TITLE V SIGNIFICANT PERMIT REVISION

ARCHAEA ENERGY

Prepared By:

TRINITY CONSULTANTS
909 Wright's Summit Pkwy. Ste. 230
Covington KY, 41011
(859) 341-8100

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Project Number: 251801.0037

Trinity Consultants

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1. BACKGROUND AND FACILITY DESCRIPTION

Archaea Energy, Inc. (Archaea) operates a Lightning Renewables, LLC renewable natural gas (RNG) facility (herein referred to as "Valley View RNG") located near the Republic Services, Inc. (Republic), Valley View Landfill in Sulphur, Trimble County, Kentucky. Lightning Renewables, LLC is a joint venture between Zeus Renewables, LLC (an indirect subsidiary of Archaea) and Republic Services Renewables Energy, LLC (an indirect subsidiary of Republic). Valley View RNG will be operated solely by Archaea; thus, this application is being submitted by Archaea on behalf of Lightning Renewables, LLC.

Archaea is currently permitted by Title V permit V-23-007, which was issued by the Kentucky Division for Air Quality (KDAQ or "the Division") on July 18, 2023. Archaea is submitting this significant permit revision application to incorporate the following revisions to the original Title V application:

- Archaea has decided to construct Valley View RNG to process a maximum of 3,200 dry standard cubic feet per minute (dscfm) of untreated landfill gas (LFG) instead of the original permitted design of 6,400 dscfm.
- The back-up flare at Valley View RNG will be a non-assisted shrouded flare instead of the proposed candlestick flare.
- Two (2) LFG condensate tanks will be constructed to hold LFG condensate for testing and analysis prior to sending back to Valley View Landfill's condensate system.
- Finally, in line with recent permitting for the Archaea's Tri-K RNG facility in Stanford, KY, Archaea is requesting a 400,000 million British thermal units (MMBtu) per year voluntary limit of waste gas (WG) fed to the flare for treatment. **Thus, pursuant to 401 KAR 52:020, Section 16, this voluntary limit meets the criteria to be processed by KDAQ as a significant permit revision.**

Pursuant to 401 KAR 52:020 Sections 4, 5, and 16, this application letter and its attachments contain the following information:

(1) A process description, emissions summary and calculation methodology discussion, and overview of applicable and non-applicable regulations within this letter;

(2) A DEP 7007AI form signed by the facility's designated responsible official, as described in 401 KAR 52:020 Section 21 [Appendix A];

(3) A revised DEP 7007B form, DEP 7007N, and DEP 7007GG form in addition to a new DEP 7007DD form for the various emission units pertinent to this permit application [Appendix A]; and

(4) A set of detailed emission calculations for all significant emission units [Appendix B].

To facilitate processing of this application, Archaea is providing the information below as supplemental information not required by 401 KAR 52:020:

(1) Suggested permit edits in the form of red-line strike out of Permit V-23-007 demonstrating requested changes [Appendix C]; and

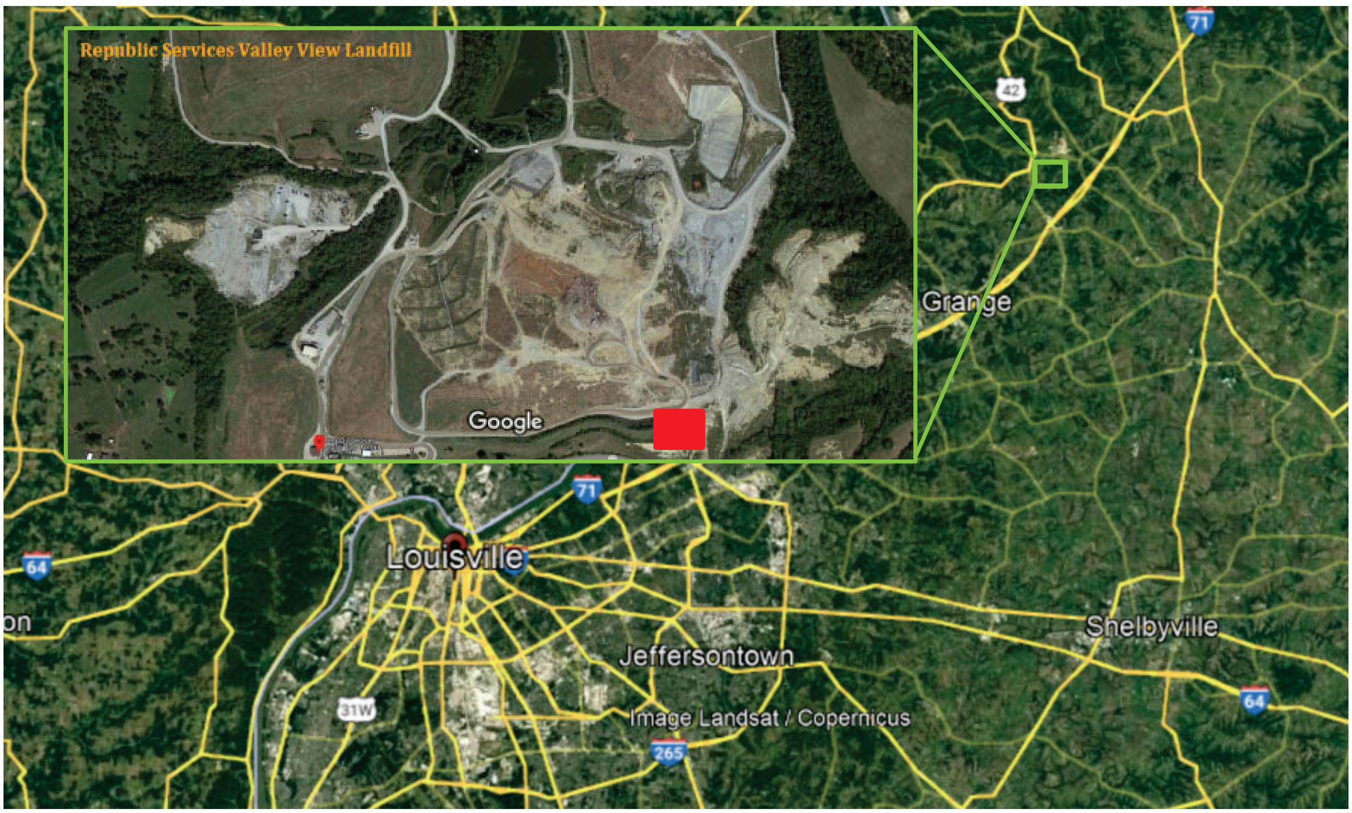
(2) Specifications for the non-assisted shrouded back-up flare and thermal recuperative oxidizer (TRO) system [Appendix D].

1.1 Facility Location

As illustrated on **Figure 1** below, the proposed location for Valley View RNG is adjacent to the southeast corner of Valley View Landfill. Valley View Landfill is located approximately 1 mile west of Sulphur, KY, and 2 miles west of Interstate-71. Valley View RNG will be approximately 25 miles northeast of the Louisville, KY, metropolitan area.

Valley View RNG will be located directly north of Highway 157. Therefore, like the Valley View Landfill, the facility will be located in Trimble County whereas Sulphur, KY, is predominantly located within Henry County.

Figure 1. Location of Valley View RNG



The Valley View RNG facility location is represented by the red box in the Valley View Landfill inset of the Figure above.

1.2 Process Description

LFG is a natural by-product created when organic materials decompose in landfills and generally consists of approximately 50% methane (CH_4), 50% carbon dioxide (CO_2), and small amounts of moisture, sulphur compounds, and other non-methane organic compounds (NMOCs). Republic will continue to operate the LFG collection and control system (GCCS) at Valley View Landfill that consists of the wellheads that capture LFG and the pre-treatment of LFG (i.e. moisture removal) prior to venting to Republic's flare. Once the construction of Valley View RNG is complete and Archaea commences operation, the untreated LFG will be diverted from Republic's flare to be treated/refined at Valley View RNG to produce pipeline quality RNG. Republic's flare will remain operational to control treated LFG as required during extended outages at Valley View RNG.

Valley View RNG will be designed to accept all the LFG generated by the Valley View Landfill. The original permit application permitted the facility for processing up to 6,400 dscfm treated LFG; however, the facility has since been re-designed for processing approximately 3,200 dscfm LFG. The untreated LFG at Valley View RNG will undergo treatment consisting of dewatering/moisture removal, sulphur compound removal, filtration, and compression. The final refining of the LFG consists of temperature swing adsorption (TSA) for siloxane and volatile organic compound (VOC)/NMOC removal, membrane separation for CO_2 removal, and pressure swing adsorption (PSA) for nitrogen (N_2) and oxygen (O_2) removal. The refined RNG will consist of greater than 95% CH_4, yielding a high-British thermal unit (Btu) gas that will be compressed to be injected into a nearby pipeline.

Two 15,000-gallon LFG condensate tanks and a diesel-fired emergency engine will also be installed as ancillary emission units supporting the RNG process. The diesel-fired emergency engine was documented in the initial permit application. Information regarding the LFG condensate tanks was not provided in the initial application; therefore, all necessary details are provided in this application. The LFG condensate tanks are used to hold LFG condensate for testing and analysis prior to sending back to the Landfill's condensate system.

1.2.1 Emissions Control

As described in the prior application, all gas that is not sent off-site as part of the final RNG product (i.e., various tail-gasses, off-specification RNG, WG from process upsets, etc.) from Valley View RNG will be controlled by one of the two control devices, the TRO, or a non-assisted shrouded flare.

- A **thermal recuperative oxidizer unit** manufactured by Conifer Systems will receive WG from each of the refinement processes (i.e., the TSA, membrane separation, and PSA).
  - As a continuous process, the WG is a fairly consistent mixture of TSA blowdown rich in NMOCs, membrane separation gas rich in CO_2, and PSA blowdown rich in N_2/O_2.
  - The maximum WG flow to the TRO will be 1,600 dscfm and 10.7 million Btu per hour (MMBtu/hr) based on the revised process design and, correspondingly, maximum TRO sizing parameters.
    - The WG typically consists of a maximum of 90% CO_2 and 12.2% CH_4, with the remainder being predominantly NMOCs, N_2, and O_2.
    - In addition, supplemental natural gas is added to the WG stream at a flow rate of 1,538 dscfh.
  - The inlet gas to the refinement process typically consists of 100 parts per million (ppm) of total reduced sulfur (TRS) as hydrogen sulfide (H_2S), as the vents from the refinement processes are downstream of the sulfur removal process. The sulfur removal process is designed to not exceed 100 ppm as H_2S on the outlet side.
  - The TRO will be designed to achieve a 99% control efficiency for methane, NMOC and HAPs.
- The **non-assisted shrouded flare** (Perennial Energy or equivalent) will operate as a supplemental control device for Valley View RNG. The flare will be designed to achieve 98% control efficiency for methane, NMOC and HAPs. Since flare utilization is not routine, Archaea considers several separate "flare modes" when characterizing flare vent gas including Untreated LFG from the Landfill that is received during an RNG plant outage, treated LFG that is flared post-CO_2 removal due to process upset, off-specification product RNG, and other vent streams as needed. Please refer to Appendix D for more details on updated flare specifications.

2. AIR EMISSIONS

All process-related emissions at Valley View RNG are emitted at either the TRO or back-up flare. Therefore, with regard to tabulating emissions and populating the appropriate DEP forms, the TRO and flare were initially proposed as Emission Units each with separate Process IDs for WG (i.e., vented process gas from various locations in the facility) and natural gas (i.e., pilot gas) combustion. Additional air emissions occur from the emergency generator and the LFG condensate tanks.

This revision application does not affect emissions from the emergency generator; thus, this emission unit is not discussed further herein. Changes from the original TRO calculations, flare calculations and the methodology for LFG condensate tank calculations are summarized in this section. Detailed calculations for all EUs are provided in Appendix B.

Finally, the original permit application was submitted under the assumption that Valley View RNG would be a separate source from the associated landfill. However, it was later determined that the two sites should be considered a single source. Thus, this application includes a total source PTE (i.e., PTE across both the landfill and RNG facility) that was not provided within the original application.

2.1 Thermal Recuperative Oxidizer

As discussed in Section 1, the facility has been re-designed to accommodate a maximum facility LFG inlet flow rate of 3,200 dscfm. As such, the as-designed WG flow rate and TRO max heat input have been updated to reflect the new facility capacity and equipment specifications. The emission factor methodology for all applicable criterial pollutants, hazardous air pollutants (HAPs), and greenhouse gasses (GHGs) are same as what was originally permitted.

In addition, the supplemental natural gas flow rate has changed to 1,538 dscfh as a result of the revision. Emission calculations pertaining to the combustion of natural gas have not changed aside from this as-designed natural gas flow rate.

2.2 Flare

The emissions at the shrouded back-up flare are calculated in a similar manner as what was provided in the original application, with the following exceptions:

- The worst-case emissions at the flare are based on Flare Mode 5/6, which has the highest methane flare flow rate and flare heat input and a 97% methane content, for calculation conservatism.
  - Flare Mode 5/6 and venting to the TRO do not occur simultaneously; however, the flow rate and heat input from all Modes are relatively similar.
- To account for limited utilization of the flare, Archaea is proposing a heat input operating limit of 400,000 MMBtu per rolling 12-month period, independent of the flare mode.

2.3 LFG Condensate Tanks

Two 15,000-gallon above ground tanks (ASTs) for LFG condensate storage will be located on the Valley RNG site. Standing and working losses of VOCs were calculated for the storage tanks using TankESP®, which calculates emissions using the equations in the current version of AP-42 Section 7.1. – *Organic Liquid*

Storage Tanks.[1] The LFG condensate was assumed to be comprised of 5% organics,[2] and all organics were conservatively assumed to be VOC and HAP. Archaea's operations suggest that the maximum amount of LFG condensate generated will be approximately 400,000 gallons per year; thus, Archaea assumed that each tank's throughput could be up to 400,000 gallons per year. Annual potential VOC and HAP emissions from the LFG condensate tanks using these assumptions and parameters are estimated to be 43.3 lb/yr for each pollutant. Refer to Appendix B for more information.

2.4 Summary of Source-Wide Potential Emissions

Archaea has calculated the site-wide maximum potential-to-emit (PTE) for Valley View RNG using the calculation methodologies summarized above. The summarized information is included in Table 2-1 below, while the detailed summary and detailed emission calculations are presented in Appendix B. Worst case emissions are represented by assuming the flare treats up to 400,000 MMBtu/yr of WG while the process continuously vents to the TRO for a conservative estimate.

Aggregated Emissions provided in Table 2-1 account for the decrease in emissions at Valley View Landfill resulting from diverting their treated LFG from the flare to Valley View RNG for processing and beneficial reuse by conservatively taking the maximum for each pollutant when comparing between Landfill and Valley View RNG PTE.

[1] <https://www.trinityconsultants.com/software/tanks/tankesp>

[2] <https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=2000TLO2.txt>

Table 2-1. Source-Wide PTE

Proposed EU ID	Proposed Process ID	Emission Unit Description	$PM/PM_{10}/PM_{2.5}$	CO	NOx	VOC	SO_2	CO_{2e}	Total HAP	Largest HAP
--	--	--	tpy	tpy	tpy	tpy	tpy	tpy	tpy	tpy
EU01		**Thermal Oxidizer**	**0.92**	**9.4**	**2.8**	**17.5**	**14.2**	**55,530**	**1.74**	**1.41**
	1	*Waste Gas Combustion*	*0.87*	*9.4*	*2.8*	*17.5*	*14.19*	*54,717*	*1.73*	*1.40*
	2	*Natural Gas Combustion*	*5.12E-02*	*-*	*-*	*3.71E-02*	*4.04E-03*	*813*	*1.27E-02*	*1.21E-02*
EU02		**Back-up Flare**	**7.1**	**20.9**	**17.9**	**2.06**	**7.27**	**87,816**	**1.68**	**1.23**
	1	*Waste Gas Combustion*	*7.1*	*20.8*	*17.6*	*2.05*	*7.27*	*87,608*	*1.68*	*1.23*
	2	*Natural Gas Combustion*	*1.31E-02*	*1.44E-01*	*3.26E-01*	*9.45E-03*	*1.03E-03*	*207*	*3.24E-03*	*1.29E-04*
EU03		**Emergency Engine**	**1.46E-02**	**0.13**	**0.49**	**4.00E-02**	**7.67E-04**	**82.9**	**8.24E-04**	--
IA01		**LFG Condensate Tanks (2)**	-	-	-	**2.17E-02**	-	-	**2.17E-02**	--
Total		**Worst Case (TRO and Flare)[1-3]**	**8.06**	**30.4**	**21.2**	**17.6**	**14.2**	**94,662**	**1.76**	**2.64**
Landfill PTE[4]			9.65	160	39.1	1.09	43.6	114,227	12.9	3.94
Aggregated Emissions[5]			9.65	160	39.1	17.6	43.6	114,227	12.9	3.94

[1] VOC, SO_2, and HAP emissions use the maximum between the TRO and flare. The vendor guarantee for VOC from the TRO is based on worst case TRO loading (which does not include flare operation) and VOC from the flare is calculated via a mass balance from the maximum amount of NMOC in the LFG. SO_2 emissions are based on a mass balance of all incoming TRS in the LFG, and organic HAP is calculated based on a mass balance of all incoming HAP in the LFG.

[2] CO_2 emissions at both the TRO and back-up flare are calculated assuming all CO_2 in the LFG is vented uncontrolled plus CO_2 generated from combustion. The contribution from LFG is 97,534 tons of CO_2 as derived in Sections 1 and 2 of Appendix B. Thus, 97,534 tons is subtracted from the CO_{2e} total to avoid double counting since CO_2 from LFG cannot be emitted from both the TRO and flare.

[3] All other pollutants are additive across the all three emission units.

[4] Per Valley View Landfill Permit Application Summary Form

[5] Aggregated emissions account for the decrease in emissions at Valley View Landfill by conservatavely using the maximum for each pollutant from either Valley View Landfill or Valley View RNG.

3. REGULATORY ANALYSIS

Valley View RNG is subject to certain federal and state air regulations. In this section of the application, the regulatory requirements that are potentially applicable are summarized.

3.1 Source Classification and Permitting Requirements

3.1.1 Single Source Determination

Please refer to the original application for discussion pertaining to the New Source Review (NSR)/Prevention of Significant Deterioration (PSD) criteria for evaluating whether two distinct facilities should be considered the same source for the purposes of air permitting.

3.1.2 PSD Permitting Program

Kentucky has incorporated the requirements of the PSD permitting program into its state implementation plan (SIP) at 401 KAR 51:017. These PSD regulations specifically define 28 industrial source categories for which the "major" source threshold of any regulated NSR pollutant is 100 tpy. Valley View RNG's source category (i.e., electric, gas, and sanitary services as represented by SIC code 49) is not on the "list of 28." Furthermore, Valley View RNG will be located in Trimble County, which has been designated as attainment or unclassified for all NSR pollutants. Thus, non-attainment NSR does not apply and the major source threshold under the PSD program for any regulated NSR pollutant emitted at Valley View RNG is 250 tpy.

As provided in Section 2 of this application, the PTE rates for all NSR pollutants—including the combined worst-case Valley View RNG and Valley View Landfill combined emission rates—are below the 250 tpy threshold for the PSD permitting program. Therefore, Valley View RNG is not a major stationary source.

3.1.3 Title V Permitting Requirements

40 CFR 70 contains the regulations implementing the federal Title V operating permit program. Kentucky has incorporated the provisions of this federal program in its Title V operating program at 401 KAR 52:020. As specified in 401 KAR 52:001, Section 1(46), major sources with respect to the Title V regulations are those facilities with potential emissions of 100 tpy or greater of any regulated pollutants, 10 tpy or greater of any single HAP and/or 25 tpy or greater of combined HAP.

As provided in Section 2, the maximum emission rate of CO from Valley View RNG is 159.96 tpy, surpassing the 100 tpy threshold to be a major source with regard to Title V. Uncontrolled total HAP emissions are below the single HAP and combined HAP emission rates without the need for synthetic limits. Therefore, Valley View RNG is classified as an area source of HAP.

3.2 New Source Performance Standards

The NSPS rules, located in 40 CFR Part 60, require new, modified, or reconstructed sources to control emissions to the level achievable by the best-demonstrated technology as specified in the applicable provisions. The applicability of NSPS subparts for affected emission units at Valley View RNG remained unchanged from the prior application. Please refer to the previous application for a detailed narrative of regulatory applicability for each Subpart listed below.

- NSPS Subpart WWW - Standards of Performance for Municipal Solid Waste Landfills That Commenced Construction, Reconstruction, or Modification on or After May 30, 1991, but Before July 18, 2014 [Not Applicable]
- NSPS Subpart XXX - Standards of Performance for Municipal Solid Waste Landfills That Commenced Construction, Reconstruction, or Modification After July 17, 2014 [Not Applicable]
- NSPS Subpart IIII - Standards of Performance for Stationary Compression Ignition Internal Combustion Engines [Applicable]

3.3 National Emission Standards for Hazardous Air Pollutants

NESHAPs in 40 CFR Part 63 apply to sources in specifically regulated industrial source classifications [Clean Air Act Section 112(d)] or on a case-by-case basis [Clean Air Act Section 112(g)] for facilities not regulated as a specific industrial source type. Pollutant-specific NESHAP in 40 CFR Part 61 may also be applicable. NESHAP are primarily developed for industrial source categories. Therefore, the applicability of a particular NESHAP to a site can be readily ascertained based on the industrial source category covered. Similarly to the NSPS rules, the regulatory applicability of NESHAPs for the Valley View RNG site has not changed since the prior application.

- Subpart AAAA – National Emission Standards for Hazardous Air Pollutants: Municipal Solid Waste Landfills [Applicable]
  - As stated in the most recent Title V Permit Application for the RNG facility located Stanford, Kentucky (Tri-K RNG), Archaea continues to contend that 40 CFR Subpart AAAA (63AAAA) applies to the flare but does not apply to the TRO.
    - The TRO only receives process vents from refinement processes that are downstream of the point at which the LFG has been treated and transferred for beneficial reuse.
    - In the December 2023 permit application for Tri-K RNG, Archaea established that the Applicability Determination used by the Division as the basis for applying 63AAAA did not account for the fact that the emission unit from the Applicability Determination used LFG as a purge gas. Alternatively, the TRO does not receive LFG and, therefore, cannot be subject to the requirements of 63AAAA.
  - If, in the future, the Division revises their interpretation of 63AAAA, the basis of pertinent regulations for the requirements for the thermal oxidizer will change from 63AAAA to 401 KAR 52:020 (i.e., the voluntary requirements that effectively mirror 63AAAA proposed in the original application). Please refer to the Title V Permit Application Submitted December 2023 for the Stanford Facility for additional context on Archaea's interpretation of 40 CFR Subpart AAAA.
- Subpart ZZZZ – National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines [Applicable]

3.4 Approval and Promulgation of State Plans for Designated Facilities and Pollutants

As covered in the previous application, 40 CFR 62 Subpart OOO applies to landfills and, in the case of an RNG facility, "treatment systems" in the same manner as 40 CFR 63 Subpart AAAA. The requirements are essentially identical to 40 CFR 63 Subpart AAAA. Refer to the applicable requirements from this regulation as provided in the DEP 7007V form of the initial application for additional information.

- Subpart OOO – Federal Plan Requirements for Municipal Solid Waste Landfills That Commenced Construction on or Before July 17, 2014, and Have Not Been Modified or Reconstructed Since July 17, 2014 [Applicable]

3.5 Kentucky SIP Regulations

Various emission units at Valley View RNG are also subject or potentially subject to certain Kentucky Administrative Regulations (401 KAR). Applicability of selected state implementation plan SIP regulations is discussed in the following subsections. Please refer to the previous application for discussion on the following SIP regulations as applicability has not changed.

- 401 KAR 50:012 - General Application
- 401 KAR 59:010 – New Process Operations
- 401 KAR 59:105 – New Process Gas Streams
- 401 KAR 63:015 – Flares
- 401 KAR 63:020 - Potentially Hazardous Matter or Toxic Substances

3.5.1 401 KAR 52:020 – Title V Permitting Program

40 CFR Part 70 contains the regulations implementing the federal Title V operating permit program. Kentucky has incorporated the provisions of this federal program in its Title V operating program at 401 KAR 52:020. As established in Section 3.1.3. of this application, Valley View RNG is a major source with regard to Title V.

With the submission of this major permit revision to the initial application, Archaea is requesting a 400,000 MMBtu/yr operating limit of WG sent to the flare for treatment.

410 KAR 52:020, Section 16 provides procedures for existing Title V sources to obtain significant permit revisions for modifications that involve significant changes in the monitoring requirements, a relaxation in the reporting or recordkeeping requirements contained in the permit, or for changes that do not qualify as administrative permit amendments or minor permit revisions. As this application requests a voluntary limit, it cannot be processed as a minor permit revision per Section 14(1)(d). Therefore, Archaea has prepared this submittal in accordance with the requirement for significant permit revisions, which follow the same procedures that are required for initial permits and permit renewals per 401 KAR 52:020 Section 16(2). The appropriate DEP7007 forms covering the proposed changes are provided in Appendix A, emission calculations are provided in Appendix B and a suggested draft permit is provided in Appendix C.

3.5.1.1 401 KAR 52:020 Section 6 – Insignificant Activities

The following bullet list demonstrates that IA01, LFG Condensate Tanks (2), meets the requirements set forth in 401 KAR 52:020, Section 6:

- The PTE from each activity shall not exceed one-half (1/2) tons per year of combined HAPs; or five (5) tons per year of a nonhazardous regulated air pollutant
  - The emissions generated by the LFG Condensate Tanks, represented by IA01, do not exceed the aforementioned emission quantities. Please refer to Appendix B for detailed emissions calculations.
- The activity shall not involve the incineration of medical waste.
  - This emissions unit does not involve the incineration of medical waste.
- This activity shall not be subject to a federally enforceable requirement, other than generally applicable requirements.
  - This unit is not subject to any federally enforceable requirement.

Since IA01 meets the aforementioned bullet points, it qualifies for the designation of an insignificant activity pursuant to 401 KAR 52:020, Section 6.

3.6 Certification Statement

Based on information and belief formed after reasonable inquiry, the statements and information contained in this notification are true, accurate, and complete and the planned formulation change meets the criteria of a Significant Permit Revision. This declaration is affirmed by the Valley View RNG's responsible official via the signature on the DEP 7007AI form in Appendix A. Through this, Archaea requests use of these procedures in accordance with 401 KAR 52:020, Section 16.

APPENDIX A. DEP 7007 FORMS

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: Lightning Renewables -- Valley View RNG

KY EIS (AFS) #: 21- 23-00022

Permit #: V-23-007

Agency Interest (AI) ID: 175095

Date: 11/3/2025

Section AI.1: Source Information

Physical Location Address:	**Street:**	9120 Sulphur Road				
	City:	Sulphur	**County:**	Trimble	**Zip Code:**	40070
Mailing Address:	**Street or P.O. Box:**	201 Helios Way, Floor 6				
	City:	Houston	**State:**	TX	**Zip Code:**	77079

Standard Coordinates for Source Physical Location

Longitude: -85.2867° (decimal degrees) **Latitude:** 38.4986° (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: Converting landfill gas to renewable natural gas for pipeline injection

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: 3-5

Approximate distance to nearest residence or commercial property: 0.2 miles **Property Area:** TBD **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: Lightning Renewables, LLC

Title: (if individual)

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

Email: (if individual)

Phone: 346-708-8272

Technical Contact

Name: Nevin Edwards

Title: Environmental Data and Development Manager

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

Email: nedwards@archaea.energy

Phone: (724) 766-8388

Air Permit Contact for Source

Name: Nevin Edwards

Title: Environmental Data and Development Manager

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

Email: nedwards@archaea.energy

Phone: (724) 766-8388

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

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 <-- Requested Operating Limit

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)* Upon Issuance or 2Q2026

Proposed Operation Start-Up Date: *(MM/YYYY)* Upon Issuance or 4Q2026

For Modifications:

Proposed Start Date of Modification: *(MM/YYYY)* ____________

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

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

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

11/21/2025

Date

Steven Boor

Type or Printed Name of Signatory

Sr. VP, Operations

Title of Signatory

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

Section AI.7: Notes, Comments, and Explanations

Division for Air Quality

300 Sower Boulevard
Frankfort, KY 40601
(502) 564-3999

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: Lightning Renewables -- Valley View RNG
KY EIS (AFS) #: 21- 23-00022
Permit #: V-23-007
Agency Interest (AI) ID: 175095
Date: 11/3/2025

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)*
EU01	Thermal Oxidizer	Thermal Oxidizer for combusting waste gas	1	Waste Gas Combustion	Conifer	TRO-65-60-100	TBD	Continuous	--	--
EU01	Thermal Oxidizer	Thermal Oxidizer for combusting waste gas	2	Natural Gas Combustion	Conifer	TRO-65-60-100	TBD	Continuous	--	--
EU02	Back-up Flare	Flare for combusting waste gas	1	Waste Gas Combustion	Perennial Energy (or equivalent)	TBD	TBD	Continuous	--	--
EU02	Back-up Flare	Flare for combusting waste gas	2	Natural Gas Combustion	Perennial Energy (or equivalent)	TBD	TBD	Continuous	--	--

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)*		
Thermal Oxidizer	Thermal Oxidizer	Waste Gas	0.096	MMscf/hr	3.67	n/a	n/a	n/a	Natural Gas	0.00154	MMscf/hr	13.5	MMscf/yr	neg	neg
Back-up Flare	Back-up Flare	Waste Gas	0.192	MMscf/hr	7.34	n/a	n/a	n/a	Natural Gas	0.00039	MMscf/hr	3.44	MMscf/yr	neg	neg

Section B.3: Notes, Comments, and Explanations

Division for Air Quality
300 Sower Boulevard
Frankfort, KY 40601
(502) 564-3999

DEP7007DD

Insignificant Activities

___ Section DD.1: Table of Insignificant Activities
___ Section DD.2: Signature Block
___ Section DD.3: Notes, Comments, and Explanations

Source Name: Lightning Renewables -- Valley View RNG
KY EIS (AFS) #: 21- 23-00022
Permit #: V-23-007
Agency Interest (AI) ID: 175095
Date: 11/3/2025

Section DD.1: Table of Insignificant Activities

*Identify each activity with a unique Insignificant Activity number (IA #); for example: 1, 2, 3… etc.

Insignificant Activity #	Description of Activity including Rated Capacity	Serial Number or Other Unique Identifier	Applicable Regulation(s)	Calculated Emissions
IA01	LFG Condensate Tanks (2)	IA01	401 KAR 63:020	<0.1 tpy VOC's, <0.1 tpy HAP's

Section DD.2: 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.

By:

DocuSigned by:
Steven Boor
B3BA495CCB09470...
Authorized Signature

11/21/2025
Date

Steven Boor
Type/Print Name of Siguatory

Sr. VP, Operations
Title of Siguatory

Section DD.3: Notes, Comments, and Explanations

Division for Air Quality

300 Sower Boulevard
Frankfort, KY 40601
(502) 564-3999

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: Lightning Renewables -- Valley View RNG
KY EIS (AFS) #: 21- 23-00022
Permit #: V-23-007
Agency Interest (AI) ID: 175095
Date: 11/3/2025

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)
EU01	Thermal Oxidizer	1	Waste Gas Combustion	Thermal Oxidizer	C01	S01	0.0960	NOX	6.69	Vendor guarantee	100.00%	--	0.64	na	2.81	na
							0.0960	CO	22.29	Vendor guarantee	100.00%	--	2.14	na	9.37	na
							0.0960	VOC	41.60	Vendor guarantee	100.00%	--	3.99	na	17.49	na
							0.0960	PM	2.07	AP-42 Table 2.4-5	100.00%	--	0.20	na	0.87	na
							0.0960	PM10	2.07	Assume all PM is PM2.5	100.00%	--	0.20	na	0.87	na
							0.0960	PM2.5	2.07	Assume all PM is PM2.5	100.00%	--	0.20	na	0.87	na
							0.0960	SO2	33.74	Mass balance/process design	100.00%	--	3.24	na	14.19	na
							0.0960	Dichloro-methane	6.40	AP-42 Table 2.4-1	100.00%	99.00%	0.61	6.15E-03	2.69	0.03
							0.0960	Hydrogen Chloride	3.33	Mass balance	100.00%	--	0.32	na	1.40	na
							0.0960	Toluene	5.92	AP-42 Table 2.4-1	100.00%	99.00%	0.57	5.69E-03	2.49	0.02
							0.0960	Perchloro-ethylene	3.26	AP-42 Table 2.4-1	100.00%	99.00%	0.31	3.13E-03	1.37	0.01
							0.0960	Xylenes	6.77	AP-42 Table 2.4-1	100.00%	99.00%	0.65	6.50E-03	2.85	0.03
							0.0960	Total HAP	45.55	AP-42 Table 2.4-1	100.00%	90.98%	4.37	0.39	19.15	1.73
							0.0960	CO2	128,775	Mass balance/40 CFR 98	100.00%	--	12,362	na	54,147	na
							0.0960	CH4	5,158	Mass balance/40 CFR 98	100.00%	98.98%	495	5.03	2,169	22.01
							0.0960	N2O	0.15	40 CFR 98	100.00%	--	0.01	na	0.07	na
							0.0960	CO2e	257,765	40 CFR 98	100.00%	49.52%	24,745	12,492	108,385	54,717

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: Uncontrolled Potential (lb/hr)	Hourly Emissions: Controlled Potential (lb/hr)	Annual Emissions: Uncontrolled Potential (tons/yr)	Annual Emissions: Controlled Potential (tons/yr)
EU01	Thermal Oxidizer	2	Natural Gas Combustion	Thermal Oxidizer	C01	S01	1.54E-03	VOC	5.50	AP-42, Table 1.4-2.	100.00%	--	8.46E-03	na	0.04	na
							1.54E-03	PM	7.60	AP-42, Table 1.4-2.	100.00%	--	0.01	na	0.05	na
							1.54E-03	PM10	7.60	Assume all PM is PM2.5	100.00%	--	0.01	na	0.05	na
							1.54E-03	PM2.5	7.60	Assume all PM is PM2.5	100.00%	--	0.01	na	0.05	na
							1.54E-03	SO2	0.60	AP-42, Table 1.4-2.	100.00%	--	9.23E-04	na	4.04E-03	na
							1.54E-03	Benzene	2.10E-03	AP-42, Table 1.4-3	100.00%	--	3.23E-06	na	1.41E-05	na
							1.54E-03	Formaldehyde	0.08	AP-42, Table 1.4-3	100.00%	--	1.15E-04	na	5.05E-04	na
							1.54E-03	Hexane	1.80	AP-42, Table 1.4-3	100.00%	--	2.77E-03	na	0.01	na
							1.54E-03	Nickel	2.10E-03	AP-42, Table 1.4-4	100.00%	--	3.23E-06	na	1.41E-05	na
							1.54E-03	Toluene	3.40E-03	AP-42, Table 1.4-3	100.00%	--	5.23E-06	na	2.29E-05	na
							1.54E-03	Total HAP	1.89	AP-42, Table 1.4-3	100.00%	--	2.91E-03	na	0.01	na
							1.54E-03	CO2	120,000	40 CFR 98	100.00%	--	185	na	808	na
							1.54E-03	CH4	2.30	40 CFR 98	100.00%	--	3.54E-03	na	0.02	na
							1.54E-03	N2O	2.20	40 CFR 98	100.00%	--	3.38E-03	na	0.01	na
							1.54E-03	CO2e	120,713	40 CFR 98	100.00%	--	186	na	813	na
EU02	Back-up Flare	1	Waste Gas Combustion	Flare	C02	S02	0.1920	NOX	40.83	AP-42 Section 2.4 Table 2.4-4	100.00%	--	7.84	na	17.59	na
							0.1920	CO	48.16	AP-42 Section 2.4 Table 2.4-4	100.00%	--	9.25	na	20.75	na
							0.1920	VOC	238	AP-42 Section 2.4.4.1	100.00%	98.00%	45.72	0.91	2.05	0.04
							0.1920	PM	16.49	AP-42 Table 2.4-5	100.00%	--	3.17	na	7.11	na
							0.1920	PM10	16.49	Assume all PM is PM2.5	100.00%	--	3.17	na	7.11	na
							0.1920	PM2.5	16.49	Assume all PM is PM2.5	100.00%	--	3.17	na	7.11	na
							0.1920	SO2	16.87	Mass balance	100.00%	--	3.24	na	7.27	na
							0.1920	Dichloro-methane	5.64	AP-42 Table 2.4-1	100.00%	98.00%	1.08	0.02	0.05	9.72E-04
							0.1920	Hydrogen Chloride	2.86	Mass balance	100.00%	--	0.55	na	1.23	na
							0.1920	Toluene	5.22	AP-42 Table 2.4-1	100.00%	98.00%	1.00	0.02	0.04	9.00E-04
							0.1920	Perchloro-ethylene	2.87	AP-42 Table 2.4-1	100.00%	98.00%	0.55	0.01	0.02	4.95E-04
							0.1920	Xylenes	5.97	AP-42 Table 2.4-1	100.00%	98.00%	1.15	0.02	0.05	1.03E-03
							0.1920	Total HAP	40.04	AP-42 Table 2.4-1	100.00%	90.26%	7.69	0.75	1.68	0.16
							0.1920	CO2	183,519	Mass balance/40 CFR 98	100.00%	--	35,236	na	79,083	na
							0.1920	CH4	38,737	Mass balance/40 CFR 98	100.00%	97.99%	7,438	150	336	6.76
							0.1920	N2O	0.98	40 CFR 98	100.00%	--	0.19	na	0.42	na
							0.1920	CO2e	1,152,242	40 CFR 98	100.00%	82.36%	221,231	39,034	87,608	15,458

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)
EU02	Back-up Flare	2	Natural Gas Combustion	Flare	C02	S02	3.92E-04	VOC	5.50	AP-42, Table 1.4-2.	100.00%	--	2.16E-03	na	9.45E-03	na
							3.92E-04	PM	7.60	AP-42, Table 1.4-2.	100.00%	--	2.98E-03	na	0.01	na
							3.92E-04	PM10	7.60	Assume all PM is PM2.5	100.00%	--	2.98E-03	na	0.01	na
							3.92E-04	PM2.5	7.60	Assume all PM is PM2.5	100.00%	--	2.98E-03	na	0.01	na
							3.92E-04	SO2	0.60	AP-42, Table 1.4-2.	100.00%	--	2.35E-04	na	1.03E-03	na
							3.92E-04	CO	84.00	AP-42, Table 1.4-1.	100.00%	--	0.03	na	0.14	na
							3.92E-04	NOx	190	AP-42, Table 1.4-1.	100.00%	--	0.07	na	0.33	na
							3.92E-04	Benzene	2.10E-03	AP-42, Table 1.4-3	100.00%	--	8.24E-07	na	3.61E-06	na
							3.92E-04	Formaldehyde	0.08	AP-42, Table 1.4-3	100.00%	--	2.94E-05	na	1.29E-04	na
							3.92E-04	Hexane	1.80	AP-42, Table 1.4-3	100.00%	--	7.06E-04	na	3.09E-03	na
							3.92E-04	Nickel	2.10E-03	AP-42, Table 1.4-4	100.00%	--	8.24E-07	na	3.61E-06	na
							3.92E-04	Toluene	3.40E-03	AP-42, Table 1.4-3	100.00%	--	1.33E-06	na	5.84E-06	na
							3.92E-04	Total HAP	1.89	AP-42, Table 1.4-3	100.00%	--	7.41E-04	na	3.24E-03	na
							3.92E-04	CO2	120,000	40 CFR 98	100.00%	--	47.06	na	206	na
							3.92E-04	CH4	2.30	40 CFR 98	100.00%	--	9.02E-04	na	3.95E-03	na
							3.92E-04	N2O	2.20	40 CFR 98	100.00%	--	8.63E-04	na	3.78E-03	na
							3.92E-04	CO2e	120,713	40 CFR 98	100.00%	--	47.34	na	207	na

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)*
S01	Thermal Oxidizer	4.50	60.0	~827	TBD	TBD	71,075	~1,000-2,000	74.48
S02	Back-up Flare	1.33	>=50.0	~827	TBD	TBD	3,400	1,000 - 2,000	40.58

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)*
Not Applicable for this Application								

Section N.4: Notes, Comments, and Explanations

Division for Air Quality

300 Sower Boulevard
Frankfort, KY 40601
(502) 564-3999

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: Lightning Renewables -- Valley View RNG
KY EIS (AFS) #: 21- 23-00022
Permit #: V-23-007
Agency Interest (AI) ID: 175095
Date: 11/3/2025

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 ($^\circ F$)	Flowrate (scfm @ 68 °F)	Average Particle Diameter (μm)	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 (%)
TRO1	Thermal Recuperative Oxidizer	$669,000	Conifer	TRO-65-60-100	TBD	<300	3,200	neg	neg	TBD	0.50%	Max 12.2% CH4 Primarily CO2	Various	na	Methane/ NMOCs	99%
F01	Back-up Flare	$369,360	Perennial Energy (or equivalent)	TBD	TBD	1,000 - 2,000	3,200	neg	neg	TBD	--	--	--	na	Methane/ NMOCs	98%

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)*
F01	RNG Facility	non-assisted	3,400	Max ~708 Btu/scf	98%	Max ~90 MMBtu/hr

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)	
TRO1	RNG Facility	TRO	1	7.5MM	unk	~0.5	1,500 - 1,800	na	Crossflow Shell-and-Tube In-line Tube Bank	NG	1,020	Max 1538	neg	neg	neg	neg	Various tailgasses/waste gas from RNG process

Section GG.12: Notes, Comments, and Explanations

APPENDIX B. DETAILED EMISSION CALCULATIONS

1. Emissions Associated with Waste Gas Combustion at the Thermal Oxidizer

1.1 Design Parameters and Constants

1.1.1 Thermal Oxidizer, Waste Gas, and System Design Parameters

Parameter	Value	Units	Notes/Basis
Facility Inlet Flow Rate	3,200	dscfm	Facility design based on treated LFG from landfill
	0.192	MMscf/hr	= 3,200 dscfm Facility Inlet Flow Rate x 60 min/hr / 1,000,000 scf/MMscf
Annual Operating Hours	8,760	hr/year	
Design Natural Gas Flow Rate	1,538	dscfh	TRO vendor specifications
Maximum Waste Gas Flow Rate	1,600	dscfm	
	0.096	MMscf/hr	= 1,600 dscfm Maximum Waste Gas Flow Rate x 60 min/hr / 1,000,000 scf/MMscf
Exhaust Flow Rate	14,653	scfm	
Exhaust Temperature	800	°F	
TRO Max Heat Input	10.70	MMBtu/hr	
Control Efficiency	99.0%	%	

1.1.2 Ideal Gas Law Constants & Chemical Parameters

Parameter	Value	Units
Standard Temperature	60	°F
Standard Pressure	1	atm
Ideal Gas Constant	0.7302	ft3-atm/lbmol-°R
HCl Molecular Weight	36.458	lbs/lbmol
Cl Molecular Weight	35.453	lbs/lbmol
HF Molecular Weight	20.01	lbs/lbmol
F Molecular Weight	18.99	lbs/lbmol

1.2 Emission Calculation Methodology and Emission Factors

1.2.1 SO2 Emission Factor Development

Parameter	Value	Units	Notes/Basis
Maximum TRS Concentration	100	ppm (as H2S)	Design basis for post-H2S removal
TRS Molar Flow	5.06E-02	lb-mol/hr	= 3,200 dscfm Facility Inlet Flow Rate x 60 min/hr x 100 ppm (as H2S) / 1e6 parts/million parts x 1 atm Standard Pressure / 0.7302 ft3-atm/lbmol-°R Ideal Gas Constant / 60 °F Standard Temperature converted to Rankine
Molar Conversion	1	mol H2S/mol SO2	1 S molecule in each compound
SO2 Molecular Weight	64.01	lb/lbmol	
SO2 Outlet Emissions	3.24	lb SO2/hr	= 5.06E-02 lb-mol/hr TRS Molar Flow as H2S / 1 mol H2S/mol SO2 x 64.01 lb/lbmol SO2 Molecular Weight
SO2 Emission Factor	33.74	lb SO2/MMscf	= 3.24 lb SO2/hr / 0.096 MMscf/hr Maximum Waste Gas Flow Rate

1.2.2 CO, NOx, and VOC Emission Factor Development

Parameter	Value	Units	Notes/Basis
CO Design Value	0.20	lb/MMBtu	Vendor Guarantee
CO Mass Flow	2.14	lb CO/hr	= 0.20 lb/MMBtu x (10.7MMBtu/hr from WG + 1.57 MMBtu/hr from NG*)
CO Emission Factor	22.29	lb CO/MMscf	= 2.14 lb CO/hr / 0.096 MMscf/hr Maximum Waste Gas Flow Rate

* CO calculations include NG heat input since the emission factor is for total outlet emissions.

Parameter	Value	Units	Notes/Basis
NOx Design Value	0.06	lb/MMBtu	Vendor Guarantee
NOx Mass Flow	0.64	lb NOx/hr	= 0.06 lb/MMBtu x (10.7MMBtu/hr from WG + 1.57 MMBtu/hr from NG*)
NOx Emission Factor	6.69	lb NOx/MMscf	= 0.64 lb NOx/hr / 0.096 MMscf/hr Maximum Waste Gas Flow Rate

* NOx calculations include NG heat input since the emission factor is for total outlet emissions.

Detailed Emission Calculations

Parameter	Value	Units	Notes/Basis
Maximum VOC Concentration in Exhaust	20	ppm (as hexane)	Vendor guarantee
VOC Molar Flow	4.63E-02	lb-mol/hr	= 14,653 scfm Exhaust Flow Rate x 60 min/hr x 20 ppm (as hexane) / 1e6 parts/million parts x 1 atm Standard Pressure / 0.7302 ft3-atm/lbmol-°R Ideal Gas Constant / 60 °F Standard Temperature converted to Rankine
Hexane Molecular Weight	86.18	lb/lbmol	
VOC Outlet Emissions	3.99	lb VOC/hr	= 4.63E-02 lb-mol/hr VOC Molar Flow as hexane x 86.18 lb/lbmol Hexane Molecular Weight
VOC Emission Factor	41.60	lb VOC/MMscf	= 3.99 lb VOC/hr / 0.096 MMscf/hr Maximum Waste Gas Flow Rate

1.2.3 PM/PM10/PM2.5 Emission Factor Development

Parameter	Value	Units	Notes/Basis
PM/PM10/PM2.5 Emission Factor	17.00	lbs PM/MMdscf CH_4	AP-42 Section 2.4 Table 2.4-5
Maximum Methane Content	12.2%	%,vol	RTO Specifications
PM/PM10/PM2.5 Mass Flow	0.20	lb PM/hr	= 17.00 lbs PM/MMdscf CH4 x 0.096 MMscf/hr Maximum Waste Gas Flow Rate x 12.2% Maximum Methane Content
PM/PM10/PM2.5 Emission Factor	2.07	lb PM/MMscf	= 0.20 lb PM/hr / 0.096 MMscf/hr Maximum Waste Gas Flow Rate

1.2.4 GHG Emission Factor Development

Parameter	Value	Units	Notes/Basis
CO2 Emission Factor	52.07	kg/MMBtu	40 CFR Part 98, Table C-1 for LFG
	114.79	lb/MMBtu	Unit Conversion
CO2 Mass Flow from Combustion	1,228.3	lb CO2/hr	= 114.79 lb/MMBtu x 10.7 MMBtu/hr TRO Max Heat Input
CO2 in LFG	50%	%,vol	Maximum CO2 Content of LFG at Valley View
CO2 Molar Flow from LFG	252.99	lb-mol/hr	= 3,200 dscfm x 60 min/hr x 50% x 1 atm Standard Pressure / 0.7302 ft3-atm/lbmol-°R Ideal Gas Constant / 60 °F Standard Temperature converted to Rankine
CO2 Molecular Weight	44.01	lb/lb-mol	
CO2 Mass Flow from LFG	11,134.0	lb CO2/hr	= 252.99 lb-mol/hr CO2 Molar Flow from LFG x 44.01 lb/lb-mol CO2 Molecular Weight
Total CO2 Emissions	12,362.4	lb CO2/hr	= 1,228.3 lb CO2/hr CO2 Mass Flow from Combustion + 11,134.0 lb CO2/hr CO2 Mass Flow from LFG
Total CO2 Emission Factor	128,774.5	lb CO2/MMscf	= 12,362.4 lb CO2/hr / 0.096 MMscf/hr Maximum Waste Gas Flow Rate

Parameter	Value	Units	Notes/Basis
CH4 Emission Factor	3.20E-03	kg/MMBtu	40 CFR Part 98, Table C-2 for Gaseous Biomass
	7.05E-03	lb/MMBtu	Unit Conversion
CH4 Mass Flow from Combustion	0.08	lb CH4/hr	= 0.01 lb/MMBtu x 10.7 MMBtu/hr TRO Max Heat Input
Maximum Methane Content	12.2%	%,vol	RTO Specifications
CH4 Molar Flow	30.86	lb-mol/hr	= 1,600 dscfm Maximum Waste Gas Flow Rate x 60 min/hr x 12.2% x 1 atm Standard Pressure / 0.7302 ft3-atm/lbmol-°R Ideal Gas Constant / 60 °F Standard Temperature converted to Rankine
CH4 Molecular Weight	16.04	lb/lb-mol	
CH4 Mass Flow to TO	495.1	lb CH4/hr	= 30.86 lb-mol/hr CH4 Molar Flow x 16.04 lb/lb-mol CH4 Molecular Weight
Total CH4 Emissions	495.1	lb CH4/hr	= 0.08 lb CH4/hr CH4 Mass Flow from Combustion + 495.1 lb CH4/hr CH4 Mass Flow to TO
CH4 Emission Factor	5,157.8	lb CH4/MMscf	= 495.1 lb CH4/hr / 0.096 MMscf/hr Maximum Waste Gas Flow Rate

Parameter	Value	Units	Notes/Basis
N2O Emission Factor	6.30E-04	kg/MMBtu	40 CFR Part 98, Table C-2 for Gaseous Biomass
	1.39E-03	lb/MMBtu	Unit Conversion
N2O Mass Flow	1.49E-02	lb N2O/hr	= 1.39E-03 lb/MMBtu x 10.7 MMBtu/hr TRO Max Heat Input
N2O Emission Factor	0.155	lb N2O/MMscf	= 1.49E-02 lb N2O/hr / 0.096 MMscf/hr Maximum Waste Gas Flow Rate

Detailed Emission Calculations

Parameter	Value	Units	Notes/Basis
Global Warming Potentials			
CO2	1	--	40 CFR Part 98
CH4	25	--	40 CFR Part 98
N2O	298	--	40 CFR Part 98
CO2e Emission Factor	257,764.6	lb CO2e/MMscf	= Sumproduct of emission factors calculated above and the corresponding global warming potentials

1.2.5 HAP Emission Estimates

Pollutant	LFG Conc.	Molar Flow[1]	Mol. Wt.	Mass Flow	Uncontrolled Emission Factor[2]	Basis
--	ppm,v	lb-mol/hr	lb/lb-mol	lb/hr	lb/MMscf	--
1,1,1-Trichloroethane	0.480	2.43E-04	133.4	3.24E-02	0.338	3
1,1,2,2-Tetrachloroethane	1.11	5.62E-04	167.9	9.43E-02	0.982	3
1,1-Dichloroethane	2.35	1.19E-03	99.0	0.118	1.23	3
1,1-Dichloroethene	0.200	1.01E-04	96.9	9.81E-03	0.102	3
1,2-Dichloroethane	0.410	2.07E-04	99.0	2.05E-02	0.214	3
1,2-Dichloropropane	0.180	9.11E-05	113.0	1.03E-02	0.107	3
1,3-Butadiene	5.78E-02	2.92E-05	54.1	1.58E-03	1.65E-02	4
1,4-Dichlorobenzene	0.210	1.06E-04	147.0	1.56E-02	0.163	3
Acrylonitrile	6.33	3.20E-03	53.1	0.170	1.77	3
Benzene	0.945	4.78E-04	78.1	3.73E-02	0.389	4
Bromomethane	5.78E-02	2.92E-05	109.0	3.19E-03	3.32E-02	4
Carbon Disulfide	0.580	2.93E-04	76.1	2.23E-02	0.233	4
Carbon Tetrachloride	4.00E-03	2.02E-06	153.8	3.11E-04	3.24E-03	3
Carbonyl Sulfide	0.490	2.48E-04	60.1	1.49E-02	0.155	4
Chlorobenzene	0.250	1.26E-04	112.6	1.42E-02	0.148	3
Chloroethane	1.250	6.32E-04	64.5	4.08E-02	0.425	3
Chloroform	3.00E-02	1.52E-05	119.4	1.81E-03	1.89E-02	3
Dichloro-methane	14.3	7.24E-03	84.9	0.615	6.40	3
Ethylbenzene	4.61	2.33E-03	106.2	0.248	2.58	3
Hexachlorobutadiene	5.78E-02	2.92E-05	260.8	7.63E-03	7.94E-02	3
Hexane	6.57	3.32E-03	86.2	0.286	2.98	3
Hydrogen Chloride	16.9	8.53E-03	36.5	0.320	3.33	4
Hydrogen Fluoride	3.21	1.62E-03	20.0	3.42E-02	0.356	4
Mercury	2.92E-04	1.48E-07	200.6	2.96E-05	3.09E-04	3
Methanol	10.4	5.26E-03	32.0	0.169	1.76	4
Methyl Isobutyl Ketone	1.87	9.46E-04	100.2	9.48E-02	0.987	3
Methyl Tert Butyl Ether	0.231	1.17E-04	88.2	1.03E-02	0.107	4
Styrene	0.287	1.45E-04	104.2	1.51E-02	0.158	4
t-1,3-Dichloropropene	0.116	5.87E-05	111.0	6.51E-03	6.78E-02	4
Toluene	12.2	6.17E-03	92.1	0.569	5.92	4
Trichloroethene	2.820	1.43E-03	131.4	0.187	1.95	3
Perchloro-ethylene	3.730	1.89E-03	165.8	0.313	3.26	3
Vinyl Acetate	0.116	5.87E-05	86.1	5.05E-03	5.26E-02	4
Vinyl Bromide	5.78E-02	2.92E-05	107.0	3.13E-03	3.26E-02	4
Vinyl Chloride	7.34	3.71E-03	62.5	0.232	2.42	3
Xylenes	12.1	6.12E-03	106.2	0.650	6.77	3
Total HAP					**45.55**	

[1] Molar flow rates are calculated from the facility inlet LFG flow and assume the Ideal Gas Law applies with a standard pressure of 1 atm, standard temperature of 60 °F, and universal gas constant of 0.7302 ft3-atm/lbmol-°R

[2] Uncontrolled emission factor is calculated from the maximum waste gas flow rate of 0.192 MMscf/hr

[3] Concentration is from AP-42 Table 2.4-1

[4] Concentration is from similar source sampling

1.3 Summary of Potential Emissions

Pollutant	Uncontrolled Emission Factor	Basis	Uncontrolled Emissions: Hourly Emissions	Uncontrolled Emissions: Annual Emissions	Control Efficiency[a-c]	Controlled Emissions: Hourly Emissions	Controlled Emissions: Annual Emissions
--	lb/MMscf		lb/hr	tpy	%	lb/hr	tpy
NOX	6.69	Vendor guarantee	0.642	2.81	--	0.642	2.81
CO	22.29	Vendor guarantee	2.14	9.37	--	2.14	9.4
VOC	41.60	Vendor guarantee	3.99	17.49	--	3.99	17.5
PM	2.074	AP-42 Table 2.4-5	0.199	0.872	--	0.199	0.872
PM10	2.074	Assume all PM is $PM_{2.5}$	0.199	0.872	--	0.199	0.872
PM2.5	2.074	Assume all PM is $PM_{2.5}$	0.199	0.872	--	0.199	0.872
SO2	33.737	Mass balance/process design	3.239	14.19	--	3.239	14.186
Dichloro-methane	6.402	AP-42 Table 2.4-1	0.615	2.69	99.0%	6.15E-03	2.69E-02
Hydrogen Chloride	3.332	Mass balance	0.320	1.40	--	0.320	1.40
Toluene	5.925	AP-42 Table 2.4-1	0.569	2.49	99.0%	5.69E-03	2.49E-02
Perchloro-ethylene	3.260	AP-42 Table 2.4-1	0.313	1.37	99.0%	3.13E-03	1.37E-02
Xylenes	6.770	AP-42 Table 2.4-1	0.650	2.85	99.0%	6.50E-03	2.85E-02
Total HAP	45.55	AP-42 Table 2.4-1	4.372	19.15	91.0%	0.394	1.73
CO2	128,775	Mass balance/40 CFR 98	12,362	54,147	--	12,362	54,147
CH4	5,158	Mass balance/40 CFR 98	495.1	2,169	98.98%	5.03	22.01
N2O	0.155	40 CFR 98	1.49E-02	0.065	--	1.49E-02	6.51E-02
CO2e	257,765	40 CFR 98	24,745	108,385	49.5%	12,492	54,717

[a] The Total HAP control efficiency is based on controlling organic HAP at 99% but creating HCl and HF based on chlorides and fluorides in the vent gas, and mercury which is not destroyed.

[b] The methane control efficiency includes 99% control for all methane from LFG and 0% control for methane generated by combustion.

[c] The CO2e control efficiency considers 99% control of methane and 0% control of CO_2 and N_2O.

2. Emissions Associated with Waste Gas Combustion at the Back-up Flare

2.1 Design Parameters and Constants

2.1.1 Flare, Waste Gas, and System Design Parameters

Parameter	Value	Units	Notes/Basis
Facility Inlet Flow Rate	3,200	dscfm	Facility design based on treated LFG from landfill
	0.192	MMscf/hr	= 3,200 dscfm Facility Inlet Flow Rate x 60 min/hr / 1,000,000 scf/MMscf
Flow Rate (Mode 1)	3,200	dscfm	Flow rates, methane contents, and resulting heat inputs for the 4 flare modes are based on process knowledge of what tail gas, off-spec gas, etc. would be venting under each mode.
Flow Rate (Mode 2A)	3,008	dscfm	
Flow Rate (Mode 2B)	1,816	dscfm	
Flow Rate (Mode 2C)	1,539	dscfm	
Flow Rate (Mode 4A)	1,473	dscfm	
Flow Rate (Mode 4B)	1,222	dscfm	
Flow Rate (Mode 5/6)	1,960	dscfm	
Methane Content (Mode 1)	30.0%	%, vol	
Methane Content (Mode 2A)	51.0%	%, vol	
Methane Content (Mode 2B)	77.9%	%, vol	
Methane Content (Mode 2C)	36.8%	%, vol	
Methane Content (Mode 4A)	47.9%	%, vol	
Methane Content (Mode 4B)	47.9%	%, vol	
Methane Content (Mode 5/6)	97.0%	%, vol	
Flare Heat Input (Mode 1)	89.1	MMBtu/hr	
Flare Heat Input (Mode 2A)	83.8	MMBtu/hr	
Flare Heat Input (Mode 2B)	77.2	MMBtu/hr	
Flare Heat Input (Mode 2C)	30.9	MMBtu/hr	
Flare Heat Input (Mode 4A)	38.5	MMBtu/hr	
Flare Heat Input (Mode 4B)	16.8	MMBtu/hr	
Flare Heat Input (Mode 5/6)	73.4	MMBtu/hr	
Voluntary Throughput Limit	400,000	MMBtu/yr	
Control Efficiency	98.0%	%	Vendor design

2.1.2 Ideal Gas Law Constants & Chemical Parameters

Parameter	Value	Units
Standard Temperature	60	°F
Standard Pressure	1	atm
Ideal Gas Constant	0.7302	ft3-atm/lbmol-°R
HCl Molecular Weight	36.458	lbs/lbmol
Cl Molecular Weight	35.453	lbs/lbmol
HF Molecular Weight	20.01	lbs/lbmol
F Molecular Weight	18.99	lbs/lbmol

2.2 Emission Calculation Methodology and Emission Factors

2.2.1 SO2 Emission Factor Development

Parameter	Value	Units	Notes/Basis
Maximum TRS Concentration	100	ppm (as H2S)	Design basis for post-H2S removal
TRS Molar Flow	5.06E-02	lb-mol/hr	= 3,200 dscfm Facility Inlet Flow Rate x 60 min/hr x 100 ppm (as H2S) / 1e6 parts/million parts x 1 atm Standard Pressure / 0.7302 ft3-atm/lbmol-°R Ideal Gas Constant / 60 °F Standard Temperature converted to Rankine
Molar Conversion	1	mol H2S/mol SO2	1 S molecule in each compound
SO2 Molecular Weight	64.01	lb/lbmol	
SO2 Outlet Emissions	3.24	lb SO2/hr	= 5.06E-02 lb-mol/hr TRS Molar Flow as H2S / 1 mol H2S/mol SO2 x 64.01 lb/lbmol SO2 Molecular Weight
SO2 Emission Factor	16.87	lb SO2/MMscf	= 3.24 lb SO2/hr / [3,200 dscfm Flow Rate (Mode 1) x 60 min/hr / 1e6 scf/MMscf]

2.2.2 CO, NOx, and PM Emission Factor Development

Parameter	Value	Units	Notes/Basis
CO Emission Factor	46.0	lbs CO/MMdscf CH4	AP-42 Section 2.4 Table 2.4-4 (Draft Version)
Maximum Methane Content	97%	%,vol	Methane Content (Mode 5/6)
CO Mass Flow from Combustion	5.25	lb CO/hr	= 46.00 lbs CO/MMdscf CH4 x 1,960 dscfm Flow Rate (Mode 5/6) x 60 min/hr / 1e6 scf/MMscf x 97.0% Maximum Methane Content
CO Emission Factor	48.16	lb CO/MMscf	= 5.25 lb CO/hr / [3,200 dscfm Flow Rate (Mode 1) x 60 min/hr / 1e6 scf/MMscf]

Parameter	Value	Units	Notes/Basis
NOx Emission Factor	39.0	lbs NOx/MMdscf CH4	AP-42 Section 2.4 Table 2.4-4 (Draft Version)
Maximum Methane Content	97%	%,vol	Methane Content (Mode 5/6)
NOx Mass Flow from Combustion	4.45	lb NOx/hr	= 39.00 lbs NOx/MMdscf CH4 x 1,960 dscfm Flow Rate (Mode 5/6) x 60 min/hr / 1e6 scf/MMscf x 97.0% Maximum Methane Content
NOx Emission Factor	40.83	lb NOx/MMscf	= 4.45 lb NOx/hr / [3,200 dscfm Flow Rate (Mode 1) x 60 min/hr / 1e6 scf/MMscf]

Parameter	Value	Units	Notes/Basis
PM/PM10/PM2.5 Emission Factor	17.00	lbs PM/MMdscf CH4	AP-42 Section 2.4 Table 2.4-5
Maximum Methane Content	97%	%,vol	Methane Content (Mode 2B)
PM/PM10/PM2.5 Mass Flow	1.80	lb PM/hr	= 17.00 lbs PM/MMdscf CH4 x 3,200 dscfm Flow Rate (Mode 1) x 60 min/hr / 1e6 scf/MMscf x 97.0% Maximum Methane Content
PM/PM10/PM2.5 Emission Factor	16.49	lb PM/MMscf	= 1.80 lb PM/hr / [3,200 dscfm Flow Rate (Mode 1) x 60 min/hr / 1e6 scf/MMscf]

2.2.3 VOC Emission Factor Development

Parameter	Value	Units	Notes/Basis
Maximum VOC in LFG	595	ppm (as hexane)	AP-42 Section 2.4.4.1
VOC Molar Flow	3.01E-01	lb-mol/hr	= 3,200 dscfm Facility Inlet Flow Rate x 60 min/hr x 595 ppm (as hexane) / 1e6 parts/million parts x 1 atm Standard Pressure / 0.7302 ft3-atm/lbmol-°R Ideal Gas Constant / 60 °F Standard Temperature converted to Rankine
Hexane Molecular Weight	86.18	lb/lbmol	
VOC Outlet Emissions	25.95	lb VOC/hr	= 3.01E-01 lb-mol/hr VOC Molar Flow as hexane x 86.18 lb/lbmol Hexane Molecular Weight
VOC Emission Factor	238.12	lb VOC/MMscf	= 25.95 lb VOC/hr / [3,200 dscfm Flow Rate (Mode 1) x 60 min/hr / 1e6 scf/MMscf]

2.2.4 GHG Emission Factor Development

Parameter	Value	Units	Notes/Basis
CO2 Emission Factor	52.07	kg/MMBtu	40 CFR Part 98, Table C-1 for LFG
	114.79	lb/MMBtu	Unit Conversion
CO2 Mass Flow from Combustion	8,862.2	lb CO2/hr	= 114.79 lb/MMBtu x 77.2 MMBtu/hr Flare Heat Input (Mode 2B)
CO2 in LFG	50%	%,vol	Max CO2 content (LFG Sampling at Valley View indicated approx. 32%)
CO2 Molar Flow from LFG	252.99	lb-mol/hr	= 3,200 dscfm x 60 min/hr x 50% x 1 atm Standard Pressure / 0.7302 ft3-atm/lbmol-°R Ideal Gas Constant / 60 °F Standard Temperature converted to Rankine
CO2 Molecular Weight	44.01	lb/lb-mol	
CO2 Mass Flow from LFG	11,134.0	lb CO2/hr	= 252.99 lb-mol/hr CO2 Molar Flow from LFG x 44.01 lb/lb-mol CO2 Molecular Weight
Total CO2 Emissions	19,996.2	lb CO2/hr	= 8,862.2 lb CO2/hr CO2 Mass Flow from Combustion + 11,134.0 lb CO2/hr CO2 Mass Flow from LFG
Total CO2 Emission Factor	183,518.7	lb CO2/MMscf	= 19,996.2 lb CO2/hr / [3,200 dscfm Flow Rate (Mode 1) x 60 min/hr / 1e6 scf/MMscf]

Detailed Emission Calculations

Parameter	Value	Units	Notes/Basis
CH4 Emission Factor	3.20E-03	kg/MMBtu	40 CFR Part 98, Table C-2 for Gaseous Biomass
	7.05E-03	lb/MMBtu	Unit Conversion
CH4 Mass Flow from Combustion	0.54	lb CH4/hr	= 0.01 lb/MMBtu x 77.2 MMBtu/hr Flare Heat Input (Mode 2B)
Maximum Methane Content	52.0%	%,vol	Maximum waste gas to flare content
CH4 Molar Flow	263.11	lb-mol/hr	= 3,200 dscfm Facility Inlet Flow Rate x 60 min/hr x 52.0% x 1 atm Standard Pressure / 0.7302 ft3-atm/lbmol-°R Ideal Gas Constant / 60 °F Standard Temperature converted to Rankine
CH4 Molecular Weight	16.04	lb/lb-mol	
CH4 Mass Flow to TO	4,220.3	lb CH4/hr	= 263.11 lb-mol/hr CH4 Molar Flow x 16.04 lb/lb-mol CH4 Molecular Weight
Total CH4 Emissions	4,220.8	lb CH4/hr	= 0.54 lb CH4/hr CH4 Mass Flow from Combustion + 4,220.3 lb CH4/hr CH4 Mass Flow to TO
CH4 Emission Factor	38,737.2	lb CH4/MMscf	= 4,220.8 lb CH4/hr / [3,200 dscfm Flow Rate (Mode 1) x 60 min/hr / 1e6 scf/MMscf]

Parameter	Value	Units	Notes/Basis
N2O Emission Factor	6.30E-04	kg/MMBtu	40 CFR Part 98, Table C-2 for Gaseous Biomass
	1.39E-03	lb/MMBtu	Unit Conversion
N2O Mass Flow	0.107	lb N2O/hr	= 1.39E-03 lb/MMBtu x 77.2 MMBtu/hr Flare Heat Input (Mode 2B)
N2O Emission Factor	0.98	lb N2O/MMscf	= 0.11 lb N2O/hr / [3,200 dscfm Flow Rate (Mode 1) x 60 min/hr / 1e6 scf/MMscf]

Parameter	Value	Units	Notes/Basis
Global Warming Potentials			
CO2	1	--	40 CFR Part 98
CH4	25	--	40 CFR Part 98
N2O	298	--	40 CFR Part 98
CO2e Emission Factor	1,152,242	lb CO2e/MMscf	= Sumproduct of emission factors calculated above and the corresponding global warming potentials

2.2.5 HAP Emission Estimates

Pollutant	LFG Conc.	Molar Flow[1]	Mol. Wt.	Mass Flow	Uncontrolled Emission Factor[2]	Notes
--	ppm,v	mol/hr	lb/lb-mol	lb/hr	lb/MMscf	--
1,1,1-Trichloroethane	0.480	2.43E-04	133.4	3.24E-02	0.297	3
1,1,2,2-Tetrachloroethane	1.11	5.62E-04	167.9	9.43E-02	0.865	3
1,1-Dichloroethane	2.35	1.19E-03	99.0	1.18E-01	1.08	3
1,1-Dichloroethene	0.200	1.01E-04	96.9	9.81E-03	0.090	3
1,2-Dichloroethane	0.410	2.07E-04	99.0	2.05E-02	0.188	3
1,2-Dichloropropane	0.180	9.11E-05	113.0	1.03E-02	0.094	3
1,3-Butadiene	5.78E-02	2.92E-05	54.1	1.58E-03	1.45E-02	4
1,4-Dichlorobenzene	0.210	1.06E-04	147.0	1.56E-02	0.143	3
Acrylonitrile	6.33	3.20E-03	53.1	1.70E-01	1.56	3
Benzene	0.945	4.78E-04	78.1	3.73E-02	0.343	4
Bromomethane	5.78E-02	2.92E-05	109.0	3.19E-03	2.92E-02	4
Carbon Disulfide	0.580	2.93E-04	76.1	2.23E-02	0.205	4
Carbon Tetrachloride	4.00E-03	2.02E-06	153.8	3.11E-04	2.86E-03	3
Carbonyl Sulfide	0.490	2.48E-04	60.1	1.49E-02	0.137	4
Chlorobenzene	0.250	1.26E-04	112.6	1.42E-02	0.131	3
Chloroethane	1.250	6.32E-04	64.5	4.08E-02	0.375	3
Chloroform	3.00E-02	1.52E-05	119.4	1.81E-03	1.66E-02	3
Dichloro-methane	14.3	7.24E-03	84.9	6.15E-01	5.64	3
Ethylbenzene	4.61	2.33E-03	106.2	0.25	2.27	3
Hexachlorobutadiene	5.78E-02	2.92E-05	260.8	7.63E-03	7.00E-02	3
Hexane	6.57	3.32E-03	86.2	2.86E-01	2.63	3
Hydrogen Chloride	16.9	8.53E-03	36.5	0.31	2.86	4
Hydrogen Fluoride	3.21	1.62E-03	20.0	0.03	0.306	4
Mercury	2.92E-04	1.48E-07	200.6	3.12E-05	2.87E-04	3
Methanol	10.4	5.26E-03	32.0	1.69E-01	1.55	4
Methyl Isobutyl Ketone	1.87	9.46E-04	100.2	0.09	0.870	3
Methyl Tert Butyl Ether	0.231	1.17E-04	88.2	1.03E-02	0.095	4
Styrene	0.287	1.45E-04	104.2	1.51E-02	0.139	4
t-1,3-Dichloropropene	0.116	5.87E-05	111.0	6.51E-03	5.98E-02	4
Toluene	12.2	6.17E-03	92.1	5.69E-01	5.22	4
Trichloroethene	2.820	1.43E-03	131.4	0.19	1.72	3
Perchloro-ethylene	3.730	1.89E-03	165.8	3.13E-01	2.87	3
Vinyl Acetate	0.116	5.87E-05	86.1	5.05E-03	4.64E-02	4
Vinyl Bromide	5.78E-02	2.92E-05	107.0	3.13E-03	2.87E-02	4
Vinyl Chloride	7.34	3.71E-03	62.5	2.32E-01	2.13	3
Xylenes	12.1	6.12E-03	106.2	0.65	5.97	3
Total HAP					**40.04**	

[1] Molar flow rates are calculated from the facility inlet LFG flow and assume the Ideal Gas Law applies with a standard pressure of 1 atm, standard temperature of 60 °F, and universal gas constant of 0.7302 ft3-atm/lbmol-°R

[2] Uncontrolled emission factor is calculated from the maximum waste gas flow rate of 0.192 MMscf/hr

[3] Concentration is from AP-42 Table 2.4-1

[4] Concentration is from similar source sampling

2.3 Summary of Potential Emissions

Pollutant	Uncontrolled Emission Factor	Basis	Uncontrolled Emissions: Hourly Emissions	Uncontrolled Emissions: Annual Emissions[a]	Control Efficiency[b-d]	Controlled Emissions: Hourly Emissions	Controlled Emissions: Annual Emissions[a]
--	lb/MMscf		lb/hr	tpy	%	lb/hr	tpy
NOX	40.83	AP-42 Section 2.4 Table 2.4-4	7.84	17.59	--	7.84	17.59
CO	48.16	AP-42 Section 2.4 Table 2.4-4	9.25	20.75	--	9.25	20.75
VOC	238.12	AP-42 Section 2.4.4.1	45.72	102.61	98.0%	0.914	2.052
PM	16.49	AP-42 Table 2.4-5	3.17	7.11	--	3.17	7.11
PM10	16.49	Assume all PM is $PM_{2.5}$	3.17	7.11	--	3.17	7.11
PM2.5	16.49	Assume all PM is $PM_{2.5}$	3.17	7.11	--	3.17	7.11
SO2	16.869	Mass balance	3.239	7.27	--	3.239	7.269
Dichloro-methane	5.640	AP-42 Table 2.4-1	1.083	2.43	98.0%	2.17E-02	4.86E-02
Hydrogen Chloride	2.855	Mass balance	0.548	1.230	--	0.548	1.230
Toluene	5.220	AP-42 Table 2.4-1	1.002	2.25	98.0%	2.00E-02	4.50E-02
Perchloro-ethylene	2.872	AP-42 Table 2.4-1	0.551	1.238	98.0%	1.10E-02	2.48E-02
Xylenes	5.965	AP-42 Table 2.4-1	1.145	2.57	98.0%	2.29E-02	5.14E-02
Total HAP	40.039	AP-42 Table 2.4-1	7.69	17.25	90.3%	0.749	1.680
CO2	183,519	Mass balance/40 CFR 98	35,236	79,083	--	35,236	79,083
CH4	38,737	Mass balance/40 CFR 98	7,438	16,693	97.99%	149.7	336.0
N2O	0.984	40 CFR 98	0.189	0.424	--	0.189	0.424
CO2e	1,152,242	40 CFR 98	221,231	496,530	82.4%	39,034	87,608

[a] The annual emissions are calculated using by dividing the uncontrolled emission factor by the Mode 2 heat content (839.96 Btu/scf = 98.4 MMBtu/hr / (1,953 dscfm x 60 min/hr / 1,000,000 scf/MMscf) and then multiplying by the voluntary throughput limit of 400,000 MMBtu/yr.

[b] The Total HAP control efficiency is based on controlling organic HAP at 99% but creating HCl and HF based on chlorides and fluorides in the vent gas, and mercury which is not destroyed.

[c] The methane control efficiency includes 98% control for all methane from LFG and 0% control for methane generated by combustion.

[d] The CO2e control efficiency considers 98% control of methane and 0% control of CO_2 and N_2O.

3. Emissions Associated with Natural Gas Combustion at the Thermal Oxidizer

3.1 Design Parameters and Constants

3.1.1 Thermal Oxidizer Design Parameters

Parameter	Value	Units	Notes/Basis
Design Natural Gas Flow Rate	1,538	dscfh	RTO Specifications
	1,020	Btu/scf	Standard Heat Content
	1.57	MMBtu/hr	
Annual Operating Hours	8,760	hr/year	

3.2 Emission Calculation Methodology and Emission Factors

3.2.1 Criteria Pollutant Emission Factor Development

> Criteria pollutant emission factors are from AP-42 Section 1.4 or vendor guarantee, as provided below.

Parameter	Value	Units	Notes/Basis
PM/PM10/PM2.5 Emission Factor	7.60	lb/MMscf	AP-42, Table 1.4-2.
SO2 Emission Factor	0.60	lb/MMscf	AP-42, Table 1.4-2.
VOC Emission Factor	5.50	lb/MMscf	AP-42, Table 1.4-2.
CO Emission Factor	--	lb/MMscf	Included in WG emission factor/vendor outlet guarantee
NOx Emission Factor	--	lb/MMscf	Included in WG emission factor/vendor outlet guarantee

3.2.2 GHG Emission Factor Development

> CO_2, CH_4 and N_2O emissions for natural gas combustion are estimated using the emission factors published in 40 CFR 98, Subpart C, Table C-1 & 2. CO_2e emissions for diesel fuel combustion are estimated using the global warming potentials published in 40 CFR 98, Subpart A, Table A-1.

Parameter	Value	Units	Notes/Basis
Total CO2 Emission Factor	120,000	lb CO2/MMscf	AP-42, Table 1.4-2.
CH4 Emission Factor	2.30	lb CH4/MMscf	AP-42, Table 1.4-2.
N2O Emission Factor	2.20	lb N2O/MMscf	AP-42, Table 1.4-2.
Global Warming Potentials			
CO2	1	--	40 CFR Part 98
CH4	25	--	40 CFR Part 98
N2O	298	--	40 CFR Part 98
CO2e Emission Factor	120,713.1	lb CO2e/MMscf	= Sumproduct of emission factors calculated above and the corresponding global warming potentials

3.2.3 HAP Emission Estimates

Pollutant	Emission Factor	Mass Flow	Basis
--	lb/MMscf	lb/hr	--
2-Methylnaphthalene	2.40E-05	3.69E-08	1
3-Methylcholanthrene	1.80E-06	2.77E-09	1
7,12-Dimethylbenz(a)anthracene	1.60E-05	2.46E-08	1
Acenaphthene	1.80E-06	2.77E-09	1
Acenaphthylene	1.80E-06	2.77E-09	1
Anthracene	2.40E-06	3.69E-09	1
Arsenic	2.40E-04	3.69E-07	2
Benz(a)anthracene	1.80E-06	2.77E-09	1
Benzene	2.10E-03	3.23E-06	1
Benzo(a)pyrene	1.20E-06	1.85E-09	1
Benzo(b)fluoranthene	1.80E-06	2.77E-09	1
Benzo(g,h,i)perylene	1.20E-06	1.85E-09	1
Benzo(k)fluoranthene	1.80E-06	2.77E-09	1
Beryllium	1.20E-05	1.85E-08	2
Cadmium	1.40E-03	2.15E-06	2
Chromium	1.40E-03	2.15E-06	2
Chrysene	1.80E-06	2.77E-09	1
Cobalt	8.40E-05	1.29E-07	2
Dibenzo(a,h)anthracene	1.20E-06	1.85E-09	1
Dichlorobenzene	1.30E-03	2.00E-06	1
Fluoranthene	3.00E-06	4.61E-09	1
Fluorene	2.80E-06	4.31E-09	1
Formaldehyde	7.50E-02	1.15E-04	1
Hexane	1.80	2.77E-03	1
Indeno(1,2,3-cd)pyrene	1.80E-06	2.77E-09	1
Lead	5.00E-04	7.69E-07	2
Manganese	3.80E-04	5.84E-07	2
Mercury	2.60E-04	4.00E-07	2
Naphthalene	6.10E-04	9.38E-07	1
Nickel	2.10E-03	3.23E-06	2
Phenanthrene	1.70E-05	2.61E-08	1
Pyrene	5.00E-06	7.69E-09	1
Selenium	2.40E-05	3.69E-08	2
Toluene	3.40E-03	5.23E-06	1
Total HAP	**1.89**		

[1] Organic HAP emission factors from AP-42, Table 1.4-3
[2] Metal HAP emission factors from AP-42, Table 1.4-4

3.3 Summary of Potential Emissions

Pollutant	Uncontrolled Emission Factor	Basis	Uncontrolled Emissions: Hourly Emissions	Uncontrolled Emissions: Annual Emissions	Control Efficiency	Controlled Emissions: Hourly Emissions	Controlled Emissions: Annual Emissions
--	lb/MMscf		lb/hr	tpy	%	lb/hr	tpy
NOX	NOX and CO Emissions included under the Waste Gas Emissions Guarantee						
CO							
VOC	5.50	AP-42, Table 1.4-2.	0.008	0.037	--	0.008	0.037
PM	7.60	AP-42, Table 1.4-2.	0.012	0.051	--	0.012	0.051
PM10	7.60	Assume all PM is $PM_{2.5}$	0.012	0.051	--	0.012	0.051
PM2.5	7.60	Assume all PM is $PM_{2.5}$	0.012	0.051	--	0.012	0.051
SO2	0.60	AP-42, Table 1.4-2.	9.23E-04	4.04E-03	--	9.23E-04	4.04E-03
Benzene	2.10E-03	AP-42, Table 1.4-3	3.23E-06	1.41E-05	--	3.23E-06	1.41E-05
Formaldehyde	7.50E-02	AP-42, Table 1.4-3	1.15E-04	5.05E-04	--	1.15E-04	5.05E-04
Hexane	1.80	AP-42, Table 1.4-3	2.77E-03	0.012	--	2.77E-03	0.012
Nickel	2.10E-03	AP-42, Table 1.4-4	3.23E-06	1.41E-05	--	3.23E-06	1.41E-05
Toluene	3.40E-03	AP-42, Table 1.4-3	5.23E-06	2.29E-05	--	5.23E-06	2.29E-05
Total HAP	1.889	AP-42, Table 1.4-3	2.91E-03	0.013	--	2.91E-03	0.013
CO2	120,000	40 CFR 98	185	808	--	185	808
CH4	2.30	40 CFR 98	3.54E-03	1.55E-02	--	3.54E-03	1.55E-02
N2O	2.20	40 CFR 98	3.38E-03	0.015	--	3.38E-03	0.015
CO2e	120,713	40 CFR 98	186	813	--	186	813

4. Emissions Associated with Natural Gas Combustion at the Back-up Flare

4.1 Design Parameters and Constants

4.1.1 Flare Design Parameters

Parameter	Value	Units	Notes/Basis
Design Flare Pilot Flow Rate	392	dscfh	Flare Specifications
Annual Operating Hours	8,760	hr/year	

4.2 Emission Calculation Methodology and Emission Factors

4.2.1 Criteria Pollutant Emission Factor Development

> Criteria pollutant emission factors are from AP-42 Section 1.4 as provided below

Parameter	Value	Units	Notes/Basis
PM/PM10/PM2.5 Emission Factor	7.60	lb/MMscf	AP-42, Table 1.4-2.
SO2 Emission Factor	0.60	lb/MMscf	AP-42, Table 1.4-2.
VOC Emission Factor	5.50	lb/MMscf	AP-42, Table 1.4-2.
CO Emission Factor	84.00	lb/MMscf	AP-42, Table 1.4-1.
NOx Emission Factor	190.00	lb/MMscf	AP-42, Table 1.4-1.

4.2.2 GHG Emission Factor Development

> CO2, CH4 and N2O emissions for natural gas combustion are estimated using the emission factors published in 40 CFR 98, Subpart C, Table C-1 & 2. CO2e emissions for diesel fuel combustion are estimated using the global warming potentials published in 40 CFR 98, Subpart A, Table A-1.

Parameter	Value	Units	Notes/Basis
Total CO2 Emission Factor	120,000	lb CO2/MMscf	AP-42, Table 1.4-2.
CH4 Emission Factor	2.30	lb CH4/MMscf	AP-42, Table 1.4-2.
N2O Emission Factor	2.20	lb N2O/MMscf	AP-42, Table 1.4-2.
Global Warming Potentials			
CO2	1	--	40 CFR Part 98
CH4	25	--	40 CFR Part 98
N2O	298	--	40 CFR Part 98
CO2e Emission Factor	120,713.1	lb CO2e/MMscf	= Sumproduct of emission factors calculated above and the corresponding global warming potentials

4.2.3 HAP Emission Estimates

Pollutant	Emission Factor	Mass Flow	Basis
--	lb/MMscf	lb/hr	--
2-Methylnaphthalene	2.40E-05	9.41E-09	1
3-Methylcholanthrene	1.80E-06	7.06E-10	1
7,12-Dimethylbenz(a)anthracene	1.60E-05	6.27E-09	1
Acenaphthene	1.80E-06	7.06E-10	1
Acenaphthylene	1.80E-06	7.06E-10	1
Anthracene	2.40E-06	9.41E-10	1
Arsenic	2.40E-04	9.41E-08	2
Benz(a)anthracene	1.80E-06	7.06E-10	1
Benzene	2.10E-03	8.24E-07	1
Benzo(a)pyrene	1.20E-06	4.71E-10	1
Benzo(b)fluoranthene	1.80E-06	7.06E-10	1
Benzo(g,h,i)perylene	1.20E-06	4.71E-10	1
Benzo(k)fluoranthene	1.80E-06	7.06E-10	1
Beryllium	1.20E-05	4.71E-09	2
Cadmium	1.40E-03	5.49E-07	2
Chromium	1.40E-03	5.49E-07	2
Chrysene	1.80E-06	7.06E-10	1
Cobalt	8.40E-05	3.29E-08	2
Dibenzo(a,h)anthracene	1.20E-06	4.71E-10	1
Dichlorobenzene	1.30E-03	5.10E-07	1
Fluoranthene	3.00E-06	1.18E-09	1
Fluorene	2.80E-06	1.10E-09	1
Formaldehyde	7.50E-02	2.94E-05	1
Hexane	1.80	7.06E-04	1
Indeno(1,2,3-cd)pyrene	1.80E-06	7.06E-10	1
Lead	5.00E-04	1.96E-07	2
Manganese	3.80E-04	1.49E-07	2
Mercury	2.60E-04	1.02E-07	2
Naphthalene	6.10E-04	2.39E-07	1
Nickel	2.10E-03	8.24E-07	2
Phenanthrene	1.70E-05	6.67E-09	1
Pyrene	5.00E-06	1.96E-09	1
Selenium	2.40E-05	9.41E-09	2
Toluene	3.40E-03	1.33E-06	1
Total HAP	**1.89 lb/MMscf**		

[1] Organic HAP emission factors from AP-42, Table 1.4-3
[2] Metal HAP emission factors from AP-42, Table 1.4-4

4.3 Summary of Potential Emissions

Pollutant	Uncontrolled Emission Factor	Basis	Uncontrolled Emissions Hourly Emissions	Uncontrolled Emissions Annual Emissions	Control Efficiency	Controlled Emissions Hourly Emissions	Controlled Emissions Annual Emissions
--	lb/MMscf		lb/hr	tpy	%	lb/hr	tpy
VOC	5.50	AP-42, Table 1.4-2.	2.16E-03	9.45E-03	--	2.16E-03	9.45E-03
PM	7.60	AP-42, Table 1.4-2.	2.98E-03	1.31E-02	--	2.98E-03	1.31E-02
PM10	7.60	Assume all PM is $PM_{2.5}$	2.98E-03	1.31E-02	--	2.98E-03	1.31E-02
PM2.5	7.60	Assume all PM is $PM_{2.5}$	2.98E-03	1.31E-02	--	2.98E-03	1.31E-02
SO2	0.60	AP-42, Table 1.4-2.	2.35E-04	1.03E-03	--	2.35E-04	1.03E-03
CO	84.0	AP-42, Table 1.4-1.	3.29E-02	1.44E-01	--	3.29E-02	1.44E-01
NOx	190.0	AP-42, Table 1.4-1.	7.45E-02	3.26E-01	--	7.45E-02	3.26E-01
Benzene	2.10E-03	AP-42, Table 1.4-3	8.24E-07	3.61E-06	--	8.24E-07	3.61E-06
Formaldehyde	7.50E-02	AP-42, Table 1.4-3	2.94E-05	1.29E-04	--	2.94E-05	1.29E-04
Hexane	1.80	AP-42, Table 1.4-3	7.06E-04	3.09E-03	--	7.06E-04	3.09E-03
Nickel	2.10E-03	AP-42, Table 1.4-4	8.24E-07	3.61E-06	--	8.24E-07	3.61E-06
Toluene	3.40E-03	AP-42, Table 1.4-3	1.33E-06	5.84E-06	--	1.33E-06	5.84E-06
Total HAP	1.889	AP-42, Table 1.4-3	7.41E-04	3.24E-03	--	7.41E-04	3.24E-03
CO2	120,000	40 CFR 98	47.1	206.1	--	47.1	206.1
CH4	2.30	40 CFR 98	9.02E-04	3.95E-03	--	9.02E-04	3.95E-03
N2O	2.20	40 CFR 98	8.63E-04	3.78E-03	--	8.63E-04	3.78E-03
CO2e	120,713	40 CFR 98	47.3	207.3	--	47.3	207.3

5. Emissions Associated with the Emergency Engine

5.1 Engine Power and Fuel Consumption Data

> Pertinent data on engine power and fuel usage pulled from the technical data sheets for the Cummins engine. Typical heating value of diesel fuel was taken from Appendix A in AP-42.

Mechanical Power in bhp (100% load, standby):	324	bhp
Generator Output in kW (100% load, standby):	200	kW
Specific Fuel Consumption Rate in Mgal/hr:	0.0148	Mgal/hr
Maximum Presumptive Annual Operating Hours:	500	hrs
Typical Heat Content of Diesel Fuel (HHV):	137	MMBtu/Mgal

5.2 Emission Calculation Methodology and Emission Factors

> Emission factors for CO, NOX + NMHC, and PM are based on the manufacturer emissions data sheet. Conservatively estimating VOC emissions by assuming NMHC is equal to VOC and estimating PM by assuming PM is equal to PM10/PM2.5. The emission factor for SO2 is based on sulfur content of the fuel and the equation found in Table 3.4-1 in AP-42 Chapter 3.4 for Large Stationary Diesel Engines.

5.2.1 VOC and NOX

Emission factor for NMHC + NOX:	4.0	g/kW-hr	Manufacturer Emissions Data Sheet
	2.98	g/bhp-hr	= 4.00 g/kW-hr / 1.341022 hp-hr/kW-hr
	144.06	lb/Mgal	= 2.98 g/bhp-hr * 324 bhp / 0.0148 Mgal/hr * 0.0022046 lb/g

> A separate VOC and NOX emission factor that conforms to the Subpart IIII requirements can be derived based on the ratio of the TOC to NOX factor in AP-42 Table 3.3-1 (10/1996 edition).

Sum of AP-42 NOX and TOC emission factors:	0.034	lb/hp-hr	= 0.031 + 0.003
Ratio of NOX factor to sum of NOX and TOC factors:	0.925		= 0.031 / 0.034
Ratio of TOC factor to sum of NOX and TOC factors:	0.075		= 0.003 / 0.034
NOX emission factor in terms of SCC units:	133.25	lb/Mgal	= 144.06 lb/Mgal NMHC + NOX x 0.925
VOC emission factor in terms of SCC units:	10.81	lb/Mgal	= 144.06 lb/Mgal NMHC + NOX x 0.075

5.2.2 CO

Emission factor for CO:	1.0	g/kW-hr	Manufacturer Emissions Data Sheet
	0.75	g/bhp-hr	= 1.00 g/kW-hr / 1.341022 hp-hr/kW-hr
CO emission factor in terms of SCC units:	36.01	lb/Mgal	= 0.75 g/bhp-hr * 324 bhp / 0.0148 Mgal/hr * 0.0022046 lb/g

5.2.3 PM/PM10/PM2.5

Emission factor for PM/PM10/PM2.5:	0.11	g/kW-hr	Manufacturer Emissions Data Sheet
	0.0820	g/bhp-hr	= 0.11 g/kW-hr / 1.341022 hp-hr/kW-hr
PM/PM10/PM2.5 emission factor in terms of SCC units:	3.962	lb/Mgal	= 0.11 g/bhp-hr * 324 bhp / 0.0148 Mgal/hr * 0.0022046 lb/g

5.2.4 SO2

> To take into account the lower sulfur content of the diesel fuel burned, for purposes of representing SO2 emissions from the engine, the factor in AP42 Table 3.4-1 (Large Stationary Diesel Engines, 10/1996 edition) is used as shown below. This factor expresses SO2 as a function of sulfur content. As required under NSPS Subpart IIII, the ultra low sulfur diesel (ULSD) must be used in the new emergency generator engine.

AP42 Factor for SO2 based on sulfur content:	1.01 S	lb/MMBtu	AP-42 Table 3.4-1 (S is sulfur content in %)
Sulfur Content:	0.0015	%	Based on maximum sulfur content in ULSD of 15 ppm
SO2 emission factor (lb/MMBtu):	1.52E-03	lb/MMBtu	= 1.01 EF x 0.0015%, sulfur
SO2 emission factor in terms of SCC units:	0.2076	lb/Mgal	= 1.52E-03 lb/MMBtu * 137 MMBtu/Mgal

5.2.5 HAP Emission Estimates

> Emission factors for organic HAP compounds expected to be emitted are based on emission factors in AP-42 Table 3.3-2 (10/96 Edition). Emission factors are converted from lb/MMBtu as provided in AP-42 to lb/Mgal as applicable to the SCC designation.

Pollutant	CAS #	HAP?	Emission Factor (lb/MMBtu)	Emission Factor (lb/hp-hr)	Emission Factor (lb/Mgal)	Emission Factor Basis
Benzene	71-43-2	Y	9.33E-04	5.83E-06	1.28E-01	AP-42 Table 3.3-2
Toluene	108-88-3	Y	4.09E-04	2.56E-06	5.60E-02	AP-42 Table 3.3-2
Xylene	1330-20-7	Y	2.85E-04	1.78E-06	3.90E-02	AP-42 Table 3.3-2

5.2.6 GHG Emission Factors

> CO2, CH4 and N2O emissions for diesel fuel combustion are estimated using the Distillate Fuel Oil No. 2 emission factors published in 40 CFR 98, Subpart C, Table C-1 & 2. CO2e emissions for diesel fuel combustion are estimated using the global warming potentials published in 40 CFR 98, Subpart A, Table A-1.

Global Warming Potentials of GHGs per 40 CFR 98 Subpart A, Table A-1.

CO2	1
CH4	25
N2O	298

Pollutant	Emission Factor (kg/MMBtu)	Equivalent Factor (lb/Mgal)	
CO2	73.96	22,338	40 CFR 98, Subpart C, Table C-1; Distillate Fuel Oil No. 2
CH4	3.00E-03	0.91	40 CFR 98, Subpart C, Table C-2; Distillate Fuel Oil No. 2
N2O	6.00E-04	0.18	40 CFR 98, Subpart C, Table C-2; Distillate Fuel Oil No. 2
CO2e	74.21	22,415	

5.3 Summary of Engine Potential Emissions

Pollutant	**Emission Factor**	**Basis**	**Hourly Emissions**	**Annual Emissions**
--	lb/Mgal	--	lb/hr	tpy
NOX	133.25	Manufacturer Emissions Data Sheet	1.97	0.493
CO	36.01	Manufacturer Emissions Data Sheet	0.533	0.133
VOC	10.81	Manufacturer Emissions Data Sheet	0.160	4.00E-02
PM/PM10/PM2.5	3.96	Manufacturer Emissions Data Sheet	0.059	1.46E-02
SO2	0.21	AP-42 Table 3.4-1 (S is sulfur content in %)	3.07E-03	7.67E-04
Benzene	0.13	AP-42 Table 3.3-2	1.89E-03	4.73E-04
Toluene	0.056	AP-42 Table 3.3-2	8.29E-04	2.07E-04
Xylene	0.039	AP-42 Table 3.3-2	5.77E-04	1.44E-04
CO2	22,338	40 CFR 98, Subpart C, Table C-1	330.4	82.6
CH4	0.91	40 CFR 98, Subpart C, Table C-2	1.34E-02	3.35E-03
N2O	0.18	40 CFR 98, Subpart C, Table C-2	2.68E-03	6.70E-04
CO2e	22,415	40 CFR 98, Subpart C	331.5	82.9

6. Derivation of Emissions Factors and Emission Calculations for LFG Condensate Tanks

6.1 Storage Tank Capacities and Throughput Rates

> The maximum hourly and annual throughput rates for the LFG condensate tanks are provided below.

Emission Unit	Permit EU ID	Permit Emission Unit Description	Tank Contents	Storage Capacity	Maximum Hourly Throughput	Maximum Annual Throughput
--	--	--	--	Mgal-Cap	Mgal/hr	Mgal/yr
T101	TBD	15,000-gal LFG Condensate Tank	LFG Condensate	15.0	4.57E-02	400.0
T102	TBD	15,000-gal LFG Condensate Tank	LFG Condensate	15.0	4.57E-02	400.0

* Throughput is based on maximum worst case of 400,000 gallons per year per tank. Archaea's operations at various RNG facilities suggest a maximum of 400,000 gallons per year total of condensate could be reasonably expected.

6.2 VOC and HAP Potential Emissions Calculations for Condensate Storage Tanks

> The following tables document the potential VOC and HAP emissions resulting from the two 15,000-gal condensate tanks at Valley View RNG. The VOC and HAP emission factors for the storage tanks documented in the following tables are based on the TankESP runs using the maximum annual throughput. The liquid composition is assumed to be 95% water and 5% organics and, conservatively, Archaea assumes that 100% of the organic phase is HAP. Archaea used 2.5% benzene and 2.5% 1,1,1-trichloroethane to calculate emissions in TankESP (i.e., 50% each of the organic phase).

6.2.1 Working Loss VOC and HAP Emissions Calculations

> Working loss emissions for the LFG condensate storage tanks are calculated below.

Emission Unit	Permit Emission Unit Description	Hourly Operating Rate	Pollutant	Emission Factor	Hourly Potential Emissions	Annual Potential Emissions
--	--	Mgal/hr	--	lb/Mgal	lb/hr	tpy
T101	15,000-gal LFG Condensate Tank	4.57E-02	VOC	4.30E-02	1.96E-03	8.60E-03
			Total HAPs	4.30E-02	1.96E-03	8.60E-03
T102	15,000-gal LFG Condensate Tank	4.57E-02	VOC	4.30E-02	1.96E-03	8.60E-03
			Total HAPs	4.30E-02	1.96E-03	8.60E-03

6.2.2 Breathing Loss VOC and HAP Emissions Calculations

> Breathing loss emissions for the LFG condensate storage tanks are calculated below.

Emission Unit	Permit Emission Unit Description	Hourly Operating Rate	Pollutant	Emission Factor	Hourly Potential Emissions	Annual Potential Emissions
--	--	Mgal-cap/hr	--	lb/Mgal-cap	lb/hr	tpy
T101	15,000-gal LFG Condensate Tank	1.71E-03	VOC	0.30	5.09E-04	2.23E-03
			Total HAPs	0.30	5.09E-04	2.23E-03
T102	15,000-gal LFG Condensate Tank	1.71E-03	VOC	0.30	5.09E-04	2.23E-03
			Total HAPs	0.30	5.09E-04	2.23E-03

6.2.3 Total VOC and HAP Emissions for LFG Condensate Storage Tanks

> Total emissions for the LFG condensate storage tanks are calculated below.

Emission Unit	Permit Emission Unit Description	Pollutant	Hourly Potential Emissions	Annual Potential Emissions
--	--	--	lb/hr	tpy
T101	15,000-gal LFG Condensate Tank	VOC	2.47E-03	1.08E-02
		Total HAPs	2.47E-03	1.08E-02
T102	15,000-gal LFG Condensate Tank	VOC	2.47E-03	1.08E-02
		Total HAPs	2.47E-03	1.08E-02

APPENDIX C. SUGGESTED PERMIT EDITS

SECTION B - EMISSION POINTS, EMISSION UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS

Emission Unit 01 (EU 01) Renewable Natural Gas (RNG) Plant

Description:

The RNG facility receives LFG from Valley View Landfill's gas collection system. The LFG stream is treated, compressed, and injected into local gas distribution or transmission networks.

Maximum Capacity: ~~6400~~3,200 scfm of treated landfill gas

Controls: Thermal Recuperative Oxidizer (TRO) (C01) and EU02 (C02) as back-up

Construction Commenced: 2023

Emission Unit 02 (EU 02/C02) LFG Flare

Description:

Shrouded candle~~Open~~ flare for use when EU 01 is not operating or produced gas is off-spec. Maximum Capacity: ~~7040~~ 3,200 scfm of landfill gas

Construction Commenced: 2023

APPLICABLE REGULATIONS:

401 KAR 53:010, *Ambient air quality standards*

401 KAR 59:010, *New process operations*, applies to EU 01.

401 KAR 63:015, *Flares*, applies to EU 02.

401 KAR 63:002, Section 2(4)(hhh), 40 C.F.R. 63.1930 through 63.1990, Table 1 (Subpart AAAA), *National Emission Standards for Hazardous Air Pollutants: Municipal Solid Waste Landfills*

40 CFR 63.11, *Control device and work practice requirements*

1. **Operating Limitations:**
   a. The permittee shall not vent any landfill gas through any process unit vent directly to the atmosphere.

   b. The requirements of 40 CFR 63, Subpart AAAA must be met and apply at all times, including during periods of SSM, and the SSM requirements of the General Provisions of 40 CFR 63 do not apply. During periods of SSM, the permittee must comply with the work practice requirements specified in 40 CFR 63.1958(e) in lieu of the compliance provisions in 40 CFR 63.1960. [40 CFR 63.1930(b); 40 CFR 63.1960(e)(2)]

   c. At all times the permittee shall operate and maintain any affected source, including associated air pollution control equipment and monitoring equipment, in a manner consistent with safety and good air pollution control practices for minimizing emissions. [40 CFR 63.1955(c)]

   d. The permittee shall ensure that all collected gasses sent to the facility are vented to a control system designed and operated in compliance with 40 CFR 63.1959(b)(2)(iii). In the event the control system is not operating: [40 CFR 63.1958(e)(1)]
      i. The gas mover system shall be shut down and all valves in the control system contributing to venting of the gas to the atmosphere shall be closed within 1 hour of the control system not operating; and [40 CFR 63.1958(e)(1)(i)]

SECTION B - EMISSION POINTS, EMISSION UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

standards and the operating standards of 40 CFR 63.1958 is required at all times. [40 CFR 63.1964]

B. A deviation is defined in 40 CFR 63.1990. For the purposes of the landfill monitoring and SSM plan requirements, deviations include the items in 40 CFR 63.1965(a) through (c). [40 CFR 63.1965]

1) A deviation occurs when the control device operating parameter boundaries described in 40 CFR 63.1983(c)(1) are exceeded. [40 CFR 63.1965(a)]

2) A deviation occurs when 1 hour or more of the hours during the 3-hour block averaging period does not constitute a valid hour of data. A valid hour of data must have measured values for at least three 15-minute monitoring periods within the hour. [40 CFR 63.1965(b)]

2. Emission Limitations:

a. The annual waste gas heat input to the flare shall not exceed 400,000 MMBtu/year.

~~a.~~b. The permittee shall not cause, suffer, allow or permit any continuous emission into the open air from a control device or stack associated with any affected facility which is equal to or greater than twenty (20) percent opacity. [401 KAR 59:010, Section 3(1)(a)]

Compliance Demonstration:
Refer to **4. Specific Monitoring Requirements (a)** and **5. Specific Recordkeeping Requirements (a)**.

~~b.~~c. For emissions from a control device or stack, the permittee shall not cause, suffer, allow or permit the emission into the open air of particulate matter from any affected facility which is in excess of the quantity specified in 401 KAR 59:010, Appendix A: [401 KAR 59:010, Section 3(2)]

i. For process weight rates of ≤ 0.5 tons/hour: 2.34 lbs/hr
ii. For process weight rates of ≤ 30 tons/hour: $E = 3.59P^{0.62}$
Where:
E = rate of emission in lb/hr; and
P = process weight rate in tons/hr.

Compliance Demonstration:
The permittee is assumed to be in compliance with the mass emission standard based on the maximum process weight rate and emission factors provided in the application.

~~c.~~d. For EU 02, the permittee shall not cause, suffer, or allow the emission into the open air of particulate matter from any flare which is greater than twenty (20) percent opacity for more than three (3) minutes in any one (1) day. [401 KAR 63:015, Section 3]

Compliance Demonstration:
Refer to **4. Specific Monitoring Requirements (a)** and **5. Specific Recordkeeping Requirements (a)**.

~~d.~~e. Flares shall be designed for and operated with no visible emissions, except for periods not to exceed a total of 5 minutes during any 2 consecutive hours. [40 CFR 63.11(b)(4)]

SECTION B - EMISSION POINTS, EMISSION UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

molecular weight for calculating the flare gas exit velocity under 40 CFR 63.11(b)(7) of subpart A. [40 CFR 63.1959(e)]

i. Within 60 days after the date of completing each performance test (as defined in 40 CFR 63.7), the permittee shall submit the results of the performance tests, including any associated fuel analyses, required by 40 CFR 63.1959(c) or (e) according to 40 CFR 63.1981(l)(1). [40 CFR 63.1959(e)(1)]

d. The performance tests required in 40 CFR 63.1959(b)(2)(iii)(A) and (B), must be conducted under such conditions as the Administrator specifies to the permittee based on representative performance of the affected source for the period being tested. Representative conditions exclude periods of startup and shutdown unless specified by the Administrator. The permittee may not conduct performance tests during periods of malfunction. The permittee shall record the process information that is necessary to document operating conditions during the test and include in such record an explanation to support that such conditions represent normal operation. Upon request, the permittee shall make available to the Administrator such records as may be necessary to determine the conditions of performance tests. [40 CFR 63.1959(f)]

e. Test Method 22 in appendix A of 40 CFR part 60 shall be used to determine the compliance of flares with the visible emission provisions of 40 CFR Part 63. The observation period is 2 hours and shall be used according to Method 22. [40 CFR 63.11(b)(4)]

f. The flare shall be designed for and operated with an exit velocity less than 18.3 m/sec (60 ft/sec), except as provided in 40 CFR 63.11(b)(7)(ii) and (b)(7)(iii). The actual exit velocity of the flare shall be determined by dividing by the volumetric flow rate of gas being combusted (in units of emission standard temperature and pressure), as determined by Test Method 2, 2A, 2C, or 2D in appendix A to 40 CFR part 60, as appropriate, by the unobstructed (free) cross-sectional area of the flare tip. [40 CFR 63.11(b)(7)(i)]

g. The maximum permitted velocity, V_{max}, for flares complying with 40 CFR 63.11(b)(7) shall be determined by the equation in 40 CFR 63.11(b)(7)(iii)]

h. Pursuant to 401 KAR 50:045, Section 1, performance testing using the reference methods specified in 401 KAR 50:015 shall be conducted if required by the Cabinet.

4. Specific Monitoring Requirements:

a. The permittee shall perform a daily qualitative observation of visible emissions from the flare and the TRO during operation, during daylight hours. Observation of any visible emissions during the daily qualitative observations shall necessitate an opacity determination using U.S. EPA Reference Method 9. [401 KAR 52:020, Section 10]

b. The permittee shall monitor the following: [401 KAR 52:020, Section 10]

i. The monthly hours of operation of the flare and RNG plant;
ii. The incoming flow of landfill gas to the facility, in MMscf;
iii. The monthly and 12-month rolling quantity of waste gas sent to the flare in MMscf;

SECTION B - EMISSION POINTS, EMISSION UNITS, APPLICABLE REGULATIONS, AND OPERATING CONDITIONS (CONTINUED)

i. Install, calibrate, and maintain a gas flow rate measuring device that records the flow to the treatment system at least every 15 minutes; and [40 CFR 63.1961(g)(1)]
ii. Secure the bypass line valve in the closed position with a car-seal or a lock-and-key type configuration. A visual inspection of the seal or closure mechanism must be performed at least once every month to ensure that the valve is maintained in the closed position and that the gas flow is not diverted through the bypass line. [40 CFR 63.1961(g)(2)]

f. The monitoring requirements of 40 CFR 63.1961(b), (c), and (g) apply at all times the affected source is operating, except for periods of monitoring system malfunctions, repairs associated with monitoring system malfunctions, and required monitoring system quality assurance or quality control activities. A monitoring system malfunction is any sudden, infrequent, not reasonably preventable failure of the monitoring system to provide valid data. Monitoring system failures that are caused in part by poor maintenance or careless operation are not malfunctions. The permittee is required to complete monitoring system repairs in response to monitoring system malfunctions and to return the monitoring system to operation as expeditiously as practicable. [40 CFR 63.1961(h)]

g. Averages are calculated according to 40 CFR 63.1983(b)(2)(i) for average combustion temperature and 40 CFR 63.1983(c)(1)(i) for 3-hour average combustion temperature for enclosed combustors, except that the data collected during the event listed in 40 CFR 63.1975(a) are not to be included in any average computed under 40 CFR 63, Subpart AAAA. [40 CFR 63.1975]
i. Monitoring system breakdowns, repairs, calibration checks, and zero (low-level) and high-level adjustments. [40 CFR 63.1975(a)]

h. Refer to **Section F** for general monitoring requirements.

5. **Specific Recordkeeping Requirements:**
a. The permittee shall maintain a log of the qualitative visual observations for the flare and the TRO including: date, time, initials of observer, whether emissions were visible and records of corrective actions taken as a result of visible emissions, and records of any U.S. EPA Reference Method 9 opacity readings performed. [401 KAR 52:020, Section 10]

b. The permittee shall maintain records of the following: [401 KAR 52:020, Section 10]
i. The monthly hours of operation of the flare and RNG plant;
ii. The incoming flow of landfill gas to the facility, in MMscf;
iii. The monthly and 12-month rolling quantity of waste gas sent to the flare in MMscf;
iv. The monthly quantity of landfill gas sent to the RNG plant, in MMscf;
v. The monthly quantity of waste gas sent to the TRO, in MMscf;
vi. The monthly natural gas usage in the flare and the TRO, in MMscf;
vii. The monthly and 12-month rolling VOC emissions in tons;

SECTION C - INSIGNIFICANT ACTIVITIES

~~At the time of issuance of permit V-23-007, there are no insignificant activities at this source.~~

The following listed activities have been determined to be insignificant activities for this source pursuant to 401 KAR 52:020, Section 6. Although these activities are designated as insignificant the permittee must comply with the applicable regulation if necessary.

Description	Generally Applicable Regulation
1. IA01: LFG Condensate Tanks (2)	N/A

SECTION D - SOURCE EMISSION LIMITATIONS AND TESTING REQUIREMENTS

1. As required by Section 1b of the *Cabinet Provisions and Procedures for Issuing Title V Permits* incorporated by reference in 401 KAR 52:020, Section 26; compliance with annual emissions and processing limitations contained in this permit, shall be based on emissions and processing rates for any twelve (12) consecutive months.

2. VOC, PM, HAP, and opacity emissions, measured by applicable reference methods, or an equivalent or alternative method specified in 40 C.F.R. Chapter I, or by a test method specified in the state implementation plan shall not exceed the respective limitations specified herein.

3. The permittee shall not exceed source-wide VOC emissions of 90.0 tons per year on a rolling 12-month basis. [To preclude the major source threshold for regulated air pollutants other than HAPs]

   Compliance Demonstration Method:
   To preclude major source classification for regulated air pollutants other than HAPs, the permittee shall calculate the source-wide VOC emissions each month using the following equations:

   $$E_{VOC_i} = \sum_{n=1}^{N} \frac{PR_n \times EF_{VOC_i} \times (1 - CE_n)}{2000\ (lb/ton)}$$

   Where:
   i is the month;
   E_{VOC_i} is the monthly VOC emissions for month *i* (tons/month);
   n is the emission unit from which VOC is emitted;
   N is the total number of emission units from which VOC is emitted;
   PR_n is the process rate (waste gas sent to TRO/flare, natural gas/diesel used as fuel, etc.) used at emission point *n* (units/month);
   EF_{VOCi} is the overall uncontrolled KYEIS emission factor for VOC or other emission factor as approved by the Division (pounds/unit);
   CE_n is the control efficiency for controls, if any, used at emission unit *n* (percent).

   The permittee shall calculate the 12-month rolling total each month of VOC emissions using the following equation:

   $$\text{Total VOC emissons (tons/year)} = \sum_{i=1}^{12} E_{VOC_i}$$

4. The permittee shall not exceed source-wide Toluene emissions of 6.23 tons per year on a rolling 12-month basis. [To preclude the major source threshold for HAPs]

5. The permittee shall not exceed source-wide combined HAPs emissions of 14.06 tons per year on a rolling 12-month basis. [To preclude the major source threshold for HAPs]

Compliance Demonstration Method:
To preclude major source classification for individual and combined HAPs, the permittee shall not vent any landfill gas through any process unit vent directly to the atmosphere and shall operate the flare, TRO, and/or control and treatment system at all times when collected gas is routed to the system.

6. The heat input rate of waste gas sent to the flare shall be limited to 400,000 MMBtu per year so as not to exceed applicable emission limitations. The source shall monitor and keep applicable records of monthly and 12-month rolling totals of waste gas sent to the flare.

APPENDIX D. CONTROL DEVICE SPECIFICATIONS

April 2, 2024

Archaea Energy

P24076 New Hanover RNG – Shrouded Candlestick Flare

Attn: Eric Addessi

Per your request, following and attached please find our **quotation** to supply the described products and services relative to your project requirements. We appreciate the opportunity to furnish this proposal.

Perennial Energy proposes to provide a unitized, modular, ***raw landfill and off-spec product gas shrouded candlestick flare station*** with off-loading and installation by others. The flare station shall be sized to handle **up to 3,200 SCFM** of 30% min methane content raw LFG or up to **1,960 SCFM** of off-spec product gas at **83** to **97% methane content** with a 40 CFR 60.18 compliant flare tip. The flare will need **at least 1 psig** gas pressure at the inlet of the flare system. The single-phase, 120 VAC control panel are provided loose for installation by others.

Estimated Utility Requirements

Natural Gas or Propane Pilot Fuel:	10 PSIG, 1/2" NPT, **400,000 Btu/hr**
Instrument Quality Compressed Air or Nitrogen:	80 – 125 psig
Power:	**30 A** @ 480VAC / 1ph / 60 Hz
Ethernet:	Quantity 1, Cat 6 Cable

Not included in this proposal are the following:

- Site Civil, Electrical, or Structural Engineering
- Freight, off-loading, or Installation
- Bonds or liquidated damages
- Taxes, permits, fees, etc.
- Interconnection piping, wiring, and conduit
- Flow modulating of process gasses between the ranges described in RFP
- Flow Meter / Transmitter

Clarifications, assumptions, and exceptions to the proposal:

- **Equipment Area Classification:**
  - ***Unclassified, Non-Hazardous:*** control panel, flare, and flare-mounted devices (pilot and thermocouples)
- **Incoming Power Requirements:**
  - ***Estimated equipment service size:*** 30 A @ 480VAC / 1ph / 60 Hz

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

- The SCCR rating of the system is **2 kA**. If higher kA is required, please contact Perennial for additional cost adders.

○ Final gas stream composition and pressure should be reviewed before order/approval.

○ The Shrouded Candlestick Flare is equipped with a large wind/thermal shield. At full flow rates, as much as 7' of visible flame tip may extend beyond the top of the 50' shroud, making the remaining thermal radiation inconsequential. Not equipped with temperature control louvers, or source testing ports.

○ The quoted flare is designed to mostly hide the flame that would otherwise be completely visible with a typical candlestick, utility style flare. Be aware that some flame may be still be visible from the opening at the top of the flare stack – especially when operating at or near max capacity or abnormal conditions.

The Shrouded Candlestick Flare shall include:

○ **PEI *3,200 SCFM* shrouded candlestick flare**
- ASTM A-36, 7/16" carbon steel flare shell assembly
- ***Approximate estimated size:*** 146 in. diameter x 50 ft. O.A.H.
- Stainless steel burner system
- Engineered mounting system

○ Encloses the candlestick flare within an insulated, carbon steel flare shell to help hide the flame. Maintains compliance with 40 CFR 60.18. *Some flame may be still be visible from the opening at the top of the flare stack.*

○ 12" IPS – ANSI 150# flanged Inlet Nozzle

○ **Flare shell insulation includes:**
- Stainless steel insulation retainer band and weather shield at top of flare
- Ceramic fiber blanket insulation, installed in overlapping layers
- High temperature retainer pins and keepers (washers) for insulation
- High temperature sealant/fixative solution sprayed on insulation

○ **Natural gas or propane pilot system includes:**
- Assume four pilots are necessary to ensure adequate ignition with multiple tip burner system. *This will be reviewed during the design phase.*
- Gas line with flexible hose, strainer, regulator, double block solenoid valves, manual shutoff valves, and pressure gauge
- Pilot ignition transformers mounted on flare within NEMA 4 enclosure
- **Continuous or interrupted pilot, rated for 100,000 Btu/hr each**
  - ***Estimate 400,000 Btu/hr total***

○ **Ignition and flame monitoring system includes:**
- Two (2) UV, self-checking flame safeguard sensors
- Type "K" pilot monitoring thermocouple assembly, serviceable / removable from outside of flare shroud

  - Type “K” flame monitoring thermocouple assembly, serviceable / removable from outside of flare shroud

- All “on flare” flare wiring pre-installed and pre-conduited to flare-mounted junction boxes. Will require field reconnection of numbered wires to numbered terminals in junction boxes.

- All carbon steel surfaces sand blasted to SSPC SP-6 standards, primed and painted to Perennial Energy standard paint specs. Paint color for flare stack to be PEI-standard, high-heat SAND.

Flare Inlet Gas Valves and Devices:

- 12**”** **Detonation Arrester** with **Carbon Steel housing** and 304L SS element. ATEX approval. Flow design of 3200 SCFM. Operating max temperature of **140 deg F.**

- Upstream and downstream pressure / differential pressure indication across the flame arrester

- 12**”** Safety Shutdown Valve. Butterfly Valve w/ cast iron body body, SS disc & stem and Viton seat
  - Includes **pneumatically** controlled safety shutoff actuator w/spring assisted shut off, dry instrument quality compressed air or nitrogen supplied by others.

- 12**”** stainless steel bellows type flex connector

- Flashback thermocouple and temperature gauge installed at flare inlet

- Pressure transmitter and pressure gauge supplied on upstream side of shutdown valve

The Candlestick Flare Station Control System shall include:

- **30A**, 480VAC / 1ph / 60 Hz, 2 pole enclosed (NEMA 3R) breaker for incoming power

- **NEMA 4** Control Panel enclosure with panel heater pre-installed
  - Includes rain/sun shield over control panel and interior lighting
  - Rack-mounted enclosure

- **Allen-Bradley CompactLogix PLC** digital and analog logical supervision system

- **C-More EA9, 10” Color Touchscreen** operator interface
  - All temperatures, pressures, flows, and other analog data displayed
  - All timers, setpoints, PID loops, and other system operator inputs available
  - Alarms and shutdowns with history log
  - **With daily, weekly, monthly, and resettable flow totalization**

- **Panel-mounted hand switches include:**
  - OFF / ON switch for the Candlestick Flare System
  - TEST / OFF / AUTO switch for each pilot ignition system

- TEST / OFF / AUTO switch for the shutdown valve
- E-Stop Switch at the Control Panel and Flare
- Flame failure reset (ALARM RESET / LAMP TEST switch)
- Automatic relight and remote reset functions available

○ Alarm and shutdown message annunciation and history (Touch Screen)

○ **Control Panel Additional Features:**
- Uninterruptable Power Supply for PLC, HMI, and communication devices
- AC and DC control voltage surge protection
- 5-Port unmanaged Ethernet switch for network connection to PLC and HMI
- **10 kVA**, 480VAC to 120/240VAC single phase stepdown transformer
- Single-phase load distribution
- **U.L. 508A Listed Control Panel**

General:

○ System is priced on an **FCA Factory, West Plains, MO basis**. **Quoted price is exclusive of freight & taxes.** Final freight costs will be billed at 115% of final freight invoices as received. Any freight amounts provided on this quote are estimates and are subject to change. Freight can be pre-paid and added to invoicing.

○ Factory testing is included

○ **1 trip, 3 days (quantity 3, 10-hour days) of on-site start-up & training services** by a factory field services technician/engineer is included.
- Additional days necessary will be quoted at time of trip / request.
- Weekends and holidays are subject to additional fees.

○ 1 digital copy of full engineering submittals is included

○ 1 digital copy and 2 hard copies of “as-built” Operation & Maintenance Manuals are included

○ Failure to ship unit within 30 days of notice to ship may result in storage and refurbishing fees.

○ **Due to current material and component pricing volatility, the project price is subject to review and change at time of order and at time of submittal approval (release for manufacturing), even within 30 days from date of quote.**

○ The control panel will be UL 508A listed. If any other codes are required, please contact Perennial Energy for design/cost changes.

○ The SCCR rating of the control panel is **2 kA**. If higher kA is required, please contact Perennial for additional cost adders.

The system as described above and attached is provided as completely pre-packaged, pre-wired, and factory pre-tested as is possible. The system is offered **FCA Factory**, with freight billed at 115% of shipping invoice(s).

The pricing does not include any site civil or structural engineering, or site preparation work of any kind. Neither does the price include any local, state or federal taxes, or any permits, or tariffs of any kind. The system as quoted is to be off-loaded, set-in place, installed and interconnected by others. The system is designed for installation on equipment pad(s) installed at the same finished elevation. **The system includes only the standard Perennial Energy warranty for 18 months from date of shipment or 12 months from date of first service, whichever occurs first.** The pricing is dependent on receiving an approved order that would include industry standard commercial terms. Perennial Energy standard terms are:

10% with order
30% with approved submittals or release for manufacturing
30% upon receipt of major components
25% upon notification to customer of ready to ship
05% upon successful start-up, unless failure to achieve successful start-up is neither the fault nor cause of Perennial Energy, then net 60 days of shipment

10% order due upon Receipt of invoice. All other is Net 30 days of Invoice.

The system as described above is offered for $348,959.00
12" US Valve Check Valve (SS housing/internals) $8,634.00
***2" High pressure bleed down option .... $ 11,767.00**
Total $369,360.00

***3200 Model Candlestick Pressure Bleed System to utilize Pressure or Flow to control bleed-off valve position at startup. If we proceed to control the position of the pressure bleed valve with flare flow, we will need to confirm the flow reading is received in real time into the PEI control system. No changes are made to the existing shutdown valve. This is an option, but is not shown in base quote. Keep in mind, the existing and newly quoted valves are both rated to 50 PSIG pressure. Any excess pressure will simply blow by the disc and out the flare. A pressure transmitter is included in this configuration, measuring pressure between 0 and 100 PSIG. 12" Piping is supplied with the pressure transmitter mounted prior to the shutdown valve and after. All pipe is ASTM A-36 carbon steel. Analog PLC cards are included as well to accommodate the added devices.**

We anticipate that submittals can be provided in **6 to 8 weeks** from receipt of an approved order. We anticipate that we could ship the system in **32 to 36 weeks** from receipt of approved submittals or other irrevocable release to order all materials. Actual submittal and shipping estimates will have to be given at time of order.

Note: Although the above lead times are stated, actual lead times may be different than quoted depending on full release of submittal as the supply chain is unstable and changes daily. It will be imperative to expedite review of the submittal.

Thank you for your consideration of Perennial Energy RNG products and services. Should you have any questions, or require further information in this regard, please do not hesitate to call.

Respectfully,

Colby Staggs

Perennial Energy, LLC
West Plains, MO 65775

ARCHAEA
ENERGY

A Conifer Systems Custom Solution Utilizing
A Thermal Recuperative Oxidizer (TRO) System
For the Abatement of Waste Gas
From an Archaea V1 3,200 SCFM
LFG to RNG Plant

6515 Willowbrook Park
Houston, Texas 77066
832.476.9024
www.conifersystems.com

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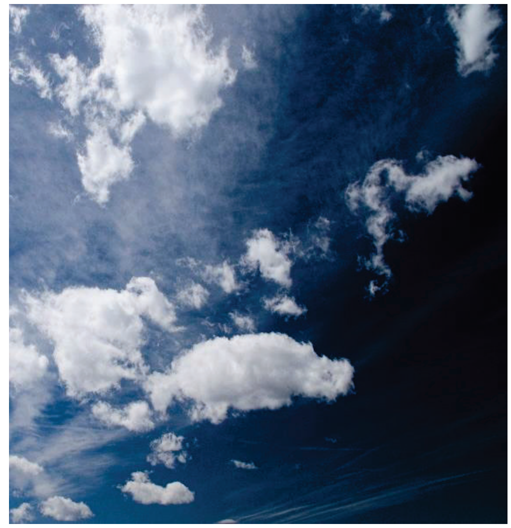

Customer	**Emily Zambuto** **Nevin Edwards**
Address	**2999 Judge Road** **Oakfield, New York 14125**
Company	**Archaea Energy**
Telephone	**+1 (585) 948-4616**
E-Mail	**ezambuto@archaea.energy** **nedwards@archaea.energy**
Date	**May 24th, 2023**
Proposed Solution	**TRO w/ External Heat Recovery**

V1 TRO Example

Your Application Engineer
James Smith
Sr. Application Engineer
jsmith@conifersytems.com
346.440.1436

Your Sales Representative
Cary Allen
VP of Enviromental Solutions
callen@conifersystems.com
832.374.5089

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SECTION 1: EXECUTIVE SUMMARY

1.1 Theory of Operation

Thermal Recuperative Oxidizer (TRO)

The method of reduction of Volatile Organic Compounds in a Thermal Oxidizer revolves around thermal destruction. The chemical process is quite simple; the process air stream temperature is raised to a point that the chemical bonds that hold the volatile organic molecules together are broken. The VOCs in the process air stream are converted to combinations of carbon dioxide and water vapor by the high temperature of the combustion chamber. This exothermic process also releases a substantial amount of additional heat. For gas streams with low levels of oxygen, dilution with additional air may be required to ensure that enough oxygen is present for complete oxidation of the pollutants. Additionally, more air may be added during periods of high VOC loading to protect from overheating of the internal system components. However, this excess heat does have the benefit of reducing demand on the burner.

In a recuperative system heat from the exhaust gas is typically recovered and applied to the incoming air stream as a way to reduce fuel consumption. Heat may also be recovered for external use depending on plant requirements.

Application Specific Details

- This oxidizer is intended for use in Archaea's standard V1 3,200 SCFM size RNG plant.
- The oxidizer in this application uses two heat exchangers. The primary heat exchanger is used to pre-heat the incoming dilution air in order to minimize fuel consumption. The secondary heat exchanger recovers heat from the oxidizer exhaust for external use. In this case, incoming process gas from the CO_2 separation membrane (by others) is heated to a target temperature and sent to the TSA unit (by others) to heat the media. A set of high temperature rated control dampers shall be used to bypass gas around the hot side of the heat exchangers as a means of controlling the temperature. During a TSA cooling cycle the secondary heat exchanger may be bypassed immediately to eliminate any time lost to cooling the heat exchanger. During a heating cycle it may take up to 20 minutes for the gas to fully come back up to temperature before it's ready to send to the TSA. During this time the gas may be circulated back to the inlet of the oxidizer as long as it is cooled prior to reaching the flame arrestor. This would allow at least a portion, if not all, of the warm-up time to take place while the TSA is depressurizing. The gas coming from the TSA during a depressurization cycle, or at the start of the heating cycle should not be sent to the oxidizer as this would increase the total methane load over maximum design capacity of the system.
- After going through the TSA the gas is expected increase in VOC and water vapor content up to the amount specified in section 3.1. No other changes in composition are expected. It is recommended that additional filtration (not included here) be installed upstream of the oxidizer if the additional water vapor and organic compounds have the potential to condense before reaching the oxidizer as this may lead to plugging of the flame arrestor. See section 3.1 for more design clarifications.
- When the gas is first passed through the TSA a volume will be displaced that contains a higher concentration of methane (>50% by volume). The oxidizer is not designed to process this high concentration "slug". The gas should be momentarily directed to a separate flare, oxidizer, or other piece of equipment until methane concentration returns to normal.
- The minimal amount of oxygen present (<1% by volume) prevents the waste gas stream from becoming combustible. Conifer has provided a standard flame arrestor on the unit for flashback protection. However, this may not be sufficient to prevent ignition within the process line upstream of the arrestor if higher levels of oxygen are present. The process gas should always be delivered as oxygen deficient when the methane concentration is near the flammable limits. If greater oxygen content is possible (typically >6% by volume) then design of the feed equipment to the oxidizer may need to change. Customer bears full responsibility for the process conditions shown in section 3.1 as well as any changes which could impact equipment performance or safety.
- To help deal with any potential silica buildup due to the combustion of any siloxanes or other silicone bound compounds the heat exchanger has been designed with an in-line tube arrangement to make cleanout easier. The tube bank is also slightly oversized to account for a certain amount of additional resistance to heat transfer due to fouling. However, these are just basic precautionary measures. No silica forming compounds have been specified so no guarantee has been made regarding performance degradation of any part of the system due to fouling. Alternate heat exchanger designs are available if higher amounts of silica forming compounds are expected.

1.2 Proposal Overview

This unpriced proposal provides technical information for the thermal recuperative oxidizer (TRO). The 5,000 SCFM system shall be capable of treating up to 1,600 SCFM total waste gas combined with up to 3,400 SCFM of dilution air for oxygen addition. Additional cooling air may be added downstream of the combustion zone for temperature control. The fresh air source shall be ambient air provided through the Conifer supplied dilution and cooling air fans.

The system is assumed to be ground mounted, outdoors, and operated in a Class I Div. II electrical area. All electronic instruments on the oxidizer shall be rated for the classified area. Control panel enclosure is purged with appropriate conduit seal-offs for operation in the classified area when the doors are closed. All burner mounted components shall rated for the classified area. For clarity the burner itself cannot be “classified” due to its inherent function. Burners are not UL approved.

In this revision, Rev.1 of the proposal, the following updates have been made:

- Proposal branding has been updated to reflect the change of Gulf Coast Environmental Systems to Conifer Systems.
- Updated the manufacturer of several major components to reflect currently used vendors.
- Updated heat exchanger bypass & isolation damper materials.
- Provided a statement on the maximum allowable process heat release.
- Updated the exhaust stack discharge height.
- Removed standard NO_x emissions rating as all units are now being produced with low-NO_x burners.
- Updated approximate footprint & weight.

SECTION 2: DESIGN CONSIDERATIONS

2.1 Process Data

Stream #1	
Application:	Membrane Waste Gas / TSA Regen
Maximum process volume:	Up to 1,260 SCFM
Process Gas Inlet Temperature:	Up to 300°F *(return from heating)*
Process Gas Inlet Pressure:	~2.5 psig at heat exchanger inlet <0.5 psig at oxidizer inlet 15 psig max. allowable at start-up
Process Volume Turndown Requirement:	~4:1
Minimum Total VOC/HAP Load:	0.00 lb/hr
*Maximum Total VOC/HAP Load:	100.61 lb/hr
*VOC/HAP Mixture Average Heat of Combustion:	~21,154 BTU/lb
*Maximum VOC Heat Release:	2,128,220 BTU/hr or 35,470 BTU/min
**Process Gas Composition at max. Condition:	
- Nitrogen, N_2	1.48% Vol. or 81.04 lb/hr
- Oxygen, O_2	0.64% Vol. or 40.03 lb/hr
- Water Vapor, H_2O	0.50% Vol. or 17.61 lb/hr
- Carbon Dioxide, CO_2	94.61% Vol. or 8,138.30 lb/hr
- Methane, CH_4	2.67% Vol. or 83.73 lb/hr
- Other Non-Corrosive VOCs *(as Hexane, C_6H_{14})*	1,000 ppm_v or 16.84 lb/hr
- ***Hydrogen Sulfide, H_2S	6 ppm_v or 0.04 lb/hr
- Total	100.00% Vol. or 8,377.58 lb/hr

Stream #2	
Application:	NRU Waste Gas
Maximum process volume:	Up to 340 SCFM
Process Gas Inlet Temperature:	Up to 80°F
Process Gas Inlet Pressure:	<0.5 psig at oxidizer inlet 15 psig max. allowable at start-up
Process Volume Turndown Requirement:	~4:1
Minimum Total VOC/HAP Load:	0.00 lb/hr
*Maximum Total VOC/HAP Load:	186.07 lb/hr
*VOC/HAP Mixture Average Heat of Combustion:	~21,500 BTU/lb
*Maximum VOC Heat Release:	4,000,409 BTU/hr or 66,673 BTU/min
**Process Gas Composition at max. Condition:	
- Nitrogen, N_2	77.10% Vol. or 1,139.14 lb/hr
- Oxygen, O_2	0.91% Vol. or 15.36 lb/hr
- Water Vapor, H_2O	0.00% Vol. or 0.00 lb/hr
- Carbon Dioxide, CO_2	0.00% Vol. or 0.00 lb/hr
- Methane, CH_4	21.99% Vol. or 186.07 lb/hr
- Other Non-Corrosive VOCs *(as Hexane, C_6H_{14})*	0 ppm_v or 0.00 lb/hr
- ***Hydrogen Sulfide, H_2S	0 ppm_v or 0.00 lb/hr
- Total	100.00% Vol. or 1,340.57 lb/hr

The VOC/HAP load shown represents the expected operating conditions based on information provided by Archaea. For design purposes the oxidizer shall be capable of operating with a combined methane load of 12.2% by vol. in 1,600 SCFM of total waste gas at the system inlet, or ~485.78 lb/hr of total methane. The maximum allowable total process heat release under any scenario is approximately 10,700,000 BTU/hr.

The process stream composition is limited to the constituents in the above table and does not contain any particulate, acids, halogenated, or additional corrosive compounds. All compounds to be oxidized are expected to have auto-ignition temperatures of approximately 1,000°F or less.

Any SO_x compounds formed as a result of hydrogen sulfide oxidation will not be removed by this equipment alone. Conifer can provide additional post-combustion treatment solutions for the removal of these compounds if required.

2.2 Operating Conditions

Minimum Operating Temperature:	1,500°F
Maximum Operating Temperature:	1,800°F
Target Internal Heat Transfer Effectiveness:	~65% (for dilution air pre-heating)
Target External Heat Transfer Effectiveness:	~60% (for TSA heating)
Equipment Location:	Outdoors
Control Panel Location	Outdoors (on the oxidizer skid)
Site Location Elevation:	<1,000 ft ASL
Electrical Area Classification:	Class I Div. II
Wind Load Design:	100 MPH
Seismic Design:	Not Specified (no seismic provisions included)
Noise Requirement:	<85 dBa @ 5ft from rotating equipment

2.3 Utilities

Natural Gas Requirement (Installed Capacity):	7,500 SCFH @ 10 psig pressure LHV = ~1,000 btu/SCF
Estimated Natural Gas Usage: At full volume, maximum operating temperature, and **Specified VOC Load, ~6.78% CH_4**	~1,538 SCFH *(varies with inlet methane content)*
Electrical Supply Voltage:	480V / 60Hz / 3 Phase
Estimated Electrical Power Consumption:	~58 kW at maximum capacity
Compressed Air Supply:	80 psig @ -20°F dewpoint
Estimated Compressed Air Usage:	10 CFM peak; <5 CFM average
Oxygen Analyzer Additional Utilities	120 V / 60 Hz / 1 Ph – power (from control panel) 0.4% and 8% O_2, Balance N_2 – Calibration Gas 2 SCFH, 2.5 psig, 20.95% O_2 – Reference Air

2.4 Emissions Guarantee

Volatile Organic Compound (VOC) Destruction Removal Efficiency (DRE):
99% or less than 20 ppm_v as hexane

Burner NO_x Emissions:
<0.06 lb/MMBTU as NO_2

Burner Carbon Monoxide Emissions:
<0.20 lb/MMBTU

EPA Method 25A, 7E, & 10 and/or mutually agreed upon test method(s) will be used to determine/validate VOC, NO_x, & CO destruction performance respectively.

2.5 Performance Guarantee provisions

- The unit is installed (if applicable), operated and maintained by Buyer in accordance with Conifer instructions. This includes replacing of consumable or maintenance components by Buyer, as required.
- Buyer agrees to operate the system within the system design data as specified in this proposal.
- The performance guarantees apply only during normal operation, not during any maintenance procedures.
- All functional tests are arranged and paid for by Buyer. Conifer must be notified in writing 14 days prior to the tests for scheduling purposes.
- Conifer reserves the right to adjust the burner chamber operating temperature and any other settings as required to meet the guarantees.
- If Conifer fails to meet the Performance Guarantee, Conifer must be given reasonable time to investigate and take corrective action within the scope of this contract.

SECTION 3: EQUIPMENT SPECIFICATIONS

This proposal is based on preliminary engineering intended to achieve the performance goals. Conifer reserves the right to alter component selections during project engineering.

3.1 5,000 SCFM Thermal Recuperative Oxidizer

General Requirement	Conifer Provision
Fans & Blowers	
Dilution Air Fan	
Fan Manufacturer	New York Blower
Approximate Volume @ Design Conditions	3,400 SCFM
Expected Motor Size	15 HP
Motor Type	TEFC Premium Efficiency
Fan Materials of Construction	Carbon Steel Housing and Fan Wheel Base & Pedestal are Carbon Steel
Safety Pressure Switch	Dwyer 1950 Series or equal
Motor Starter	Allen Bradley or equal Located in the Control Panel
Flow Control	Pneumatic Modulating Damper
Other Features	Inlet Screen Outlet Flex Joint Housing Access Door & Drain
Cooling Air Fan	
Fan Manufacturer	New York Blower
Approximate Volume @ Design Conditions	9,500 SCFM
Expected Motor Size	40 HP
Motor Type	TEFC Premium Efficiency
Fan Materials of Construction	Carbon Steel Housing and Fan Wheel Base & Pedestal are Carbon Steel
Safety Pressure Switch	Dwyer 1950 Series or equal
Motor Starter	Allen Bradly or equal Located in the Control Panel
Flow Control	Pneumatic Modulating Dampers Two (2) total
Other Features	Inlet Screen Outlet Flex Joint Housing Access Door & Drain

Fans & Blowers (continued)	
Combustion Air Fan	
Fan Manufacturer	New York Blower
Approximate Volume @ Design Conditions	1,450 SCFM
Expected Motor Size	10 HP
Motor Type	TEFC Premium Efficiency
Fan Materials of Construction	Carbon Steel Housing and Fan Wheel Base & Pedestal are Carbon Steel
Safety Pressure Switch	Dwyer 1950 Series or equal
Motor Starter	Allen Bradly or equal Located in the Control Panel
Flow Control	Pneumatic Modulating Damper
Other Features	Wire Mesh Inlet Filter Housing Access Door & Drain

Burner, Gas Train, & Combustion System	
Burner	Fives EcoFornax SLEx 4225
Quantity of Burners	One (1)
Maximum Rated Capacity of Each Burner	7,500,000 BTU/hr
Flame Monitoring	Self-Scheck UV Scanner
Gas Train Design Standard	NFPA 86
Expected Gas Line Size	2” NPT Sch. 40
Manual Shut-off Valves	Apollo or equal
Y-Strainer	Mueller or equal
Gas Pressure Regulator	Sensus or equal
Low and High Gas Pressure Switches	United Electric or equal
Fuel Gas Safety Shut-Off Valves	Maxon or equal
Pressure Gauges	Miljocco or equal
Gas Control Valve	Indelec or equal
Adjustable Orifice Valve	Eclipse or equal

Combustion Chamber	
Shell Material	Minimum ¼” thick Carbon Steel
Internal Insulation (Shop Installed)	Ceramic Fiber Modules
Chamber Size	Ø 48” I.D.
Combustion Chamber Access Door	30” x 30” minimum opening size Davit Arm Assisted
Burner Site Port	2” Dia. Pyrex Glass with Air Purge
Temperature Elements	Duplex Type “K” Thermocouple Pyromation or equal
Residence Time *(volumetric basis)*	~0.5 Seconds @ 1,800°F and maximum flow rate

Exhaust Stack	
Stack Discharge Height	60ft above grade
Stack Diameter	38” I.D. / 46” O.D. at discharge point
Max. Expected Volume	35,573 ACFM @ 800°F
Max. Expected Velocity	4,517 ft/min
Materials of Construction	Carbon Steel Shell Internally Insulated with Ceramic Fiber
Test Ports	Two (2) 3” NPT Threaded Pipe Nipples Set at 90° Apart
Stack Test Platform	Not Included
Other Features	Free Standing (no guy wires) Drain at Stack Base

Controls	
Control Panel Type	NEMA 4X – Outdoor Rated with Weather Hood & A/C Purged for Class I Div. II
Operator Interface	Altronic
Control Panel Standard	UL508a
Programmable Logic Controller (PLC)	Altronic
Burner Management System (BMS)	Siemens or equal
Communications Connection	Ethernet Switch
Voltage Main Control	480 VAC / 3 phase / 60 Hz 120 VAC / 1 phase / 60 Hz (via Conifer supplied transformer)

Process Valves	
Membrane Gas Process Isolation Valve	
Type / Size	Wafer Style Butterfly / 8”Ø Two (2) Total
Materials of Construction	Carbon Steel Body Stainless Steel Disk PTFE Seat
Actuator Type / Manufacturer	Spring Return Pneumatic / Fail Closed On-Off Max-Air or equal
TSA Return Process Isolation Valve	
Type / Size	Wafer Style Butterfly / 10”Ø Two (2) Total
Materials of Construction	Carbon Steel Body Stainless Steel Disk PTFE Seat
Actuator Type / Manufacturer	Spring Return Pneumatic / Fail Closed One (1) On-Off & One (1) Modulating Max-Air or equal

Process Valves (continued)	
NRU Gas Process Isolation Valve	
Type / Size	Wafer Style Butterfly / 4"Ø Two (2) Total
Materials of Construction	Carbon Steel Body Stainless Steel Disk PTFE Seat
Actuator Type / Manufacturer	Spring Return Pneumatic / Fail Closed One (1) On-Off & One (1) Modulating Max-Air or equal

Primary Heat Exchanger – Dilution Air Pre-Heat	
Heat Exchanger Type	Crossflow Shell-and-Tube In-line Tube Bank
Materials of Construction	Carbon Steel Housing Internally Insulated with Ceramic Fiber 304 Stainless Steel Internals
Internal Expansion Joint	Included
Cold Side Inlet Design Conditions	Flow Rate: 2,200 SCFM Temperature: 70°F
Hot Side Inlet Design Conditions	Flow Rate: 7,090 SCFM Temperature: 1,200°F
Cold Side Outlet Temperature	805°F (clean, no bypass)
Hot Side Outlet Temperature	1,015°F (clean, no bypass)
Maximum Expected Heat Transfer Rate	~1,789,000 BTU/hr
Maximum Expected Heat Transfer Effectiveness	~65%
Expected Cold Side Pressure Drop	~2.0" w.c. (at design flow rate)
Expected Hot Side Pressure Drop	~3.0" w.c. (at design flow rate)
Maximum Design Differential Pressure from Cold Side to Hot Side	1.0 psig (PSV not included or required)
Cold Side Bypass	None
Hot Side Bypass	Rectangular Louver Dampers Refractory Lined with 253MA Stainless Steel Metal Internals

Secondary Heat Exchanger – TSA Heater	
Heat Exchanger Type	Crossflow Shell-and-Tube In-line Tube Bank
Materials of Construction	Carbon Steel Housing Internally Insulated with Ceramic Fiber 304 Stainless Steel Internals
Internal Expansion Joint	Included
Cold Side Inlet Design Conditions	Flow Rate: 1,260 SCFM Temperature: 65°F
Hot Side Inlet Design Conditions	Flow Rate: 9,410 SCFM Temperature: 800°F
Cold Side Outlet Temperature	543°F (clean, no bypass)
Hot Side Outlet Temperature	722°F (clean, no bypass)
Maximum Expected Heat Transfer Rate	~919,000 BTU/hr
Maximum Expected Heat Transfer Effectiveness	~65%
Expected Cold Side Pressure Drop	~1.0” w.c. (at design flow rate)
Expected Hot Side Pressure Drop	~3.0” w.c. (at design flow rate)
Maximum Design Differential Pressure from Cold Side to Hot Side	5.0 psig (PSV included)
Cold Side Bypass	Wafer Style Butterfly Valves
Hot Side Bypass	Rectangular Louver Dampers Refractory Lined with 253MA Stainless Steel Metal Internals

Miscellaneous	
Flame Arrestor	Carbon Steel Housing Stainless Steel Element Protego or equal
Oxygen Analyzer	Rosemount or equal
Area Lighting	Not Included
Factory Mounting	Pre-piped and Pre-wired to maximum extent practical for shipping

Estimated Size	
Approximate Equipment Footprint	35ft X 43ft Note: Footprint dimensions may be altered to fit available space. Includes all fans and exhaust stack
Approximate Equipment Total Dry Weight	52,000 lbs

SECTION 4: RESPONSIBILITY MATRIX

Work Item	Owner	Conifer	Optional	Remarks
General conditions				
Building permits	X			
EPA permits	X			
Taxes	X			
General site work conditions				
Temporary utilities	X			
Daily job site clean-up	X		X	With Optional Installation
Building alterations / wall penetrations	X			If required
Temporary storage area on-site	X			If required
Demolition and disposal work	X			If required
Lifting equipment for installation – cranes, forklifts, etc.	X			
Civil				
Footings and foundations	X			With grounding grid
Structural support steel	X			N/A
Mechanical				
Fuel Gas Piping	X			To connection point on Conifer Equipment
Compressed air piping	X			To connection point on Conifer Equipment
Fire protection	X			If required
Electrical				
Power feed	X			To connection point on Conifer Equipment
Process interlock wiring to plant	X			
Supplied Equipment				
Engineering and fabrication of the abatement equipment as described in the Technical Section		X		
Freight			X	Pre-pay & Add FCA Houston, TX
Installation – Conifer supplied equipment only	X			
Installation – outside of battery limits	X			
Installation supervision		X		
Commissioning & Start-up		X		
Operator training		X		
Plant Acceptance				
Factory Functional Testing		X		
Quality Assurance		X		As defined by Conifer (Section 7.3)
Compliance Testing	X			
Spare parts			X	Defined during the engineering phase
Maintenance and operating manuals		X		One (1) electronic copy, English only
Record mechanical and electrical drawings		X		One (1) electronic copy, English only

SECTION 5: DOCUMENTATION, SERVICES, & CLARIFICATIONS

5.1 Review & Approval of Documentation

As project activities must continue to progress, in order to meet cost & schedules objectives, project documentation is considered "Approved As Submitted" if review comments are not received within seven (7) calendar days of submittal.

5.2 Surface Painting & Preparation

All carbon steel, which is not galvanized or aluminized, shall be treated and coated in the paint system specified by Archaea utilizing Sherwin William Envirolastic 940 LV basecoat and Sherwin Williams SW 9035 "Frosted Emerald" color. Stainless steel, plastic, and other finishes shall not be painted. Purchased components will be coated per the OEM standard paint system and color.

5.3 Quality Assurance

Conifer shall assemble the system in the factory to the greatest extent reasonable, considering system size and configuration, to inspect fit-up of the major structures. A full test of the control panel according to Conifer testing standards is performed before shipment of the equipment. Safeties, controls, and components which may be pre-wired for shipment are verified through operation as functionally correct and calibrated during internal pre-commissioning. The customer is always welcome and recommended to visit during shop pre-commissioning of the control panel.

With standard Conifer internal pre-commissioning, the unit may not be operated completely. Components which cannot be practically pre-wired for shipment will not be operated. Other testing options, if required, are available. Any additional testing procedures outside of Conifer standard procedures may occur additional costs and impact project schedule.

5.4 Standards & Codes

Equipment manufactured by Conifer complies with the U.S. applicable sections of the Occupational Safety and Health Act (OSHA), National Fire Protection Association (NFPA), National Electric Code (NEC), and National Electric Manu. Assoc. (NEMA).

5.5 Standard Project Clarifications – Customer's Responsibility

The following items are excluded from the Conifer offering and shall require completion by others ***unless otherwise specified***:

- Modifications, retrofitting, removal, or cleaning of any equipment or component existing or provided by others.
- Responsibility and costs associated with unloading, storing, handling, and installing the equipment on site at final location. This includes providing materials required for site installation – conduit, wiring, piping, etc. to interconnect the system components once it reaches final mechanical assembly.
- Purchaser must provide process gas and all utilities to the point of utilization according to the design drawings – includes, but not limited to, instrument quality and compressed air (-20°F dew point), main switch gear and power plant distribution, electricity power, Ethernet / phone line(s), natural gas, water, and main gas meter and regulator.
- Purchaser is responsible for interconnecting wiring between the Control Panel and Field Instrumentation, unless Conifer is selected for installation. If the panel is to be located far away from the abetment system please notify Conifer as this may require an adjustment to installation scope.
- Temporary utilities, restrooms, and work area for Conifer field service engineer if required.
- Surge and lightning protection or transformers.
- Any and all compliance testing by third party shall be purchaser's responsibility.
- Purchaser shall obtain all the necessary construction and operation permits as may be required.
- Any VAT, state, local, or federal sales tax, insurance, bonding, or duty associated with the project or equipment.
- A secured location under lock and key for Conifer tools and materials used for installation and commissioning provided in a convenient area close to the installation location.
- At a minimum Conifer must supervise installation and be present for commissioning to verify proper equipment operation and for validation of the factory warranty.

SECTION 6: Attachments

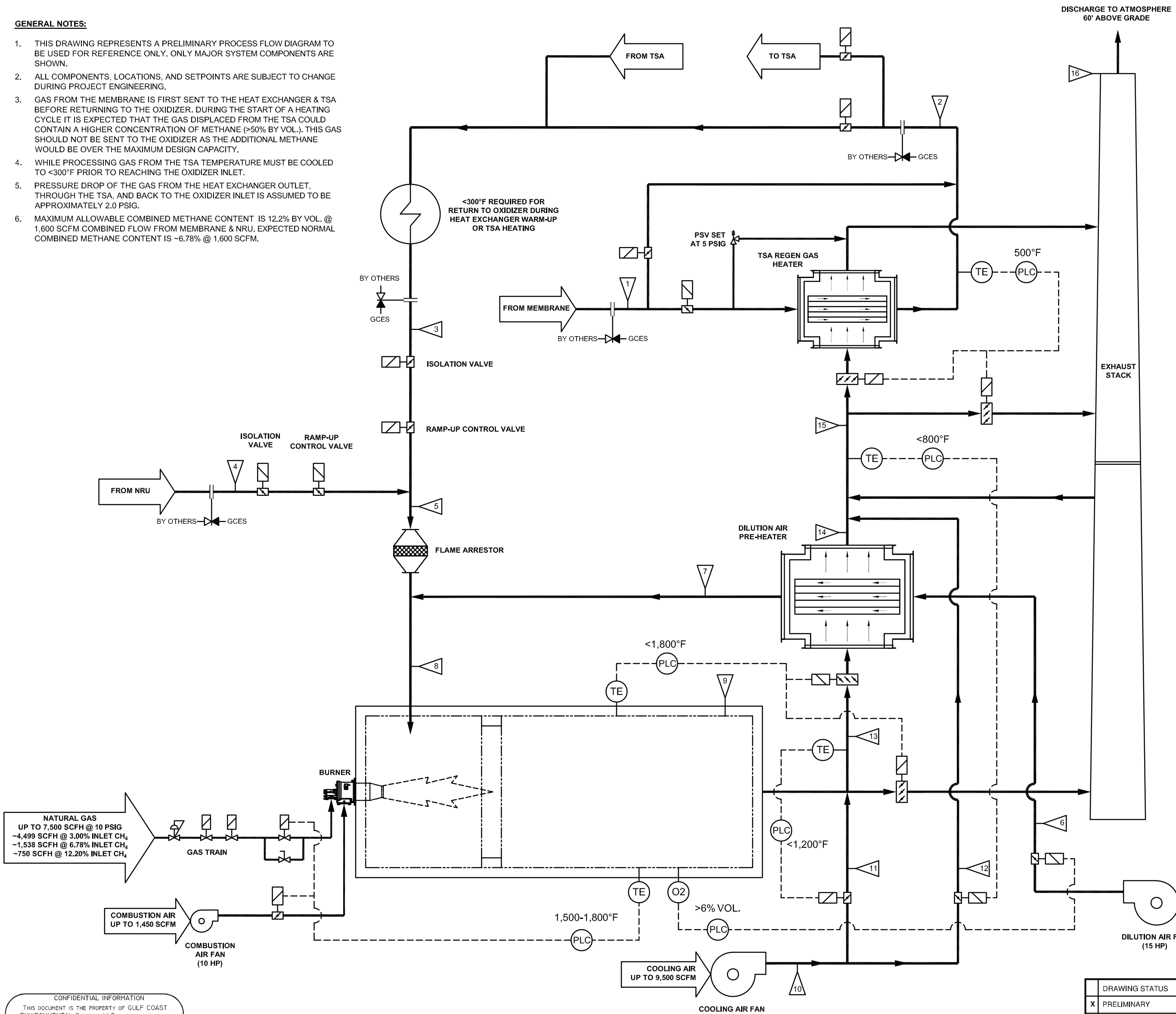
Please find and review the following attachments.

Preliminary Flow Schematic Drawing

Preliminary General Arrangement Drawing

GENERAL NOTES:

1. THIS DRAWING REPRESENTS A PRELIMINARY PROCESS FLOW DIAGRAM TO BE USED FOR REFERENCE ONLY. ONLY MAJOR SYSTEM COMPONENTS ARE SHOWN.
2. ALL COMPONENTS, LOCATIONS, AND SETPOINTS ARE SUBJECT TO CHANGE DURING PROJECT ENGINEERING.
3. GAS FROM THE MEMBRANE IS FIRST SENT TO THE HEAT EXCHANGER & TSA BEFORE RETURNING TO THE OXIDIZER. DURING THE START OF A HEATING CYCLE IT IS EXPECTED THAT THE GAS DISPLACED FROM THE TSA COULD CONTAIN A HIGHER CONCENTRATION OF METHANE (>50% BY VOL.). THIS GAS SHOULD NOT BE SENT TO THE OXIDIZER AS THE ADDITIONAL METHANE WOULD BE OVER THE MAXIMUM DESIGN CAPACITY.
4. WHILE PROCESSING GAS FROM THE TSA TEMPERATURE MUST BE COOLED TO <300°F PRIOR TO REACHING THE OXIDIZER INLET.
5. PRESSURE DROP OF THE GAS FROM THE HEAT EXCHANGER OUTLET, THROUGH THE TSA, AND BACK TO THE OXIDIZER INLET IS ASSUMED TO BE APPROXIMATELY 2.0 PSIG.
6. MAXIMUM ALLOWABLE COMBINED METHANE CONTENT IS 12.2% BY VOL. @ 1,600 SCFM COMBINED FLOW FROM MEMBRANE & NRU. EXPECTED NORMAL COMBINED METHANE CONTENT IS ~6.78% @ 1,600 SCFM.



REVISION HISTORY

REV	DESCRIPTION	DATE	BY
0	INITIAL RELEASE	9-30-21	JBS
1	UPDATED STACK HEIGHT	5-24-23	JBS

EXPECTED MAXIMUM OPERATING CONDITIONS
WITH 3,200 SCFM TOTAL PROCESS GAS @ 6.78% CH_4 & TSA HEATING

FULL FLOW		1	2	3	4	5	6	7	8
VOLUME	SCFM	1,260	1,260	1,260	340	1,600	2,200	2,200	3,800
TEMPERATURE	°F	65	500	300	80	253	70	805	473
PRESSURE	IN. W.C.	+41.0	+40.0	+12.0	+12.0	+11.0	+10.5	+8.5	+8.0

1 MEMBRANE WASTE GAS INLET
2 HEAT EXCHANGER OUTLET
3 TSA RETURN TO OXIDIZER
4 NRU WASTE GAS INLET
5 OXIDIZER INLET
6 DILUTION AIR INLET
7 HEATED DILUTION AIR
8 DILUTED PROCESS GAS

FULL FLOW		9	10	11	12	13	14	15	16
VOLUME	SCFM	4,144	5,265	2,942	2,323	7,090	7,090	9,413	9,413
TEMPERATURE	°F	1,800	70	70	70	1,200	1,001	800	738
PRESSURE	IN. W.C.	+7.5	+17.5	+9.5	+6.5	+7.0	+4.0	+3.5	+0.5

9 COMBUSTION CHAMBER
10 COOLING AIR INLET
11 FIRST STAGE COOLING AIR
12 SECOND STAGE COOLING AIR
13 DILUTION PRE-HEATER HOT SIDE INLET
14 DILUTION PRE-HEATER HOT SIDE OUTLET
15 TSA HEATER HOT SIDE INLET
16 EXHAUST STACK

EXPECTED MAXIMUM OPERATING CONDITIONS
WITH 3,200 SCFM TOTAL PROCESS GAS @ 12.2% CH_4 & TSA COOLING

FULL FLOW		1	2	3	4	5	6	7	8
VOLUME	SCFM	1,260	1,260	1,260	340	1,600	3,400	3,400	5,000
TEMPERATURE	°F	65	65	65	80	68	70	217	163
PRESSURE	IN. W.C.	+36.0	+35.0	+7.5	+7.5	+6.5	+9.0	+4.5	+3.5

1 MEMBRANE WASTE GAS INLET
2 HEAT EXCHANGER OUTLET
3 TSA RETURN TO OXIDIZER
4 NRU WASTE GAS INLET
5 OXIDIZER INLET
6 DILUTION AIR INLET
7 HEATED DILUTION AIR
8 DILUTED PROCESS GAS

FULL FLOW		9	10	11	12	13	14	15	16
VOLUME	SCFM	5,171	8,458	3,549	4,909	8,723	8,723	13,632	13,632
TEMPERATURE	°F	1,800	70	70	70	1,200	1,156	800	800
PRESSURE	IN. W.C.	+3.0	+16.5	+6.5	+5.5	+2.5	+1.5	+1.0	+0.5

9 COMBUSTION CHAMBER
10 COOLING AIR INLET
11 FIRST STAGE COOLING AIR
12 SECOND STAGE COOLING AIR
13 DILUTION PRE-HEATER HOT SIDE INLET
14 DILUTION PRE-HEATER HOT SIDE OUTLET
15 TSA HEATER HOT SIDE INLET
16 EXHAUST STACK

DRAWING STATUS	DATE	BY
X PRELIMINARY	05-24-23	JBS
. FOR APPROVAL	.	.
. APPROVED FOR FAB	.	.
. AS BUILT	.	.
. AS FIELD MODIFIED	.	.

MAT'L: SEE PROPOSAL
WEIGHT: SEE PROPOSAL
TOLERANCES: N/A
THIRD ANGLE PROJECTION
SHT 1 OF 1
INCH [mm]

Gulf Coast Environmental Systems
1689 HAWTHORNE DRIVE, CONROE, TX 77301
Telephone: 832-476-9024 Fax: 855-301-9672

DO NOT SCALE THIS DRAWING

DATE: 05/24/23
SCALE: NTS
DRAWN BY: JBS
CHECKED BY: CA

CUSTOMER: ARCHAEA ENERGY

TITLE: THERMAL RECUPERATIVE OXIDIZER (TRO) FOR 3,200 SCFM (SMALL) V1 PLANT PRELIMINARY PROCESS FLOW DIAGRAM

PROPOSAL	DRAWING	REV	SIZE
	010	1	D

REVISIONS				
REV.	DESCRIPTION	DATE	ECN/ECR	APPROVED
1	INITIAL SUBMITTAL	01/10/2022	22-0376	BL

PROCESS DATA:

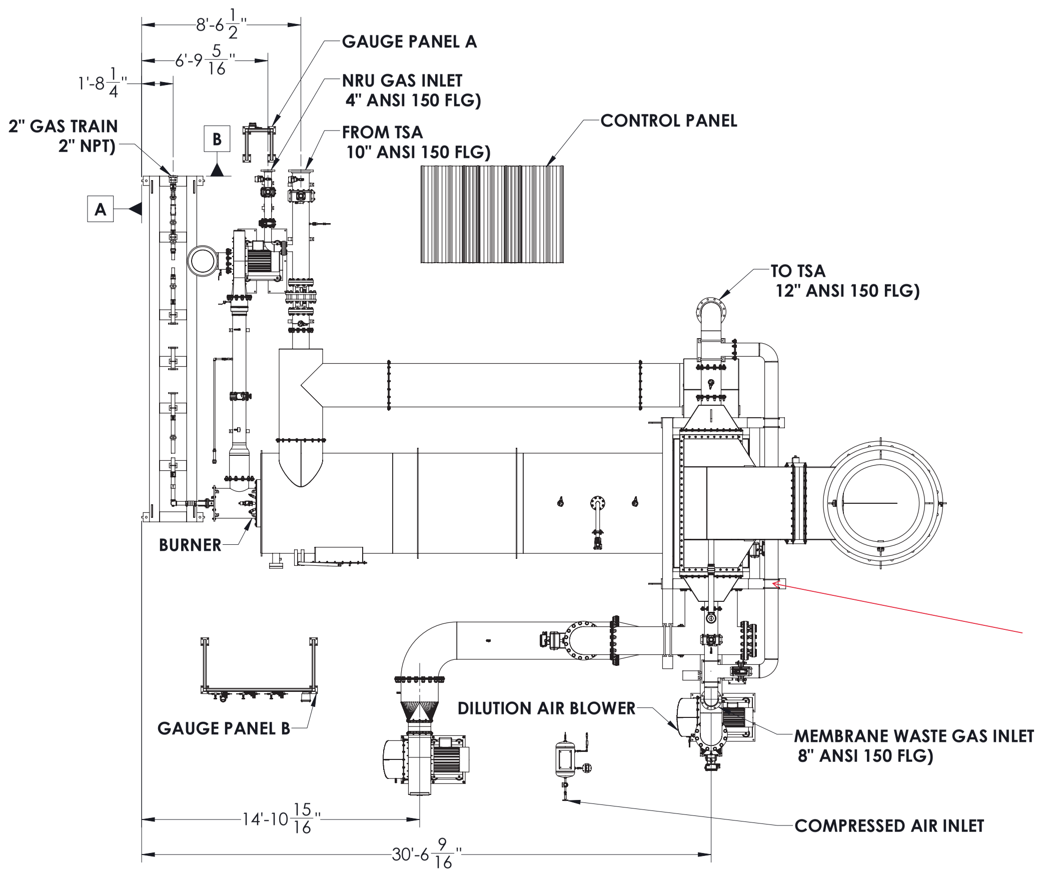
Stream #1	
Application:	Membrane/TSA Regen
Process Gas Flow Rate	Up to 1,260 SCFM
Process Gas Inlet Temperature:	Up to 300°F (return from heating)
Process Gas Inlet Pressure:	~2.5 psig at heat exchanger inlet <0.5 psig at oxidizer inlet 15 psig max. allowable at start up
Process Turndown Requirement:	~4:1 (assumed)
Minimum VOC/PFC Load:	0.00 lb/hr
Maximum VOC/PFC Load:	100.61 lb/hr
VOC/PFC Mixture Heat of Combustion:	~21,154 BTU/lb
Maximum VOC Heat Release:	2,128,220 BTU/hr or 35,470 BTU/min
Process Gas Composition at Max Condition:	
- Nitrgogen, N2	1.48% Vol.
- Oxygen, O2	0.64% Vol.
- Carbon Dioxide, CO2	94.61% Vol.
- Methane, CH4	2.67% Vol.
- Hydrogen Sulfide, H2S	6 ppmv
- Other Non-Corrosive VOCs	1,000 ppmv
- Water Vapor, H2O	0.50% Vol.
- Total	100.00% Vol.
Stream #2	
Application:	NRU waste gas
Process Gas Flow Rate:	Up to 340 SCFM
Process Gas Inlet Temperature:	UP to 80°F
Process Gas Inlet Pressure:	<0.5 psig at oxidizer inlet 15 psig max. allowable at start up
Process Turndown Requirement:	~4:1 (assumed)
Minimum VOC/PFC Load:	0.00 lb/hr
Maximum VOC/PFC Load:	186.07 lb/hr
VOC/PFC Mixture Heat of Combustion:	~21,000 BTU/lb
Maximum VOC Heat Release:	4,000,409 BTU/hr or 66,673 BTU/min
Process Gas Composition at Max Condition:	
- Nitrogen, N2	77.10% Vol.
- Oxygen, O2	0.91% Vol.
- Carbon Dioxide, CO2	0.00% Vol.
- Methane, CH4	21.99% Vol.
- Hydrogen Sulfide, H2S	0.00% Vol.
- Other Non-Corrosive VOCs (as Hexane, C6H14)	0.00% Vol.
- Water Vapor	0.00% Vol.
- Total	100.00% Vol.

OPERATING CONDITIONS

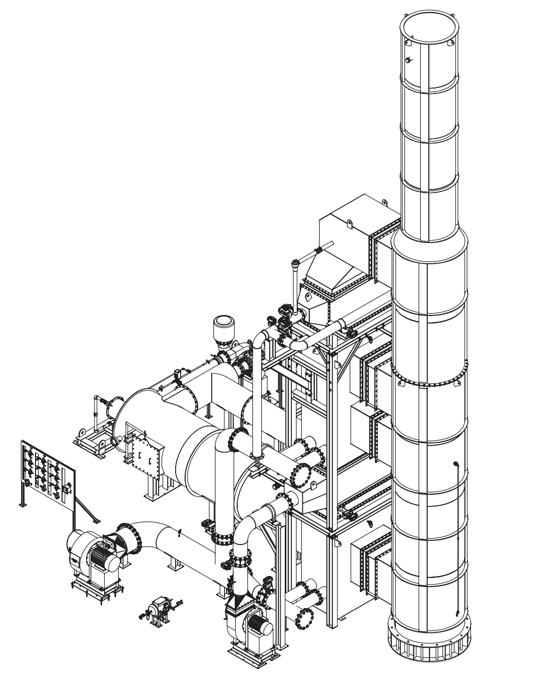
Minimum Operating Temperature:	1,500°F
Maximum Operating Temperature:	1,800°F
Internal Heat Recovery Efficiency:	~65% (for dilution air pre-heating)
External Heat Recovery Efficiency:	~60% (for TSA heating)
Site Location Elevation:	<1,000 ft ASL
Equipment Location:	Outdoors
Control Panel Location:	Outdoors (on the oxidizer skid)
Electrical Area Classification:	Class I Div. II
Wind Load:	100 MPH
Seismic Design:	Not specified (no seismic provisions provided)
Noise Requirement:	<85 dBa @ 5ft from rotating equipment

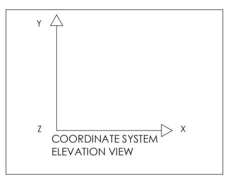
UTILITIES

Natural Gas Requirement (Installed Capacity):	7,500 SCFH @ 10 psig pressure LVH = 1,000 btu/SCF
Natural Gas Usage: At full process volume, maximum operating temperature, and specified VOC load	~1,538 SCFH (varies with inlet methane content)
Electrical Supply Voltage:	480V / 60 Hz / 3 Phase
Elecrical Power Consumption:	~58 kW at full capacity
Compressed Air Supply:	80 psig @ -20°F dewpoint
Compressed Air Usage:	10 CFM peak (<5 CFM average)
Oxygen Analyzer:	120V / 60 Hz / 1 Phase - power (from control panel) 0.4% and 8% O2, Balanced N2 - Calibration Gas 2 SCFH, 2.5 psig, 20.95% O2 - Reference Air



PLAN VIEW





Risk CAT = II / Site Class D		
Ss	S1	SDC
2.455	0.785	E

Conifer SYSTEMS

TELEPHONE 832-476-9024
FAX 936-344-6731
ADDRESS 6515 WILLOWBROOK PARK
HOUSTON, TX 77066

THIRD ANGLE PROJECTION

DO NOT SCALE DRAWING

	NAME	DATE
DRAWN BY	SAZ	12/12/2022
ENG APPR	BL	01/04/2022

UNLESS OTHERWISE SPECIFIED

DIMENSIONS ARE IN INCHES
TOLERANCES
FRACTIONAL: ±1/16"
WELDMENTS: ±1/8"
ANGULAR MACH: ±1/2° BEND: ±1°
X.XX: ±0.06" X.XXX: ±0.005"

INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5

MATERIAL

FINISH

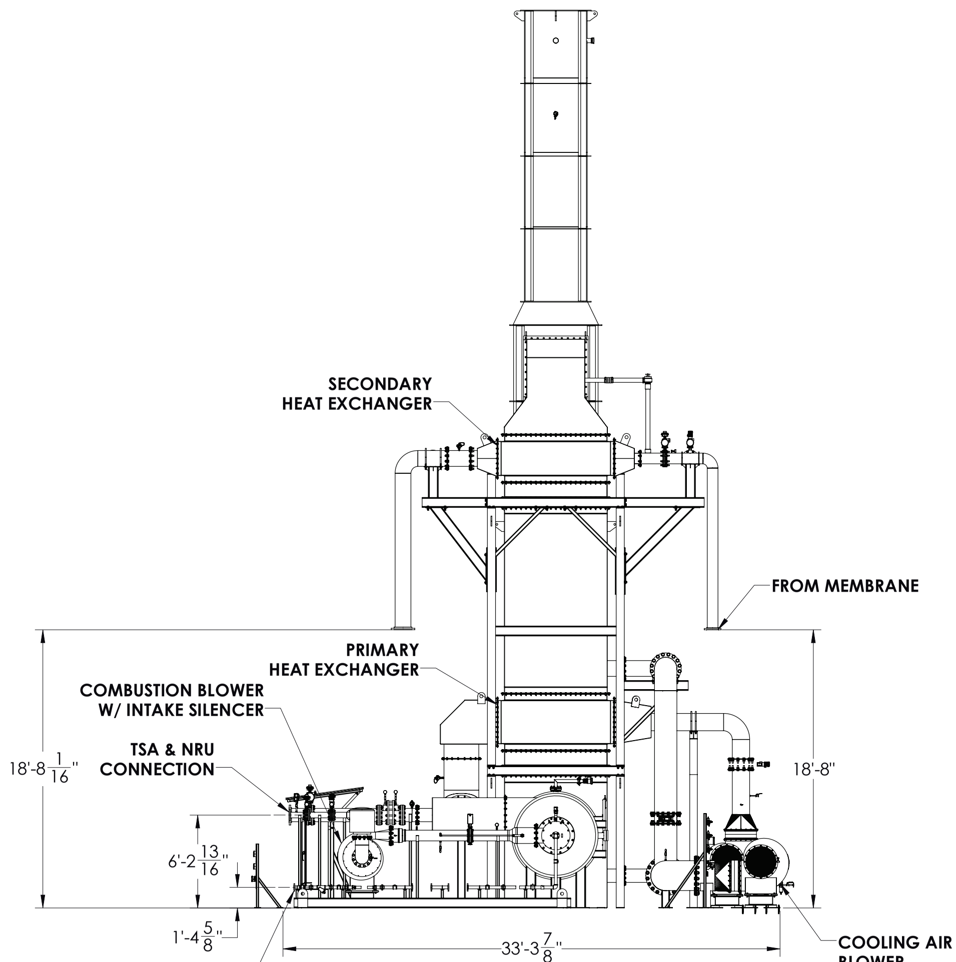
CUSTOMER ARCHAEA ENERGY

LOCATION CANTON

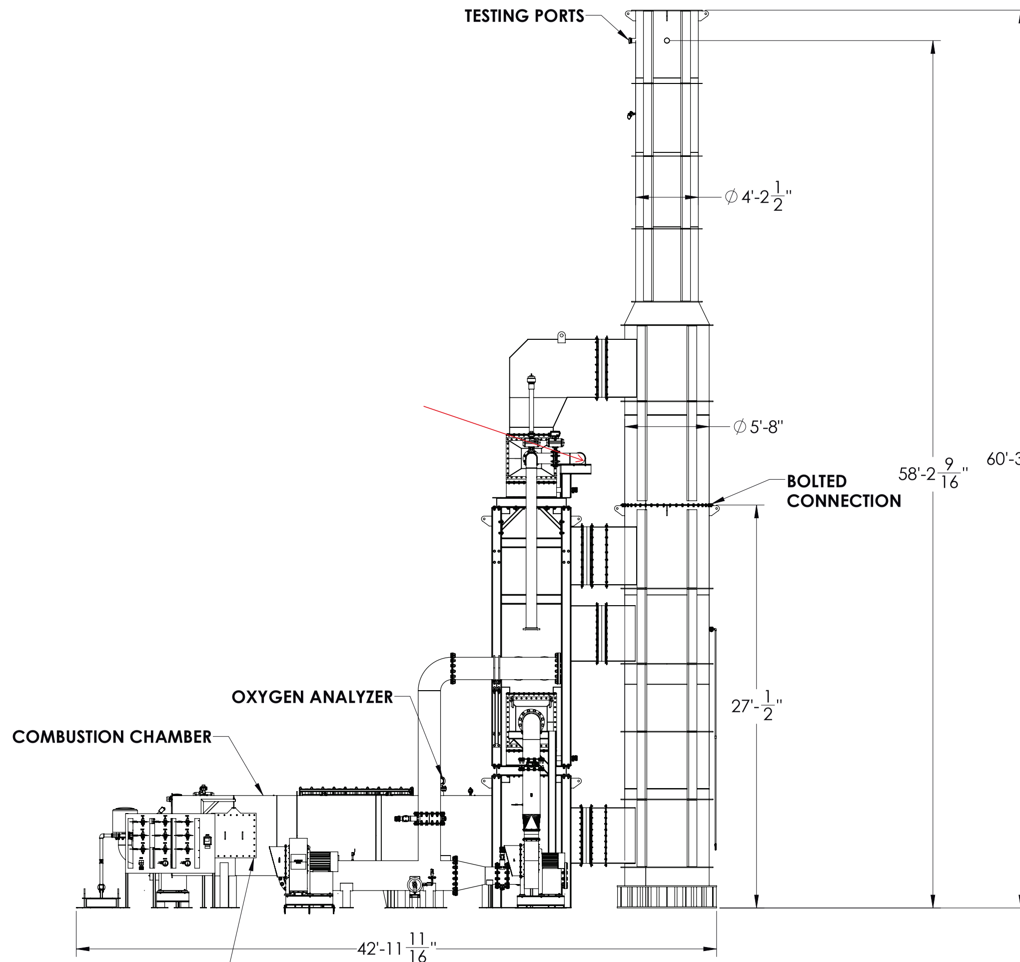
TITLE 3200 LOW Nox GENERAL ASSEMBLY

SIZE D DWG NO 21E1054D500 REV 1

SCALE 2:1 WEIGHT 95972.8 SHEET 1 OF 15



LEFT VIEW



ELEVATION VIEW

CUSTOMER	ARCHAEA ENERGY
LOCATION	CANTON
TITLE	3200 V1 LOW Nox GENERAL ASSEMBLY
SIZE D	DWG NO 21E1054D500
REV	1
SCALE 1:50	WEIGHT 95972.8
SHEET 2 OF 15	