E-05	0.00408047	0.00408047 *	0.000423936
Cyclohexane	0.00190159	7.39326E-05	0.0163219	0.0163219 *	0.00197729
i-Heptane	0.0127889	0.000297701	0.0734484	0.0734484 *	0.0130872
Toluene	0.0107589	0.000147679	0.0408047	0.0408047 *	0.0110079
i-Octane	0.0156528	0.000262253	0.0703881	0.0703881 *	0.0159155
n-Octane	0.00797197	3.69927E-05	0.0163219	0.0163219 *	0.00800897
Ethylbenzene	0.000540523	2.16847E-06	0.00102012	0.00102012 *	0.000544056
m-Xylene	0.00279929	1.0366E-05	0.00510058	0.00510058 *	0.00281373
Isononane	0.0116419	2.41492E-05	0.017342	0.017342 *	0.011666
n-Nonane	0.00381793	5.31217E-06	0.00510058	0.00510058 *	0.00382324
Decane	0.0300704	1.33177E-05	0.0336639	0.0336639 *	0.0300838
Water	6.61481E-05	0.00100065	0.158176	0 *	10.2035

* User Specified Values
? Extrapolated or Approximate Values

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Janus	Job:	
Location:	Storage Tank Calculations		
Flowsheet:	Janus Station		

Mass Fraction	Condensate Outlet %	Flash Vapor %	Gas Mixture %	Inlet Gas %	Produced Fluids %
Nitrogen	2.85124E-05	0.0563149	0.646509	0.647405 *	0.000430784
Methane	0.0280971	15.751	64.0717	64.1604 *	0.122325
Carbon Dioxide	0.00290416	0.568046	0.414117	0.414691 *	0.00507535
Ethane	0.230571	20.4514	19.1968	19.2234 *	0.173404
Propane	0.919728	21.5389	7.80718	7.818 *	0.23121
Isobutane	0.639934	5.87952	1.30971	1.31153 *	0.091204
n-Butane	2.0011	12.4895	2.40066	2.40399 *	0.240348
Isopentane	2.19157	5.14202	0.821826	0.822964 *	0.197972
n-Pentane	2.75971	4.9378	0.764655	0.765715 *	0.23747
Isohexane	4.98844	3.54941	0.546281	0.547038 *	0.388395
n-Hexane	4.86819	2.35965	0.375568	0.376088 *	0.37061
Benzene	0.209148	0.0975477	0.0154739	0.0154953 *	0.0165727
Cyclohexane	1.10556	0.410271	0.0666877	0.0667801 *	0.0832815
i-Heptane	8.85267	1.96693	0.357299	0.357794 *	0.656293
Toluene	6.84813	0.897203	0.182526	0.182778 *	0.507602
i-Octane	12.3518	1.97527	0.390343	0.390884 *	0.909852
n-Octane	6.29076	0.278627	0.0905144	0.0906398 *	0.457854
Ethylbenzene	0.396423	0.0151798	0.0052578	0.00526509 *	0.0289068
m-Xylene	2.05302	0.0725646	0.026289	0.0263254 *	0.149499
Isononane	10.3148	0.204226	0.107981	0.10813 *	0.748814
n-Nonane	3.38272	0.044924	0.0317591	0.0318031 *	0.245405
Decane	29.5564	0.124942	0.232534	0.232856 *	2.14219
Water	0.00823231	1.18865	0.138342	0 *	91.9953

Mass Flow	Condensate Outlet lb/h	Flash Vapor lb/h	Gas Mixture lb/h	Inlet Gas lb/h	Produced Fluids lb/h
Nitrogen	4.12734E-06	0.000854066	13.3169	13.3169 *	0.000860763
Methane	0.00406722	0.238878	1319.75	1319.75 *	0.244421
Carbon Dioxide	0.000420394	0.00861493	8.53002	8.53002 *	0.0101412
Ethane	0.0333765	0.310164	395.418	395.418 *	0.346484
Propane	0.133136	0.326657	160.813	160.813 *	0.461988
Isobutane	0.0926343	0.0891682	26.9776	26.9776 *	0.182238
n-Butane	0.289671	0.189415	49.4491	49.4491 *	0.480246
Isopentane	0.317243	0.0779833	16.928	16.928 *	0.395575
n-Pentane	0.399485	0.0748861	15.7504	15.7504 *	0.474496
Isohexane	0.722107	0.0538299	11.2523	11.2523 *	0.776064
n-Hexane	0.704699	0.0357863	7.73599	7.73599 *	0.740527
Benzene	0.0302755	0.0014794	0.318733	0.318733 *	0.0331144
Cyclohexane	0.160037	0.00622213	1.37364	1.37364 *	0.166407
i-Heptane	1.28148	0.0298302	7.35967	7.35967 *	1.31136
Toluene	0.991308	0.0136069	3.75968	3.75968 *	1.01425
i-Octane	1.788	0.0299567	8.04032	8.04032 *	1.818
n-Octane	0.910626	0.00422562	1.86442	1.86442 *	0.914853
Ethylbenzene	0.0573846	0.000230216	0.108301	0.108301 *	0.0577597
m-Xylene	0.297186	0.00110051	0.541504	0.541504 *	0.298719
Isononane	1.49313	0.00309726	2.2242	2.2242 *	1.49623
n-Nonane	0.489669	0.000681312	0.654176	0.654176 *	0.49035
Decane	4.27847	0.00189486	4.78975	4.78975 *	4.28037
Water	0.00119168	0.018027	2.84958	0 *	183.819

Stream Properties

Property	Units	Condensate Outlet	Flash Vapor	Gas Mixture	Inlet Gas	Produced Fluids
Temperature	°F	68.989	68.989	70	70 *	69.6421
Pressure	psia	14.9959	14.9959 *	250.696	250.696 *	245.696
Mole Fraction Vapor	%	0	100	99.8284	99.8277	0
Mole Fraction Light Liquid	%	100	0	0.171642	0.172267	1.67127
Mole Fraction Heavy Liquid	%	0	0	0	0	98.3287

* User Specified Values
? Extrapolated or Approximate Values

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Janus	Job:	
Location:	Storage Tank Calculations		
Flowsheet:	Janus Station		

Stream Properties

Property	Units	Condensate Outlet	Flash Vapor	Gas Mixture	Inlet Gas	Produced Fluids
Molecular Weight	lb/lbmol	106.549	35.5299	20.162	20.1654	19.2472
Mass Density	lb/ft^3	44.318	0.0949753	0.947027	0.9472	60.1248
Molar Flow	lbmol/h	0.135859	0.0426849	102.163	102.005	10.3814
Mass Flow	lb/h	14.4756	1.51659	2059.81	2056.96	199.813
Vapor Volumetric Flow	ft^3/h	0.32663	15.9683	2175.03	2171.62	3.3233
Liquid Volumetric Flow	gpm	0.0407227	1.99085	271.172	270.748	0.414334
Std Vapor Volumetric Flow	MMSCFD	0.00123735	0.000388757	0.930459	0.929018 *	0.0945497
Std Liquid Volumetric Flow	sgpm	0.0408425	0.00665685	12.2223	12.2166	0.415
Compressibility		0.00635481	0.988823	0.938968	0.938952	0.0138464
Specific Gravity		0.710577	1.22676			0.964018
API Gravity		66.4363				15.0137
Enthalpy	Btu/h	-12579.9	-1863.83	-3.49605E+06	-3.47958E+06	-1.26965E+06
Mass Enthalpy	Btu/lb	-869.045	-1228.96	-1697.27	-1691.61	-6354.17
Mass Cp	Btu/(lb*°F)	0.495953	0.419145	0.516415	0.516481	0.94437
Ideal Gas CpCv Ratio		1.05222	1.155	1.25679	1.25671	1.30362
Net Ideal Gas Heating Value	Btu/ft^3	5352.11	1846.17	1103.05	1104.76	77.7299
Net Liquid Heating Value	Btu/lb	18931.8	19578.8	20706.2	20736.4	547.202

Remarks

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Janus	Job:	
Location:	Storage Tank Calculations		
Flowsheet:	Janus Station		

Connections

	Vapor	Water	Water Outlet	1	2
From Block	Separator	--	VSSL-100	--	MIX-100
To Block	--	SAT-1	--	MIX-100	Separator

Stream Composition

Mole Fraction	Vapor %	Water %	Water Outlet %	1 %	2 %
Nitrogen	0.466089	0 *	8.98903E-07	0 *	0.423055
Methane	80.6497	0 *	0.000901289	0 *	73.2122
Carbon Dioxide	0.189823	0 *	0.000246291	0 *	0.17249
Ethane	12.883	0 *	0.000959256	0 *	11.703
Propane	3.56564	0 *	0.00048778	0 *	3.24554
Isobutane	0.452042	0 *	7.33695E-05	0 *	0.413069
n-Butane	0.826112	0 *	0.000195764	0 *	0.757142
Isopentane	0.224683	0 *	4.72947E-05	0 *	0.208804
n-Pentane	0.207606	0 *	1.70304E-05	0 *	0.194279
Isohexane	0.119202	0 *	1.45392E-05	0 *	0.116204
n-Hexane	0.0795966	0 *	4.72548E-06	0 *	0.0798903
Benzene	0.00358534	0 *	0.000170587	0 *	0.00363138
Cyclohexane	0.0140653	0 *	1.72692E-05	0 *	0.0145255
i-Heptane	0.0591861	0 *	5.07677E-06	0 *	0.0653648
Toluene	0.0292166	0 *	0.000993545	0 *	0.0363138
i-Octane	0.053412	0 *	4.24966E-06	0 *	0.0626412
n-Octane	0.00815105	0 *	1.31509E-07	0 *	0.0145255
Ethylbenzene	0.000466793	0 *	1.33729E-05	0 *	0.000907844
m-Xylene	0.00224233	0 *	3.99263E-05	0 *	0.00453922
Isononane	0.00556545	0 *	3.93297E-08	0 *	0.0154333
n-Nonane	0.00125247	0 *	2.12358E-08	0 *	0.00453922
Decane	0.0035104	0 *	1.51869E-08	0 *	0.0299589
Water	0.155848	100 *	99.9958	100 *	9.22195

Molar Flow	Vapor lbmol/h	Water lbmol/h	Water Outlet lbmol/h	1 lbmol/h	2 lbmol/h
Nitrogen	0.475344	0 *	9.17137E-08	0 *	0.475374
Methane	82.2511	0 *	9.19571E-05	0 *	82.2663
Carbon Dioxide	0.193592	0 *	2.51287E-05	0 *	0.193822
Ethane	13.1388	0 *	9.78714E-05	0 *	13.1503
Propane	3.63644	0 *	4.97675E-05	0 *	3.64692
Isobutane	0.461018	0 *	7.48577E-06	0 *	0.464153
n-Butane	0.842515	0 *	1.99735E-05	0 *	0.850777
Isopentane	0.229144	0 *	4.8254E-06	0 *	0.234627
n-Pentane	0.211728	0 *	1.73759E-06	0 *	0.218305
Isohexane	0.121569	0 *	1.48341E-06	0 *	0.130575
n-Hexane	0.081177	0 *	4.82133E-07	0 *	0.0897703
Benzene	0.00365653	0 *	1.74048E-05	0 *	0.00408047
Cyclohexane	0.0143446	0 *	1.76196E-06	0 *	0.0163219
i-Heptane	0.0603613	0 *	5.17975E-07	0 *	0.0734484
Toluene	0.0297967	0 *	0.00010137	0 *	0.0408047
i-Octane	0.0544726	0 *	4.33586E-07	0 *	0.0703881
n-Octane	0.0083129	0 *	1.34176E-08	0 *	0.0163219
Ethylbenzene	0.000476061	0 *	1.36442E-06	0 *	0.00102012
m-Xylene	0.00228686	0 *	4.07362E-06	0 *	0.00510058
Isononane	0.00567596	0 *	4.01275E-09	0 *	0.017342
n-Nonane	0.00127734	0 *	2.16665E-09	0 *	0.00510058
Decane	0.0035801	0 *	1.5495E-09	0 *	0.0336639
Water	0.158942	0.158176 *	10.2024	10.2043 *	10.3624

Mass Fraction	Vapor %	Water %	Water Outlet %	1 %	2 %
Nitrogen	0.651522	0 *	1.39767E-06	0 *	0.593538

* User Specified Values
? Extrapolated or Approximate Values

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Janus	Job:	
Location:	Storage Tank Calculations		
Flowsheet:	Janus Station		

Mass Fraction	Vapor %	Water %	Water Outlet %	1 %	2 %
Methane	64.5607	0 *	0.00080253	0 *	58.822
Carbon Dioxide	0.416859	0 *	0.00060162	0 *	0.380186
Ethane	19.33	0 *	0.00160096	0 *	17.6239
Propane	7.84563	0 *	0.00119384	0 *	7.1675
Isobutane	1.31104	0 *	0.000236692	0 *	1.2024
n-Butane	2.39594	0 *	0.000631541	0 *	2.20396
Isopentane	0.808897	0 *	0.000189395	0 *	0.75449
n-Pentane	0.747418	0 *	6.81994E-05	0 *	0.702003
Isohexane	0.512581	0 *	6.95423E-05	0 *	0.501521
n-Hexane	0.342272	0 *	2.26024E-05	0 *	0.344796
Benzene	0.0139747	0 *	0.000739588	0 *	0.014206
Cyclohexane	0.0590672	0 *	8.06683E-05	0 *	0.0612237
i-Heptane	0.295931	0 *	2.82351E-05	0 *	0.328024
Toluene	0.134328	0 *	0.00508106	0 *	0.16757
i-Octane	0.304444	0 *	2.69436E-05	0 *	0.35836
n-Octane	0.0464604	0 *	8.33788E-07	0 *	0.0830981
Ethylbenzene	0.00247286	0 *	7.88013E-05	0 *	0.00482701
m-Xylene	0.0118789	0 *	0.00023527	0 *	0.024135
Isononane	0.035618	0 *	2.79976E-07	0 *	0.0991334
n-Nonane	0.00801562	0 *	1.51171E-07	0 *	0.0291569
Decane	0.024923	0 *	1.19935E-07	0 *	0.213481
Water	0.140099	100 *	99.9883	100 *	8.32049

Mass Flow	Vapor lb/h	Water lb/h	Water Outlet lb/h	1 lb/h	2 lb/h
Nitrogen	13.316	0 *	2.56921E-06	0 *	13.3169
Methane	1319.51	0 *	0.00147522	0 *	1319.75
Carbon Dioxide	8.51988	0 *	0.0011059	0 *	8.53002
Ethane	395.071	0 *	0.0029429	0 *	395.418
Propane	160.351	0 *	0.00219453	0 *	160.813
Isobutane	26.7954	0 *	0.00043509	0 *	26.9776
n-Butane	48.9688	0 *	0.0011609	0 *	49.4491
Isopentane	16.5325	0 *	0.000348147	0 *	16.928
n-Pentane	15.2759	0 *	0.000125365	0 *	15.7504
Isohexane	10.4763	0 *	0.000127833	0 *	11.2523
n-Hexane	6.99546	0 *	4.1548E-05	0 *	7.73599
Benzene	0.285618	0 *	0.00135952	0 *	0.318733
Cyclohexane	1.20723	0 *	0.000148285	0 *	1.37364
i-Heptane	6.04831	0 *	5.19021E-05	0 *	7.35967
Toluene	2.74542	0 *	0.00934006	0 *	3.75968
i-Octane	6.22232	0 *	4.95279E-05	0 *	8.04032
n-Octane	0.94957	0 *	1.53268E-06	0 *	1.86442
Ethylbenzene	0.050541	0 *	0.000144853	0 *	0.108301
m-Xylene	0.242784	0 *	0.000432476	0 *	0.541504
Isononane	0.72797	0 *	5.14655E-07	0 *	2.2242
n-Nonane	0.163825	0 *	2.77884E-07	0 *	0.654176
Decane	0.509383	0 *	2.20465E-07	0 *	4.78975
Water	2.86339	2.84958 *	183.799	183.832 *	186.682

Stream Properties

Property	Units	Vapor	Water	Water Outlet	1	2
Temperature	°F	69.6421	401.317	68.989	70 *	70.0164
Pressure	psia	245.696	250.696	14.9959	250.696 *	250.696
Mole Fraction Vapor	%	100	83.8655	0	0	90.7588
Mole Fraction Light Liquid	%	0	16.1345	100	100	0.15588
Mole Fraction Heavy Liquid	%	0	0	0	0	9.08536
Molecular Weight	lb/lbmol	20.0404	18.0153	18.0166	18.0153	19.9671
Mass Density	lb/ft^3	0.92072	0.63176	62.2896	62.2946	1.03015
Molar Flow	lbmol/h	101.986	0.158176	10.2028	10.2043	112.367
Mass Flow	lb/h	2043.83	2.84958	183.821	183.832	2243.64

* User Specified Values
? Extrapolated or Approximate Values

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Janus	Job:	
Location:	Storage Tank Calculations		
Flowsheet:	Janus Station		

Stream Properties

Property	Units	Vapor	Water	Water Outlet	1	2
Vapor Volumetric Flow	ft^3/h	2219.81	4.51054	2.95107	2.95102	2177.97
Liquid Volumetric Flow	gpm	276.756	0.562354	0.367926	0.367919	271.539
Std Vapor Volumetric Flow	MMSCFD	0.928845	0.0014406	0.0929236	0.0929364	1.0234
Std Liquid Volumetric Flow	sgpm	12.1747	0.00569652	0.3675	0.367494 *	12.5897
Compressibility		0.941457	0.773706	0.000764527	0.0127547	0.854826
Specific Gravity		0.691942		0.998727	0.998807	
API Gravity				10.0023	9.97026	
Enthalpy	Btu/h	-3.48151E+06	-16472.3	-1.2552E+06	-1.25511E+06	-4.75115E+06
Mass Enthalpy	Btu/lb	-1703.43	-5780.58	-6828.4	-6827.45	-2117.61
Mass Cp	Btu/(lb*°F)	0.515631	0.608847	0.982249	0.981757	0.554595
Ideal Gas CpCv Ratio		1.25831	1.31096	1.32587	1.32584	1.26183
Net Ideal Gas Heating Value	Btu/ft^3	1097.05	0	0.0987798	0	1002.88
Net Liquid Heating Value	Btu/lb	20719.3	-1059.76	-1057.57	-1059.76	18922.8

Remarks

Environments Report

Client Name:	Janus	Job:	
Location:	Storage Tank Calculations		

Project-Wide Constants

Atmospheric Pressure	14.6959 psia	Ideal Gas Reference Pressure	14.6959 psia
Ideal Gas Reference Temperature	60 °F	Ideal Gas Reference Volume	379.484 ft^3/lbmol
Liquid Reference Temperature	60 °F		

Environment [Water]

Environment Settings

Number of Poynting Intervals	0	Phase Tolerance	1 %
Gibbs Excess Model Evaluation Temperature	77 °F	Emulsion Enabled	False
Freeze Out Temperature Threshold Difference	10 °F		

Components

Component Name	Henry's Law Component	Phase Initiator	Component Name	Henry's Law Component	Phase Initiator
Nitrogen	False	False	Cyclohexane	False	False
Methane	False	False	i-Heptane	False	False
Carbon Dioxide	False	False	Toluene	False	False
Ethane	False	False	i-Octane	False	False
Propane	False	False	n-Octane	False	False
Isobutane	False	False	Ethylbenzene	False	False
n-Butane	False	False	m-Xylene	False	False
Isopentane	False	False	Isononane	False	False
n-Pentane	False	False	n-Nonane	False	False
Isohexane	False	False	Decane	False	False
n-Hexane	False	False	Water	False	True
Benzene	False	False			

Physical Property Method Sets

Liquid Molar Volume	COSTALD	Overall Package	Peng-Robinson
Stability Calculation	Peng-Robinson	Vapor Package	Peng-Robinson
Light Liquid Package	Peng-Robinson	Heavy Liquid Package	Peng-Robinson

Remarks

Calculator Report

Client Name:	Janus	Job:
Location:	Storage Tank Calculations	

Condensate Throughput

Source Code

Residual Error (for CV1) = 1-Water/1.4

Calculated Variable [CV1]

Source Moniker	ProMax ProMax!Project!Flowsheets!Janus Station!PStreams!Inlet Gas!Phases!Total!Properties!Std Vapor Volumetric Flow
Value	0.929018
Unit	

Measured Variable [Water]

Source Moniker	ProMax ProMax!Project!Flowsheets!Janus Station!PStreams!Condensate Outlet!Phases!Total!Properties!Std Liquid Volumetric Flow
Value	1.40031
Unit	

Solver Properties

Status: Solved

Error	-0.000224369		Iterations	2
Calculated Value	0.929018	MMSCFD	Max Iterations	20
Lower Bound		MMSCFD	Weighting	1
Upper Bound		MMSCFD	Priority	0
Step Size		MMSCFD	Solver Active	Active
Is Minimizer	False		Group	
Algorithm	Default		Skip Dependency Check	False

Remarks

Water Throughput

Source Code

Residual Error (for CV1) = 1-Water/12.6

Calculated Variable [CV1]

Source Moniker	ProMax ProMax!Project!Flowsheets!Janus Station!PStreams!1!Phases!Total!Properties!Std Liquid Volumetric Flow
Value	12.5998
Unit	

Measured Variable [Water]

Source Moniker	ProMax ProMax!Project!Flowsheets!Janus Station!PStreams!Water Outlet!Phases!Total!Properties!Std Liquid Volumetric Flow
Value	12.6
Unit	

Solver Properties

Status: Solved

Error	-4.49239E-07		Iterations	2
Calculated Value	0.367494	sgpm	Max Iterations	20
Lower Bound		sgpm	Weighting	1
Upper Bound		sgpm	Priority	0
Step Size		sgpm	Solver Active	Active
Is Minimizer	False		Group	
Algorithm	Default		Skip Dependency Check	False

Remarks

User Value Sets Report

Client Name:	Janus	Job:	
Location:	Storage Tank Calculations		

Tank-1

User Value [BlockReady]

* Parameter	1	Upper Bound	
Lower Bound		* Enforce Bounds	False

User Value [ShellLength]

* Parameter	15 ft	Upper Bound	ft
Lower Bound	ft	* Enforce Bounds	False

User Value [ShellDiam]

* Parameter	10 ft	Upper Bound	ft
Lower Bound	ft	* Enforce Bounds	False

User Value [BreatherVP]

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

User Value [BreatherVacP]

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

User Value [DomeRadius]

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

User Value [OpPress]

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

User Value [AvgPercentLiq]

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

User Value [MaxPercentLiq]

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

User Value [AnnNetTP]

* Parameter	13.9797 bbl/day	Upper Bound	bbl/day
Lower Bound	bbl/day	* Enforce Bounds	False

User Value [OREff]

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

User Value [MaxAvgT]

* Parameter	65.75 °F	Upper Bound	°F
Lower Bound	°F	* Enforce Bounds	False

User Value [MinAvgT]

* Parameter	44.2167 °F	Upper Bound	°F
Lower Bound	°F	* Enforce Bounds	False

User Value [BulkLiqT]

* Parameter	59.3233 °F	Upper Bound	°F
Lower Bound	°F	* Enforce Bounds	False

User Value Sets Report

Client Name:	Janus	Job:	
Location:	Storage Tank Calculations		

User Value [FlashingLosses]

* Parameter	4.99417 ton/yr	Upper Bound	ton/yr
Lower Bound	ton/yr	* Enforce Bounds	False

User Value [TotalResidual]

* Parameter	867.517 ton/yr	Upper Bound	ton/yr
Lower Bound	ton/yr	* Enforce Bounds	False

User Value [GasMoleWeight]

* Parameter	0.0248456 kg/mol	Upper Bound	kg/mol
Lower Bound	kg/mol	* Enforce Bounds	False

User Value [VapReportableFrac]

* Parameter	31.8362 %	Upper Bound	%
Lower Bound	%	* Enforce Bounds	False

User Value [LiqReportableFrac]

* Parameter	7.1953 %	Upper Bound	%
Lower Bound	%	* Enforce Bounds	False

User Value [FlashReportableFrac]

* Parameter	65.7307 %	Upper Bound	%
Lower Bound	%	* Enforce Bounds	False

Remarks

This User Value Set was programmatically generated. GUID={FE19CC69-03C7-4375-AE86-6FE748563745}

User Value Sets Report

Client Name:	Janus	Job:	
Location:	Storage Tank Calculations		

User Value [AvgP]

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

User Value [Therml]

* Parameter	1250.57	Btu/ft^2/day	Upper Bound		Btu/ft^2/day
Lower Bound		Btu/ft^2/day	* Enforce Bounds	False	

User Value [AvgWindSpeed]

* Parameter	6.05	mi/h	Upper Bound		mi/h
Lower Bound		mi/h	* Enforce Bounds	False	

User Value [MaxHourlyLoadingRate]

* Parameter	0.582489	bbl/hr	Upper Bound		bbl/hr
Lower Bound		bbl/hr	* Enforce Bounds	False	

User Value [EntrainedOilFrac]

* Parameter	1	%	Upper Bound		%
Lower Bound		%	* Enforce Bounds	False	

User Value [TurnoverRate]

* Parameter	13.5086		Upper Bound		
Lower Bound			* Enforce Bounds	False	

User Value [LLossSatFactor]

* Parameter	1.45		Upper Bound		
Lower Bound			* Enforce Bounds	False	

User Value [AtmPressure]

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

User Value [TVP]

* Parameter	0.447885	psia	Upper Bound		psia
Lower Bound		psia	* Enforce Bounds	False	

User Value [MaxVP]

* Parameter	0.62204	psia	Upper Bound		psia
Lower Bound		psia	* Enforce Bounds	False	

User Value [MinVP]

* Parameter	0.322082	psia	Upper Bound		psia
Lower Bound		psia	* Enforce Bounds	False	

User Value [AvgLiqSurfaceT]

* Parameter	66.2065	°F	Upper Bound		°F
Lower Bound		°F	* Enforce Bounds	False	

User Value [MaxLiqSurfaceT]

* Parameter	77.8736	°F	Upper Bound		°F
Lower Bound		°F	* Enforce Bounds	False	

User Value [TotalLosses]

* Parameter	0.0213406	ton/yr	Upper Bound		ton/yr

User Value Sets Report

Client Name:	Janus	Job:	
Location:	Storage Tank Calculations		

User Value [TotalLosses]

Lower Bound	ton/yr	* Enforce Bounds	False

User Value [WorkingLosses]

* Parameter	0.00451929 ton/yr	Upper Bound	ton/yr
Lower Bound	ton/yr	* Enforce Bounds	False

User Value [StandingLosses]

* Parameter	0.00615099 ton/yr	Upper Bound	ton/yr
Lower Bound	ton/yr	* Enforce Bounds	False

User Value [RimSealLosses]

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

User Value [WithdrawalLoss]

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

User Value [LoadingLosses]

* Parameter	0.0130422 ton/yr	Upper Bound	ton/yr
Lower Bound	ton/yr	* Enforce Bounds	False

User Value [MaxHourlyLoadingLoss]

* Parameter	0.00297768 lb/hr	Upper Bound	lb/hr
Lower Bound	lb/hr	* Enforce Bounds	False

User Value [PStar]

Parameter		Upper Bound	
Lower Bound		* Enforce Bounds	False

User Value [AllCTotalLosses]

* Parameter	0.0670323 ton/yr	Upper Bound	ton/yr
Lower Bound	ton/yr	* Enforce Bounds	False

User Value [AllCLoadingLosses]

* Parameter	0.0409667 ton/yr	Upper Bound	ton/yr
Lower Bound	ton/yr	* Enforce Bounds	False

User Value [AllCMaxHLoadingLoss]

* Parameter	0.00935312 lb/hr	Upper Bound	lb/hr
Lower Bound	lb/hr	* Enforce Bounds	False

User Value [AllCFlashingLosses]

* Parameter	7.59793 ton/yr	Upper Bound	ton/yr
Lower Bound	ton/yr	* Enforce Bounds	False

User Value [DeckFittingLosses]

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

User Value [DeckSeamLosses]

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

G3616

GAS COMPRESSION APPLICATION

GAS ENGINE SITE SPECIFIC TECHNICAL DATA
Janus

CATERPILLAR®

ENGINE SPEED (rpm):	1000	RATING STRATEGY:	STANDARD
COMPRESSION RATIO:	7.6	RATING LEVEL:	CONTINUOUS
AFTERCOOLER TYPE:	SCAC	FUEL SYSTEM:	GAV
AFTERCOOLER - STAGE 1 INLET (°F):	174		WITH AIR FUEL RATIO CONTROL
JACKET WATER OUTLET (°F):	190	**SITE CONDITIONS:**	
ASPIRATION:	TA	FUEL:	Gas Analysis
COOLING SYSTEM:	JW+1AC, OC+2AC	FUEL PRESSURE RANGE(psig):	58.0-70.3
CONTROL SYSTEM:	ADEM4	FUEL METHANE NUMBER:	58.5
EXHAUST MANIFOLD:	DRY	FUEL LHV (Btu/scf):	1106
COMBUSTION:	LOW EMISSION	ALTITUDE(ft):	1205
NOx EMISSION LEVEL (g/bhp-hr NOx):	0.5	MAXIMUM INLET AIR TEMPERATURE(°F):	100
SET POINT TIMING:	17	STANDARD RATED POWER:	5350 bhp@1000rpm

				MAXIMUM RATING	SITE RATING AT MAXIMUM INLET AIR TEMPERATURE		
RATING		**NOTES**	**LOAD**	**100%**	**100%**	**75%**	**50%**
ENGINE POWER	(WITHOUT FAN)	(1)	bhp	5350	5004	3753	2502
INLET AIR TEMPERATURE			°F	61	100	100	100
AFTERCOOLER - STAGE 2 INLET (°F)		(2)	°F	90	129	129	129
ENGINE DATA							
FUEL CONSUMPTION (LHV)		(3)	Btu/bhp-hr	6649	6688	6875	7346
FUEL CONSUMPTION (HHV)		(3)	Btu/bhp-hr	7338	7382	7588	8107
AIR FLOW (@inlet air temp, 14.7 psia)	(WET)	(4)(5)	ft3/min	12300	12572	9479	6485
AIR FLOW	(WET)	(4)(5)	lb/hr	56238	53453	40303	27575
FUEL FLOW (60°F, 14.7 psia)			scfm	536	504	389	277
INLET MANIFOLD PRESSURE		(6)	in Hg(abs)	104.7	101.4	76.1	53.5
EXHAUST TEMPERATURE - ENGINE OUTLET		(7)	°F	812	831	890	957
EXHAUST GAS FLOW (@engine outlet temp, 14.5 psia)	(WET)	(8)(5)	ft3/min	31980	30834	24342	17517
EXHAUST GAS MASS FLOW	(WET)	(8)(5)	lb/hr	57938	55053	41536	28454
EMISSIONS DATA - ENGINE OUT							
NOx (as NO2)		(9)(10)	g/bhp-hr	0.50	0.50	0.50	0.50
CO		(9)(10)	g/bhp-hr	2.47	2.47	2.47	2.47
THC (mol. wt. of 15.84)		(9)(10)	g/bhp-hr	3.33	3.55	3.86	4.04
NMHC (mol. wt. of 15.84)		(9)(10)	g/bhp-hr	1.23	1.31	1.42	1.49
NMNEHC (VOCs) (mol. wt. of 15.84)		(9)(10)(11)	g/bhp-hr	0.55	0.59	0.64	0.67
HCHO (Formaldehyde)		(9)(10)	g/bhp-hr	0.20	0.20	0.22	0.24
CO2		(9)(10)	g/bhp-hr	434	436	449	478
EXHAUST OXYGEN		(9)(12)	% DRY	10.7	11.0	10.7	10.3
HEAT REJECTION							
HEAT REJ. TO JACKET WATER (JW)		(13)	Btu/min	53513	53105	42942	36257
HEAT REJ. TO ATMOSPHERE		(13)	Btu/min	17853	17700	16186	14721
HEAT REJ. TO LUBE OIL (OC)		(13)	Btu/min	32563	30635	27055	23552
HEAT REJ. TO A/C - STAGE 1 (1AC)		(13)(14)	Btu/min	46341	50313	25135	6019
HEAT REJ. TO A/C - STAGE 2 (2AC)		(13)(14)	Btu/min	19487	11640	7974	4850
COOLING SYSTEM SIZING CRITERIA							
TOTAL JACKET WATER CIRCUIT (JW+1AC)		(14)(15)	Btu/min	111244			
TOTAL STAGE 2 AFTERCOOLER CIRCUIT (OC+2AC)		(14)(15)	Btu/min	59536			

A cooling system safety factor of 0% has been added to the cooling system sizing criteria.

CONDITIONS AND DEFINITIONS

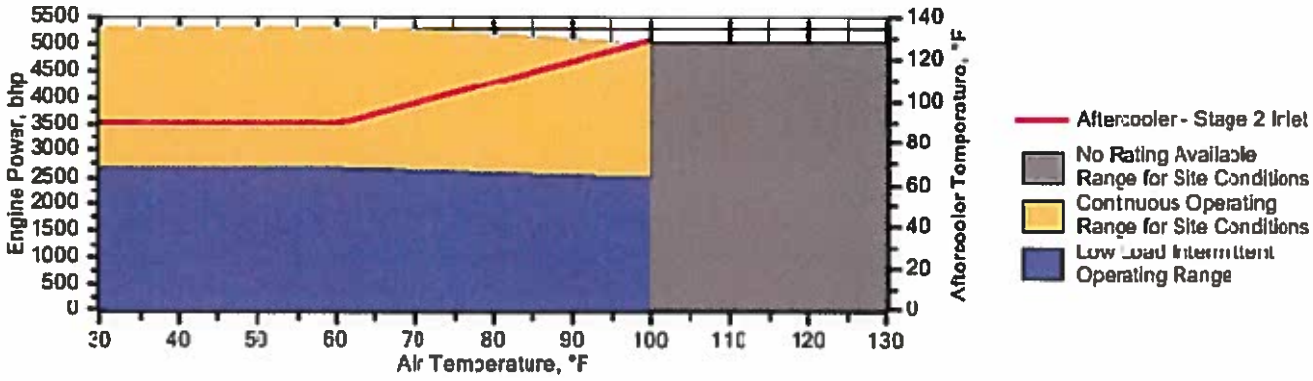
Engine rating obtained and presented in accordance with ISO 3046/1, adjusted for fuel, site altitude and site inlet air temperature. 100% rating at maximum inlet air temperature is the maximum engine capability for the specified fuel at site altitude and maximum site inlet air temperature. Maximum rating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

For notes information consult page three.

PREPARED BY: Ryan Hoffman, eqt
Data generated by Gas Engine Rating Pro Version 5.03.00
Ref. Data Set EM0457-03-001, Printed 16Jun2015

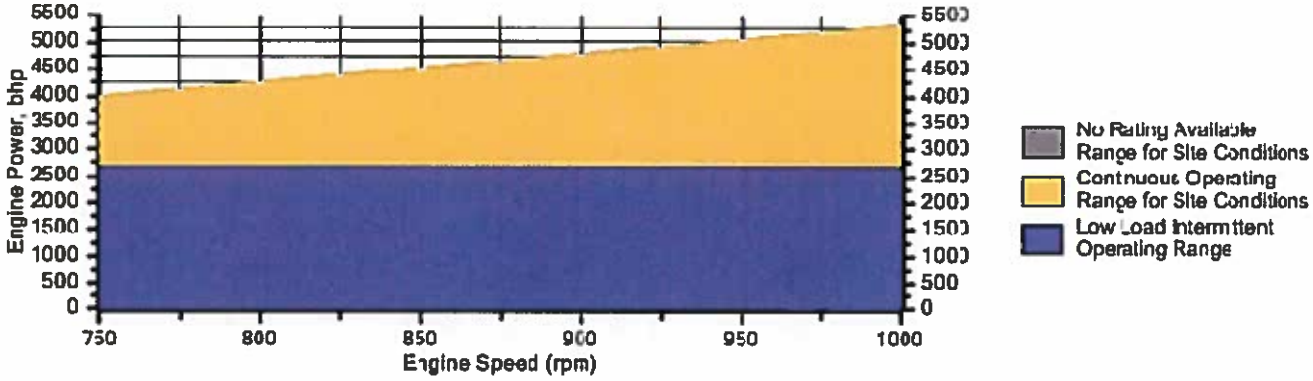
Engine Power vs. Inlet Air Temperature

Data represents temperature sweep at 1205 ft and 1000 rpm



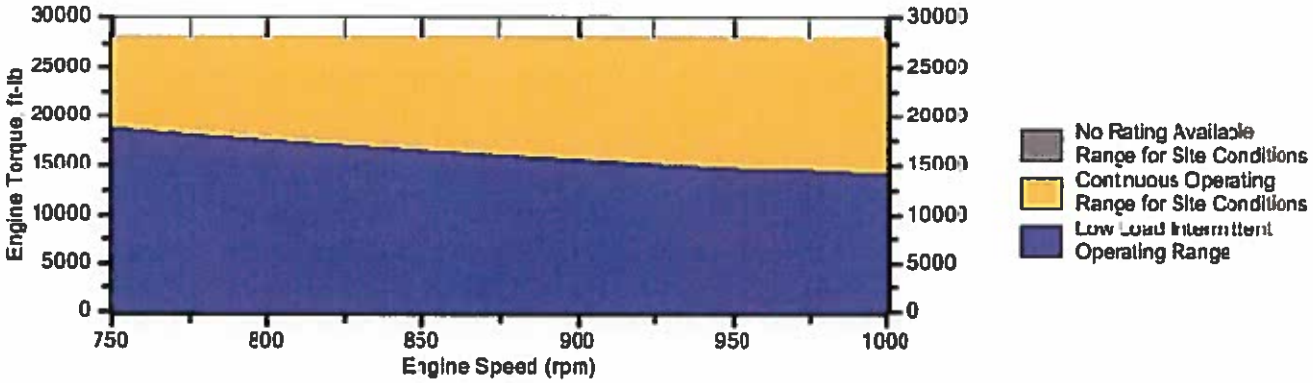
Engine Power vs. Engine Speed

Data represents speed sweep at 1205 ft and 100 °F



Engine Torque vs. Engine Speed

Data represents speed sweep at 1205 ft and 100 °F



Note: At site conditions of 1205 ft and 100°F inlet air temp., constant torque can be maintained down to 750 rpm. The minimum speed for loading at these conditions is 750 rpm.

NOTES

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

2. Aftercooler temperature is based on site specified cooling system ambient capability. Refer to the table below.

Site Ambient Capability	
AC Temp.	Ambient Cap.
90°F	60°F
110°F	80°F
130°F	100°F

3. Fuel consumption tolerance is ± 2.5% of full load data.

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

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

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

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

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

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

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

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

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

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

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

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

Constituent	Abbrev	Mole %	Norm
Water Vapor	H2O	0.0000	0.0000
Methane	CH4	80.6440	80.6440
Ethane	C2H6	12.8910	12.8910
Propane	C3H8	3.5750	3.5750
Isobutane	iso-C4H1O	0.4550	0.4550
Norbutane	nor-C4H1O	0.8340	0.8340
Isopentane	iso-C5H12	0.2300	0.2300
Norpentane	nor-C5H12	0.2140	0.2140
Hexane	C6H14	0.5010	0.5010
Heptane	C7H16	0.0000	0.0000
Nitrogen	N2	0.4660	0.4660
Carbon Dioxide	CO2	0.1900	0.1900
Hydrogen Sulfide	H2S	0.0000	0.0000
Carbon Monoxide	CO	0.0000	0.0000
Hydrogen	H2	0.0000	0.0000
Oxygen	O2	0.0000	0.0000
Helium	HE	0.0000	0.0000
Neopentane	neo-C5H12	0.0000	0.0000
Octane	C8H18	0.0000	0.0000
Nonane	C9H20	0.0000	0.0000
Ethylene	C2H4	0.0000	0.0000
Propylene	C3H6	0.0000	0.0000
TOTAL (Volume %)		100.0000	100.0000

Fuel Makeup:	Gas Analysis
Unit of Measure:	English
Calculated Fuel Properties	
Caterpillar Methane Number:	58.5
Lower Heating Value (Btu/scf):	1106
Higher Heating Value (Btu/scf):	1220
WOBBE Index (Btu/scf):	1327
THC: Free Inert Ratio:	151.44
Total % Inerts (% N2, CO2, He):	0.66%
RPC (%) (To 905 Btu/scf Fuel):	100%
Compressibility Factor:	0.997
Stoich A/F Ratio (Vol/Vol):	11.48
Stoich A/F Ratio (Mass/Mass):	16.54
Specific Gravity (Relative to Air):	0.694
Specific Heat Constant (K):	1.286

CONDITIONS AND DEFINITIONS

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

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

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

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

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

FUEL LIQUIDS

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

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

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Prepared For:
Mike Robinson
ENERFLEX ENERGY SERVICES INC

QUOTE: QUO-15753-M1M7

INFORMATION PROVIDED BY CATERPILLAR

Engine:	G3616
Horsepower:	5000
RPM:	1000
Compression Ratio:	9.0
Exhaust Flow Rate:	30823 CFM
Exhaust Temperature:	831 °F
Reference:	DM8608-01
Fuel:	Natural Gas
Annual Operating Hours:	8760

Uncontrolled Emissions

	g/bhp-hr	Lb/Hr	Tons/Year
NOx:	0.50	5.51	24.14
CO:	2.47	27.23	119.25
THC:	3.55	39.13	171.40
NMHC	1.31	14.44	63.25
NMNEHC:	0.59	6.50	28.49
HCHO:	0.20	2.20	9.66
O2:	12.00 %		

POST CATALYST EMISSIONS

	g/bhp-hr
NOx:	Unaffected by Oxidation Catalyst
CO:	<2.00
VOC:	<0.70

CONTROL EQUIPMENT

Catalyst Housing

Model:	EBH-9000-3036F-6C4E-48
Manufacturer:	EMIT Technologies, Inc
Element Size:	Rectangle 48" x 15" x 3.5"
Housing Type:	6 Element Capacity
Catalyst Installation:	Accessible Housing
Construction:	3/16" Carbon Steel
Sample Ports:	9 (0.5" NPT)
Inlet Connections:	30" Flat Face Flange
Outlet Connections:	36" Flat Face Flange
Configuration:	Side In / End Out
Silencer:	Integrated
Silencer Grade:	Hospital
Insertion Loss:	35-40 dBA

Catalyst Element

Model:	RT-4815-Z
Catalyst Type:	Oxidation, Standard Precious Group Metals
Substrate Type:	BRAZED
Manufacturer:	EMIT Technologies, Inc
Element Quantity:	3
Element Size:	Rectangle 48" x 15" x 3.5"

Capstone Turbine Corporation • 21211 Nordhoff Street • Chatsworth • CA 91311 • USA
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Technical Reference

Capstone MicroTurbine™ Systems Emissions

Summary

Capstone MicroTurbine™ systems are inherently clean and can meet some of the strictest emissions standards in the world. This technical reference is to provide customers with information that may be requested by local air permitting organizations or to compare air quality impacts of different technologies for a specific project. The preferred units of measure are "output based"; meaning that the quantity of a particular exhaust emission is reported relative to the useable output of the microturbine – typically in pounds per megawatt hour for electrical generating equipment. This technical reference also provides volumetric measurements in parts per million and milligrams per normal cubic meter. A conversion between several common units is also provided.

Maximum Exhaust Emissions at ISO Conditions

Table 1 below summarizes the exhaust emissions at full power and ISO conditions for different Capstone microturbine models. Note that the fuel can have a significant impact on certain emissions. For example landfill and digester gas can be made up of a wide variety of fuel elements and impurities, and typically contains some percentage of carbon dioxide (CO_2). This CO_2 dilutes the fuel, makes complete combustion more difficult, and results in higher carbon monoxide emissions (CO) than for pipeline-quality natural gas.

Table 1. Emission for Different Capstone Microturbine Models in [lb/MWhe]

Model	Fuel	NOx	CO	VOC [5]
C30 NG	Natural Gas [1]	0.64	1.8	0.23
CR30 MBTU	Landfill Gas [2]	0.64	22.0	1.00
CR30 MBTU	Digester Gas [3]	0.64	11.0	1.00
C30 Liquid	Diesel #2 [4]	2.60	0.41	0.23
C65 NG Standard	Natural Gas [1]	0.46	1.25	0.10
C65 NG Low NOx	Natural Gas [1]	0.17	1.30	0.10
C65 NG CARB	Natural Gas [1]	0.17	0.24	0.05
CR65 Landfill	Landfill Gas [2]	0.46	4.0	0.10
CR65 Digester	Digester Gas [3]	0.46	4.0	0.10
C200 NG	Natural Gas [1]	0.40	1.10	0.10
C200 NG CARB	Natural Gas [1]	0.14	0.20	0.04
CR200 Digester	Digester Gas [3]	0.40	3.6	0.10

Notes:

(1) Emissions for standard natural gas at 1,000 BTU/scf (HHV) or 39.4 MJ/m3 (HHV)
(2) Emissions for surrogate gas containing 42% natural gas, 39% CO2, and 19% Nitrogen
(3) Emissions for surrogate gas containing 63% natural gas and 37% CO2
(4) Emissions for Diesel #2 according to ASTM D975-07b
(5) Expressed as Methane

Table 2 provides the same output-based information shown in Table 1, but expressed in grams per horsepower hour (g/hp-hr).

Table 2. Emission for Different Capstone Microturbine Models in [g/hp-hr]

Model	Fuel	NOx	CO	VOC [5]
C30 NG	Natural Gas [1]	0.22	0.60	0.078
CR30 MBTU	Landfill Gas [2]	0.22	7.4	0.340
CR30 MBTU	Digester Gas [3]	0.22	3.7	0.340
C30 Liquid	Diesel #2 [4]	0.90	0.14	0.078
C65 NG Standard	Natural Gas [1]	0.16	0.42	0.034
C65 NG Low NOx	Natural Gas [1]	0.06	0.44	0.034
C65 NG CARB	Natural Gas [1]	0.06	0.08	0.017
CR65 Landfill	Landfill Gas [2]	0.16	1.4	0.034
CR65 Digester	Digester Gas [3]	0.16	1.4	0.034
C200 NG	Natural Gas [1]	0.14	0.37	0.034
C200 NG CARB	Natural Gas [1]	0.05	0.07	0.014
CR200 Digester	Digester Gas [3]	0.14	1.3	0.034

Notes: - same as for Table 1

Emissions may also be reported on a volumetric basis, with the most common unit of measurement being parts per million. This is typically a measurement that is corrected to specific oxygen content in the exhaust and without considering moisture content. The abbreviation for this unit of measurement is "ppmvd" (parts per million by volume, dry) and is corrected to 15% oxygen for electrical generating equipment such as microturbines. The relationship between an output based measurement like pounds per MWh and a volumetric measurement like ppmvd depends on the characteristics of the generating equipment and the molecular weight of the criteria pollutant being measured. Table 3 expresses the emissions in ppmvd at 15% oxygen for the Capstone microturbine models shown in Table 1. Note that raw measurements expressed in ppmv will typically be lower than the corrected values shown in Table 3 because the microturbine exhaust has greater than 15% oxygen.

Another volumetric unit of measurement expresses the mass of a specific criteria pollutant per standard unit of volume. Table 4 expresses the emissions in milligrams per normal cubic meter at 15% oxygen. Normal conditions for this purpose are expresses as one atmosphere of pressure and zero degrees Celsius. Note that both the ppmvd and mg/m3 measurements are for specific oxygen content. A conversion can be made to adjust either unit of measurement to other reference oxygen contents, if required. Use the equation below to convert from one reference oxygen content to another:

$$\text{Emissions at New } O_2 = \frac{(20.9 - \text{New } O_2 \text{ Percent})}{(20.9 - \text{Current } O_2 \text{ Percent})} \text{ X Emissions at Current } O_2$$

For example, to express 9 ppmvd of NOx at 15% oxygen to ppmvd at 3% oxygen:

$$\text{Emissions at 3\% } O_2 = \frac{(20.9 - 3.0)}{(20.9 - 15.0)} \text{ X } 9 = 27 \text{ ppmvd}$$

Table 3. Emission for Different Capstone Microturbine Models in [ppmvd] at 15% O2

Model	Fuel	NOx	CO	VOC
C30 NG	Natural Gas (1)	9	40	9
CR30 MBTU	Landfill Gas (2)	9	500	40
CR30 MBTU	Digester Gas (3)	9	250	40
C30 Liquid	Diesel #2 (4)	35	9	9
C65 NG Standard	Natural Gas (1)	9	40	7
C65 NG Low NOx	Natural Gas (1)	4	40	7
C65 NG CARB	Natural Gas (1)	4	8	3
CR65 Landfill	Landfill Gas (2)	9	130	7
CR65 Digester	Digester Gas (3)	9	130	7
C200 NG	Natural Gas (1)	9	40	7
C200 NG CARB	Natural Gas (1)	4	8	3
CR200 Digester	Digester Gas (3)	9	130	7

Notes: same as Table 1

Table 4. Emission for Different Capstone Microturbine Models in [mg/m3] at 15% O2

Model	Fuel	NOx	CO	VOC (5)
C30 NG	Natural Gas (1)	18	50	6
CR30 MBTU	Landfill Gas (2)	18	620	30
CR30 MBTU	Digester Gas (3)	18	310	30
C30 Liquid	Diesel #2 (4)	72	11	6
C65 NG Standard	Natural Gas (1)	19	50	5
C65 NG Low NOx	Natural Gas (1)	8	50	5
C65 NG CARB	Natural Gas (1)	8	9	2
CR65 Landfill	Landfill Gas (2)	18	160	5
CR65 Digester	Digester Gas (3)	18	160	5
C200 NG	Natural Gas (1)	18	50	5
C200 NG CARB	Natural Gas (1)	8	9	2
CR200 Digester	Digester Gas (3)	18	160	5

Notes: same as Table 1

The emissions stated in Tables 1, 2, 3 and 4 are guaranteed by Capstone for new microturbines during the standard warranty period. They are also the expected emissions for a properly maintained microturbine according to manufacturer's published maintenance schedule for the useful life of the equipment.

Emissions at Full Power but Not at ISO Conditions

The maximum emissions in Tables 1, 2, 3 and 4 are at full power under ISO conditions. These levels are also the expected values at full power operation over the published allowable ambient temperature and elevation ranges.

Emissions at Part Power

Capstone microturbines are designed to maintain combustion stability and low emissions over a wide operating range. Capstone microturbines utilize multiple fuel injectors, which are switched on or off depending on the power output of the turbine. All injectors are typically on when maximum power is demanded, regardless of the ambient temperature or elevation. As the load requirements of the microturbine are decreased, injectors will be switched off to maintain stability and low emissions. However, the emissions relative to the lower power output may increase. This effect differs for each microturbine model.

Emissions Calculations for Permitting

Air Permitting agencies are normally concerned with the maximum amount of a given pollutant being emitted per unit of time (for example pounds per day of NOx). The simplest way to make this calculation is to use the maximum microturbine full electrical power output (expressed in MW) multiplied by the emissions rate in pounds per MWhe times the number of hours per day. For example, the C65 CARB microturbine operating on natural gas would have a NOx emissions rate of:

NOx = .17 X (65/1000) X 24 = .27 pounds per day

This would be representative of operating the equipment full time, 24 hours per day, at full power output of 65 kWe.

As a general rule, if local permitting is required, use the published agency levels as the stated emissions for the permit and make sure that this permitted level is above the calculated values in this technical reference.

Consideration of Useful Thermal Output

Capstone microturbines are often deployed where their clean exhaust can be used to provide heating or cooling, either directly or using hot water or other heat transfer fluids. In this case, the local permitting or standards agencies will usually consider the emissions from traditional heating sources as being displaced by the useful thermal output of the microturbine exhaust energy. This increases the useful output of the microturbine, and decreases the relative emissions of the combined heat and power system. For example, the CARB version C65 ICHP system with integral heat recovery can achieve a total system efficiency of 70% or more, depending on inlet water temperatures and other installation-specific characteristics. The electric efficiency of the CARB version C65 microturbine is 28% at ISO conditions. This means that the total NOx output based emissions, including the captured thermal value, is the electric-only emissions times the ratio of electric efficiency divided by total system efficiency:

NOx = .17 X 28/70 = .068 pounds per MWh (based on total system output)

This is typically much less than the emissions that would result from providing electric power using traditional central power plants, plus the emissions from a local hot water heater or boiler. In fact microturbine emissions are so low compared with traditional hot water heaters that installing a Capstone microturbine with heat recovery can actually decrease the local emissions of NOx and other criteria pollutants, without even considering the elimination of emissions from a remote power plant.

Greenhouse Gas Emissions

Many gasses are considered "greenhouse gasses", and agencies have ranked them based on their global warming potential (GWP) in the atmosphere compared with carbon dioxide (CO_2), as well as their ability to maintain this effect over time. For example, methane is a greenhouse gas with a GWP of 21. Criteria pollutants like NOx and organic compounds like methane are monitored by local air permitting authorities, and are subject to strong emissions controls. Even though some of these criteria pollutants can be more troublesome for global warming than CO_2, they are released in small quantities – especially from Capstone microturbines. So the major contributor of concern is carbon dioxide, or CO_2. Emission of CO_2 depends on two things:

1. Carbon content in the fuel
2. Efficiency of converting fuel to useful energy

It is for these reasons that many local authorities are focused on using clean fuels (for example natural gas compared with diesel fuel), achieving high efficiency using combined heat and power systems, and displacing emissions from traditional power plants using renewable fuels like waste landfill and digester gasses.

Table 5 shows the typical CO_2 emissions due to combustion for different Capstone microturbine models at full power and ISO conditions. The values do not include CO_2 that may already exist in the fuel itself, which is typical for renewable fuels like landfill and digester gas. These values are expressed on an output basis, as is done for criteria pollutants in Table 1. The table shows the pounds per megawatt hour based on electric power output only, as well as considering total useful output in a CHP system with total 70% efficiency (LHV). As for criteria pollutants, the relative quantity of CO_2 released is substantially less when useful thermal output is also considered in the measurement.

Table 5. CO_2 Emission for Capstone Microturbine Models in [lb/MWh]

Model	Fuel	CO_2	
		Electric Only	70% Total CHP
C30 NG	Natural Gas (1)	1,690	625
CR30 MBTU	Landfill Gas (1)	1,690	625
CR30 MBTU	Digester Gas (1)	1,690	625
C30 Liquid	Diesel #2 (2)	2,400	855
C65 NG Standard	Natural Gas (1)	1,520	625
C65 NG Low NOx	Natural Gas (1)	1,570	625
C65 NG CARB	Natural Gas (1)	1,570	625
CR65 Landfill	Landfill Gas (1)	1,520	625
CR65 Digester	Digester Gas (1)	1,520	625
C200 NG	Natural Gas (1)	1,330	625
C200 NG CARB	Natural Gas (1)	1,330	625
CR200 Digester	Digester Gas (1)	1,330	625

Notes:

(1) Emissions due to combustion, assuming natural gas with CO_2 content of 117 lb/MMBTU (HHV)

(2) Emissions due to combustion, assuming diesel fuel with CO_2 content of 160 lb/MMBTU (HHV)

Useful Conversions

The conversions shown in Table 6 can be used to obtain other units of emissions outputs. These are approximate conversions.

Table 6. Useful Unit Conversions

From	Multiply By	To Get
lb/MWh	0.338	g/bhp-hr
g/bhp-hr	2.96	lb/MWh
lb	0.454	kg
kg	2.20	lb
kg	1,000	g
hp (electric)	.746	kW
kW	1.34	hp (electric)
MW	1,000	kW
kW	0.001	MW

Definitions

- ISO conditions are defined as: 15 °C (59 °F), 60% relative humidity, and sea level pressure of 101.3 kPa (14.696 psia).
- HHV: Higher Heating Value
- LHV: Lower Heating Value
- kW_{th}: Kilowatt (thermal)
- kW_e : Kilowatt (electric)
- MWh: Megawatt-hour
- hp-hr: horsepower-hour (sometimes referred to as "electric horsepower-hour")
- Scf: Standard cubic foot (standard references ISO temperature and pressure)
- m3: Normal cubic meter (normal references 0 °C and one atmosphere pressure)

Capstone Contact Information

If questions arise regarding this technical reference, please contact Capstone Turbine Corporation for assistance and information:

Capstone Applications

Toll Free Telephone: (866) 4-CAPSTONE or (866) 422-7786

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