October 8, 2024

***ELECTRONIC SUBMITTAL***

Amy Tempus-Doom
Environmental Engineer Consultant
Kentucky Department for Environmental Protection
Division for Air Quality
Permit Review Branch
300 Sower Boulevard, 2nd Floor
Frankfort, KY 40601

**RE**: **Big Run Power Producers, LLC**
**Source ID: 21-019-00134**
**Agency Interest: 128843**
**Permit F-16-052 R3**
**Proposed Addition of RNG Plant Backup Flare**
**Permit Modification Application**

Dear Ms. Tempus-Doom,

Archaea Holdings, LLC (Archaea) is submitting the enclosed permit modification application for the addition of a Renewable Natural Gas (RNG) plant backup flare for its Big Run Power Producers, LLC (BRPP), facility, located at the Rumpke of Kentucky, Inc. (Rumpke) Boyd County Landfill in Ashland, Kentucky. This attachment constitutes a part of the Title V permit modification application. Archaea is proposing the addition of a new non-enclosed flare as a backup control device for the thermal oxidizer, consistent with other similar RNG facilities operated by Archaea.

In Permit #F-016-052, initially issued on September 13, 2016, and the subsequent modifications and renewals, the RNG process is divided into three emission points: Emission Point 01 – Temperature Swing Adsorption System, Emission Point 02 – Membrane System, and Emission Point 03 – Pressure Swing Adsorption System. The thermal oxidizer is included as a control device for each emission point. To simplify and align the permit with other similar facilities, the renewal application submitted on March 30, 2021 requested the emission point be combined into one emission unit (Renewable Natural Gas Plant). This permit modification application uses the same emission unit configuration for the calculations and forms.

The facility currently sends excess treated landfill gas (LFG) that cannot be processed by the RNG plant to the Rumpke Landfill Flare (FL-02), permitted under Title V Permit #V-016-053 R2. Landfill Flare (FL-02) is also used for the disposal of LFG that cannot be processed by the RNG plant due to low quality, RNG product gas that does not meet pipeline quality specifications, and RNG process waste gases during periods of thermal oxidizer downtime. The new RNG Plant Backup Flare will be used for the disposal of RNG plant waste gas during periods of thermal oxidizer downtime and off-spec product gas that cannot be sent to the pipeline. The new flare will not have the ability to process treated LFG that has not been processed by the RNG plant.

Based on communications with KDAQ during the renewal application process in 2021, it is the understanding of Archaea and Rumpke that the landfill and RNG plant will be considered a single source in future permits. While the RNG Plant Backup Flare is a new emission unit, the total emissions for the combined landfill and RNG plant will remain the same. The new flare is a backup control device that will not increase the capacity or potential emissions of the RNG plant. Currently, emissions due to RNG plant waste gas and off-spec gas disposal are included in the potential emissions calculations for the Rumpke Landfill Flare. In this permit modification application, the emissions from those activities are included in the potential emissions for the RNG Plant Backup Flare.

The included calculations provide emissions for two operating scenarios: the off-spec mode where the RNG plant is producing off-spec gas that is sent to the RNG Plant Backup Flare, and thermal oxidizer backup mode where RNG Plant waste gas is sent to the RNG Plant Backup Flare instead of the thermal oxidizer. Please note that the emissions calculations use the emission factors from Final AP-42 Chapter 2.4, published in August 2024.

Included with this application are emission calculations, process flow diagrams, a site map, and the following required application forms:

- DEP7007AI – Administrative Information
- DEP7007B – Manufacturing or Processing Operations
- DEP7007N – Source Emissions Profile
- DEP7007V – Applicable Requirements and Compliance Activities
- DEP7007GG – Control Equipment

Please note that in previous permits, the RNG plant process was regulated under 401 KAR 63:020, Potentially hazardous matter or toxic substances. 40 CFR 60 Subpart WWW was precluded by requiring BRPP to purchase and use only treated gas from Boyd County Landfill. Since the most recent permit renewal application submitted on March 30, 2021, Boyd County Landfill and BRPP have become subject to 40 CFR 63 Subpart AAAA. This change is reflected in Form DEP7007V – Application Requirements and Compliance Activities.

Archaea trusts that this application addresses all requirements of the KDAQ and USEPA. Please do not hesitate to contact Emily Zambuto at (585) 948-4616 or e-mail ezambuto@archaea.energy should you need any additional information or have any questions.

*I, the undersigned, hereby certify under penalty of law, that I am a responsible official, and that I have personally examined, and am familiar with, the 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 information is on knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false or incomplete information, including the possibility of fine or imprisonment.*

Sincerely,

Archaea Holdings, LLC

DocuSigned by:
Steven Boor
B3BA495CCB09470...

Steven Boor
Chief Operating Officer

Enclosures

cc: Kristen Bell, Optim Environmental Resources, Inc.

Archaea Energy

201 Helios Way
Floor 6
Houston, TX 77079

archaeaenergy.com
+1 346 708 8272

Division for Air Quality

300 Sower Boulevard

Frankfort, KY 40601

(502) 564-3999

# DEP7007AI

## Administrative Information

___ Section AI.1: Source Information

___ Section AI.2: Applicant Information

___ Section AI.3: Owner Information

___ Section AI.4: Type of Application

___ Section AI.5: Other Required Information

___ Section AI.6: Signature Block

___ Section AI.7: Notes, Comments, and Explanations

**Additional Documentation**

___ Additional Documentation attached

**Source Name:** **Big Run Power Producers, LLC**

**KY EIS (AFS) #:** **21- 019-00134**

**Permit #:** **F-16-052 R3**

**Agency Interest (AI) ID:** **128843**

**Date:** **10/1/2024**

## Section AI.1: Source Information

| | | | | | | |
|---|---|---|---|---|---|---|
| **Physical Location Address:** | **Street:** | 2238 River Cities Drive | | | | |
| | **City:** | Ashland | **County:** | Boyd | **Zip Code:** | 41102 |
| **Mailing Address:** | **Street or P.O. Box:** | 201 Helios Way, Floor 6 | | | | |
| | **City:** | Houston | **State:** | Texas | **Zip Code:** | 77079 |

**Standard Coordinates for Source Physical Location**

**Longitude:** -82.7500 (decimal degrees) **Latitude:** 38.3707 (decimal degrees)

**Primary (NAICS) Category:** Natural Gas Distribution **Primary NAICS #:** 221210

#

**Classification (SIC) Category:** Gas Production and/or Distribution **Primary SIC #:** 4925

**Briefly discuss the type of business conducted at this site:** Collecting LFG from Rumpke of Kentucky - Boyd County Sanitary Landfill to produce pipeline quality renewable natural gas (RNG)

**Description of Area Surrounding Source:** ☐ Rural Area ☐ Industrial Park ☐ Residential Area ☐ Urban Area ☑ Industrial Area ☐ Commercial Area

**Is any part of the source located on federal land?** ☐ Yes ☑ No

**Number of Employees:** 3

**Approximate distance to nearest residence or commercial property:** 0.5 miles **Property Area:** 2 acres **Is this source portable?** ☐ Yes ☑ No

**What other environmental permits or registrations does this source currently hold or need to obtain in Kentucky?**

| | | | |
|---|---|---|---|
| **NPDES/KPDES:** | ☑ Currently Hold | ☐ Need | ☐ N/A |
| **Solid Waste:** | ☐ Currently Hold | ☐ Need | ☑ N/A |
| **RCRA:** | ☐ Currently Hold | ☐ Need | ☑ N/A |
| **UST:** | ☐ Currently Hold | ☐ Need | ☑ N/A |

**Type of Regulated Waste Activity:** ☐ Mixed Waste Generator ☐ Generator ☐ Recycler ☐ Other: _____ ☐ U.S. Importer of Hazardous Waste ☐ Transporter ☐ Treatment/Storage/Disposal Facility ☑ N/A

## Section AI.2: Applicant Information

**Applicant Name:** Big Run Power Producers, LLC

**Title:** (if individual)

**Mailing Address:** **Street or P.O. Box:** 201 Helios Way, Floor 6
**City:** Houston **State:** TX **Zip Code:** 77079

**Email:** (if individual)

**Phone:**

**Technical Contact**

**Name:** Nevin Edwards

**Title:** Air Permitting Manager

**Mailing Address:** **Street or P.O. Box:** 201 Helios Way, Floor 6
**City:** Houston **State:** TX **Zip Code:** 77079

**Email:** nedwards@archaea.energy

**Phone:** (412) 860-4550

**Air Permit Contact for Source**

**Name:** Emily Zambuto

**Title:** Director of Compliance and Permitting

**Mailing Address:** **Street or P.O. Box:** 201 Helios Way, Floor 6
**City:** Houston **State:** TX **Zip Code:** 77079

**Email:** ezambuto@archaea.energy

**Phone:** (585) 948-4616

## Section AI.3: Owner Information

☑ **Owner same as applicant**

**Name:** _____

**Title:** _____

**Mailing Address:** **Street or P.O. Box:** _____

**City:** _____ **State:** _____ **Zip Code:** _____

**Email:** _____

**Phone:** _____

**List names of owners and officers of the company who have an interest in the company of 5% or more.**

| Name | Position |
|---|---|
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## Section AI.4: Type of Application

**Current Status:** ☐ Title V ☑ Conditional Major ☐ State-Origin ☐ General Permit ☐ Registration ☐ None

**Requested Action:** *(check all that apply)*

☐ Name Change ☐ Initial Registration ☐ Significant Revision ☐ Administrative Permit Amendment
☐ Renewal Permit ☐ Revised Registration ☐ Minor Revision ☐ Initial Source-wide OperatingPermit
☐ 502(b)(10)Change ☐ Extension Request ☐ Addition of New Facility ☐ Portable Plant Relocation Notice
☐ Revision ☐ Off Permit Change ☐ Landfill Alternate Compliance Submittal ☑ Modification of Existing Facilities
☐ Ownership Change ☐ Closure

**Requested Status:** ☑ Title V ☐ Conditional Major ☐ State-Origin ☐ PSD ☐ NSR ☐ Other: _____

**Is the source requesting a limitation of potential emissions?** ☐ Yes ☑ No

| Pollutant: | Requested Limit: | Pollutant: | Requested Limit: |
|---|---|---|---|
| ☐ Particulate Matter | | ☐ Single HAP | |
| ☐ Volatile Organic Compounds (VOC) | | ☐ Combined HAPs | |
| ☐ Carbon Monoxide | | ☐ Air Toxics (40 CFR 68, Subpart F) | |
| ☐ Nitrogen Oxides | | ☐ Carbon Dioxide | |
| ☐ Sulfur Dioxide | | ☐ Greenhouse Gases (GHG) | |
| ☐ Lead | | ☐ Other | |

**For New Construction:**

**Proposed Start Date of Construction:** *(MM/YYYY)* N/A

**Proposed Operation Start-Up Date:** *(MM/YYYY)* N/A

**For Modifications:**

**Proposed Start Date of Modification:** *(MM/YYYY)* Upon permit issuance

**Proposed Operation Start-Up Date:** *(MM/YYYY)* Upon permit issuance

**Applicant is seeking coverage under a permit shield.** ☐ **Yes** ☑ **No**

**Identify any non-applicable requirements for which permit shield is sought on a separate attachment to the application.**

## Section AI.5 Other Required Information

**Indicate the documents attached as part of this application:**

☐ DEP7007A Indirect Heat Exchangers and Turbines
☑ DEP7007B Manufacturing or Processing Operations
☐ DEP7007C Incinerators and Waste Burners
☐ DEP7007F Episode Standby Plan
☐ DEP7007J Volatile Liquid Storage
☐ DEP7007K Surface Coating or Printing Operations
☐ DEP7007L Mineral Processes
☐ DEP7007M Metal Cleaning Degreasers
☑ DEP7007N Source Emissions Profile
☐ DEP7007P Perchloroethylene Dry Cleaning Systems
☐ DEP7007R Emission Offset Credit
☐ DEP7007S Service Stations
☐ DEP7007T Metal Plating and Surface Treatment Operations
☑ DEP7007V Applicable Requirements and Compliance Activities
☐ DEP7007Y Good Engineering Practice and Stack Height Determination
☐ DEP7007AA Compliance Schedule for Non-complying Emission Units
☐ DEP7007BB Certified Progress Report
☐ DEP7007CC Compliance Certification
☐ DEP7007DD Insignificant Activities
☐ DEP7007EE Internal Combustion Engines
☐ DEP7007FF Secondary Aluminum Processing
☑ DEP7007GG Control Equipment
☐ DEP7007HH Haul Roads
☐ Confidentiality Claim
☐ Ownership Change Form
☐ Secretary of State Certificate
☑ Flowcharts or diagrams depicting process
☐ Digital Line Graphs (DLG) files of buldings, roads, etc.
☐ Site Map
☐ Map or drawing depicting location of facility
☐ Safety Data Sheet (SDS)
☐ Emergency Response Plan
☐ Other: _____

## Section AI.6: Signature Block

**I, the undersigned, hereby certify under penalty of law, that I am a responsible official*, and that I have personally examined, and am familiar with, the 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 information is on knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false or incomplete information, including the possibility of fine or imprisonment.**

DocuSigned by: Steven Boor B3BA495CCB09470...
**Authorized Signature**

10/3/2024
**Date**

Steven Boor
**Type or Printed Name of Signatory**

Chief Operating Officer
**Title of Signatory**

*Responsible official as defined by 401 KAR 52:001.

| Section AI.7: Notes, Comments, and Explanations |
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# DEP7007B

## Manufacturing or Processing Operations

___ Section B.1: Process Information
___ Section B.2: Materials and Fuel Information
___ Section B.3: Notes, Comments, and Explanations

**Additional Documentation**

___ Complete DEP7007AI, DEP7007N, DEP7007V, and DEP7007GG.
___ Attach a flow diagram
___ Attach SDS

**Source Name:** **Big Run Power Producers, LLC**
**KY EIS (AFS) #:** **21- 019-00134**
**Permit #:** **F-16-052 R3**
**Agency Interest (AI) ID:** **128843**
**Date:** **9/24/2024**

## Section B.1: Process Information

| Emission Unit # | Emission Unit Name | Describe Emission Unit | Process ID | Process Name | Manufacturer | Model No. | Proposed/Actual Date of Construction Commencement *(MM/YYYY)* | Is the Process Continuous or Batch? | Number of Batches per 24 Hours *(if applicable)* | Hours per Batch *(if applicable)* |
|---|---|---|---|---|---|---|---|---|---|---|
| EU03 | Renewable Natural Gas Plant | Treatment system process converts landfill gas (LFG) to high BTU pipeline quality gas | - | Renewable Natural Gas Plant | Gas Plant: N/A<br>Thermal Oxidizer: Process Combustion Corporation<br>Flare: Perennial Energy, Inc | Gas Plant: N/A<br>Thermal Oxidizer: Custom<br>Flare: FL-14-C | Gas Plant/Thermal Oxidizer: 05/2018<br>Flare: Upon Permit Issuance | Continuous | N/A | N/A |
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## Section B.2: Materials and Fuel Information

**Maximum yearly fuel usage rate only applies if applicant request operating restrictions through federally enforceable limitations.*

| Emission Unit # | Emission Unit Name | Name of Raw Materials Input | Maximum Quantity of Each Raw Material Input | | Total Process Weight Rate for Emission Unit *(tons/hr)* | Name of Finished Materials | Maximum Quantity of Each Finished Material Output | | Fuel Type | Maximum Hourly Fuel Usage Rate | | Maximum Yearly Fuel Usage Rate | | Sulfur Content *(%)* | Ash Content *(%)* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | *(Specify Units/hr)* | | | | *(Specify Units/hr)* | | | *(Specify Units)* | | *(Specify Units)* | | |
| EU03 | Renewable Natural Gas Plant | Landfill Gas (LFG) | 0.24 | mmscf/hr | N/A | High BTU Pipeline Quality Gas | 0.14 | mmscf/hr | Thermal Oxidizer: Natural Gas | 133 | scf/hr | 70 | mmscf/yr | 0% | 0% |
| | | | | | | | | | | | | | | | |
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## Section B.3: Notes, Comments, and Explanations

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# DEP7007N

## Source Emissions Profile

__ Section N.1: Emission Summary
__ Section N.2: Stack Information
__ Section N.3: Fugitive Information
__ Section N.4: Notes, Comments, and Explanations

**Additional Documentation**

___ Complete DEP7007AI

**Source Name:** **Big Run Power Producers, LLC**

**KY EIS (AFS) #:** **21- 019-00134**

**Permit #:** **F-16-052 R3**

**Agency Interest (AI) ID:** **128843**

**Date:** **10/1/2024**

## N.1: Emission Summary

| Emission Unit # | Emission Unit Name | Process ID | Process Name | Control Device Name | Control Device ID | Stack ID | Maximum Design Capacity *(SCC Units/hour)* | Pollutant | Uncontrolled Emission Factor *(lb/SCC Units)* | Emission Factor Source (e.g. AP-42, Stack Test, Mass Balance) | Capture Efficiency *(%)* | Control Efficiency *(%)* | Hourly Emissions | | Annual Emissions | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | Uncontrolled Potential *(lb/hr)* | Controlled Potential *(lb/hr)* | Uncontrolled Potential *(tons/yr)* | Controlled Potential *(tons/yr)* |
| EU03 | Renewable Natural Gas Plant | - | - | Thermal Oxidizer | TOU-1 | TOU-1 | Please see attached emissions calculations | | | | | | | | | |
| EU03 | Renewable Natural Gas Plant | - | - | Backup Flare | CS-1 | CS-1 | Please see attached emissions calculations | | | | | | | | | |
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## Section N.2: Stack Information

### UTM Zone:

| Stack ID | Identify all Emission Units (with Process ID) and Control Devices that Feed to Stack | Stack Physical Data | | | Stack UTM Coordinates | | Stack Gas Stream Data | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Equivalent Diameter *(ft)* | Height *(ft)* | Base Elevation *(ft)* | Northing *(m)* | Easting *(m)* | Flowrate *(acfm)* | Temperature *(° F)* | Exit Velocity *(ft/sec)* |
| TOU-1 | Renewable Natural Gas Plant Thermal Oxidizer | 3 | 35 | 775 | 4248370 | 347109 | 7,785 | 1,600 | 18.4 |
| CS-1 | RNG Plant Backup Flare | 1.33 | 40 | 774 | 4248363 | 347108 | 4,381 | 1,400 | 52.3 |
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## Section N.3: Fugitive Information

### UTM Zone:

| Emission Unit # | Emission Unit Name | Process ID | Area Physical Data | | Area UTM Coordinates | | Area Release Data | |
|---|---|---|---|---|---|---|---|---|
| | | | Length of the X Side *(ft)* | Length of the Y Side *(ft)* | Northing *(m)* | Easting *(m)* | Release Temperature *(°F)* | Release Height *(ft)* |
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| Section N.4: Notes, Comments, and Explanations |
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# DEP7007V

## Applicable Requirements and Compliance Activities

___ Section V.1: Emission and Operating Limitation(s)
___ Section V.2: Monitoring Requirements
___ Section V.3: Recordkeeping Requirements
___ Section V.4: Reporting Requirements
___ Section V.5: Testing Requirements
___ Section V.6: Notes, Comments, and Explanations

**Additional Documentation**

___ Complete DEP7007AI

**Source Name:** **Big Run Power Producers, LLC**
**KY EIS (AFS) #:** **21-019-00134**
**Permit #:** **F-16-052 R3**
**Agency Interest (AI) ID:** **128843**
**Date:** **10/1/2024**

**Section V.1: Emission and Operating Limitation(s)**

| Emission Unit # | Emission Unit Description | Applicable Regulation or Requirement | Pollutant | Emission Limit (if applicable) | Voluntary Emission Limit or Exemption (if applicable) | Operating Requirement or Limitation (if applicable) | Method of Determining Compliance with the Emission and Operating Requirement(s) |
|---|---|---|---|---|---|---|---|
| EU03 | Renewable Natural Gas Plant | 40 CFR 63.1959(b)(2)(iii)(B) (40 CFR 63 Subpart AAAA incorporated by reference in 401 KAR 63:002, Section 2(4)(hhh)) | NMOC | Reduce NMOC by 98% or reduce the outlet NMOC concentration to less than 20 ppmv, at 3% $O_2$ | N/A | The 3-hour average combustion chamber temperature in any 24-hour period shall not fall 28°C below the average combustion temperature during the most recent performance test. | Methods as outlined under 40 CFR 63.1959(b)(2)(iii)(B). |
| | | 401 KAR 59:020 Section 3 | Particulate Matter | No visible emissions equal to or greater than 20% opacity.<br><br>No particulate emissions in excess of the quantity specified in 401 KAR 59:020 Appendix A | N/A | N/A | Operation and maintenance of thermal oxidizer in conformance with its design. If requested by KDAQ, use of USEPA Method 9, Kentucky Method 150 (F-1), or comparable method selected by Archaea and approved by KDAQ. |
| CS-1 | RNG Plant Backup Flare | 40 CFR 63.1959(b)(2)(iii)(A)<br>40 CFR 63.11(b)(4)<br>(40 CFR Subpart A incorporated by reference in 401 KAR 63:002, Section 2(1)) | Visible Emissions | No visible emissions except for periods not to exceed a total of 5 minutes during any 2 consecutive hours. | N/A | Flares shall be operated with a flame present at all times. | Operation and maintenance of flare in conformance with its design. If requested by KDAQ, USEPA Method 22, or comparable method selected by Archaea and approved by KDAQ. |
| | | 401 KAR 63:015, Section 3 | Particulate Matter | No emissions of particulate matter greater than 20% opacity for more than 3 minutes in any 1 day. | N/A | N/A | Operation and maintenance of flare in conformance with its design. If requested by KDAQ, use of USEPA Method 9, Kentucky Method 150 (F-1), or comparable method selected by Archaea and approved by KDAQ. |

## Section V.2: Monitoring Requirements

| Emission Unit # | Emission Unit Description | Pollutant | Applicable Regulation or Requirement | Parameter Monitored | Description of Monitoring |
|---|---|---|---|---|---|
| EU03 | Renewable Natural Gas Plant | NMOC | 40 CFR 63.1961(b) | Parameters as required under 40 CFR 63.1961(b). | Monitoring as required under 40 CFR 63.1961(b). |
| | | Particulate Matter | 401 KAR 52:020 | Visible Emissions | Daily qualitative observation of visible emissions from thermal oxidizer stack. |
| CS-1 | RNG Plant Backup Flare | Visible Emissions | 40 CFR 63.1961(c) | Parameters as required under 40 CFR 63.1961(c) | Monitoring as required under 40 CFR 63.1961(c). |
| | | Particulate Matter | 401 KAR 52:020 | Visible Emissions | Daily qualitative observation of visible emissions from flare. |

## Section V.3: Recordkeeping Requirements

| Emission Unit # | Emission Unit Description | Pollutant | Applicable Regulation or Requirement | Parameter Recorded | Description of Recordkeeping |
|---|---|---|---|---|---|
| EU03 | Renewable Natural Gas Plant | NMOC | 40 CFR 63.1983(b)&(c) | Parameters as required under 40 CFR 63.1983(b)&(c). | Records as required under 40 CFR 63.1983 maintained for 5 years, except for initial records required under 40 CFR 63.1983(b)(2)&(5), which must be maintained for the life of the equipment. |
| | | Particulate Matter | 401 KAR 52:020 | Visible Emissions | Maintain log of daily qualitative visible emissions observations of thermal oxidizer stack. |
| CS-1 | RNG Plant Backup Flare | Visible Emissions | 40 CFR 63.1983(b)&(c) | Parameters as required under 40 CFR 63.1983(b)&(c). | Records as required under 40 CFR 63.1983 maintained for 5 years. |
| | | Particulate Matter | 401 KAR 52:020 | Visible Emissions | Maintain log of daily qualitative visible emissions observations of flare. |

## Section V.4: Reporting Requirements

| Emission Unit # | Emission Unit Description | Pollutant | Applicable Regulation or Requirement | Parameter Reported | Description of Reporting |
|---|---|---|---|---|---|
| EU03 | Renewable Natural Gas Plant | NMOC | 40 CFR 63.1981(h) | Parameters as required under 40 CFR 63.1981(h). | Reports as required under 40 CFR 63.1981(h) will be submitted. |
| | | Particulate Matter | 401 KAR 52:020 | N/A | N/A |
| CS-1 | RNG Plant Backup Flare | Visible Emissions | 40 CFR 63.1981(h) | Parameters as required under 40 CFR 63.1981(h). | Reports as required under 40 CFR 63.1981(h) will be submitted. |
| | | Particulate Matter | 401 KAR 52:020 | N/A | N/A |

## Section V.5: Testing Requirements

| Emission Unit # | Emission Unit Description | Pollutant | Applicable Regulation or Requirement | Parameter Tested | Description of Testing |
|---|---|---|---|---|---|
| EU03 | Renewable Natural Gas Plant | NMOC | 40 CFR 63.1959(d)&(f) | Parameters as required under 40 CFR63.1959(d)&(f). | Testing as required under 40 CFR 63.1959(d)&(f) will be performed. |
| | | Particulate Matter | 401 KAR 52:020 | N/A | N/A |
| CS-1 | RNG Plant Backup Flare | Visible Emissions | 40 CFR 63.1959(e)&(f), 40 CFR 63.11(b) | Parameters as required by 40 CFR 63.1959(e)&(f) and 40 CFR 63.11(b). | Testing as required under 40 CFR 63.1959(e)&(f) using USEPA Method 22 per 40 CFR 63.11(b) or comparable method approved by KDAQ. |
| | | Particulate Matter | 401 KAR 52:020 | N/A | N/A |

| **Section V.6: Notes, Comments, and Explanations** |
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Division for Air Quality

300 Sower Boulevard

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# DEP7007GG

## Control Equipment

**Additional Documentation**

___ Complete Sections GG.1 through GG.12, as applicable

___ Attach manufacturer's specifications for each control device

___ Complete DEP7007AI

**Source Name:** Big Run Power Producers, LLC

**KY EIS (AFS) #:** 21- 019-00134

**Permit #:** F-16-052 R3

**Agency Interest (AI) ID:** 128843

**Date:** 10/1/2024

**Section GG.1: General Information - Control Equipment**

| Control Device ID # | Control Device Name | Cost | Manufacturer | Model Name/ Serial # | Date Installed | Inlet Gas Stream Data For All Control Devices | | | | | Inlet Gas Stream Data For Condensers, Adsorbers, Afterburners, Incinerators, Oxidizers Only | | | Equipment Operational Data For All Control Devices | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Temperature *(°F)* | Flowrate *(scfm @ 68°F)* | Average Particle Diameter *(mm)* | Particle Density *($lb/ft^3$)* or Specific Gravity | Gas Density *($lb/ft^3$)* | Gas Moisture Content *(%)* | Gas Composition | Fan Type | Pressure Drop Range *(in. $H_2O$)* | Pollutants Collected/Controlled | Pollutant Removal *(%)* |
| TOU-1 | Thermal Oxidizer | $900,000 | Process Combustion Corporation | Custom | 05/2018 | 77 | 2,000 | N/A | N/A | 0.109 | Minimal | $CO_2$: 93-95%<br>$CH_4$: 3-5%<br>$O_2$: 0.5%<br>$N_2$: 1.5-2% | Blower | N/A | VOC/HAP | 98% |
| CS-1 | RNG Plant Backup Flare | $200,500 | Perennial Energy, Inc. | FL-14-C | Upon Permit Issuance | 77 | 2,000 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | VOC/HAP | 98% |
| | | | | | | | | | | | | | | | | |
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## Section GG.2: Flare Source Information

| **Control Device ID #** | **Identify all Emission Units and Control Devices that Feed to Flare** | **Type of Flare** (e.g. steam-assisted, air-assisted, nonassisted) | **Process Gas Flowrate** *(acfm)* | **Net Heating Value of Stream(s)** (Btu/scf) | **Removal Efficiency** *(%)* | **Flare Rated Capacity** *(MMBtu/hr)* |
|---|---|---|---|---|---|---|
| CS-1 | EU03 - Renewable Natural Gas Plant | Nonassisted | 2,000 | 1,000 (Off-Spec Gas)<br>100 (Waste Gas) | 98 | 108.0 |
| | | | | | | |

## Section GG.7: Afterburner/Incinerator/Oxidizer

| Control Device ID # | Identify all Emission Units and Control Devices that Feed to Afterburner/Incinerator/Oxidizer | Identify Type: Afterburner, Incinerator, Oxidizer, or Other (specify) | Number of Burners | Burner Rating *(BTU/hr)* | Dimensions of Combustion Chamber *(specify units)* | Residence Time *(sec)* | Combustion Chamber Temperature *(° F)* | Type of Catalyst (if applicable) | Type of Heat Exchanger (if applicable) | Auxiliary Fuel | | | | | | | Composition and Quantities of Combusted Waste |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Identify Fuel Type | Higher Heating Value *(MMBtu/scf)* | Hourly Fuel Usage *(scf/hr)* | % Sulfur (Maximum) | % Sulfur (Average) | % Ash (Maximum) | % Ash (Average) | |
| EP01 | Renewable Natural Gas Plant | Oxidizer | 2 (Main & Aux.) | Main: 8 mmBTU/hr Aux: 2 mmBTU/hr | 15 ft length 5.33 ft O.D. 5.08 ft I.D. | 0.5 | 1600 | N/A | Tubular | Natural Gas | 0.000001 | 133 | N/A | N/A | N/A | N/A | See attatched emission calculations |
| | | | | | | | | | | | | | | | | | |
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| **Section GG.12: Notes, Comments, and Explanations** |
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Attachment 1: Big Run Flare Addition Potential Emissions Calculations

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**Facility Emissions Summary**
**Potential Emissions Calculations**
**Dedicated RNG Plant Flare Application**
**Big Run Power Producers, LLC**

| Emission Unit ID & Description | Waste Stream | Off-Spec Mode: Pre-Modification Worst Case Potential Emissions (tons/yr) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | CO | NOx | PM | $PM_{10}$ | $PM_{2.5}$ | $SO_2$ | VOC | Single HAP | Total HAP |
| RNG Plant | LFG Controlled Emissions | 10.69 | | | | | | 1.88 | 4.10(HCl) | 7.61 |
| Thermal Oxidizer | Natural Gas & RNG Waste Gas | 7.36 | 8.76 | 0.67 | 0.67 | 0.67 | 2.05 | 0.19 | | |
| Rumpke Landfill Flares | Off-Spec RNG | 30.48 | 19.97 | 8.94 | 8.94 | 8.94 | | | | |
| **Total RNG Plant Emissions** | | **48.53** | **28.73** | **9.60** | **9.60** | **9.60** | **2.05** | **2.07** | | |

| Emission Unit ID & Description | Waste Stream | Off-Spec Mode: Post-Modification Worst Case Potential Emissions (tons/yr) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | CO | NOx | PM | $PM_{10}$ | $PM_{2.5}$ | $SO_2$ | VOC | Single HAP | Total HAP |
| RNG Plant | LFG Controlled Emissions | 10.69 | | | | | | 1.88 | 4.10(HCl) | 7.61 |
| Thermal Oxidizer | Natural Gas & RNG Waste Gas | 7.36 | 8.76 | 0.67 | 0.67 | 0.67 | 2.05 | 0.19 | | |
| RNG Plant Backup Flare | Off-Spec RNG | 30.48 | 19.97 | 8.94 | 8.94 | 8.94 | | | | |
| Rumpke Landfill Flares | N/A | No Flow from RNG Plant | | | | | | | | |
| **Total RNG Plant Emissions** | | **48.53** | **28.73** | **9.60** | **9.60** | **9.60** | **2.05** | **2.07** | | |
| **Project Net Emissions** | | **0** | **0** | **0** | **0** | **0** | **0** | **0** | | |

| Emission Unit ID & Description | Waste Stream | RTO Backup Mode: Pre-Modification Worst Case Potential Emissions (tons/yr) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | CO | NOx | PM | $PM_{10}$ | $PM_{2.5}$ | $SO_2$ | VOC | Single HAP | Total HAP |
| RNG Plant | LFG Controlled Emissions | 10.69 | | | | | | 1.88 | 4.10(HCl) | 7.61 |
| Thermal Oxidizer | N/A | No Flow from RNG Plant | | | | | | | | |
| Rumpke Landfill Flares | RNG Waste Gas | 3.05 | 2.00 | 0.89 | 0.89 | 0.89 | 2.03 | | | |
| **Total RNG Plant Emissions** | | **13.74** | **2.00** | **0.89** | **0.89** | **0.89** | **2.03** | **1.88** | | |

| Emission Unit ID & Description | Waste Stream | RTO Backup Mode: Post-Modification Worst Case Potential Emissions (tons/yr) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | CO | NOx | PM | $PM_{10}$ | $PM_{2.5}$ | $SO_2$ | VOC | Single HAP | Total HAP |
| RNG Plant | LFG Controlled Emissions | 10.69 | | | | | | 1.88 | 4.10(HCl) | 7.61 |
| Thermal Oxidizer | N/A | No Flow from RNG Plant | | | | | | | | |
| RNG Plant Backup Flare | RNG Waste Gas | 3.05 | 2.00 | 0.89 | 0.89 | 0.89 | 2.03 | | | |
| Rumpke Landfill Flares | N/A | No Flow from RNG Plant | | | | | | | | |
| **Total RNG Plant Emissions** | | **13.74** | **2.00** | **0.89** | **0.89** | **0.89** | **2.03** | **1.88** | | |
| **Project Net Emissions** | | **0** | **0** | **0** | **0** | **0** | **0** | **0** | | |

**Facility-Wide Emissions**
**Potential Emissions Calculations**
**Dedicated RNG Plant Flare Application**
**Big Run Power Producers, LLC**

**Annual Potential Criteria and GHG Pollutant Emissions:**

| Pollutant | LFG Controlled Emissions[a] (tons/yr) | Normal Operation | | | RTO Backup Mode | | | Off-Spec Mode | | | Maximum Total Emissions[c] (tons/yr) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Flare CS-1 Combustion Emissions (tons/yr) | RTO Combustion Emissions[b] (tons/yr) | Total Combustion Emissions (tons/yr) | Flare CS-1 Combustion Emissions (tons/yr) | RTO Combustion Emissions[b] (tons/yr) | Total Combustion Emissions (tons/yr) | Flare CS-1 Combustion Emissions (tons/yr) | RTO Combustion Emissions[b] (tons/yr) | Total Combustion Emissions (tons/yr) | |
| CO | 10.69 | | 7.36 | 7.36 | 3.05 | | 3.05 | 30.48 | 7.36 | 37.84 | 48.53 |
| NMOC | 3.91 | | 0.30 | 0.30 | | | | | 0.30 | 0.30 | 4.21 |
| NOx | | | 8.76 | 8.76 | 2.00 | | 2.00 | 19.97 | 8.76 | 28.73 | 28.73 |
| $PM/PM_{10}/PM_{2.5}$ | | | 0.67 | 0.67 | 0.89 | | 0.89 | 8.94 | 0.67 | 9.60 | 9.60 |
| $SO_2$ | | | 0.02 | 0.02 | 2.03 | | 2.03 | | 2.05 | 2.05 | 2.05 |
| VOC | 1.88 | | 0.19 | 0.19 | | | | | 0.19 | | 2.07 |
| $CO_2$ | 47,990 | | 10,239 | 10,239 | 6,035 | | 6,035 | 60,346 | 10,239 | 70,586 | 118,576 |
| Methane | 480.99 | | 0.08 | 0.08 | | | | | 0.08 | | 481.07 |
| $N_2O$ | | | 0.10 | 0.10 | 0.07 | | 0.07 | 0.73 | 0.10 | 0.83 | 0.83 |
| $CO_2e$ | 60,015 | | 10,270 | 10,270 | 6,056 | | 6,056 | 60,564 | 10,270 | 70,834 | 130,849 |

[a]LFG Controlled Emissions calculated based on LFG inlet concentration and a minimum control efficiency of 98%. LFG Controlled Emissions are independent of operating mode.
[b]Total RTO Combustion Emissions include emissions generated from combusting the maximum flowrate of RNG waste gases and from combusting natural gas as fuel in the RTO.
[c]Maximum Plant Emissions includes the LFG controlled emissions and the maximum Total RNG Plant Combustion emissions.

**Hourly Potential Criteria and GHG Pollutant Emissions:**

| Pollutant | LFG Controlled Emissions (lb/hr) | Normal Operation | | | RTO Backup Mode | | | Off-Spec Mode | | | Maximum RNG Plant Emissions (tons/yr) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Flare CS-1 Combustion Emissions (tons/yr) | RTO Combustion Emissions (tons/yr) | Total Combustion Emissions (tons/yr) | Flare CS-1 Combustion Emissions (tons/yr) | RTO Combustion Emissions (tons/yr) | Total Combustion Emissions (tons/yr) | Flare CS-1 Combustion Emissions (tons/yr) | RTO Combustion Emissions (tons/yr) | Total Combustion Emissions (tons/yr) | |
| CO | 2.44 | | 1.68 | 1.68 | 0.70 | | 0.70 | 6.96 | 1.68 | 8.64 | 11.08 |
| NMOC | 0.89 | | 0.07 | 0.07 | | | | | 0.07 | 0.07 | 0.96 |
| NOx | | | 2.00 | 2.00 | 0.46 | | 0.46 | 4.56 | 2.00 | 6.56 | 6.56 |
| $PM/PM_{10}/PM_{2.5}$ | | | 0.15 | 0.15 | 0.20 | | 0.20 | 2.04 | 0.15 | 2.19 | 2.19 |
| $SO_2$ | | | 4.80E-03 | 4.80E-03 | | | | | 0.47 | 0.47 | 0.47 |
| VOC | 0.43 | | 0.04 | 0.04 | | | | | 0.04 | | 0.47 |
| $CO_2$ | 10,957 | | 2,338 | 2,338 | 1,378 | | 1,378 | 13,778 | 2,338 | 16,115 | 27,072 |
| Methane | 109.82 | | 0.02 | 0.02 | | | | | 0.02 | | 109.83 |
| $N_2O$ | | | 0.02 | 0.02 | 0.02 | | 0.02 | 0.17 | 0.02 | 0.19 | 0.19 |
| $CO_2e$ | 13,702 | | 2,345 | 2,345 | 1,383 | | 1,383 | 13,827 | 2,345 | 16,172 | 29,874 |

Note: Emissions operating scenarios described in footnotes for Total Criteria and GHG Pollutant Emissions table.

**Facility-Wide Emissions**
**Potential Emissions Calculations**
**Dedicated RNG Plant Flare Application**
**Big Run Power Producers, LLC**

**Potential HAP Emissions:**

| Pollutant | LFG Controlled Emissions (tons/yr) | Normal Operation | | | RTO Backup Mode | | | Off-Spec Mode | | | Maximum RNG Plant Emissions (tons/yr) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Flare CS-1 Combustion Emissions (tons/yr) | RTO Combustion Emissions (tons/yr) | Total Combustion Emissions (tons/yr) | Flare CS-1 Combustion Emissions (tons/yr) | RTO Combustion Emissions (tons/yr) | Total Combustion Emissions (tons/yr) | Flare CS-1 Combustion Emissions (tons/yr) | RTO Combustion Emissions (tons/yr) | Total Combustion Emissions (tons/yr) | |
| 1,1,1-Trichloroethane | 3.49E-03 | | | | | | | | | | 3.49E-03 |
| 1,1,2,2-Tetrachloroethane | 0.01 | | | | | | | | | | 0.01 |
| 1,1-Dichloroethane | 0.01 | | | | | | | | | | 0.01 |
| 1,1-Dichloroethene | 1.06E-03 | | | | | | | | | | 1.06E-03 |
| 1,2-Dichloroethane | 2.21E-03 | | | | | | | | | | 2.21E-03 |
| 1,2-Dichloropropane | 1.11E-03 | | | | | | | | | | 1.11E-03 |
| Acrylonitrile | 0.02 | | | | | | | | | | 0.02 |
| Arsenic Compounds | | | 9.25E-06 | 9.25E-06 | | | | | 9.25E-06 | 9.25E-06 | 9.25E-06 |
| Benzene | 0.10 | | 7.36E-05 | 7.36E-05 | | | | | 7.36E-05 | 7.36E-05 | 0.10 |
| Beryllium Compounds | | | 1.17E-06 | 1.17E-06 | | | | | 1.17E-06 | 1.17E-06 | 1.17E-06 |
| Cadmium Compounds | | | 4.41E-05 | 4.41E-05 | | | | | 4.41E-05 | 4.41E-05 | 4.41E-05 |
| Carbon Disulfide | 1.86E-04 | | | | | | | | | | 1.86E-04 |
| Carbon Tetrachloride | 3.36E-05 | | | | | | | | | | 3.36E-05 |
| Carbonyl Sulfide | 5.50E-05 | | | | | | | | | | 5.50E-05 |
| Chlorobenzene | 1.60E-03 | | | | | | | | | | 1.60E-03 |
| Chloroethane | 4.57E-03 | | | | | | | | | | 4.57E-03 |
| Chloroform | 1.02E-03 | | | | | | | | | | 1.02E-03 |
| Chloromethane | 3.30E-03 | | | | | | | | | | 3.30E-03 |
| Chromium Compounds | | | 6.42E-05 | 6.42E-05 | | | | | 6.42E-05 | 6.42E-05 | 6.42E-05 |
| Cobalt Compounds | | | 3.74E-06 | 3.74E-06 | | | | | 3.74E-06 | 3.74E-06 | 3.74E-06 |
| Dichlorobenzene | 4.00E-03 | | 4.20E-05 | 4.20E-05 | | | | | 4.20E-05 | 4.20E-05 | 4.04E-03 |
| Dichloromethane | 0.06 | | | | | | | | | | 0.06 |
| Ethylbenzene | 0.05 | | | | | | | | | | 0.05 |
| Ethylene Dibromide | 1.02E-05 | | | | | | | | | | 1.02E-05 |
| Formaldehyde | | | 2.63E-03 | 2.63E-03 | | | | | 2.63E-03 | 2.63E-03 | 2.63E-03 |
| HCl | | | 4.10 | 4.10 | 4.10 | | 4.10 | | 4.10 | 4.10 | 4.10 |
| Hexane | 0.03 | | 0.06 | 0.06 | | | | | 0.06 | 0.06 | 0.09 |
| HF | | | 2.03 | 2.03 | 2.03 | | 2.03 | | 2.03 | 2.03 | 2.03 |
| Lead Compounds | | | 1.89E-05 | 1.89E-05 | | | | | 1.89E-05 | 1.89E-05 | 1.89E-05 |
| Manganese Compounds | | | 1.72E-05 | 1.72E-05 | | | | | 1.72E-05 | 1.72E-05 | 1.72E-05 |
| Mercury Compounds | 1.59E-04 | | 9.47E-06 | 9.47E-06 | | | | | 9.47E-06 | 9.47E-06 | 1.68E-04 |
| Methyl Isobutyl Ketone | 0.03 | | | | | | | | | | 0.03 |
| Naphthalene | | | 2.14E-05 | 2.14E-05 | | | | | 2.14E-05 | 2.14E-05 | 2.14E-05 |
| Nickel Compounds | | | 9.35E-05 | 9.35E-05 | | | | | 9.35E-05 | 9.35E-05 | 9.35E-05 |
| Perchloroethylene | 0.03 | | | | | | | | | | 0.03 |
| Selenium Compounds | | | 1.18E-06 | 1.18E-06 | | | | | 1.18E-06 | 1.18E-06 | 1.18E-06 |
| Toluene | 0.85 | | 1.19E-04 | 1.19E-04 | | | | | 1.19E-04 | 1.19E-04 | 0.85 |
| Total POM | | | 3.09E-06 | 3.09E-06 | | | | | 3.09E-06 | 3.09E-06 | 3.09E-06 |
| Trichloroethene | 0.02 | | | | | | | | | | 0.02 |
| Vinyl Chloride | 0.02 | | | | | | | | | | 0.02 |
| Xylene | 0.15 | | | | | | | | | | 0.15 |
| **Highest Individual HAP** | | | | | | | | | | | **4.10 (HCl)** |
| **Total HAPs** | **1.42** | **0** | **6.19** | **6.19** | **6.13** | **0** | **6.13** | **0** | **6.19** | **6.19** | **7.61** |
| **Total HAPs (lb/hr)** | **0.32** | **0** | **1.41** | **1.41** | **1.40** | **0** | **1.40** | **0** | **1.41** | **1.41** | **1.74** |

Note: Emissions operating scenarios described in footnotes for Total Criteria and GHG Pollutant Emissions table.

**RNG Plant Operating Specifications**
**Potential Emissions Calculations**
**Dedicated RNG Plant Flare Application**
**Big Run Power Producers, LLC**

**Equipment Specifications:**

| | | |
|---|---|---|
| RNG Plant Inlet LFG Capacity (mmscf/hr) | 0.24 | Reference: Permit F-16-052 R3. |
| RNG Plant Inlet LFG Capacity (scfm) | 4,000 | |
| RNG Plant Inlet LFG Capacity (mmscf/yr) | 2,102 | |
| Maximum waste gas produced (scfm) | 2,000 | Reference: Archaea RNG plant specifications. |
| TOU-1 Natural Gas Required (mmBtu/hr) | 8.00 | Reference: Manufacturer's specifications. |
| Natural Gas/Methane Heat Content (BTU/scf) | 1,000 | |
| TOU-1 Maximum Natural Gas Input (scf/hr) | 133.33 | |
| Flare Control Efficiency | 98% | Reference: Manufacturer's guarantees. |
| TOU-1 Destruction Efficiency | 98% | Reference: Manufacturer's guarantees. |

**RNG Plant Gas Streams Specifications:**

| | Inlet LFG | Total Waste Gas | Off-Spec Gas |
|---|---|---|---|
| Maximum Gas Inlet Flow Rate (scfm) | 4,000 | 2,000 | 2,000 |
| Maximum Gas Methane Content (vol%) | 55% | 10% | 100% |
| Maximum Methane Inlet Flow Rate (scfm) | 2,200 | 200 | 2,000 |
| Maximum Annual Methane Inlet Flow Rate (mmscf/yr) | 1,156 | 105.12 | 1,051 |
| Maximum Annual Methane Inlet Flow Rate (ton/yr) | 24,050 | 2,186 | 21,863 |
| Gas Heat Content (BTU/scf) | 550.00 | 100.00 | 1,000 |
| Maximum Heat Input (mmBTU/hr) | 132.00 | 12.00 | 120.00 |
| Maximum Annual Heat Input (mmBTU/yr) | 1,156,320 | 105,120 | 1,051,200 |

**Operating Scenarios Flow Rates:**

| | Normal Operation: TOU-1 Operating CS-1 Not in Operation | | | TOU-1 Backup Mode: TOU-1 Not Operating CS-1 Operating on RNG Waste Gas at Maximum Production Rate | | | Off-Spec Operation: TOU-1 Operating CS-1 Operating on Off-spec RNG at Maximum Production Rate | | |
|---|---|---|---|---|---|---|---|---|---|
| | TOU-1 | | CS-1 | TOU-1 | | CS-1 | TOU-1 | | CS-1 |
| Gas Description | RNG Plant Waste Gas | TOU-1 Natural Gas | | | | RNG Plant Waste Gas | RNG Plant Waste Gas | TOU-1 Natural Gas | Off-spec Gas |
| Maximum Gas Inlet Flow Rate (scfm) | 2,000 | 133.33 | N/A | N/A | N/A | 2,000 | 2,000 | 133.33 | 2,000 |
| Maximum Annual Gas Inlet Flow Rate (mmscf/yr) | 1,051 | 70.08 | | | | 1,051 | 1,051 | 70.08 | 1,051 |
| Maximum Gas Methane Content (vol%) | 10% | 100% | | | | 10% | 10% | 100% | 100% |
| Maximum Annual Methane Inlet Flow Rate (mmscf/yr) | 105.12 | 70.08 | | | | 105.12 | 105.12 | 70.08 | 1,051 |
| Maximum Annual Methane Inlet Flow Rate (ton/yr) | 2,186 | 1,458 | | | | 2,186 | 2,186 | 1,458 | 21,863 |
| Maximum Annual Heat Input (mmBTU/yr) | 105,120 | 70,080 | | | | 105,120 | 105,120 | 70,080 | 1,051,200 |

**LFG Inlet, Controlled, and Generated Emissions**
**Potential Emissions Calculations**
**Dedicated RNG Plant Flare Application**
**Big Run Power Producers, LLC**

**LFG Inlet, Controlled, and Generated Pollutant Flow Rates:**

| Pollutant | LFG Concentration (ppmv) | Molecular Weight (g/mol) | Inlet Flow Rate ($m^3$/yr) | Inlet Flow Rate (tons/yr) | Sulfur System Removal Efficiency (%) | Uncontrolled Emissions (tons/yr) | TOU-1/Flare Destruction Efficiency (%) | Controlled Emissions (tons/yr) | VOC? (Y/N) | Number of Chlorine Atoms | Number of Fluorine Atoms |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO[a] | 140.00 | 28.01 | 8,341 | 10.69 | 0% | 10.69 | 0% | 10.69 | | | |
| NMOC[a] | 831.87 | 86.18 | 49,562 | 195.43 | 0% | 195.43 | 98% | 3.91 | | | |
| Total Chloride Compounds (as Chlorine) | 42.00 | 35.45 | 2,502 | 4.06 | 0% | 4.06 | 98% | 0.08 | | | |
| Total Fluoride Compounds (as Fluorine) | 37.96 | 19.00 | 2,262 | 1.97 | 0% | 1.97 | 98% | 0.04 | | | |
| Total Reduced Sulfur (as Sulfur)[b] | 1,454 | 32.06 | 86,602 | 127.04 | 99.2% | 1.02 | 100% | 0 | | | |
| VOC[c] | 399.06 | 86.18 | 23,776 | 93.75 | 0% | 93.75 | 98% | 1.88 | | | |
| $CO_2$[d] | | 44.01 | 23,831,633 | 47,990 | 0% | 47,990 | 0% | 47,990 | | | |
| $CH_4$[d] | | 16.04 | 32,768,496 | 24,050 | 0% | 24,050 | 98% | 480.99 | | | |
| 1,1,1-Trichloroethane[a] | 0.48 | 133.41 | 28.60 | 0.17 | 0% | 0.17 | 98% | 3.49E-03 | N | 3 | |
| 1,1,2,2-Tetrachloroethane[a] | 1.10 | 167.85 | 65.54 | 0.50 | 0% | 0.50 | 98% | 0.01 | Y | 4 | |
| 1,1-Dichloroethane[a] | 2.40 | 98.97 | 142.99 | 0.65 | 0% | 0.65 | 98% | 0.01 | Y | 2 | |
| 1,1-Dichloroethene[a] | 0.20 | 96.94 | 11.92 | 0.05 | 0% | 0.05 | 98% | 1.06E-03 | Y | 2 | |
| 1,2-Dichloroethane[a] | 0.41 | 98.96 | 24.43 | 0.11 | 0% | 0.11 | 98% | 2.21E-03 | Y | 2 | |
| 1,2-Dichloropropane[a] | 0.18 | 112.99 | 10.72 | 0.06 | 0% | 0.06 | 98% | 1.11E-03 | Y | 2 | |
| Acrylonitrile[a] | 6.30 | 53.06 | 375.35 | 0.91 | 0% | 0.91 | 98% | 0.02 | Y | | |
| Benzene[e] | 23.08 | 78.11 | 1,375 | 4.91 | 0% | 4.91 | 98% | 0.10 | Y | | |
| Carbon Disulfide[e] | 5.60 | 76.13 | 333.64 | 1.16 | 99.2% | 9.30E-03 | 98% | 1.86E-04 | Y | | |
| Carbon Tetrachloride[a] | 4.00E-03 | 153.84 | 0.24 | 1.68E-03 | 0% | 1.68E-03 | 98% | 3.36E-05 | Y | 4 | |
| Carbonyl Sulfide[b] | 2.10 | 60.07 | 125.12 | 0.34 | 99.2% | 2.75E-03 | 98% | 5.50E-05 | Y | | |
| Chlorobenzene[e] | 0.26 | 112.56 | 15.49 | 0.08 | 0% | 0.08 | 98% | 1.60E-03 | Y | 1 | |
| Chloroethane[a] | 1.30 | 64.52 | 77.45 | 0.23 | 0% | 0.23 | 98% | 4.57E-03 | Y | 1 | |
| Chloroform[e] | 0.16 | 119.39 | 9.35 | 0.05 | 0% | 0.05 | 98% | 1.02E-03 | Y | 3 | |
| Chloromethane[a] | 1.20 | 50.49 | 71.49 | 0.17 | 0% | 0.17 | 98% | 3.30E-03 | Y | 1 | |
| Dichlorobenzene[e] | 0.50 | 147.00 | 29.73 | 0.20 | 0% | 0.20 | 98% | 4.00E-03 | Y | 2 | |
| Dichloromethane[a] | 14.00 | 84.94 | 834.11 | 3.24 | 0% | 3.24 | 98% | 0.06 | N | 2 | |
| Ethylbenzene[e] | 8.53 | 106.16 | 508.27 | 2.47 | 0% | 2.47 | 98% | 0.05 | Y | | |
| Ethylene Dibromide[a] | 1.00E-03 | 187.88 | 0.06 | 5.12E-04 | 0% | 5.12E-04 | 98% | 1.02E-05 | Y | | |
| Hexane[a] | 6.60 | 86.18 | 393.22 | 1.55 | 0% | 1.55 | 98% | 0.03 | Y | | |
| Mercury[a] | 2.90E-04 | 200.61 | 0.02 | 1.59E-04 | 0% | 1.59E-04 | 0% | 1.59E-04 | Y | | |
| Methyl Isobutyl Ketone[e] | 5.77 | 100.16 | 343.47 | 1.57 | 0% | 1.57 | 98% | 0.03 | Y | | |
| Perchloroethylene[a] | 3.70 | 165.83 | 220.44 | 1.67 | 0% | 1.67 | 98% | 0.03 | N | 4 | |
| Toluene[a] | 170.00 | 92.13 | 10,128 | 42.70 | 0% | 42.70 | 98% | 0.85 | Y | | |
| Trichloroethene[a] | 2.80 | 131.40 | 166.82 | 1.00 | 0% | 1.00 | 98% | 0.02 | Y | 3 | |
| Vinyl Chloride[a] | 7.30 | 62.50 | 434.93 | 1.24 | 0% | 1.24 | 98% | 0.02 | Y | 1 | |
| Xylene[e] | 25.15 | 106.16 | 1,498 | 7.28 | 0% | 7.28 | 98% | 0.15 | Y | | |
| **Total LFG HAPs** | **289.12** | **2,948** | **17,225** | **72.33** | | **70.84** | | **1.42** | | | |
| Bromodichloromethane[f] | 3.10 | 163.83 | 184.70 | 1.38 | 0 | 1.38 | 0.98 | 0.03 | Y | 2 | |
| Chlorodifluoromethane[f] | 1.30 | 86.47 | 77.45 | 0.31 | 0 | 0.31 | 0.98 | 6.13E-03 | N | 1 | 2 |
| Dichlorodifluoromethane[f] | 16.00 | 120.91 | 953.27 | 5.27 | 0 | 5.27 | 0.98 | 0.11 | N | 2 | 2 |
| Dichlorofluoromethane[f] | 2.60 | 102.92 | 154.91 | 0.73 | 0 | 0.73 | 0.98 | 0.01 | Y | 2 | 1 |
| Fluorotrichloromethane[f] | 0.76 | 137.38 | 45.28 | 0.28 | 0 | 0.28 | 0.98 | 5.69E-03 | Y | 3 | 1 |
| t-1,2-Dichloroethene[f] | 2.80 | 96.94 | 166.82 | 0.74 | 0 | 0.74 | 0.98 | 0.01 | Y | 2 | |
| Acetone[g] | 7.00 | 58.08 | 417.05 | 1.11 | 0 | 1.11 | 0.98 | 0.02 | N | | |
| Ethane[g] | 890.00 | 30.07 | 53,025 | 72.96 | 0 | 72.96 | 0.98 | 1.46 | N | | |

Note: Inlet flow rates calculated based on AP-42 Section 2.4, Equations 3 and 4 (August 2024).

[a]LFG default concentration from USEPA LandGEM v3.03.

[b]Concentration based on maximum from quarterly landfill gas analyses (Sampled December 2, 2022, January 26, 2023, April 24, 2023, July 13, 2023, November 27, 2023, February 6, 2024, and April 25, 2024) and a safety factor of 20%.

[c]VOC inlet concentration calculated as NMOC concentration minus the concentration of VOC exempt compounds per the definition of VOC at 40 CFR 51.100(s).

[d]Inlet $CO_2$ flow rate based on the USEPA LandGEM v.3.03 default LFG $CO_2$ concentration of 50% by volume.

[e]LFG concentration from site-specific historical data.

[f]Pollutant is not a HAP but contributes to HCl/HF emissions.

[g]VOC exempt compounds used to calculate VOC inlet flow rate.

**Thermal Oxidizer Combustion Emissions**
**Potential Emissions Calculations**
**Dedicated RNG Plant Flare Application**
**Big Run Power Producers, LLC**

**RTO Combustion Emission Factors:**

| Pollutant | Emission Factors (lb/mmBTU) | Reference |
|---|---|---|
| CO | 0.084 | AP-42 Table 1.4-1 (July 1998) |
| NOx | 0.10 | AP-42 Table 1.4-1 (July 1998) |
| $PM/PM_{10}/PM_{2.5}$[a] | 0.0076 | AP-42 Table 1.4-2 (July 1998) |

[a]Per AP-42 Table 1.4-2 (July 1998) footnote "c", most particulate matter is less than $PM_{2.5}$. Therefore, all PM emissions have been considered to be equivalent to $PM_{2.5}$.

**RTO Natural Gas Fuel Combustion Pollutant Emission Factors:**

| Pollutant | Emission Factors (lb/mmscf) | Reference |
|---|---|---|
| NMOC | 8.70 | AP-42 Table 1.4-2 (July 1998): TOC - Methane |
| $SO_2$ | 0.60 | AP-42 Table 1.4-2 (July 1998) |
| VOC | 5.50 | AP-42 Table 1.4-2 (July 1998) |
| $CO_2$ | 120,000 | AP-42 Table 1.4-2 (July 1998) |
| Methane | 2.30 | AP-42 Table 1.4-2 (July 1998) |
| $N_2O$ | 0.64 | AP-42 Table 1.4-2 (July 1998) |

**RTO Waste Gas Combustion GHG Pollutant Emission Factors:**

| Pollutant | Emission Factor (lb/mmBTU) | Reference |
|---|---|---|
| $CO_2$ | 114.81 | 40 CFR 98 Subpart C Table C-1 |
| $N_2O$ | 0.0014 | 40 CFR 98 Subpart C Table C-2 |

**RTO Combustion Potential Emissions:**

| Pollutant | Waste Gas Combustion Emissions (tons/yr) | Natural Gas Combustion Emissions (tons/yr) | Total Combustion Emissions (tons/yr) |
|---|---|---|---|
| CO | 4.42 | 2.94 | 7.36 |
| NMOC | | 0.30 | 0.30 |
| NOx | 5.26 | 3.50 | 8.76 |
| $PM/PM_{10}/PM_{2.5}$ | 0.40 | 0.27 | 0.67 |
| $SO_2$ | 2.03 | 0.02 | 2.05 |
| VOC | | 0.19 | 0.19 |
| HCl[a] | 4.10 | | 4.10 |
| HF[a] | 2.03 | | 2.03 |
| $CO_2$ | 6,035 | 4,205 | 10,239 |
| Methane | | 0.08 | 0.08 |
| $N_2O$ | 0.07 | 0.02 | 0.10 |
| $CO_2e$[c] | 6,056 | 4,213 | 10,270 |

[a]Based on inlet chlorine compounds to TOU multiplied by the ratio of molecular weight of HCl to the molecular weight of Cl of "1.03".

[b]Based on inlet fluorine compounds to TOU multiplied by the ratio of molecular weight of HF to the molecular weight of F of 20.01/19.

[c]Based on global warming potential factors for $CO_2$, methane, and $N_2O$ in 40 CFR 98 Table A-1.

**Thermal Oxidizer HAP Emissions**
**Potential Emissions Calculations**
**Dedicated RNG Plant Flare Application**
**Big Run Power Producers, LLC**

**RTO Natural Gas Combustion Potential HAP Emissions:**

| Pollutant | Emission Factor (lb/mmcf)[a] | Potential Emissions (tons/yr) |
|---|---|---|
| Arsenic Compounds[b] | 2.64E-04 | 9.25E-06 |
| Benzene | 2.10E-03 | 7.36E-05 |
| Beryllium Compounds[b] | 3.33E-05 | 1.17E-06 |
| Cadmium Compounds[b] | 1.26E-03 | 4.41E-05 |
| Chromium Compounds[b] | 1.83E-03 | 6.42E-05 |
| Cobalt Compounds[b] | 1.07E-04 | 3.74E-06 |
| Dichlorobenzene | 1.20E-03 | 4.20E-05 |
| Formaldehyde | 7.50E-02 | 2.63E-03 |
| Hexane | 1.80 | 0.06 |
| Lead Compounds[b] | 5.39E-04 | 1.89E-05 |
| Manganese Compounds[b] | 4.91E-04 | 1.72E-05 |
| Mercury Compounds[b] | 2.70E-04 | 9.47E-06 |
| Naphthalene | 6.10E-04 | 2.14E-05 |
| Nickel Compounds[b] | 2.67E-03 | 9.35E-05 |
| Selenium Compounds[b] | 3.37E-05 | 1.18E-06 |
| Toluene | 3.40E-03 | 1.19E-04 |
| Total Polycyclic Organic Matter (POM) | 8.82E-05 | 3.09E-06 |
| 2-Methylnaphthalene - POM | 2.40E-05 | 8.41E-07 |
| 3-Methylchloranthrene - POM | 1.80E-06 | 6.31E-08 |
| 7,12-Dimethylbenz(a)anthracene - POM | 1.60E-05 | 5.61E-07 |
| Acenaphthene - POM | 1.80E-06 | 6.31E-08 |
| Acenaphthylene - POM | 1.80E-06 | 6.31E-08 |
| Anthracene - POM | 2.40E-06 | 8.41E-08 |
| Benz(a)anthracene - POM | 1.80E-06 | 6.31E-08 |
| Benzo(a)pyrene - POM | 1.20E-06 | 4.20E-08 |
| Benzo(b)fluoranthene - POM | 1.80E-06 | 6.31E-08 |
| Benzo(g,h,i)perylene - POM | 1.20E-06 | 4.20E-08 |
| Benzo(k)fluoranthene - POM | 1.80E-06 | 6.31E-08 |
| Chrysene - POM | 1.80E-06 | 6.31E-08 |
| Dibenzo(a,h)anthracene - POM | 1.20E-06 | 4.20E-08 |
| Fluoranthene - POM | 3.00E-06 | 1.05E-07 |
| Fluorene - POM | 2.80E-06 | 9.81E-08 |
| Indeno(1,2,3-cd)pyrene - POM | 1.80E-06 | 6.31E-08 |
| Phenanathrene - POM | 1.70E-05 | 5.96E-07 |
| Pyrene - POM | 5.00E-06 | 1.75E-07 |
| **Total HAPs** | | **0.07** |

[a]Reference: AP-42 Tables 1.4-3 and 1.4-4 (7/98).

[b]Metal compounds emission factors based on base metal emission factor multiplied by the metal oxide ratio.

**Flare CS-1 Combustion Emissions**
**Potential Emissions Calculations**
**Dedicated RNG Plant Flare Application**
**Big Run Power Producers, LLC**

**Flare CS-1 CO, NOx, and PM/$PM_{10}$/$PM_{2.5}$ Emission Factors:**

| Pollutant | Emission Factor (lb/mmdscf methane) | Reference |
|---|---|---|
| CO | 58.00 | AP-42 Table 2.4-5 (August 2024) |
| NOx | 38.00 | |
| PM/$PM_{10}$/$PM_{2.5}$[a] | 17.00 | |

[a]Per AP-42 Table 2.4-5 (August 2024) footnote "b", most particulate matter is less than $PM_{2.5}$. Therefore, all PM emissions have been considered to be equivalent to $PM_{2.5}$.

**GHG Pollutant Emission Factors:**

| Pollutant | Emission Factor (lb/mmBTU) | Reference |
|---|---|---|
| $CO_2$ | 114.8 | 40 CFR 98 Subpart C Table C-1 |
| $N_2O$ | 0.0014 | 40 CFR 98 Subpart C Table C-2 |

**Potential Flare CS-1 Emissions:**

| Pollutant | Normal Operation | RTO Backup Mode (Waste Gas) | Off-Spec Mode (Methane) | Total Maximum Emissions (tons/yr) |
|---|---|---|---|---|
| | CS-1 (tons/yr) | CS-1 Combustion (tons/yr) | CS-1 Combustion (tons/yr) | |
| CO | | 3.05 | 30.48 | 30.48 |
| NOx | | 2.00 | 19.97 | 19.97 |
| PM/$PM_{10}$/$PM_{2.5}$ | | 0.89 | 8.94 | 8.94 |
| $SO_2$ | | 2.03 | | 2.03 |
| HCL[a] | | 4.10 | | 4.10 |
| HF[b] | | 2.03 | | 2.03 |
| $CO_2$ | | 6,035 | 60,346 | 60,346 |
| $N_2O$ | | 0.07 | 0.73 | 0.73 |
| $CO_2e$[c] | | 6,056 | 60,564 | 60,564 |

[a]Based on inlet chlorine compounds to TOU multiplied by the ratio of molecular weight of HCl to the molecular weight of Cl of "1.03".

[b]Based on inlet fluorine compounds to TOU multiplied by the ratio of molecular weight of HF to the molecular weight of F of 20.01/19.

[c]Based on global warming potential factors for $CO_2$, methane, and $N_2O$ in 40 CFR 98 Table A-1.

**Metal Oxide Ratios**
**Potential Emissions Calculations**
**Dedicated RNG Plant Flare Application**
**Big Run Power Producers, LLC**

| Metal | Metal Molecular Weight | Metal Oxide | Oxide Molecular Weight | Oxide:Metal |
|---|---|---|---|---|
| Antimony | 122 | $Sb_2O_3$ | 292 | 1.20 |
| Arsenic | 75 | $As_2O_3$ | 198 | 1.32 |
| Barium | 137 | BaO | 153 | 1.12 |
| Beryllium | 9 | BeO | 25 | 2.78 |
| Cadmium | 112 | CdO | 128 | 1.14 |
| Chlorine | 35.5 | $Cl_2O$ | 87 | 1.23 |
| Chromium | 52 | CrO | 68 | 1.31 |
| Cobalt | 59 | CoO | 75 | 1.27 |
| Copper | 64 | CuO | 80 | 1.25 |
| Fluorine | 19 | $F_2O$ | 54 | 1.42 |
| Lead | 207 | PbO | 223 | 1.08 |
| Manganese | 55 | MnO | 71 | 1.29 |
| Mercury | 201 | $Hg_2O$ | 418 | 1.04 |
| Nickel | 59 | NiO | 75 | 1.27 |
| Selenium | 79 | $SeO_2$ | 111 | 1.41 |
| Silver | 108 | $Ag_2O$ | 232 | 1.07 |
| Vanadium | 51 | VO | 67 | 1.31 |
| Zinc | 65 | ZnO | 81 | 1.25 |

Attachment 2: Big Run Flare Addition Process Flow Diagram

Archaea Energy

201 Helios Way
Floor 6
Houston, TX 77079

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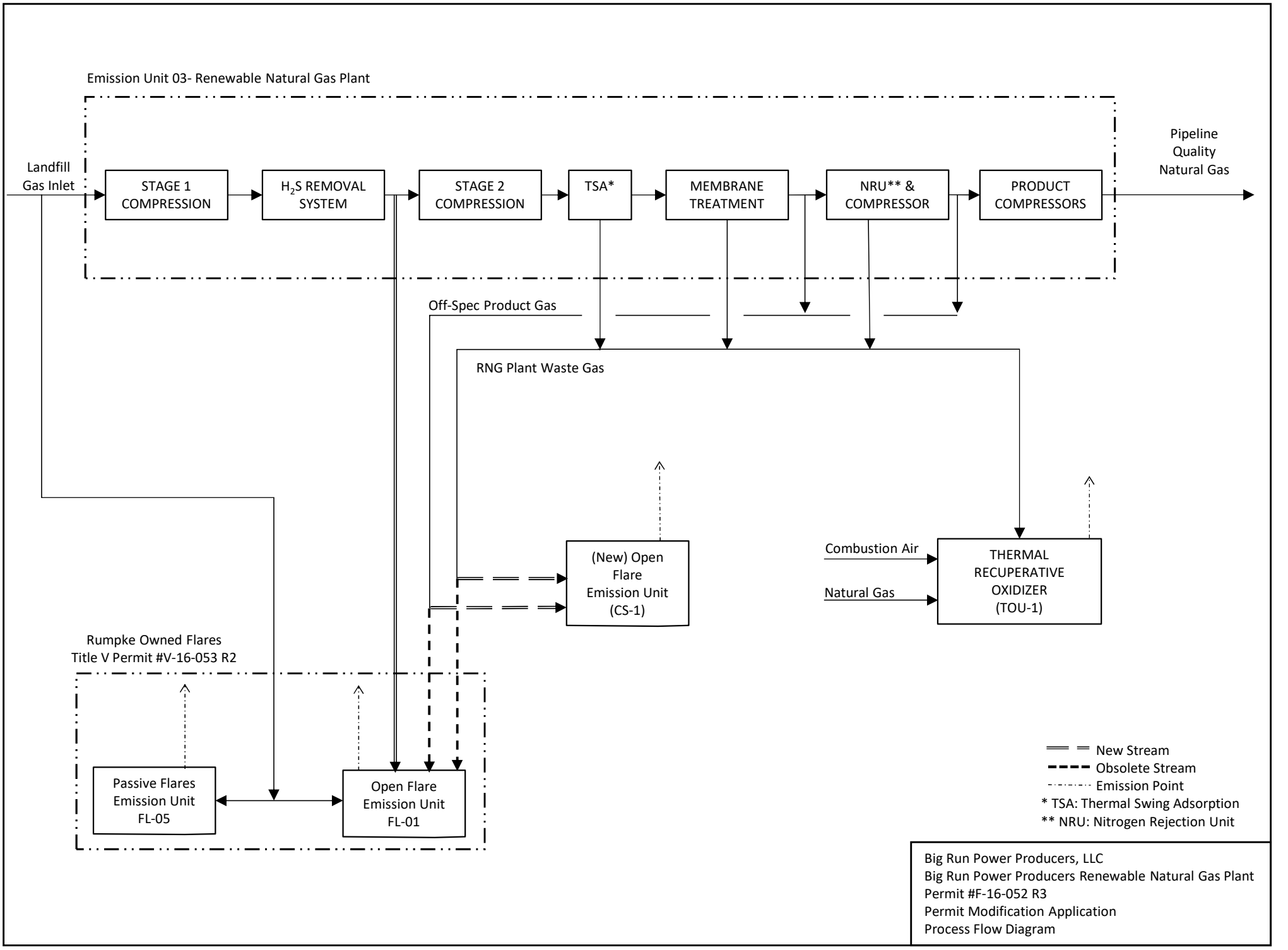

Attachment 3: Big Run Flare Addition Control Equipment Specifications

Archaea Energy

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# AS SOLD PROPOSAL

FOR

VENTURE

THERMAL OXIDIZER SYSTEM

FOR

LANDFILL GAS PROJECT

BIG RUN LANDFILL, KENTUCKY

PCC PROJECT NO.: 4175

July 18, 2017

Prepared by

**Process Combustion Corporation**
5460 Horning Road, Pittsburgh, PA 15236
**Phone** (412) 655-0955 / **Fax** (412) 655-0961 / **E-mail** PCC@pcc-group.com

## 2.2 DESIGN BASIS

Our design is based on the preliminary information supplied by Venture Engineering.

Process Design Basis:

| Waste Gas | Design Case |
|---|---|
| Flow, scfm | 2000 max |
| Pressure, psig | 5 |
| Temperature, °F | 75 to 100 |
| Composition, vol% | |
| Carbon Dioxide | 93 to 95 |
| Methane | 3 to 5 |
| Oxygen | 0.5 |
| Nitrogen | 1.5 to 2 |
| Elevation | 775 ft AMSL |
| Ambient temp, °F | 6 to 91 |
| Design wind speed | 90 mph |
| Turndown, min | 5:1 |

Specified Emission Limits:

| | |
|---|---|
| NOx: | 50 $ppm_v$ |
| VOC: | 98% DRE |
| CO: | 75 $ppm_v$ |

Thermal Oxidizer Design Basis:

| | |
|---|---|
| Type: | Forced Draft |
| Orientation: | Horizontally fired |
| Residence Time: | 0.5 seconds min |
| Design Oxidizer Temp.: | 1600°F |
| Operating Time: | 24/7/365 |

Estimated Fuel Consumption:

**1600°F operating temp, 600°F combustion air preheat**

| Waste stream CH4 content at 2000 scfm flow and **75°F** | Total System Heat Release | Waste Stream Heat Release | Natural Gas Burner Heat Release |
|---|---|---|---|
| 5% | 10.265MM Btu/hr | 6.06MM Btu/hr | 4.2MM Btu/hr |
| 3% | 10MM Btu/hr | 3.6MM Btu/hr | 6.4MM Btu/hr |

| Waste stream CH4 content at 2000 scfm flow and **450°F** | Total System Heat Release | Waste Stream Heat Release | Natural Gas Burner Heat Release |
|---|---|---|---|
| 5% | 8.4MM Btu/hr | 6.06MM Btu/hr | 2.34MM Btu/hr |
| 3% | 8.16MM Btu/hr | 3.6MM Btu/hr | 4.5MM Btu/hr |

Burner design advantages:

- Refractory baffle flame stabilization (no metal flame stabilizer that wears out)
- Refractory baffle shields the burner body/internals from flame radiant heat
- Rugged long life construction
- No moving parts and very low maintenance
- High turndown, multiple fuel capabilities, wide range of operation (sub-stoic – high excess air)

A typical PCC "Baffle Type" burner is shown below.


**Typical Large Capacity Burners**

Main Natural Gas Burner Design Data:

| | |
|---|---|
| • Burner Capacity: | 8MM Btu/hr, approximately |
| • Main Fuel Type: | Natural gas |
| • Auxiliary fuel: | Natural gas (only when needed) |
| • Turndown: | 10:1 on fuel, 5:1 on air |
| • Pilot: | Premix natural gas |
| • UV Scanners: | Two (2) included |
| • Casing: | Carbon steel |
| • Flame Stabilizer: | Patented refractory baffle shop installed |
| • Fuel Nozzle: | Single stainless steel nozzle |
| • Surface Prep.: | PCC standard SSPC-SP6 |
| • Paint:: | Primer coat of inorganic zinc |
| • Accessories: | Sight ports, pressure& temperature taps, plate flange connections, bolt kit and mounting gaskets |

Auxiliary Natural Gas Burner:

An auxiliary burner has been included with a maximum capacity of 2MM Btu/hr and spark ignitor. This burner will serve as a continuous pilot/source of ignition for the waste stream and the main burner. This approach provides a continuous, reliable source of ignition while increasing the available turndown capacity of natural gas.

3.1.2 Thermal Oxidizer:

The Thermal Oxidizer is a custom designed horizontal unit designed to destroy the contaminants contained in a single waste gas stream from a landfill gas processing system.

Preliminary Thermal Oxidizer Design Data:

Combustion Chamber:

- Diameter: 5'-4" OD
- Length: ~ 15'-0"
- Casing Thickness: 1/4" min
- Casing Material: Carbon Steel
- Refractory Lining: Materials & installation by PCC. Refractory material will be selected specifically for the application and rated several hundred degrees above the design operating temperature of the unit.
- Estimated Shell Temp.: Above the acid dewpoint temp, unless no sulfur or chlorides will be present in the waste stream
- Retention Time: 0.5 seconds minimum
- Surface Prep & Paint: PCC standard SSPC-SP6 & prime coat of inorganic zinc
- Horizontally oriented system on saddles, located at grade for access
- Two (2) Tubular heat exchangers with sootblowers, bypass configuration and in parallel, located between the combustion chamber and stack to preheat the combustion air to approximately 600°F and the waste gas stream to 450°F - 490°F.
- Refractory-lined ductwork will be necessary to deliver the products of combustion (POCs) from the combustion chamber to the heat exchangers. Ducts from the heat exchangers to the induced draft fan, and from the induced draft fan to the stack may not be lined.
- Combustion air ductwork post-heat exchanger will be unlined (externally insulated by others). Personnel protection on the ducts is possibly required to prevent injury, but not included at this time.
- A high temperature induced draft fan rated for approximately 10,000 ACFM, 8" wcdp, 20 HP has been added to draw the products of combustion (POCs) from the combustion chamber and through the heat exchangers. A variable frequency drive has been included.
- Regen ductwork and expansion joints, gaskets, hardware etc for the end user's process to/from the exchanger are not included.
- Additional controls and instrumentation for temperature and flow control of exchangers is included (control valves, thermocouples, etc)
- Expansion/flex joints in the combustion air ducts, where necessary
- ADVANTAGE: This option offers the greatest efficiency in the form of reduced fuel consumption and the most operational flexibility
- ADVANTAGE: This configuration offers the greatest protection with respect to the heat exchangers. Flow would be controlled with dampers downstream of each heat exchanger and the variable frequency drive on the induced draft fan. This design can control the flow and temperature of each exchanger individually, regardless of operating case. Hot exhaust flow from the oxidizer can actually be shut off completely to one or both exchangers.

PERENNIAL ENERGY
WEST PLAINS, MO 65775 USA

*Equipment Data Sheet*

# 14” Candlestick Flare

Spec. # **FLR-1**
Sheet # **1** of **1**
By:
Date:

Reference Designator or Item # **FLR-1 (3200 Model)**

| | | |
|---|---|---|
| Quantity | **1** | |
| Manufacturer | **Perennial Energy, Inc.** | **West Plains, MO 65775 USA** |
| Model # | **FL-14-C** | **Open / Non-Assisted** |
| Capacity | **360-3600 SCFM** | **10.8 – 108 MMBtuh** |
| Design Criteria | **EPA- 40 CFR, §60.18** | |
| Theoretical NMOC Destruction Efficiency | **98%** | **Per EPA-CICA Fact Sheet-Flare** |
| | | |
| Design Heat Flux | **See Heat Flux Calcs** | |
| | | |
| Flame Presence Monitoring | **Yes** | **Thermocouples (Type “K”)** |
| Burner Tip I.D. | **13 5/8”** | **304L S.S.** |
| Overall Flare Height | **40 ft** | **From bottom of base** |
| Fuel Gas Nozzle Adjustment | **No** | **Velocity Seal** |
| Wind Shroud Air Inlet Adjustment | **Yes** | **Manual** |
| Wind Shroud Diameter /Height | **60” / 96”** | |
| Wind Shroud Insulation | **1” Ceramic Fiber** | |
| Insulation Attachment | **Inconel Studs & Retainers** | |
| Insulation Layers | **1** | |
| Insulation Density | **8 lb/ft$^3$ density** | |
| Inlet Nozzle Size | **12"** | **ANSI 150# Flange Pattern** |
| Flare Burner – Construction Material | **304L S.S.** | |
| Wind Shroud – Construction Material | **304L S.S.** | |
| | | |
| Self Supporting Base | **Yes** | **No Guys Required*** |
| Flare Mounted Equipment | **12” Detonation Arrester** | **Safety Shutdown Valve** |
| Supplied with other Equipment | **Yes** | **Flare System Controls** |

COMMENTS or NOTES:

*** If anchored adequately to appropriately designed equipment pad/foundation**

**CSF provided with other process control devices and control panel system**

**CSF provided with ground serviceable thermocouple assemblies and a flame front generator ignition continuous pilot locally mounted to the stack.**

16 August 2022

**Perennial Energy, LLC Candlestick (Utility) Flares operating on Landfill Gas**

This document certifies that all standard PEI designed and manufactured candlestick (utility} type flares are compliant with 40 CFR 60.18 requirements for non-assisted devices.

Specifically, PEI designed and manufactured flares comply with the following requirements of 40 CFR 60.18 when in good repair & operated in accordance with nameplate limitations on Landfill Gas (LFG):

(c) ( 1) requires that the flare doesn't produce visible emissions as determined by EPA Method 22. PEI designed and manufactured flares operated on typical LFG are guaranteed to comply with this requirement.

(c) (2) requires that a flame is present at all times the flare is operational, and the presence of flame is confirmed with a device such as a thermocouple (f) (2). PEI designed and manufactured flares use a thermocouple to ensure a pilot flame is present before opening the safety shutdown valve and allowing gas to flow to the flare. A thermocouple is used to ensure main flame presence, and the flare will automatically shut down in event of a flame failure, and will not vent unburned LFG.

(c) (3) (ii) requires that the net heating value of the gas going to the flare is 200 BTU/ scf (net heating value} or greater. PEI designed & manufactured flares are compliant when operated in accordance with Manufacturer's instructions. .

(c) (4) limits exit velocity to 60 ft/ sec, and exit velocity is determined by dividing the SCFM by the unobstructed cross-sectional area of the flare tip (f) (4). PEI designed & manufactured flares are compliant.

Emission Factors are taken from values published by the US EPA in AP-42. Several different values are presented in this reference, the owner must consult with a qualified Subject Matter Expert to ascertain the appropriate Emission Factor for their application. Published values, and their sources, are as shown on the following page:

**Published EPA AP-42 Emission Factors for Utility Flares**

| Compound | Table 2-4-3 Dated 11/98 | Table 2.4-5 Dated 11/98 | Section 2.4.4.2 Dated 11/98 | Table 2-4-3 DRAFT Dated 10/08 | Table 2.4-4 DRAFT Dated 10/08 | Section 2.4.4.2 DRAFT Dated 10/08 | Table 13.5-1 Dated 02/18* | Table 13.5-2 Dated 02/18* | Chapter 13.5 Text Page 13.5-3 Dated 02/18 |
|---|---|---|---|---|---|---|---|---|---|
| NMOCs Destruction Efficency | 99.20% | | | 97.70% | | | | | 98% |
| VOCs Destruction Efficiency | Halogenated-98.0% Non-Halogenated 99.7% | | | 97.70% | | | | | |
| NOX Units as noted | | 40 #/ MM SCF CH4 | | | 39#/MM SCF CH4 | | 0.068 # /MM BTU HHV | | |
| CO Units as noted | | 750#/ MM SCF CH4 | | | 46#/MM SCF CH4 | | | 0.031 #/ MM BTU LHV | |
| SO2 | | | Site Specific- Use Mass Balance | | | Site Specific- Use Mass Balance | | | |
| PM #/Million SCF CH4 | | 17#/MM SCF CH4 | | | 15#/MM SCF CH4 | | 0** | | |
| HCL | | | Site Specific- Use Mass Balance | | | Site Specific- Use Mass Balance | | | |
| Dioxin/Furans | | | | | 4.2E-7 #/MM SCF CH4 | | | | |

* Valid for flares running on gas with a net heating value greater than 300 BTU/Cu Ft

** See table 13.5-1 footnote d for a non-smoking flare

***PEI JOB# N/A***

# SCOPE OF SUPPLY

*FOR Archaea Model 3200 CSF's*

Perennial Energy will supply the following equipment as described in the accompanying documents:

1. A 360 – 3600 SCFM fully rated RNG Candlestick Flare system with one 10" ANSI Flanged inlet, detonation arrestor and pneumatically actuated shutdown valve with spring fail closed capabilities.

2. A 100,000 BTU/Hr Continuous pilot w/ Flame Front Generator assembly. All electrical parts for the pilot are mounted integral to the flare stack.

3. Qty 2 Ground Serviceable thermocouple assemblies, with removable straightener.

4. Fully outdoor rated and automated control system with stand and sunshield, assembly mounted by others in an unclassified location.

5. Qty 3 System O&M Manuals.

The above equipment will be delivered to the Job Site.
Unloading and installation are *not* included.

All piping and wiring are pre-installed at factory to the extent possible.

A 3-Day Onsite Startup Trip is included.

# SYSTEM OPERATION INFORMATION – R0

PROJECT Archaea CSF's All Models

## SYSTEM DESCRIPTION

The Flare System consists of the following major components:

| | |
|---|---|
| TSE-301(..2) | Flare Detonation Arrestor(s) |
| FV-301 | Flare Shutdown Valve |

The Flare acts as relief to the RNG plant. When the plant goes down, both in the process of the plant shutting down and, in the aftermath, the Flare will handle the gas. Either off-spec, reject gas or biogas is combusted in the Flare.

## STANDARD AUTO MODE

For the Flare System to run in AUTO mode, the following switches on the Flare System control panel must be in the following positions:

| | Switch | Description | Position |
|---|---|---|---|
| 1. | HS-1 | System | On |
| 2. | HS-2 | Continuous Pilot Fuel | Auto |
| 3. | HS-3 | FFG Fuel | Auto |
| 3. | HS-4 | Spark | Auto |
| 4. | HS-5 | Main Shutdown Valve | Auto |
| 5. | HS-7 | CP E-Stop (@ CP) | Out |
| 6. | HS-8 | FLR E-Stop (@ FLR) | Out |

In addition to the physical hand switch positions, selections of pilot mode can be made in the touchscreen. Any pilot mode can be selected in order to run the Flare. These modes are listed and below:

1. Continuous Mode
   a. As long as all of the hand switches are in the positions described in the table above, the pilot will run.
   b. If the pilot fails to stay lit, it will attempt to relight for a user settable number of times. If the pilot succeeds to relight, the counter resets. If not, the system will shut down.
   c. In continuous mode, Flare flame proof is through the pilot thermocouple. This helps in times where brief spurts of gas are sent to the flare (i.e. at startup). CAUTION! Continuous mode should be used when flow rate is greater than the "Starting" values presented below at starting*. After a period of time, when the stack composition dips below the LEL, flow can reach as low as the "Running" values presented below when running.

| Model | Starting (SCFM) | Running (SCFH) |
|---|---|---|
| 9600 | 350 | 500 |
| 6400 | 250 | 300 |
| 3200 | 150 | 200 |

   d. Low main flame temperature is ignored in "Continuous" mode.
2. Intermittent Mode
   a. The pilot will attempt to light when the flare receives a "Run" signal from the BOP. The pilot will continue to run until the "Run" signal is lost.
   b. If the pilot fails to light, the same actions as in (b) in the first section will take place.
   c. In intermittent mode, Flare flame proof is through the pilot thermocouple, as in Continuous mode.
   d. Low main flame temperature is ignored in "Intermittent" mode.
3. Interrupted Mode (selected when both Continuous Mode and Intermittent Mode are de-selected)
   a. The pilot will attempt to light when the Flare system receives a "Run" signal from the BOP and will shut off when the main flame is proven. Flare flame proof is through the main flame thermocouple.
   b. If the pilot fails to light, the same actions as in (b) in the first section will take place.

*This is the minimum recommended flowrate to start. Adjustment of this value can be made in the system touchscreen. Lower starting flowrates may result in flashback or detonation!

## AUTOMATIC SEQUENCE OF OPERATION

## CANDLESTICK FLARE OPERATION

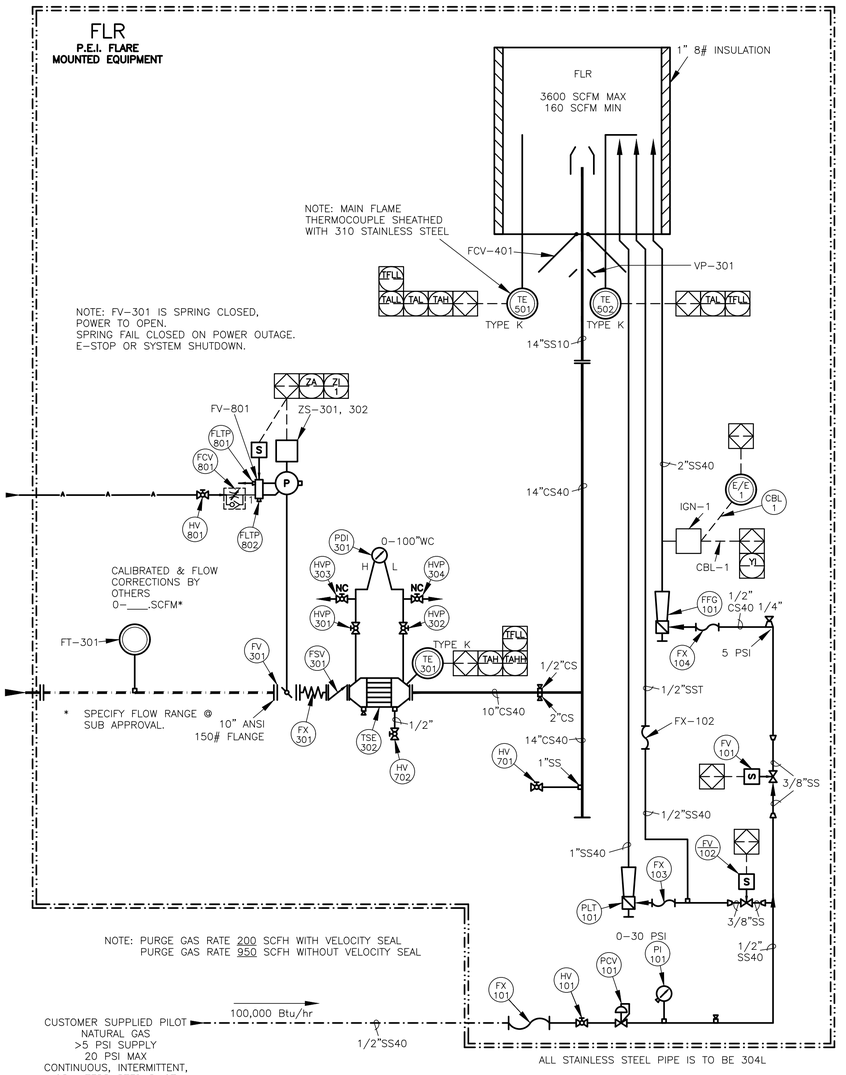
1. All hand-operated butterfly valves should be in the position described by the P&ID
2. The switches should be in the position described herein under *Standard Auto Mode*.
3. Pre-Start PLC Checks
    a. The PLC verifies, via digital inputs, the necessary switches are in the AUTO position.
    b. The PLC verifies there are no active shutdowns.
4. Start Sequence
    a. A "FLARE READY" signal is sent to the BOP when all hand switches are in the prescribed positions in the table above and when there are no outstanding shutdowns.
    b. The Flare control panel will then receive a "RUN" command from the BOP.
    c. If the pilot is in "Interrupted" or "Intermittent" mode, it will attempt to light and prove using the pilot thermocouple (TE-502).
        i. Solenoid valves FV-101..2 will open simultaneously.
        ii. The igniter will pulse for a settable time, then de-energize for a settable time.
        iii. This will happen until either the pilot flame is proven or the cycle limit is reached. At this time, only FV-101 will shut and the igniter will stop. If the cycle limit is reached with no pilot proof, the pilot will cycle again and again for a settable number of times. Once this limit is reached, the flare will shut down on a "Pilot Fail" shutdown.
        iv. Once pilot temp is proven, the shutdown valve will open and send gas to the flare.
        v. When in interrupted mode, the pilot will wait until main flame temperature is proven to shut off.
    d. If the pilot is switched to "Continuous" mode, the pilot will be lit continuously, as long as all hand switches are in the prescribed positions in the table above.
        i. The pilot will start as in section (c) above, and once proven, will shut only FV-101 and the igniter will stop.
        ii. The pilot it will run regardless of FV-301's position.
        iii. When the Flare System receives the "RUN" command from the BOP, the shutdown valve (FV-301) will open and the Flare will be controlled by the pilot thermocouple. NOTE! This is to ensure smooth operation when short spurts of gas are sent to the flare (i.e. at startup). CAUTION! Continuous mode should be used when flowrate is greater than the "Starting" flowrates at starting, as aforementioned.
5. Run and Stop Sequences
    a. The flare will continue to run until a shutdown is experienced.
        i. Most shutdowns will require a manual reset action.
        ii. Loss of flame is an exception. Depending on the selected pilot mode the PEI control system will operate differently.
            - Continuous Mode: In Continuous Mode, loss of flame is a lack of temperature on the pilot thermocouple. The system will simply attempt to relight the pilot a set number of times until it relights (resulting in counter resetting) or the limit is reached, which will require a manual reset. If the shutdown valve is open when pilot proof is lost, the valve will close until pilot is re-proven. This will take place regardless of Run Command status from the BOP.
            - Intermittent Mode: Intermittent Mode performs similarly to Continuous Mode in this regard. Loss of flame is a lack of temperature on the pilot thermocouple. When attempting to relight, the shutdown valve (FV-301) will close until pilot is proven.
            - Interrupted Mode: In Interrupted Mode, loss of flame is a lack of temperature on the main flame thermocouple. In this event, the pilot will attempt to relight until the attempt limit is reached or main flame temperature is re-established. This will take place only if a Run Command is maintained from the BOP control system.
        iii. Cool-Down Mode - This is a feature selectable in the flare system's HMI, which applies to all pilot modes. Cool-Down mode is used to allow the pilot thermocouple to cool down before attempting to re-light. This ensures a strict pilot proof before introducing biogas to the flare. As aforementioned, this mode can be disabled, which will disable the pilot thermocouple's influence in the flare's operation. Additionally, the shutdown valve (FV-301) will close at loss of main flame temperature. The pilot will try to relight only on main flame lost. Additionally, FV-301 remains closed until either the main flame is proven again or the relight fail threshold is reached.
    b. The Flare will continue to run until the "RUN" signal is lost.

i. If the pilot is in “Intermittent” mode, the pilot will extinguish and the shutdown valve will close. If the pilot is in “Interrupted” or “Continuous” mode, only the shutdown valve will close.

c. If the system experiences a shutdown, power failure or controlled shutdown, FV-301 will spring closed.

6. The following signals will be communicated over Ethernet:
   a. Flare Flowrate – This is an analog signal derived from the site supplied flow transmitter adjacent to the candlestick flare. This analog signal is sent from the BOP via Ethernet to the CSF control system.
   b. BOP Communications Heartbeat – This is a simple Ethernet communications heart beat that occurs once a second. The counter starts at 1 and resets to 1 at 60. This signal will be derived from the BOP control system.

*See asterisk note on the previous page…




MODE 3: OFFSPEC PRODUCT GAS
FLOW RATE:
MIN: 160 SCFM
MAX: 1585 SCFM
MAX PRESSURE: 5 PSIG
MAX TEMP: 140 DEG F
COMPOSITION:
CH4: 97%
CO2:___%
N2:___%
H2S:<1500 PPMV
NH3:<10 PPMV

MODE 1: RAW LFG
FLOW RATE:
MIN: 352 SCFM
MAX: 3520 SCFM
MAX PRESSURE: 5 PSIG
MAX TEMP: 140 DEG F
COMPOSITION:
CH4: 52%
CO2:___%
N2:___%
H2S:<1500 PPMV
NH3:<10 PPMV

MODE 4: TSA BLOWDOWN
FLOW RATE:
MIN: 300 SCFM
MAX PRESSURE: 5 PSIG
MAX TEMP: 140 DEG F
COMPOSITION:
CH4: 52%
CO2:___%
N2:___%
H2S:<1500 PPMV
NH3:<10 PPMV

MODE 2: PRODUCT GAS
FLOW RATE:
MIN: 196 SCFM
MAX: 1960 SCFM
MAX PRESSURE: 5 PSIG
MAX TEMP: 140 DEG F
COMPOSITION:
CH4: 83%
CO2:___%
N2:___%
H2S:<1500 PPMV
NH3:<10 PPMV

NOTE: FAILURE TO MAINTAIN SUFFICIENT FLOW MAY RESULT IN FLASHBACK & DETONATION

CONTROL PANEL MOUNTED LOGIC ELEMENTS

(AL 1) REFERENCE DESIGNATORS OF LOGIC OR CONTROL PANEL MOUNTED EQUIPMENT. IDENTIFICATION LETTERS CONFORM TO ISA'S INSTRUMENTATION SYMBOLS AND IDENTIFICATION MANUAL TABLE #1

MANUAL VALVES ARE NORMALLY OPEN DURING SYSTEM OPERATION UNLESS DESIGNATED BY "NC"

| | | | |
|---|---|---|---|
| AL: | ALUMINUM | 10: | SCH 10 PIPE |
| BI: | BLACK IRON | 40: | SCH 40 PIPE |
| CI: | CAST IRON | 80: | SCH 80 PIPE |
| CS: | CARBON STEEL | H: | I.D. HOSE |
| CPVC: | CHLOROPOLYVINYLCHLORIDE | T: | O.D. TUBING |
| SS: | STAINLESS STEEL | | |
| EPDM: | ETHYLENE PROPYLENE DIENE MONOMER | | |
| FRP: | FIBERGLASS REINFORCED PLASTIC | | |

(EXAMPLE: 6"AL40 = 6" ALUMINUM SCHEDULE 40 PIPE)

- ELECTRICAL CONNECTIONS
- MAIN PIPING
- SUB PIPING
- AIR LINE
- CONDENSATE LINE
- CUSTOMER SUPPLIED MAIN PIPING
- CUSTOMER SUPPLIED SUB PIPING
- LOCATION BORDER
- FUTURE/PENDING PIPING BORDER

## Fluid Designators

| Ref Des | Fluid |
|---|---|
| 1XX | Fossil Fuels |
| 2XX | Oils |
| 3XX | Biogas |
| 4XX | Air |
| 5XX | Combustion Exhaust |
| 6XX | Coolants |
| 7XX | Condensate |
| 8XX | Inert Gases |
| 9XX | Digester Fluids |

REDUCED FROM ORIGINAL SIZE

PRELIMINARY FOR REVIEW/INFO. ONLY PERENNIAL ENERGY, INC.

SITE ELEVATION: 839FT AMSL

| LTR | DESCRIPTION | DATE | APPROVED |
|---|---|---|---|
| 0 | | | |

REVISIONS

APPLICABLE JOB NO(S). 2012
AH MEDORA RNG CSF

PERENNIAL ENERGY
1375 COUNTY ROAD 8690
WEST PLAINS, MO 65775
www.PerennialEnergy.com



ENGINEERING SIGNATURES

| | |
|---|---|
| DESIGNED BY: J.FOSTER | DATE 4/1/22 |
| DRAWN BY: B.HOLMAN | DATE 4/1/22 |

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
FRACT ±1/16 | .XX ±.03 | ANGLES ±0°30

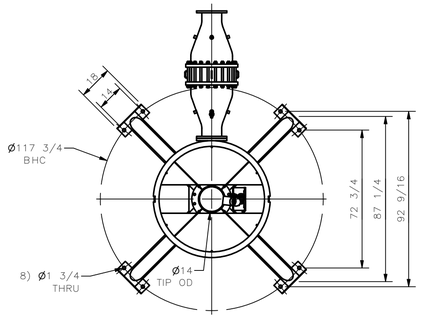
TITLE
CSF FLARE
P & ID

SIZE D 34x22 | DWG. NO. ME-009-0551

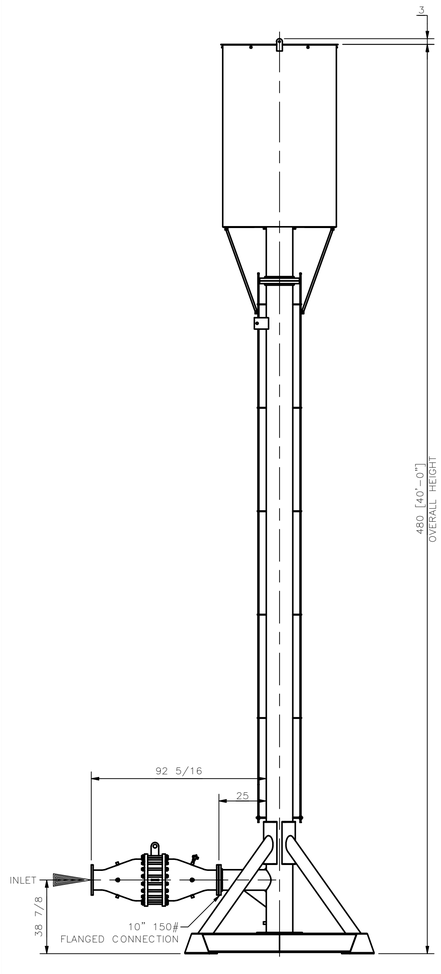
MATERIAL: AS NOTED | SCALE AS NOTED | FILE NO. ME-009-0551 R0.DWG | SHEET 1 OF 2

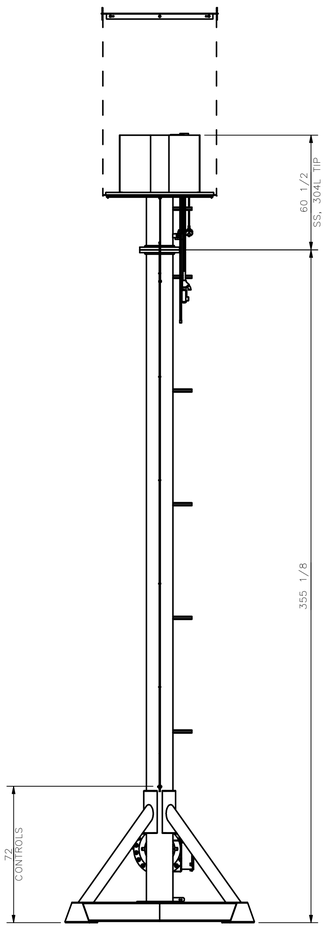
PRELIMINARY
FOR REVIEW/INFO.
ONLY
PERENNIAL ENERGY, LLC

REDUCED
FROM ORIGINAL
SIZE

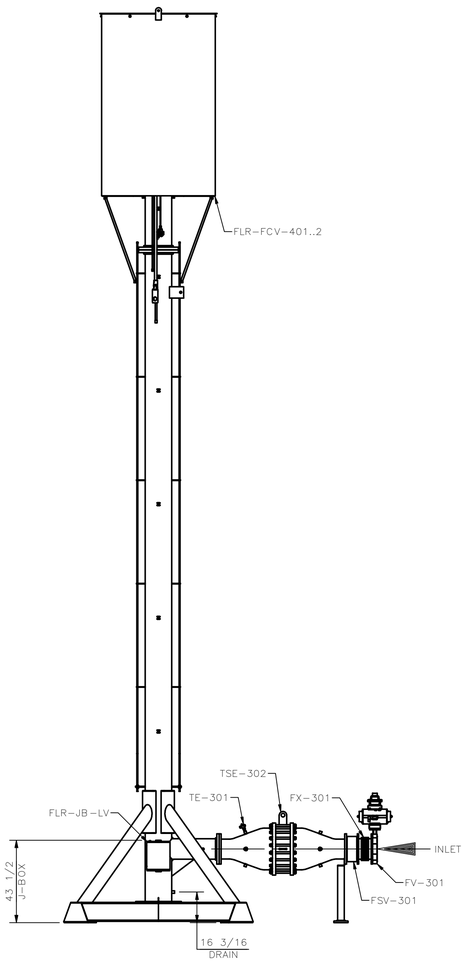


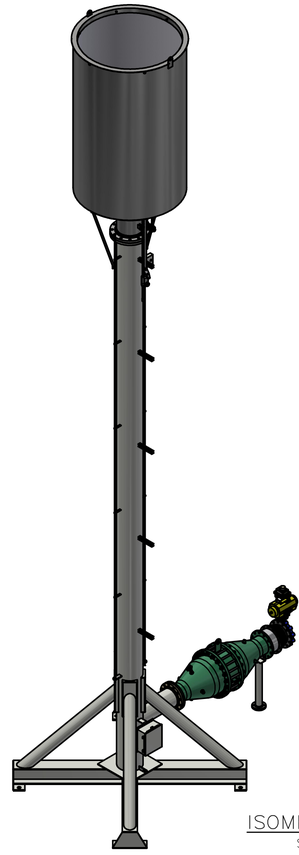

PLAN VIEW
SCALE 1:40

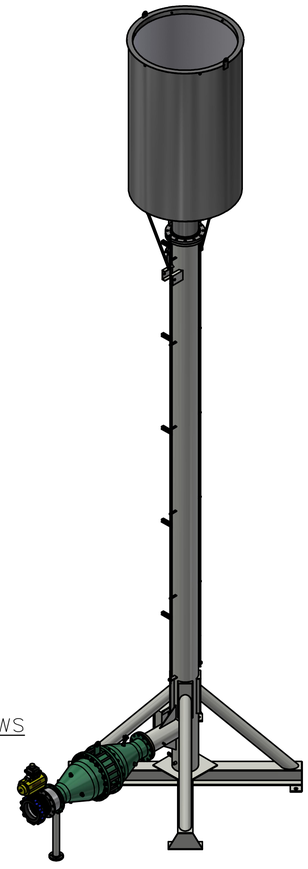



ELEVATION VIEWS
SCALE 1:40





ISOMETRIC VIEWS
SCALE 1:40

NOTE:
1. CLASSIFIED AREAS ARE SPECIFICALLY NOTED. ALL OTHER AREAS ARE UNCLASSIFIED.
2. SKIDS MUST BE LEVEL 1/8" SIDE TO SIDE, 1/4" END TO END.
3. CONTACT PERENNIAL ENERGY FOR INTERIM MAINTENANCE PROCEDURES IF EQUIPMENT IS NOT RUNNING WITHIN 21 DAYS OF ARRIVAL ON SITE.
4. REMOVE SHIPPING STANDS, BRACES, AND COVERS PRIOR TO INSTALLATION.
5. UNLESS OTHERWISE NOTED, USE ON GAS WITH MORE THAN 1500 PPM, $H_2S$ VOIDS WARRANTY.
6. BLOWERS 50HP AND ABOVE MUST HAVE SKID FRAME RAILS UNDER THE BLOWER SOLIDLY SHIMMED OR GROUTED TO A SUITABLE CONCRETE PAD.
7. TOP ASSEMBLY DIMENSIONS SHOWN ARE NOT ACTUAL SHIPPING DIMENSIONS, CONFIRM FIELD DIMENSIONS PRIOR TO ORDERING THE PROPER SHIPPING PERMITS.
8. DO NOT USE THIS DRAWING FOR LOCATION OF CAST IN PLACE ANCHORS.

| LTR | DESCRIPTION | DATE | APPROVED |
|---|---|---|---|
| 0 | | | |

REVISIONS

APPLICABLE JOB NO(S). 2012
AH MEDORA RNG CSF

PERENNIAL ENERGY
1375 COUNTY ROAD 8690
WEST PLAINS, MO 65775
www.PerennialEnergy.com



ENGINEERING SIGNATURES

| | | |
|---|---|---|
| DESIGNED BY: | J.FOSTER | DATE: 4/19/22 |
| DRAWN BY: | A.PARKER | DATE: 4/19/22 |

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
FRACT ±1/16 .XX ±.03 ANGLES ±0°30

TITLE:
# CSF FLARE TOP ASSEMBLY – 14"

SIZE D | DWG. NO. PA-001-1191

MATERIAL: AS NOTED | SCALE: AS NOTED | FILE NO. PA-001-1191.dwg | SHEET 1 OF 1

07 February, 2019

**Perennial Energy, LLC Candlestick (Utility) Flares operating on Off Spec Gas**

This document certifies that all standard PEI designed and manufactured candlestick (utility) type flares are compliant with 40 CFR 60.18 requirements for non-assisted devices.

Off Spec Gas is gas produced from Biogas to Pipeline projects that is predominately methane with a few percentages of Nitrogen &/or Carbon Dioxide.

Specifically, PEI designed and manufactured flares comply with the following requirements of 40 CFR 60.18 when in good repair & operated in accordance with nameplate limitations and operations instructions on Off Spec Gas with a methane content of greater than 90%:

**(c) (1)** requires that the flare doesn't produce visible emissions as determined by EPA Method 22. PEI designed and manufactured flares are guaranteed to comply with this requirement.
**(c) (2)** requires that a flame is present at all times the flare is operational, and the presence of flame is confirmed with a device such as a thermocouple (f) (2). PEI designed and manufactured flares use a thermocouple to ensure a pilot flame is present before opening the safety shutdown valve and allowing gas to flow to the flare. A thermocouple is used to ensure flame presence, and the flare will automatically shut down in event of a flame failure, and will not vent unburned gas.
**(c) (3) (ii)** requires that the net heating value of the gas going to the flare is 200 BTU/scf (net heating value) or greater. PEI designed & manufactured flares are compliant.
**(c) (4)** limits exit velocity to 60 ft/sec, and exit velocity is determined by dividing the SCFM by the unobstructed cross sectional area of the flare tip (f) (4). PEI designed & manufactured flares are compliant.

Emission Factors for utility flares operating on Off Spec Gas with a net heating value greater than 820 BTU/scf:

| Compound | LFG Utility Flare Emission Factor | Data Source | Date |
|---|---|---|---|
| VOCs | 98%- 99.99% | EPA AP 42 Section 13.5.2, footnotes to tables 13.5-1 and 13.5-2 | 02/18 |
| NOX | 0.068 lb/Million BTU, HHV | EPA AP 42, table 13.5-1 | 02/18 |
| CO | 0.31 lb/Million BTU, LHV | EPA AP 42, table 13.5-2 | 02/18 |

Respectfully,

ET Boys

Edward T Boys, PE
Engineering Manager

STATE OF MISSOURI
EDWARD T. BOYS
NUMBER E-025378
07 FEB 2019
PROFESSIONAL ENGINEER

1375 County Road 8690 West Plains, MO 65775
Phone (417) 256-2002 Fax (417) 256-2801
www.PerennialEnergy.com PEI@PerennialEnergy.com

Attachment 4: Big Run Flare Addition LFG Sample Analyses

Archaea Energy

201 Helios Way
Floor 6
Houston, TX 77079

archaeaenergy.com
+1 346 708 8272

CRITICAL CONTROL Energy Services

# Speciated Sulfur Analysis Report

## Critical Control Energy Services

South Charleston, West Virginia
1740 Union Carbide Drive
South Charleston, WV 25303

Report Date: Dec 23, 2022 12:36p

| | | | |
|---|---|---|---|
| Client: | ARCHAEA ENERGY | Date Sampled: | Dec 2, 2022 |
| Client Code: | 2697 | Analysis Date: | Dec 6, 2022 |
| Site: | BRPP - QUARTERLY | Collected By: | WAYLON TACKETT |
| Field: | 100 - ARCHAEA ENERGY | Date Effective: | Dec 2, 2022 12:00a |
| Meter: | 1301 | Source Pressure (PSI): | |
| Source Laboratory: | Charleston, WV | Source Temp (P): | |
| **Lab File No:** | **SS3747** | | |
| Cylinder No: | BAG1 | | |
| Analysis Status: | good | | |
| Sample Type: | Spot | | |
| Measurement Analyst: | | | |

Method: GPA-2199

| **SULFIDES** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Hydrogen | 700.2 | 41.381 |
| Carbonyl | 0.8 | 0.049 |
| Dimethyl | 23.9 | 1.414 |
| Methyl Ethyl | <0.5 | <0.5 |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | N/D | N/D |
| Di-n-propyl | N/D | N/D |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | N/D | N/D |
| Di-n-Butyl | N/D | N/D |
| Unknown | N/D | N/D |

| **DiSULFIDES** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Carbon | N/D | N/D |
| Dimethyl | <0.5 | <0.5 |
| Methyl Ethyl | N/D | N/D |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | N/D | N/D |
| Di-n-Propyl | N/D | N/D |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | N/D | N/D |
| Di-n-Butyl | N/D | N/D |
| Unknown | N/D | N/D |
| Total Sulfur | 686.0 PPMV S | |
| | 40.546 Grains/100 cu.ft | |

| **MERCAPTANS** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Methyl | 16.8 | 0.991 |
| Ethyl | 0.6 | 0.035 |
| Isopropyl | 2.0 | 0.119 |
| n-Propyl | <0.5 | <0.5 |
| Isobutyl | N/D | N/D |
| sec-Butyl | N/D | N/D |
| tert-Butyl | 0.8 | 0.046 |
| n-Butyl | N/D | N/D |
| Isoamyl | <0.5 | <0.5 |
| pri-Amyl | N/D | N/D |
| n-Amyl | N/D | N/D |

| **OTHER** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Misc. Sulfurs | N/D | N/D |
| Thiophene | 3.9 | 0.230 |
| Thiophane | N/D | N/D |

**Odorant Concentration**

19.540 PPMV 1.155 Grains/100 cu.ft

| Source | Date | Notes |
|---|---|---|

CRITICAL CONTROL Energy Services

# Speciated Sulfur Analysis Report

## Critical Control Energy Services

South Charleston, West Virginia
1740 Union Carbide Drive
South Charleston, WV 25303

Report Date: Dec 23, 2022 12:40p

| | | | |
|---|---|---|---|
| Client: | ARCHAEA ENERGY | Date Sampled: | Dec 2, 2022 |
| Client Code: | 2697 | Analysis Date: | Dec 6, 2022 |
| Site: | BRPP - QUARTERLY | Collected By: | WAYLON TACKETT |
| Field: | 100 - ARCHAEA ENERGY | Date Effective: | Dec 2, 2022 12:00a |
| Meter: | 1301 | Source Pressure (PSI): | |
| Source Laboratory: | Charleston, WV | Source Temp (P): | |
| **Lab File No:** | **SS3748** | | |
| Cylinder No: | BAG2 | | |
| Analysis Status: | good | | |
| Sample Type: | Spot | | |
| Measurement Analyst: | | | |

Method: GPA-2199

| **SULFIDES** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Hydrogen | 629.4 | 37.196 |
| Carbonyl | 0.6 | 0.036 |
| Dimethyl | 17.6 | 1.041 |
| Methyl Ethyl | N/D | N/D |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | N/D | N/D |
| Di-n-propyl | N/D | N/D |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | N/D | N/D |
| Di-n-Butyl | N/D | N/D |
| Unknown | N/D | N/D |

| **DiSULFIDES** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Carbon | N/D | N/D |
| Dimethyl | <0.5 | <0.5 |
| Methyl Ethyl | N/D | N/D |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | N/D | N/D |
| Di-n-Propyl | N/D | N/D |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | N/D | N/D |
| Di-n-Butyl | N/D | N/D |
| Unknown | N/D | N/D |
| Total Sulfur | 612.1 PPMV S | |
| | 36.174 Grains/100 cu.ft | |

| **MERCAPTANS** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Methyl | 13.1 | 0.774 |
| Ethyl | 0.6 | 0.034 |
| Isopropyl | 1.4 | 0.083 |
| n-Propyl | N/D | N/D |
| Isobutyl | N/D | N/D |
| sec-Butyl | N/D | N/D |
| tert-Butyl | N/D | N/D |
| n-Butyl | N/D | N/D |
| Isoamyl | N/D | N/D |
| pri-Amyl | N/D | N/D |
| n-Amyl | N/D | N/D |

| **OTHER** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Misc. Sulfurs | N/D | N/D |
| Thiophene | 2.1 | 0.124 |
| Thiophane | N/D | N/D |

**Odorant Concentration**

14.500 PPMV 0.857 Grains/100 cu.ft

| Source | Date | Notes |
|---|---|---|

CRITICAL CONTROL Energy Services

# Speciated Sulfur Analysis Report

## Critical Control Energy Services

South Charleston, West Virginia
1740 Union Carbide Drive
South Charleston, WV 25303

Report Date: Dec 23, 2022 12:42p

| | | | |
|---|---|---|---|
| Client: | ARCHAEA ENERGY | Date Sampled: | Dec 2, 2022 |
| Client Code: | 2697 | Analysis Date: | Dec 6, 2022 |
| Site: | BRPP - QUARTERLY | Collected By: | WAYLON TACKETT |
| Field: | 100 - ARCHAEA ENERGY | Date Effective: | Dec 2, 2022 12:00a |
| Meter: | 1301 | Source Pressure (PSI): | |
| Source Laboratory: | Charleston, WV | Source Temp (P): | |
| **Lab File No:** | **SS3749** | | |
| Cylinder No: | BAG3 | | |
| Analysis Status: | good | | |
| Sample Type: | Spot | | |
| Measurement Analyst: | | | |

Method: GPA-2199

| **SULFIDES** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Hydrogen | 706.6 | 41.761 |
| Carbonyl | 0.7 | 0.043 |
| Dimethyl | 15.1 | 0.892 |
| Methyl Ethyl | N/D | N/D |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | N/D | N/D |
| Di-n-propyl | N/D | N/D |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | N/D | N/D |
| Di-n-Butyl | N/D | N/D |
| Unknown | N/D | N/D |

| **MERCAPTANS** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Methyl | 12.6 | 0.742 |
| Ethyl | <0.5 | <0.5 |
| Isopropyl | 1.4 | 0.085 |
| n-Propyl | N/D | N/D |
| Isobutyl | N/D | N/D |
| sec-Butyl | N/D | N/D |
| tert-Butyl | N/D | N/D |
| n-Butyl | N/D | N/D |
| Isoamyl | N/D | N/D |
| pri-Amyl | N/D | N/D |
| n-Amyl | N/D | N/D |

| **DiSULFIDES** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Carbon | N/D | N/D |
| Dimethyl | <0.5 | <0.5 |
| Methyl Ethyl | N/D | N/D |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | N/D | N/D |
| Di-n-Propyl | N/D | N/D |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | N/D | N/D |
| Di-n-Butyl | N/D | N/D |
| Unknown | N/D | N/D |
| Total Sulfur | 683.0 PPMV S | |
| | 40.366 Grains/100 cu.ft | |

| **OTHER** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Misc. Sulfurs | N/D | N/D |
| Thiophene | 2.2 | 0.128 |
| Thiophane | N/D | N/D |

**Odorant Concentration**

13.990 PPMV 0.827 Grains/100 cu.ft

| Source | Date | Notes |
|---|---|---|

CRITICAL CONTROL Energy Services

# Speciated Sulfur Analysis Report

## Critical Control Energy Services

South Charleston, West Virginia
1740 Union Carbide Drive
South Charleston, WV 25303

Report Date: Feb 10, 2023 12:15p

| | | | |
|---|---|---|---|
| Client: | ARCHAEA ENERGY | Date Sampled: | Jan 26, 2023 |
| Client Code: | 2697 | Analysis Date: | Jan 30, 2023 |
| Site: | BRPP - QUARTERLY | Collected By: | WAYLON TACKETT |
| Field: | 100 - ARCHAEA ENERGY | Date Effective: | Jan 26, 2023 12:00a |
| Meter: | 1301 | Source Pressure (PSI): | |
| Source Laboratory: | Charleston, WV | Source Temp (P): | |
| **Lab File No:** | **SS3877** | | |
| Cylinder No: | BAG | | |
| Analysis Status: | good | | |
| Sample Type: | Spot | | |
| Measurement Analyst: | | | |

Method: GPA-2199

| SULFIDES | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Hydrogen | 482.4 | 28.509 |
| Carbonyl | 1.2 | 0.069 |
| Dimethyl | 182.6 | 10.790 |
| Methyl Ethyl | 0.8 | 0.047 |
| Diethyl | <0.5 | <0.5 |
| Di-iso-Propyl | N/D | N/D |
| Di-n-propyl | <0.5 | <0.5 |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | <0.5 | <0.5 |
| Di-n-Butyl | N/D | N/D |
| Unknown | 0.8 | 0.047 |

| MERCAPTANS | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Methyl | 121.2 | 7.163 |
| Ethyl | 2.6 | 0.151 |
| Isopropyl | 3.0 | 0.177 |
| n-Propyl | 1.8 | 0.104 |
| Isobutyl | N/D | N/D |
| sec-Butyl | N/D | N/D |
| tert-Butyl | 0.7 | 0.039 |
| n-Butyl | N/D | N/D |
| Isoamyl | <0.5 | <0.5 |
| pri-Amyl | <0.5 | <0.5 |
| n-Amyl | <0.5 | <0.5 |

| DiSULFIDES | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Carbon | <0.5 | <0.5 |
| Dimethyl | 2.8 | 0.167 |
| Methyl Ethyl | <0.5 | <0.5 |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | N/D | N/D |
| Di-n-Propyl | N/D | N/D |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | <0.5 | <0.5 |
| Di-n-Butyl | N/D | N/D |
| Unknown | N/D | N/D |
| Total Sulfur | 639.1 PPMV S | |
| | 37.769 Grains/100 cu.ft | |

| OTHER | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Misc. Sulfurs | N/D | N/D |
| Thiophene | 8.3 | 0.488 |
| Thiophane | N/D | N/D |

**Odorant Concentration**

124.849 PPMV 7.379 Grains/100 cu.ft

| Source | Date | Notes |
|---|---|---|

CRITICAL CONTROL Energy Services

# Speciated Sulfur Analysis Report

## Critical Control Energy Services

South Charleston, West Virginia
1740 Union Carbide Drive
South Charleston, WV 25303

Report Date: Feb 10, 2023 12:21p

| | | | |
|---|---|---|---|
| Client: | ARCHAEA ENERGY | Date Sampled: | Jan 26, 2023 |
| Client Code: | 2697 | Analysis Date: | Jan 30, 2023 |
| Site: | BRPP - QUARTERLY | Collected By: | WAYLON TACKETT |
| Field: | 100 - ARCHAEA ENERGY | Date Effective: | Jan 26, 2023 12:00a |
| Meter: | 1301 | Source Pressure (PSI): | |
| Source Laboratory: | Charleston, WV | Source Temp (P): | |
| **Lab File No:** | **SS3878** | | |
| Cylinder No: | BAG | | |
| Analysis Status: | good | | |
| Sample Type: | Spot | | |
| Measurement Analyst: | | | |

Method: GPA-2199

| **SULFIDES** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Hydrogen | 543.7 | 32.131 |
| Carbonyl | 1.8 | 0.106 |
| Dimethyl | 237.0 | 14.009 |
| Methyl Ethyl | 0.9 | 0.052 |
| Diethyl | <0.5 | <0.5 |
| Di-iso-Propyl | N/D | N/D |
| Di-n-propyl | <0.5 | <0.5 |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | <0.5 | <0.5 |
| Di-n-Butyl | N/D | N/D |
| Unknown | 0.7 | 0.044 |

| **DiSULFIDES** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Carbon | <0.5 | <0.5 |
| Dimethyl | 3.0 | 0.176 |
| Methyl Ethyl | <0.5 | <0.5 |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | N/D | N/D |
| Di-n-Propyl | N/D | N/D |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | <0.5 | <0.5 |
| Di-n-Butyl | N/D | N/D |
| Unknown | N/D | N/D |
| Total Sulfur | 769.9 PPMV S | |
| | 45.502 Grains/100 cu.ft | |

| **MERCAPTANS** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Methyl | 187.1 | 11.058 |
| Ethyl | 3.5 | 0.206 |
| Isopropyl | 3.5 | 0.204 |
| n-Propyl | 1.9 | 0.110 |
| Isobutyl | N/D | N/D |
| sec-Butyl | N/D | N/D |
| tert-Butyl | 0.6 | 0.035 |
| n-Butyl | N/D | N/D |
| Isoamyl | 0.5 | 0.031 |
| pri-Amyl | <0.5 | <0.5 |
| n-Amyl | <0.5 | <0.5 |

| **OTHER** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Misc. Sulfurs | N/D | N/D |
| Thiophene | 8.2 | 0.483 |
| Thiophane | N/D | N/D |

**Odorant Concentration**

191.150 PPMV 11.297 Grains/100 cu.ft

| Source | Date | Notes |
|---|---|---|

CRITICAL CONTROL Energy Services

# Speciated Sulfur Analysis Report

## Critical Control Energy Services

South Charleston, West Virginia
1740 Union Carbide Drive
South Charleston, WV 25303

Report Date: Feb 10, 2023 12:26p

| | | | |
|---|---|---|---|
| Client: | ARCHAEA ENERGY | Date Sampled: | Jan 26, 2023 |
| Client Code: | 2697 | Analysis Date: | Jan 30, 2023 |
| Site: | BRPP - QUARTERLY | Collected By: | WAYLON TACKETT |
| Field: | 100 - ARCHAEA ENERGY | Date Effective: | Jan 26, 2023 12:00a |
| Meter: | 1301 | Source Pressure (PSI): | |
| Source Laboratory: | Charleston, WV | Source Temp (P): | |
| **Lab File No:** | **SS3879** | | |
| Cylinder No: | BAG | | |
| Analysis Status: | good | | |
| Sample Type: | Spot | | |
| Measurement Analyst: | | | |

Method: GPA-2199

| SULFIDES | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Hydrogen | 565.6 | 33.425 |
| Carbonyl | 2.1 | 0.124 |
| Dimethyl | 264.5 | 15.632 |
| Methyl Ethyl | 0.9 | 0.056 |
| Diethyl | <0.5 | <0.5 |
| Di-iso-Propyl | N/D | N/D |
| Di-n-propyl | <0.5 | <0.5 |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | <0.5 | <0.5 |
| Di-tert-Butyl | N/D | N/D |
| Di-n-Butyl | N/D | N/D |
| Unknown | 0.8 | 0.050 |

| MERCAPTANS | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Methyl | 211.3 | 12.488 |
| Ethyl | 3.8 | 0.223 |
| Isopropyl | 3.8 | 0.225 |
| n-Propyl | 2.1 | 0.126 |
| Isobutyl | N/D | N/D |
| sec-Butyl | N/D | N/D |
| tert-Butyl | 0.5 | 0.031 |
| n-Butyl | N/D | N/D |
| Isoamyl | 0.5 | 0.030 |
| pri-Amyl | <0.5 | <0.5 |
| n-Amyl | <0.5 | <0.5 |

| DiSULFIDES | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Carbon | <0.5 | <0.5 |
| Dimethyl | 3.4 | 0.200 |
| Methyl Ethyl | <0.5 | <0.5 |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | N/D | N/D |
| Di-n-Propyl | N/D | N/D |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | <0.5 | <0.5 |
| Di-n-Butyl | N/D | N/D |
| Unknown | N/D | N/D |
| Total Sulfur | 822.0 PPMV S | |
| | 48.582 Grains/100 cu.ft | |

| OTHER | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Misc. Sulfurs | N/D | N/D |
| Thiophene | 9.0 | 0.531 |
| Thiophane | N/D | N/D |

**Odorant Concentration**

215.638 PPMV 12.745 Grains/100 cu.ft

| Source | Date | Notes |
|---|---|---|

CONTROL Energy Services

# Speciated Sulfur Analysis Report

## Critical Control Energy Services

South Charleston, West Virginia
1740 Union Carbide Drive
South Charleston, WV 25303

Report Date: May 02, 2023 8:36 PM

| | | | |
|---|---|---|---|
| Client: | ARCHAEA ENERGY | Date Sampled: | Apr 24, 2023 |
| Client Code: | 2697 | Analysis Date: | Apr 28, 2023 |
| Site: | BRPP - QUARTERLY | Collected By: | WAYLON TACKETT |
| Field: | 100 - ARCHAEA ENERGY | Date Effective: | Apr 24, 2023 12:00 AM |
| Meter: | 1301 | Source Pressure (kPa): | |
| Source Laboratory: | Charleston, WV | Source Temp (P): | |
| **Lab File No:** | **SS4081** | | |
| Cylinder No: | BAG | | |
| Analysis Status: | good | | |
| Sample Type: | Spot | | |
| Measurement Analyst: | | | |

Method: GPA-2199

| **SULFIDES** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Hydrogen | 514.1 | 30.383 |
| Carbonyl | 1.1 | 0.065 |
| Dimethyl | 65.0 | 3.839 |
| Methyl Ethyl | N/D | N/D |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | N/D | N/D |
| Di-n-propyl | N/D | N/D |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | N/D | N/D |
| Di-n-Butyl | N/D | N/D |
| Unknown | N/D | N/D |

| **DiSULFIDES** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Carbon | <0.5 | <0.5 |
| Dimethyl | 0.5 | 0.027 |
| Methyl Ethyl | N/D | N/D |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | N/D | N/D |
| Di-n-Propyl | N/D | N/D |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | N/D | N/D |
| Di-n-Butyl | N/D | N/D |
| Unknown | N/D | N/D |

| **MERCAPTANS** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Methyl | 18.3 | 1.082 |
| Ethyl | 1.1 | 0.066 |
| Isopropyl | 3.1 | 0.184 |
| n-Propyl | <0.5 | <0.5 |
| Isobutyl | N/D | N/D |
| sec-Butyl | N/D | N/D |
| tert-Butyl | 0.8 | 0.044 |
| n-Butyl | N/D | N/D |
| Isoamyl | <0.5 | <0.5 |
| pri-Amyl | N/D | N/D |
| n-Amyl | N/D | N/D |

| **OTHER** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Misc. Sulfurs | N/D | N/D |
| Thiophene | 5.4 | 0.322 |
| Thiophane | N/D | N/D |

Total Sulfur 534.9 PPMV S

31.611 Grains/100 cu.ft

**Odorant Concentration**

22.170 PPMV 1.310 Grains/100 cu.ft

| Source | Date | Notes |
|---|---|---|

CONTROL Energy Services

# Speciated Sulfur Analysis Report

## Critical Control Energy Services

South Charleston, West Virginia
1740 Union Carbide Drive
South Charleston, WV 25303

Report Date: May 02, 2023 8:40 PM

| | | | |
|---|---|---|---|
| Client: | ARCHAEA ENERGY | Date Sampled: | Apr 24, 2023 |
| Client Code: | 2697 | Analysis Date: | Apr 28, 2023 |
| Site: | BRPP - QUARTERLY | Collected By: | WAYLON TACKETT |
| Field: | 100 - ARCHAEA ENERGY | Date Effective: | Apr 24, 2023 12:00 AM |
| Meter: | 1301 | Source Pressure (kPa): | |
| Source Laboratory: | Charleston, WV | Source Temp (P): | |
| **Lab File No:** | **SS4082** | | |
| Cylinder No: | BAG 2 | | |
| Analysis Status: | good | | |
| Sample Type: | Spot | | |
| Measurement Analyst: | | | |

Method: GPA-2199

| **SULFIDES** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Hydrogen | 554.8 | 32.791 |
| Carbonyl | 1.3 | 0.078 |
| Dimethyl | 49.2 | 2.908 |
| Methyl Ethyl | N/D | N/D |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | N/D | N/D |
| Di-n-propyl | N/D | N/D |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | N/D | N/D |
| Di-n-Butyl | N/D | N/D |
| Unknown | N/D | N/D |

| **DiSULFIDES** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Carbon | <0.5 | <0.5 |
| Dimethyl | <0.5 | <0.5 |
| Methyl Ethyl | N/D | N/D |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | N/D | N/D |
| Di-n-Propyl | N/D | N/D |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | N/D | N/D |
| Di-n-Butyl | N/D | N/D |
| Unknown | N/D | N/D |

| **MERCAPTANS** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Methyl | 16.9 | 1.002 |
| Ethyl | 0.9 | 0.050 |
| Isopropyl | 2.4 | 0.140 |
| n-Propyl | <0.5 | <0.5 |
| Isobutyl | N/D | N/D |
| sec-Butyl | N/D | N/D |
| tert-Butyl | 0.6 | 0.035 |
| n-Butyl | N/D | N/D |
| Isoamyl | <0.5 | <0.5 |
| pri-Amyl | N/D | N/D |
| n-Amyl | N/D | N/D |

| **OTHER** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Misc. Sulfurs | N/D | N/D |
| Thiophene | 4.4 | 0.260 |
| Thiophane | N/D | N/D |

Total Sulfur 563.2 PPMV S

33.288 Grains/100 cu.ft

**Odorant Concentration**

19.920 PPMV 1.177 Grains/100 cu.ft

| Source | Date | Notes |
|---|---|---|

CONTROL Energy Services

# Speciated Sulfur Analysis Report

## Critical Control Energy Services

South Charleston, West Virginia
1740 Union Carbide Drive
South Charleston, WV 25303

Report Date: May 02, 2023 8:43 PM

| | | | |
|---|---|---|---|
| Client: | ARCHAEA ENERGY | Date Sampled: | Apr 24, 2023 |
| Client Code: | 2697 | Analysis Date: | Apr 28, 2023 |
| Site: | BRPP - QUARTERLY | Collected By: | WAYLON TACKETT |
| Field: | 100 - ARCHAEA ENERGY | Date Effective: | Apr 24, 2023 12:00 AM |
| Meter: | 1301 | Source Pressure (kPa): | |
| Source Laboratory: | Charleston, WV | Source Temp (P): | |
| **Lab File No:** | **SS4083** | | |
| Cylinder No: | BAG 3 | | |
| Analysis Status: | good | | |
| Sample Type: | Spot | | |
| Measurement Analyst: | | | |

Method: GPA-2199

| **SULFIDES** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Hydrogen | 582.2 | 34.410 |
| Carbonyl | 1.2 | 0.071 |
| Dimethyl | 34.1 | 2.016 |
| Methyl Ethyl | N/D | N/D |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | N/D | N/D |
| Di-n-propyl | N/D | N/D |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | N/D | N/D |
| Di-n-Butyl | N/D | N/D |
| Unknown | N/D | N/D |

| **DiSULFIDES** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Carbon | <0.5 | <0.5 |
| Dimethyl | <0.5 | <0.5 |
| Methyl Ethyl | N/D | N/D |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | N/D | N/D |
| Di-n-Propyl | N/D | N/D |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | N/D | N/D |
| Di-n-Butyl | N/D | N/D |
| Unknown | N/D | N/D |

| **MERCAPTANS** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Methyl | 14.5 | 0.859 |
| Ethyl | 0.7 | 0.042 |
| Isopropyl | 2.1 | 0.124 |
| n-Propyl | <0.5 | <0.5 |
| Isobutyl | N/D | N/D |
| sec-Butyl | N/D | N/D |
| tert-Butyl | 0.5 | 0.031 |
| n-Butyl | N/D | N/D |
| Isoamyl | N/D | N/D |
| pri-Amyl | <0.5 | <0.5 |
| n-Amyl | N/D | N/D |

| **OTHER** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Misc. Sulfurs | N/D | N/D |
| Thiophene | 3.4 | 0.201 |
| Thiophane | N/D | N/D |

Total Sulfur 578.9 PPMV S

34.212 Grains/100 cu.ft

**Odorant Concentration**

17.160 PPMV 1.014 Grains/100 cu.ft

| Source | Date | Notes |
|---|---|---|

CONTROL Energy Services

Speciated Sulfur Analysis Report

## Critical Control Energy Services

South Charleston, West Virginia
1740 Union Carbide Drive
South Charleston, WV 25303

Report Date: Aug 08, 2023 1:18 PM

| | | | |
|---|---|---|---|
| Client: | ARCHAEA ENERGY | Date Sampled: | Jul 13, 2023 |
| Client Code: | 2697 | Analysis Date: | Jul 27, 2023 |
| Site: | BRPP - QUARTERLY | Collected By: | WAYLON TACKETT |
| Field: | 100 - ARCHAEA ENERGY | Date Effective: | Jul 13, 2023 12:00 AM |
| Meter: | 1301 | Source Pressure (kPa): | |
| Source Laboratory: | Charleston, WV | Source Temp (P): | |
| **Lab File No:** | **SS4354** | | |
| Cylinder No: | BAG 1 | | |
| Analysis Status: | good | | |
| Sample Type: | Spot | | |
| Measurement Analyst: | | | |

Method: GPA-2199

| **SULFIDES** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Hydrogen | 466.4 | 27.563 |
| Carbonyl | 1.1 | 0.062 |
| Dimethyl | 115.6 | 6.835 |
| Methyl Ethyl | <0.5 | <0.5 |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | 0.8 | 0.048 |
| Di-n-propyl | N/D | N/D |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | N/D | N/D |
| Di-n-Butyl | N/D | N/D |
| Unknown | N/D | N/D |

| **DiSULFIDES** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Carbon | N/D | N/D |
| Dimethyl | 1.1 | 0.063 |
| Methyl Ethyl | N/D | N/D |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | N/D | N/D |
| Di-n-Propyl | N/D | N/D |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | N/D | N/D |
| Di-n-Butyl | N/D | N/D |
| Unknown | N/D | N/D |

| **MERCAPTANS** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Methyl | 85.9 | 5.077 |
| Ethyl | 2.0 | 0.121 |
| Isopropyl | 3.8 | 0.223 |
| n-Propyl | 1.6 | 0.092 |
| Isobutyl | N/D | N/D |
| sec-Butyl | N/D | N/D |
| tert-Butyl | 0.9 | 0.050 |
| n-Butyl | N/D | N/D |
| Isoamyl | <0.5 | <0.5 |
| pri-Amyl | N/D | N/D |
| n-Amyl | N/D | N/D |

| **OTHER** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Misc. Sulfurs | N/D | N/D |
| Thiophene | 4.8 | 0.281 |
| Thiophane | N/D | N/D |

Total Sulfur 562.8 PPMV S
33.261 Grains/100 cu.ft

**Odorant Concentration**

90.540 PPMV 5.351 Grains/100 cu.ft

| Source | Date | Notes |
|---|---|---|

CONTROL Energy Services

# Speciated Sulfur Analysis Report

## Critical Control Energy Services

South Charleston, West Virginia
1740 Union Carbide Drive
South Charleston, WV 25303

Report Date: Aug 08, 2023 1:21 PM

| | | | |
|---|---|---|---|
| Client: | ARCHAEA ENERGY | Date Sampled: | Jul 13, 2023 |
| Client Code: | 2697 | Analysis Date: | Jul 27, 2023 |
| Site: | BRPP - QUARTERLY | Collected By: | WAYLON TACKETT |
| Field: | 100 - ARCHAEA ENERGY | Date Effective: | Jul 13, 2023 12:00 AM |
| Meter: | 1301 | Source Pressure (kPa): | |
| Source Laboratory: | Charleston, WV | Source Temp (P): | |
| **Lab File No:** | **SS4355** | | |
| Cylinder No: | BAG 2 | | |
| Analysis Status: | good | | |
| Sample Type: | Spot | | |
| Measurement Analyst: | | | |

Method: GPA-2199

| **SULFIDES** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Hydrogen | 447.8 | 26.463 |
| Carbonyl | 1.1 | 0.065 |
| Dimethyl | 88.7 | 5.242 |
| Methyl Ethyl | <0.5 | <0.5 |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | 0.6 | 0.035 |
| Di-n-propyl | N/D | N/D |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | N/D | N/D |
| Di-n-Butyl | N/D | N/D |
| Unknown | N/D | N/D |

| **DiSULFIDES** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Carbon | N/D | N/D |
| Dimethyl | 0.7 | 0.040 |
| Methyl Ethyl | N/D | N/D |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | N/D | N/D |
| Di-n-Propyl | N/D | N/D |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | N/D | N/D |
| Di-n-Butyl | N/D | N/D |
| Unknown | N/D | N/D |

| **MERCAPTANS** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Methyl | 71.4 | 4.220 |
| Ethyl | 1.6 | 0.092 |
| Isopropyl | 3.2 | 0.191 |
| n-Propyl | 0.9 | 0.056 |
| Isobutyl | N/D | N/D |
| sec-Butyl | N/D | N/D |
| tert-Butyl | 0.6 | 0.035 |
| n-Butyl | N/D | N/D |
| Isoamyl | <0.5 | <0.5 |
| pri-Amyl | N/D | N/D |
| n-Amyl | N/D | N/D |

| **OTHER** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Misc. Sulfurs | N/D | N/D |
| Thiophene | 3.4 | 0.198 |
| Thiophane | N/D | N/D |

Total Sulfur 519.9 PPMV S
30.729 Grains/100 cu.ft

**Odorant Concentration**

75.230 PPMV 4.446 Grains/100 cu.ft

| Source | Date | Notes |
|---|---|---|

CONTROL Energy Services

# Speciated Sulfur Analysis Report

## Critical Control Energy Services

South Charleston, West Virginia
1740 Union Carbide Drive
South Charleston, WV 25303

Report Date: Aug 08, 2023 1:23 PM

| | | | |
|---|---|---|---|
| Client: | ARCHAEA ENERGY | Date Sampled: | Jul 13, 2023 |
| Client Code: | 2697 | Analysis Date: | Jul 27, 2023 |
| Site: | BRPP - QUARTERLY | Collected By: | WAYLON TACKETT |
| Field: | 100 - ARCHAEA ENERGY | Date Effective: | Jul 13, 2023 12:00 AM |
| Meter: | 1301 | Source Pressure (kPa): | |
| Source Laboratory: | Charleston, WV | Source Temp (P): | |
| **Lab File No:** | **SS4356** | | |
| Cylinder No: | BAG | | |
| Analysis Status: | good | | |
| Sample Type: | Spot | | |
| Measurement Analyst: | | | |

Method: GPA-2199

| **SULFIDES** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Hydrogen | 548.6 | 32.426 |
| Carbonyl | 1.8 | 0.104 |
| Dimethyl | 127.0 | 7.508 |
| Methyl Ethyl | <0.5 | <0.5 |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | 0.7 | 0.043 |
| Di-n-propyl | N/D | N/D |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | N/D | N/D |
| Di-n-Butyl | N/D | N/D |
| Unknown | N/D | N/D |

| **DiSULFIDES** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Carbon | N/D | N/D |
| Dimethyl | 0.9 | 0.056 |
| Methyl Ethyl | N/D | N/D |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | N/D | N/D |
| Di-n-Propyl | N/D | N/D |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | N/D | N/D |
| Di-n-Butyl | N/D | N/D |
| Unknown | N/D | N/D |

| **MERCAPTANS** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Methyl | 105.8 | 6.251 |
| Ethyl | 2.3 | 0.135 |
| Isopropyl | 4.2 | 0.245 |
| n-Propyl | 1.6 | 0.098 |
| Isobutyl | N/D | N/D |
| sec-Butyl | N/D | N/D |
| tert-Butyl | 0.9 | 0.053 |
| n-Butyl | N/D | N/D |
| Isoamyl | <0.5 | <0.5 |
| pri-Amyl | N/D | N/D |
| n-Amyl | N/D | N/D |

| **OTHER** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Misc. Sulfurs | N/D | N/D |
| Thiophene | 4.7 | 0.278 |
| Thiophane | N/D | N/D |

Total Sulfur 659.8 PPMV S

38.996 Grains/100 cu.ft

**Odorant Concentration**

110.810 PPMV 6.549 Grains/100 cu.ft

| Source | Date | Notes |
|---|---|---|

CONTROL Energy Services

# Speciated Sulfur Analysis Report

## Critical Control Energy Services

South Charleston, West Virginia
1740 Union Carbide Drive
South Charleston, WV 25303

Report Date: Dec 08, 2023 12:52 PM

| | | | |
|---|---|---|---|
| Client: | ARCHAEA ENERGY | Date Sampled: | Nov 27, 2023 |
| Client Code: | 2697 | Analysis Date: | Nov 30, 2023 |
| Site: | BRPP - QUARTERLY | Collected By: | W TACKETT |
| Field: | 100 - ARCHAEA ENERGY | Date Effective: | Nov 27, 2023 12:00 AM |
| Meter: | 1301 | Source Pressure (kPa): | |
| Source Laboratory: | Charleston, WV | Source Temp (P): | |
| **Lab File No:** | **SS4584** | | |
| Cylinder No: | BAG1 | | |
| Analysis Status: | good | | |
| Sample Type: | Spot | | |
| Measurement Analyst: | | | |

Method: GPA-2199

| **SULFIDES** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Hydrogen | 426.9 | 25.230 |
| Carbonyl | 0.7 | 0.044 |
| Dimethyl | 62.0 | 3.663 |
| Methyl Ethyl | <0.5 | <0.5 |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | <0.5 | <0.5 |
| Di-n-propyl | N/D | N/D |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | N/D | N/D |
| Di-n-Butyl | N/D | N/D |
| Unknown | N/D | N/D |

| **DiSULFIDES** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Carbon | N/D | N/D |
| Dimethyl | 0.7 | 0.043 |
| Methyl Ethyl | N/D | N/D |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | N/D | N/D |
| Di-n-Propyl | N/D | N/D |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | N/D | N/D |
| Di-n-Butyl | N/D | N/D |
| Unknown | N/D | N/D |

| **MERCAPTANS** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Methyl | 82.3 | 4.866 |
| Ethyl | 1.8 | 0.106 |
| Isopropyl | 2.4 | 0.142 |
| n-Propyl | 1.9 | 0.110 |
| Isobutyl | N/D | N/D |
| sec-Butyl | N/D | N/D |
| tert-Butyl | 0.6 | 0.033 |
| n-Butyl | N/D | N/D |
| Isoamyl | N/D | N/D |
| pri-Amyl | N/D | N/D |
| n-Amyl | N/D | N/D |

| **OTHER** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Misc. Sulfurs | N/D | N/D |
| Thiophene | 2.9 | 0.169 |
| Thiophane | N/D | N/D |

| | | |
|---|---|---|
| Total Sulfur | 493.5 PPMV S | |
| | 29.168 Grains/100 cu.ft | |

**Odorant Concentration**

85.298 PPMV 5.041 Grains/100 cu.ft

| Source | Date | Notes |
|---|---|---|

CONTROL Energy Services

# Speciated Sulfur Analysis Report

## Critical Control Energy Services

South Charleston, West Virginia
1740 Union Carbide Drive
South Charleston, WV 25303

Report Date: Dec 08, 2023 12:55 PM

| | | | |
|---|---|---|---|
| Client: | ARCHAEA ENERGY | Date Sampled: | Nov 27, 2023 |
| Client Code: | 2697 | Analysis Date: | Nov 30, 2023 |
| Site: | BRPP - QUARTERLY | Collected By: | W TACKETT |
| Field: | 100 - ARCHAEA ENERGY | Date Effective: | Nov 27, 2023 12:00 AM |
| Meter: | 1301 | Source Pressure (kPa): | |
| Source Laboratory: | Charleston, WV | Source Temp (P): | |
| **Lab File No:** | **SS4585** | | |
| Cylinder No: | BAG | | |
| Analysis Status: | good | | |
| Sample Type: | Spot | | |
| Measurement Analyst: | | | |

Method: GPA-2199

| **SULFIDES** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Hydrogen | 401.7 | 23.741 |
| Carbonyl | 1.0 | 0.058 |
| Dimethyl | 53.3 | 3.149 |
| Methyl Ethyl | <0.5 | <0.5 |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | <0.5 | <0.5 |
| Di-n-propyl | N/D | N/D |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | N/D | N/D |
| Di-n-Butyl | N/D | N/D |
| Unknown | N/D | N/D |

| **DiSULFIDES** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Carbon | N/D | N/D |
| Dimethyl | 0.9 | 0.051 |
| Methyl Ethyl | N/D | N/D |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | N/D | N/D |
| Di-n-Propyl | N/D | N/D |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | N/D | N/D |
| Di-n-Butyl | N/D | N/D |
| Unknown | N/D | N/D |

| **MERCAPTANS** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Methyl | 79.0 | 4.668 |
| Ethyl | 1.7 | 0.102 |
| Isopropyl | 1.9 | 0.113 |
| n-Propyl | 1.5 | 0.088 |
| Isobutyl | N/D | N/D |
| sec-Butyl | N/D | N/D |
| tert-Butyl | <0.5 | <0.5 |
| n-Butyl | N/D | N/D |
| Isoamyl | N/D | N/D |
| pri-Amyl | N/D | N/D |
| n-Amyl | N/D | N/D |

| **OTHER** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Misc. Sulfurs | N/D | N/D |
| Thiophene | 2.6 | 0.155 |
| Thiophane | N/D | N/D |

Total Sulfur 462.8 PPMV S

27.353 Grains/100 cu.ft

**Odorant Concentration**

81.313 PPMV 4.806 Grains/100 cu.ft

| Source | Date | Notes |
|---|---|---|

CONTROL Energy Services

Speciated Sulfur Analysis Report

## Critical Control Energy Services

South Charleston, West Virginia
1740 Union Carbide Drive
South Charleston, WV 25303

Report Date: Dec 08, 2023 1:03 PM

| | | | |
|---|---|---|---|
| Client: | ARCHAEA ENERGY | Date Sampled: | Nov 27, 2023 |
| Client Code: | 2697 | Analysis Date: | Nov 30, 2023 |
| Site: | BRPP - QUARTERLY | Collected By: | W TACKETT |
| Field: | 100 - ARCHAEA ENERGY | Date Effective: | Nov 27, 2023 12:00 AM |
| Meter: | 1301 | Source Pressure (kPa): | |
| Source Laboratory: | Charleston, WV | Source Temp (P): | |
| **Lab File No:** | **SS4586** | | |
| Cylinder No: | BAG3 | | |
| Analysis Status: | good | | |
| Sample Type: | Spot | | |
| Measurement Analyst: | | | |

Method: GPA-2199

| **SULFIDES** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Hydrogen | 412.0 | 24.348 |
| Carbonyl | 1.2 | 0.071 |
| Dimethyl | 51.0 | 3.016 |
| Methyl Ethyl | <0.5 | <0.5 |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | <0.5 | <0.5 |
| Di-n-propyl | N/D | N/D |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | N/D | N/D |
| Di-n-Butyl | N/D | N/D |
| Unknown | N/D | N/D |

| **DiSULFIDES** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Carbon | N/D | N/D |
| Dimethyl | 0.6 | 0.037 |
| Methyl Ethyl | N/D | N/D |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | N/D | N/D |
| Di-n-Propyl | N/D | N/D |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | N/D | N/D |
| Di-n-Butyl | N/D | N/D |
| Unknown | N/D | N/D |

| **MERCAPTANS** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Methyl | 79.7 | 4.708 |
| Ethyl | 1.6 | 0.093 |
| Isopropyl | 2.1 | 0.123 |
| n-Propyl | 1.1 | 0.068 |
| Isobutyl | N/D | N/D |
| sec-Butyl | N/D | N/D |
| tert-Butyl | <0.5 | <0.5 |
| n-Butyl | N/D | N/D |
| Isoamyl | N/D | N/D |
| pri-Amyl | N/D | N/D |
| n-Amyl | N/D | N/D |

| **OTHER** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Misc. Sulfurs | N/D | N/D |
| Thiophene | 2.1 | 0.126 |
| Thiophane | N/D | N/D |

Total Sulfur 471.3 PPMV S

27.855 Grains/100 cu.ft

**Odorant Concentration**

82.185 PPMV 4.857 Grains/100 cu.ft

| Source | Date | Notes |
|---|---|---|

CONTROL ENERGY SERVICES

Speciated Sulfur Analysis Report

## Critical Control Energy Services

South Charleston, West Virginia
1740 Union Carbide Drive
South Charleston, WV 25303

Report Date: Mar 04, 2024 11:32 AM

| | | | |
|---|---|---|---|
| Client: | ARCHAEA ENERGY | Date Sampled: | Feb 6, 2024 |
| Client Code: | 2697 | Analysis Date: | Feb 15, 2024 |
| Site: | BRPP - QUARTERLY | Collected By: | WAYLON TACKETT |
| Field: | 100 - ARCHAEA ENERGY | Date Effective: | Feb 06, 2024 12:00 AM |
| Meter: | 1301 | Source Pressure (kPa): | |
| Source Laboratory: | Charleston, WV | Source Temp (P): | |
| **Lab File No:** | **SS4828** | | |
| Cylinder No: | BAG1 | | |
| Analysis Status: | good | | |
| Sample Type: | Spot | | |
| Measurement Analyst: | | | |

Method: GPA-2199

| **SULFIDES** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Hydrogen | 158.7 | 9.381 |
| Carbonyl | 1.5 | 0.089 |
| Dimethyl | 58.7 | 3.469 |
| Methyl Ethyl | N/D | N/D |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | N/D | N/D |
| Di-n-propyl | N/D | N/D |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | N/D | N/D |
| Di-n-Butyl | N/D | N/D |
| Unknown | N/D | N/D |

| **DiSULFIDES** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Carbon | <0.5 | <0.5 |
| Dimethyl | 2.0 | 0.118 |
| Methyl Ethyl | N/D | N/D |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | N/D | N/D |
| Di-n-Propyl | N/D | N/D |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | N/D | N/D |
| Di-n-Butyl | N/D | N/D |
| Unknown | N/D | N/D |

| **MERCAPTANS** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Methyl | 33.8 | 1.998 |
| Ethyl | 1.1 | 0.063 |
| Isopropyl | 4.2 | 0.246 |
| n-Propyl | 0.9 | 0.052 |
| Isobutyl | N/D | N/D |
| sec-Butyl | N/D | N/D |
| tert-Butyl | 0.9 | 0.055 |
| n-Butyl | N/D | N/D |
| Isoamyl | 1.6 | 0.092 |
| pri-Amyl | N/D | N/D |
| n-Amyl | N/D | N/D |

| **OTHER** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Misc. Sulfurs | N/D | N/D |
| Thiophene | 6.3 | 0.374 |
| Thiophane | N/D | N/D |

| | | |
|---|---|---|
| Total Sulfur | 210.4 PPMV S | |
| | 12.437 Grains/100 cu.ft | |

| Source | Date | Notes |
|---|---|---|

CONTROL ENERGY SERVICES

Speciated Sulfur Analysis Report

## Critical Control Energy Services

South Charleston, West Virginia
1740 Union Carbide Drive
South Charleston, WV 25303

Report Date: Mar 04, 2024 11:36 AM

| | | | |
|---|---|---|---|
| Client: | ARCHAEA ENERGY | Date Sampled: | Feb 6, 2024 |
| Client Code: | 2697 | Analysis Date: | Feb 15, 2024 |
| Site: | BRPP - QUARTERLY | Collected By: | WAYLON TACKETT |
| Field: | 100 - ARCHAEA ENERGY | Date Effective: | Feb 06, 2024 12:00 AM |
| Meter: | 1301 | Source Pressure (kPa): | |
| Source Laboratory: | Charleston, WV | Source Temp (P): | |
| **Lab File No:** | **SS4839** | | |
| Cylinder No: | BAG2 | | |
| Analysis Status: | good | | |
| Sample Type: | Spot | | |
| Measurement Analyst: | | | |

Method: GPA-2199

| **SULFIDES** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Hydrogen | 211.0 | 12.470 |
| Carbonyl | 1.7 | 0.102 |
| Dimethyl | 75.5 | 4.462 |
| Methyl Ethyl | 0.8 | 0.047 |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | N/D | N/D |
| Di-n-propyl | N/D | N/D |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | N/D | N/D |
| Di-n-Butyl | N/D | N/D |
| Unknown | N/D | N/D |

| **DiSULFIDES** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Carbon | N/D | N/D |
| Dimethyl | 2.3 | 0.134 |
| Methyl Ethyl | N/D | N/D |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | N/D | N/D |
| Di-n-Propyl | N/D | N/D |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | N/D | N/D |
| Di-n-Butyl | N/D | N/D |
| Unknown | N/D | N/D |

| **MERCAPTANS** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Methyl | 42.6 | 2.517 |
| Ethyl | 1.9 | 0.111 |
| Isopropyl | 3.4 | 0.198 |
| n-Propyl | 1.2 | 0.070 |
| Isobutyl | N/D | N/D |
| sec-Butyl | N/D | N/D |
| tert-Butyl | 0.8 | 0.047 |
| n-Butyl | N/D | N/D |
| Isoamyl | N/D | N/D |
| pri-Amyl | N/D | N/D |
| n-Amyl | N/D | N/D |

| **OTHER** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Misc. Sulfurs | N/D | N/D |
| Thiophene | 6.3 | 0.370 |
| Thiophane | N/D | N/D |

| | | |
|---|---|---|
| Total Sulfur | 274.2 PPMV S | |
| | 16.204 Grains/100 cu.ft | |

| Source | Date | Notes |
|---|---|---|

CONTROL ENERGY SERVICES

Speciated Sulfur Analysis Report

## Critical Control Energy Services

South Charleston, West Virginia
1740 Union Carbide Drive
South Charleston, WV 25303

Report Date: Mar 04, 2024 11:40 AM

| | | | |
|---|---|---|---|
| Client: | ARCHAEA ENERGY | Date Sampled: | Feb 6, 2024 |
| Client Code: | 2697 | Analysis Date: | Feb 15, 2024 |
| Site: | BRPP - QUARTERLY | Collected By: | WAYLON TACKETT |
| Field: | 100 - ARCHAEA ENERGY | Date Effective: | Feb 06, 2024 12:00 AM |
| Meter: | 1301 | Source Pressure (kPa): | |
| Source Laboratory: | Charleston, WV | Source Temp (P): | |
| **Lab File No:** | **SS4840** | | |
| Cylinder No: | BAG3 | | |
| Analysis Status: | good | | |
| Sample Type: | Spot | | |
| Measurement Analyst: | | | |

Method: GPA-2199

| **SULFIDES** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Hydrogen | 196.7 | 11.626 |
| Carbonyl | 2.0 | 0.118 |
| Dimethyl | 63.8 | 3.773 |
| Methyl Ethyl | N/D | N/D |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | N/D | N/D |
| Di-n-propyl | N/D | N/D |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | N/D | N/D |
| Di-n-Butyl | N/D | N/D |
| Unknown | N/D | N/D |

| **DiSULFIDES** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Carbon | N/D | N/D |
| Dimethyl | 1.9 | 0.115 |
| Methyl Ethyl | N/D | N/D |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | N/D | N/D |
| Di-n-Propyl | N/D | N/D |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | N/D | N/D |
| Di-n-Butyl | N/D | N/D |
| Unknown | N/D | N/D |

| **MERCAPTANS** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Methyl | 37.9 | 2.240 |
| Ethyl | 1.4 | 0.085 |
| Isopropyl | 3.0 | 0.177 |
| n-Propyl | 0.8 | 0.045 |
| Isobutyl | N/D | N/D |
| sec-Butyl | N/D | N/D |
| tert-Butyl | 0.8 | 0.044 |
| n-Butyl | N/D | N/D |
| Isoamyl | 0.7 | 0.044 |
| pri-Amyl | N/D | N/D |
| n-Amyl | N/D | N/D |

| **OTHER** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Misc. Sulfurs | N/D | N/D |
| Thiophene | 6.7 | 0.398 |
| Thiophane | N/D | N/D |

| | | |
|---|---|---|
| Total Sulfur | 251.0 PPMV S | |
| | 14.836 Grains/100 cu.ft | |

| Source | Date | Notes |
|---|---|---|

CONTROL ENERGY SERVICES

Speciated Sulfur Analysis Report

## Critical Control Energy Services

South Charleston, West Virginia
1740 Union Carbide Drive
South Charleston, WV 25303

Report Date: Apr 25, 2024 2:53 PM

| | | | |
|---|---|---|---|
| Client: | ARCHAEA ENERGY | Date Sampled: | Apr 4, 2024 |
| Client Code: | 2697 | Analysis Date: | Apr 15, 2024 |
| Site: | BRPP - QUARTERLY | Collected By: | WAYLON TACKETT |
| Field: | 100 - ARCHAEA ENERGY | Date Effective: | Apr 04, 2024 12:00 AM |
| Meter: | 1301 | Source Pressure (PSI): | |
| Source Laboratory: | Charleston, WV | Source Temp (°F): | |
| **Lab File No:** | **SS4942** | | |
| Cylinder No: | BAG 1 | | |
| Analysis Status: | good | | |
| Sample Type: | Spot | | |
| Measurement Analyst: | | | |

Method: GPA-2199

| **SULFIDES** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Hydrogen | 377.7 | 22.323 |
| Carbonyl | 1.1 | 0.062 |
| Dimethyl | 82.3 | 4.864 |
| Methyl Ethyl | <0.5 | <0.5 |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | N/D | N/D |
| Di-n-propyl | <0.5 | <0.5 |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | N/D | N/D |
| Di-n-Butyl | N/D | N/D |
| Unknown | 0.5 | 0.030 |

| **DiSULFIDES** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Carbon | <0.5 | <0.5 |
| Dimethyl | 7.7 | 0.456 |
| Methyl Ethyl | <0.5 | <0.5 |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | N/D | N/D |
| Di-n-Propyl | N/D | N/D |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | 0.6 | 0.033 |
| Di-n-Butyl | N/D | N/D |
| Unknown | N/D | N/D |

| **MERCAPTANS** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Methyl | 52.6 | 3.111 |
| Ethyl | 1.6 | 0.092 |
| Isopropyl | 2.6 | 0.152 |
| n-Propyl | 0.9 | 0.053 |
| Isobutyl | N/D | N/D |
| sec-Butyl | N/D | N/D |
| tert-Butyl | 0.6 | 0.034 |
| n-Butyl | N/D | N/D |
| Isoamyl | 0.7 | 0.040 |
| pri-Amyl | N/D | N/D |
| n-Amyl | N/D | N/D |

| **OTHER** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Misc. Sulfurs | N/D | N/D |
| Thiophene | 4.9 | 0.291 |
| Thiophane | N/D | N/D |

| | | |
|---|---|---|
| Total Sulfur | 444.0 PPMV S | |
| | 26.244 Grains/100 cu.ft | |

| Source | Date | Notes |
|---|---|---|

CONTROL ENERGY SERVICES

Speciated Sulfur Analysis Report

## Critical Control Energy Services

South Charleston, West Virginia
1740 Union Carbide Drive
South Charleston, WV 25303

Report Date: Apr 25, 2024 2:58 PM

| | | | |
|---|---|---|---|
| Client: | ARCHAEA ENERGY | Date Sampled: | Apr 4, 2024 |
| Client Code: | 2697 | Analysis Date: | Apr 15, 2024 |
| Site: | BRPP - QUARTERLY | Collected By: | WAYLON TACKETT |
| Field: | 100 - ARCHAEA ENERGY | Date Effective: | Apr 04, 2024 12:00 AM |
| Meter: | 1301 | Source Pressure (PSI): | |
| Source Laboratory: | Charleston, WV | Source Temp (°F): | |
| **Lab File No:** | **SS4943** | | |
| Cylinder No: | BAG 2 | | |
| Analysis Status: | good | | |
| Sample Type: | Spot | | |
| Measurement Analyst: | | | |

Method: GPA-2199

| **SULFIDES** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Hydrogen | 371.4 | 21.952 |
| Carbonyl | 0.8 | 0.044 |
| Dimethyl | 65.8 | 3.889 |
| Methyl Ethyl | <0.5 | <0.5 |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | N/D | N/D |
| Di-n-propyl | N/D | N/D |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | N/D | N/D |
| Di-n-Butyl | N/D | N/D |
| Unknown | <0.5 | <0.5 |

| **DiSULFIDES** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Carbon | <0.5 | <0.5 |
| Dimethyl | 2.1 | 0.125 |
| Methyl Ethyl | N/D | N/D |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | N/D | N/D |
| Di-n-Propyl | N/D | N/D |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | N/D | N/D |
| Di-n-Butyl | N/D | N/D |
| Unknown | N/D | N/D |

| **MERCAPTANS** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Methyl | 44.4 | 2.623 |
| Ethyl | 1.2 | 0.070 |
| Isopropyl | 2.0 | 0.121 |
| n-Propyl | 1.0 | 0.057 |
| Isobutyl | N/D | N/D |
| sec-Butyl | N/D | N/D |
| tert-Butyl | <0.5 | <0.5 |
| n-Butyl | N/D | N/D |
| Isoamyl | N/D | N/D |
| pri-Amyl | N/D | N/D |
| n-Amyl | N/D | N/D |

| **OTHER** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Misc. Sulfurs | N/D | N/D |
| Thiophene | 2.7 | 0.158 |
| Thiophane | N/D | N/D |

| | | |
|---|---|---|
| Total Sulfur | 418.1 PPMV S | |
| | 24.708 Grains/100 cu.ft | |

| Source | Date | Notes |
|---|---|---|

CONTROL ENERGY SERVICES

Speciated Sulfur Analysis Report

## Critical Control Energy Services

South Charleston, West Virginia
1740 Union Carbide Drive
South Charleston, WV 25303

Report Date: Apr 25, 2024 3:02 PM

| | | | |
|---|---|---|---|
| Client: | ARCHAEA ENERGY | Date Sampled: | Apr 4, 2024 |
| Client Code: | 2697 | Analysis Date: | Apr 15, 2024 |
| Site: | BRPP - QUARTERLY | Collected By: | WAYLON TACKETT |
| Field: | 100 - ARCHAEA ENERGY | Date Effective: | Apr 15, 2024 12:00 AM |
| Meter: | 1301 | Source Pressure (PSI): | |
| Source Laboratory: | Charleston, WV | Source Temp (°F): | |
| **Lab File No:** | **SS4944** | | |
| Cylinder No: | BAG 3 | | |
| Analysis Status: | good | | |
| Sample Type: | Spot | | |
| Measurement Analyst: | | | |

Method: GPA-2199

| **SULFIDES** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Hydrogen | 384.6 | 22.728 |
| Carbonyl | 1.2 | 0.071 |
| Dimethyl | 101.5 | 5.998 |
| Methyl Ethyl | <0.5 | <0.5 |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | N/D | N/D |
| Di-n-propyl | 0.6 | 0.034 |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | N/D | N/D |
| Di-n-Butyl | N/D | N/D |
| Unknown | <0.5 | <0.5 |

| **DiSULFIDES** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Carbon | <0.5 | <0.5 |
| Dimethyl | 15.2 | 0.899 |
| Methyl Ethyl | 0.5 | 0.032 |
| Diethyl | N/D | N/D |
| Di-iso-Propyl | N/D | N/D |
| Di-n-Propyl | N/D | N/D |
| Di-iso-Butyl | N/D | N/D |
| Di-sec-Butyl | N/D | N/D |
| Di-tert-Butyl | 0.7 | 0.041 |
| Di-n-Butyl | N/D | N/D |
| Unknown | N/D | N/D |

| **MERCAPTANS** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Methyl | 62.7 | 3.707 |
| Ethyl | 1.6 | 0.092 |
| Isopropyl | 2.9 | 0.173 |
| n-Propyl | 1.3 | 0.079 |
| Isobutyl | N/D | N/D |
| sec-Butyl | N/D | N/D |
| tert-Butyl | 0.6 | 0.036 |
| n-Butyl | N/D | N/D |
| Isoamyl | 1.2 | 0.072 |
| pri-Amyl | N/D | N/D |
| n-Amyl | 0.6 | 0.037 |

| **OTHER** | PPMV | Grains / 100 cu.ft |
|---|---|---|
| Misc. Sulfurs | N/D | N/D |
| Thiophene | 5.3 | 0.313 |
| Thiophane | N/D | N/D |

| | | |
|---|---|---|
| Total Sulfur | 473.4 PPMV S | |
| | 27.978 Grains/100 cu.ft | |

| Source | Date | Notes |
|---|---|---|