Weaver Consultants Group

November 29, 2023

Kentucky Department of Environmental Protection
Division for Air Quality
300 Sower Boulevard
2nd Floor
Frankfort, Kentucky 40601

Re: Application for Permit Modification
Owensboro Renewable Natural Gas Facility
Owensboro, Daviess County, Kentucky

On behalf of our client, Owensboro RNG, LLC, we respectfully submit this application to modify the pending permit to construct a renewable natural gas facility located near the West Daviess County Landfill. The proposed renewable natural gas facility is designed to handle up to 2,000 standard cubic feet of raw landfill gas. The proposed renewable natural gas facility will be owned and operated by Owensboro RNG, LLC a separate corporate entity from West Daviess County Landfill which is owned and operated by West Daviess County.

Due to issues with establishing permanent utility services for the planned renewable natural gas plant, we are requesting to add two natural gas fired generators to provide power to the facility. In addition, some of the internal processing equipment during the gas refining process has changed to help reduce the electricity demand for the plant. In addition, the site requests a limit on the operation of the planned open flare, which will only be used to purge the process lines and therefore will operate much lower than the previously permitted PTE values.

If you have any questions regarding this application, please contact me at (513) 254-9224 or jhall@wcgrp.com. We look forward to working on this beneficial use project with your office.

Sincerely,

Weaver Consultants Group

Julie Hall
Senior Project Manager

Cc: Pat O'Mahony, Owensboro RNG, LLC

Attachment: Application for Permit Modification

November 29, 2023

5445-351-50-01

APPLICATION FOR PERMIT MODIFICATION

Owensboro RNG, LLC

OWENSBORO, DAVIESS COUNTY, KENTUCKY

PREPARED BY

Weaver Consultants Group

EXECUTIVE SUMMARY

Owensboro RNG, LLC is seeking to modify the pending permit to construct a gas upgrading system at the West Daviess County Landfill. Owensboro RNG, LLC has obtained the right to purchase the landfill gas generated by the West Daviess County Landfill. The proposed gas upgrading system at West Daviess County Landfill is designed to handle 2,000 standard cubic feet (scfm) of raw landfill gas. The two-stage PSA system is designed to remove nitrogen while maintaining a high methane recovery. Prior to being processed the landfill gas is treated. Once processed the landfill gas is upgraded to pipeline quality gas and discharged directly to the pipeline for use as renewable fuel. Electric power will be generated from two natural gas fired Jenbacher Generators.

TABLE OF CONTENTS

Appendices:

1 INTRODUCTION

1.1 Site Location

The Owensboro renewable natural gas (RNG) facility will be located on a portion of the property owned by Daviess County at the West Daviess County Landfill. The West Daviess County Landfill is located at 7772 KY Route 815 in Owensboro, West Daviess County, Kentucky. The area allocated for the RNG facility is outside the waste boundary (permitted waste disposal area) and adjacent to the existing landfill gas flare. Owensboro RNG, LLC is leasing a portion of the property for the RNG facility from West Daviess County Landfill.

1.2 Source Information

The Owensboro RNG facility will be co-located on the West Daviess County Landfill property. The Owensboro RNG Facility and West Daviess County Landfill are owned and operated by separate corporate entities. For purposes of determining site wide emission limits Owensboro and West Daviess County Landfill are considered separate sources; therefore; each entity will obtain and maintain separate permits and complete independent reporting as required by each individual construction and/or operating permit.

1.3 Project Schedule

Construction of the RNG facility is expected to commence upon permit issuance, ideally during April of 2024 and will be completed within twelve to eighteen months.

1.4 Application for Permit - ÏÄÉÆÉÃÁÔÉÏÎ

This Application for a Permit Modification has been prepared on behalf of Owensboro RNG, LLC. This application is comprised of a cover letter, this narrative text and appendices. The Kentucky Department of Environmental Protection (KDEP) Division of Air Quality (DAQ) form DEP7007AI "Administrative Information" form is presented as Appendix A.

2 PROCESS DESCRIPTION

Landfill gas typically consists of approximately fifty percent methane, forty percent carbon dioxide, and ten percent nitrogen. Landfill gas also includes other minute compounds and water vapor. West Davies County Landfill has installed and currently operates an active landfill gas collection and control system used to extract landfill gas from the waste mass. The landfill gas will be extracted via this existing system and sent via pipeline to the proposed RNG facility. The Owensboro RNG facility design includes a second set of blowers dedicated to the RNG facility to maintain vacuum on the existing landfill gas collection system. In addition, the RNG facility design includes an open flare for the destruction of excess or out of specification treated landfill gas. The open flare will be limited to 2000 hours/year as discussed in Section 3 and shown in the Emission Calculations in Appendix D. To provide power to the RNG facility, Owensboro RNG will be using two (2) Jenbacher natural gas fired generators.

2.1 Proposed System

Owensboro RNG will be using a landfill gas upgrading system designed and built by Guild Associates. In this process, raw feed gas from the landfill collection blowers is sent to the Molecular Gate™ PSA system at 2 PSIG and 110°F. Gas is compressed to 110 PSIG, chilled to < 50°F, and reheated to 150°F using compressor waste heat. Dry, reheated gas is sent to the Molecular Gate™ PSA system to remove: CO2, H2S, NMOCs, Siloxanes, and H2O. Vacuum compression regenerates the Molecular Gate™ PSA beds by removing the contaminants.

Off-gas treatment will be achieved via a direct fired thermal oxidizer. Thermal oxidation of the off gas is achieved with more than 98 percent destruction of non-methane organic compounds (NMOC). The direct fired thermal oxidizer destroys emissions through the process of combustion. The chemical process of thermal oxidation includes raising the exhaust stream temperature to between 1,250 and 1,800 ^{o}F, a temperature at which the chemical bonds that hold the molecules together are broken. The volatile organic compounds in the process exhaust stream are converted to various combinations of carbon dioxide, water and thermal energy by the high temperature of the combustion chamber. During RNG Plant upsets, the gas in the process pipes will be vented to the open flare. Due to limited operations, Owensboro RNG requests a limit of 2,000 hours/year for

the open flare. The Open Flare and the Thermal Oxidizer do not operate at the same time, gas would only go to one or the other. Product gas will be sent directly to the pipeline after being compressed and odorized to required standards.

3 POTENTIAL TO EMIT

The potential to emit (PTE) calculations for the proposed RNG facility control devices have been completed using the maximum operating schedule for the facility predicted to be twenty-four (24) hours per day, seven (7) days per week, three hundred and sixty-five (365) days per year. In addition, the PTE calculations for the Thermal Oxidizer and the two (2) Jenbacher Generators assume the maximum capacity of the equipment, being 2,000 scfm and continuous operations for 8,760 hours per year. Due to the very limited need for the open flare, Owensboro RNG requests an operational limit of 2,000 hours/year. PTE calculations have been prepared individually for criteria and regulated pollutants. Emission factors are based on the United States Environmental Protection Agency's (USEPA) "AP-42 Compilation of Air Pollutant Emission Factors" and manufacturers specifications. Form DEP 7007GG *Control Equipment* is included in Appendix D.

3.1 PTE Emission Calculations

Emission calculations for the facility's PTE were calculated based on the criteria presented above. Separate calculations have been prepared for the thermal oxidizer and open flare. Emission calculations are presented in Appendix D. The following summary is provided for the PTE.

Pollutant	Thermal Oxidizer		Open Flare (2,000 hr/yr Limit)	
	Tons per Year (TPY)	Pounds per Hour (lb/hr)	Tons per Year (TPY)	Pounds per Hour (lb/hr)
CO	23.3	5.3	20.8	20.8
NO_x	6.5	1.5	4.6	4.6
SO_2	10.2	2.3	6.1	1.0
$PM/PM_{10}/PM_{2.5}$	1.8	0.4	1.0	1.0
VOC	0.3	0.1	0.1	0.1
HAPs $_{(T)}$	0.3	0.1	0.5	0.5

Based on the proposed RNG plant operations, the open flare and thermal oxidizer will not be operating at the same time. When the plant is operating, the thermal oxidizer will be used. When the plant is down, the open flare will be running. For PTE purposes, the worst-case emissions for each pollutant is the highest from either the thermal oxidizer or the open flare (as shown in the table in Section 4.2 below), not the sum of the PTE from both units.

To provide electric power to the RNG Plant, two (2) Jenbacher Generators will be used. For PTE purposes, it is assumed that both generators operate at full capacity. The PTE from both generators is shown below.

Emissions From Both Generators		
Pollutant	Tons per Year (TPY)	Pounds per Hour (lb/hr)
CO	66.5	15.2
NO_x	33.2	7.6
SO_2	0.1	0.01
$PM/PM_{10}/PM_{2.5}$	3.6	0.8
VOC	11.3	2.6
$HAPs_{(T)}$	0.4	0.1

4 APPLICABILITY

4.1 Daviess County NAAQS Designations

Daviess County is designated as an attainment area for the National Ambient Air Quality Standards (NAAQS).

4.2 Major Source Status

The proposed RNG facility is a minor source.

Pollutant	Major Source Threshold (TPY)	Worse-Case Project Emissions Tons per Year (TPY)
CO	250	89.8
NO_x	250	39.7
SO_2	250	10.3
$PM/PM_{10}/PM_{2.5}$	250	5.3
VOC	250	11.6

4.3 Subparts OOO and AAAA Applicability

The West Daviess County Landfill is subject to the *Federal Plan Requirements for Municipal Solid Waste Landfills*, 40 Code of Federal Regulations (CFR) Part 62, Subpart OOO, and the National Emission Standards for Hazardous Air Pollutants (NESHAP), 40 CFR Part 63 Subpart AAAA. The USEPA has issued determinations stating that equipment that uses or combusts treated landfill gas is not subject to either of these subparts. Combustion of treated gas, including the off-gas treatment, are also exempt from these regulations.

4.4 Kentucky Permitting / Registration Thresholds

In accordance with 401 Kentucky Administrative Rule (KAR) 52 Owensboro RNG, LLC is seeking a State Origin Permit meeting the following requirements:

- PTE < 10 tpy of any combined hazardous air pollutants,
- PTE < 25 tpy of combined hazardous air pollutants, and
- PTE > 25 but < 100 tpy of any regulated air pollutant.

Commonwealth of Kentucky
Michael G. Adams, Secretary of State

Michael G. Adams
Secretary of State
P. O. Box 718
Frankfort, KY 40602-0718
(502) 564-3490
http://www.sos.ky.gov

Certificate of Existence

Authentication number: 293045
Visit https://web.sos.ky.gov/ftshow/certvalidate.aspx to authenticate this certificate.

I, Michael G. Adams, Secretary of State of the Commonwealth of Kentucky, do hereby certify that according to the records in the Office of the Secretary of State,

Owensboro RNG, LLC

is a limited liability company duly organized and existing under KRS Chapter 14A and KRS Chapter 275, whose date of organization is March 25, 2020 and whose period of duration is perpetual.

I further certify that all fees and penalties owed to the Secretary of State have been paid; that articles of dissolution have not been filed; and that the most recent annual report required by KRS 14A.6-010 has been delivered to the Secretary of State.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my Official Seal at Frankfort, Kentucky, this 22nd day of June, 2023, in the 232nd year of the Commonwealth.

Michael G. Adams
Secretary of State
Commonwealth of Kentucky
293045/1092005

Appendix A

DEP &Ïò Í ó 7007AIh̆ χπχ "h̆ χπχ . h̆ χπχ6

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: **Owensboro RNG, LLC**

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

Permit #: **V-23-025**

Agency Interest (AI) ID: **APE20230001**

Date: **29-Nov-23**

Section AI.1: Source Information

Physical Location Address:	**Street:**	7772 KY Route 815				
	City:	Owensboro	**County:**	West Daviess	**Zip Code:**	42301
Mailing Address:	**Street or P.O. Box:**	c/o BerQ RNG, 2400 Ansys Drive, Suite 102				
	City:	Canonsburg	**State:**	PA	**Zip Code:**	15314

Standard Coordinates for Source Physical Location

Longitude: 37.6744256 (decimal degrees) **Latitude:** -87.2701676 (decimal degrees)

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

Classification (SIC) Category: Mixed, Manufactured, or Liquefied Petroleum Gas Production **Primary SIC #:** 4925

Briefly discuss the type of business conducted at this site: Renewable Natural Gas Facility

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: TBD

Approximate distance to nearest residence or commercial property: *400'* **Property Area:** **rural** **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: Owensboro RNG, LLC

Title: (if individual) Pat O'Mahony, Project Manager

Mailing Address:
Street or P.O. Box: c/o BerQ RNG, 2400 Ansys Drive, Suite 102
City: Canonsburg **State:** PA **Zip Code:** 15317

Email: (if individual) pato@berqrng.com

Phone: 412-877-8808

Technical Contact

Name: Julie Hall

Title: Senior Project Manager, Weaver Consultants Group

Mailing Address:
Street or P.O. Box: 320 Cramer Creek Court
City: Dublin **State:** OH **Zip Code:** 43017

Email: jhall@wcgrp.com

Phone: 513-254-922

Air Permit Contact for Source

Name: Pat O'Mahony

Title: Project Manager

Mailing Address:
Street or P.O. Box: Owensboro RNG, LLC c/o BerQ RNG, 2400 Ansys Drive, Suite 102
City: Canonsburg **State:** PA **Zip Code:** 15317

Email: pato@berqrng.com

Phone: 412-877-8808

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
Owensboro RNG Investor, LLC	

Section AI.4: Type of Application

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

Requested Action: *(check all that apply)*

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

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

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

Pollutant:	Requested Limit:	Pollutant:	Requested Limit:
☐ Particulate Matter		☐ Single HAP	
☐ Volatile Organic Compounds (VOC)		☐ Combined HAPs	
☑ Carbon Monoxide	See attached emission calcs - limit flare hours to 2000 hrs/yr	☐ 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)* _____

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

For Modifications:

Proposed Start Date of Modification: *(MM/YYYY)* 01/2024

Proposed Operation Start-Up Date: *(MM/YYYY)* 12/2024

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

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

Section AI.5 Other Required Information

Indicate the documents attached as part of this application:

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

Section AI.6: Signature Block

I, the undersigned, hereby certify under penalty of law, that I am a responsible official*, and that I have personally examined, and am familiar with, the information submitted in this document and all its attachments. Based on my inquiry of those individuals with primary responsibility for obtaining the information, I certify that the information is on knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false or incomplete information, including the possibility of fine or imprisonment.

Martin L. Ryan

Authorized Signature

11/29/23

Date

Marty Ryan

Type or Printed Name of Signatory

President

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: **Owensboro RNG, LLC**
KY EIS (AFS) #: **21-**
Permit #: **V-23-025**
Agency Interest (AI) ID: **APE20230001**
Date: **5/25/2023**

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)*
001	RNG Processing	Processing LFG into RNG					12/2023	Continuous	N/A	N/A
002	Nat Gas Generators	Jenbacher Generator					01/2024	Continuous	N/A	N/A

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)*		
1	RNG Processing	LFG	2000	scfm		RNG	1010	scfm							
2	2 Generators	Nat Gas	1250	kw (each)											

Section B.3: Notes, Comments, and Explanations

See attached process flow diagram and emissions calculations

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: Owensboro RNG, LLC

KY EIS (AFS) #: 21-

Permit #: V-23-025

Agency Interest (AI) ID: APE20230001

Date: 11/29/2023

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)*
1	RNG Processing			Thermal Oxidizer	1		883	scfm	see attached emission calcs	AP-42 & Manufacturer	100.00%	98.00%	see attached emission calcs	see attached emission calcs	see attached emission calcs	see attached emission calcs
1	RNG Processing			Open Flare	2		1893.0000000	scfm	See attached emission calcs	AP-42 & Manufacturer	100.00%	98.00%	See attached emission calcs	See attached emission calcs	See attached emission calcs	See attached emission calcs
2	Nat Gas Generators			none					See attached emission calcs	AP-42 & Manufacturer			See attached emission calcs	See attached emission calcs	See attached emission calcs	See attached emission calcs

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)*
1	TOX details TBD								
2	Open Flare details TBD								
3	Natural Gas Generators								

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)*

Section N.4: Notes, Comments, and Explanations
See attached process flow diagram and emissions calculations

Division for Air Quality

300 Sower Boulevard

Frankfort, KY 40601

(502) 564-3999

DEP7007V

Applicable Requirements and Compliance Activities

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

___ Section V.2: Monitoring Requirements

___ Section V.3: Recordkeeping Requirements

___ Section V.4: Reporting Requirements

___ Section V.5: Testing Requirements

___ Section V.6: Notes, Comments, and Explanations

Additional Documentation

___ Complete DEP7007AI

Source Name: **Owensboro RNG, LLC**

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

Permit #: **V-23-025**

Agency Interest (AI) ID: **APE20230001**

Date: **11/29/2023**

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

Emission Unit #	Emission Unit Description	Applicable Regulation or Requirement	Pollutant	Emission Limit (if applicable)	Voluntary Emission Limit or Exemption (if applicable)	Operating Requirement or Limitation (if applicable)	Method of Determining Compliance with the Emission and Operating Requirement(s)
1	RNG Processing	40 CFR 62 Subpart OOO & 40 CFR 63 Subpart AAAA	NMOC	98% destruction	All collected LFG must be sent to an open or enclosed flare or to a treatment system that processes the collected gas for subsequent sale or beneficial use.	Limit open flare to 2000 hours/yr	Site will record flare operational hours to demonstrate compliance with limit

Section V.2: Monitoring Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Monitored	Description of Monitoring
1	RNG Processing	NMOC	40 CFR 62 Subpart OOO & 40 CFR 63 Subpart AAAA		The site will develop a treatment system monitoring plan as required to demonstrate the treatment of colleted LFG.

Section V.3: Recordkeeping Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Recorded	Description of Recordkeeping
1	RNG Processing	NMOC	40 CFR 62 Subpart OOO & 40 CFR 63 Subpart AAAA		Treatment System Monitoring Plan will detail required records to show treatment of collected LFG

Section V.4: Reporting Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Reported	Description of Reporting
1	RNG Processing	NMOC	40 CFR 62 Subpart OOO & 40 CFR 63 Subpart AAAA		Reporting of Treatment System as required by applicable rules.

Section V.5: Testing Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Tested	Description of Testing
1	RNG Procesing	NMOC	40 CFR 62 Subpart OOO & 40 CFR 63 Subpart AAAA		Initial performance test for Open Flare as required by applicable rules

Section V.6: Notes, Comments, and Explanations
See attached process flow diagram and emissions calculations

Appendix B

Typical Facility Layout

P:\BerQ RNG Inc\222363.01 - West Daviess Owensboro Landfill RNG\ - Design\3 Draft Design Deliverables & Bid Documents\3.1 Draft Plans\Concept Design\XBSP-22DBXXXXr00.dwg Dec 05,2022 - 2:13pm 03002

SYMBIONT
6737 West Washington Street, Suite 3500
Milwaukee, WI 53214-5648
T 800.748.7423 | symbiontengineer.com

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

DSGN	
DR	
CHK	
APVD	

NO.	DATE	REVISION	BY	APVD

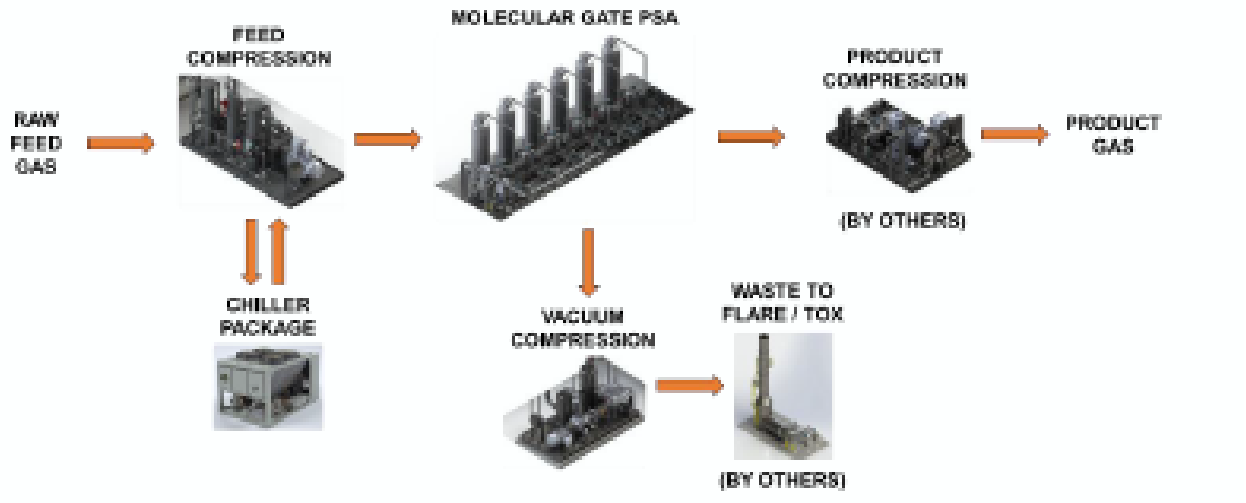
GUILD 2 STAGE PSA
LFG TO RNG

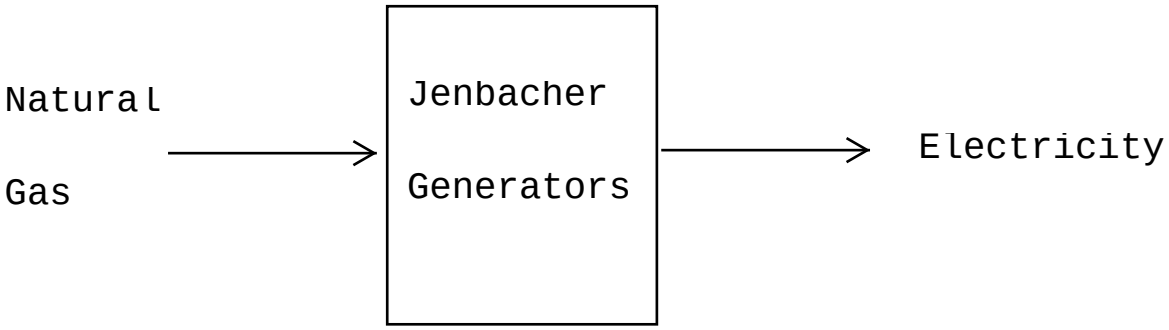
GENERAL ARRANGEMENT

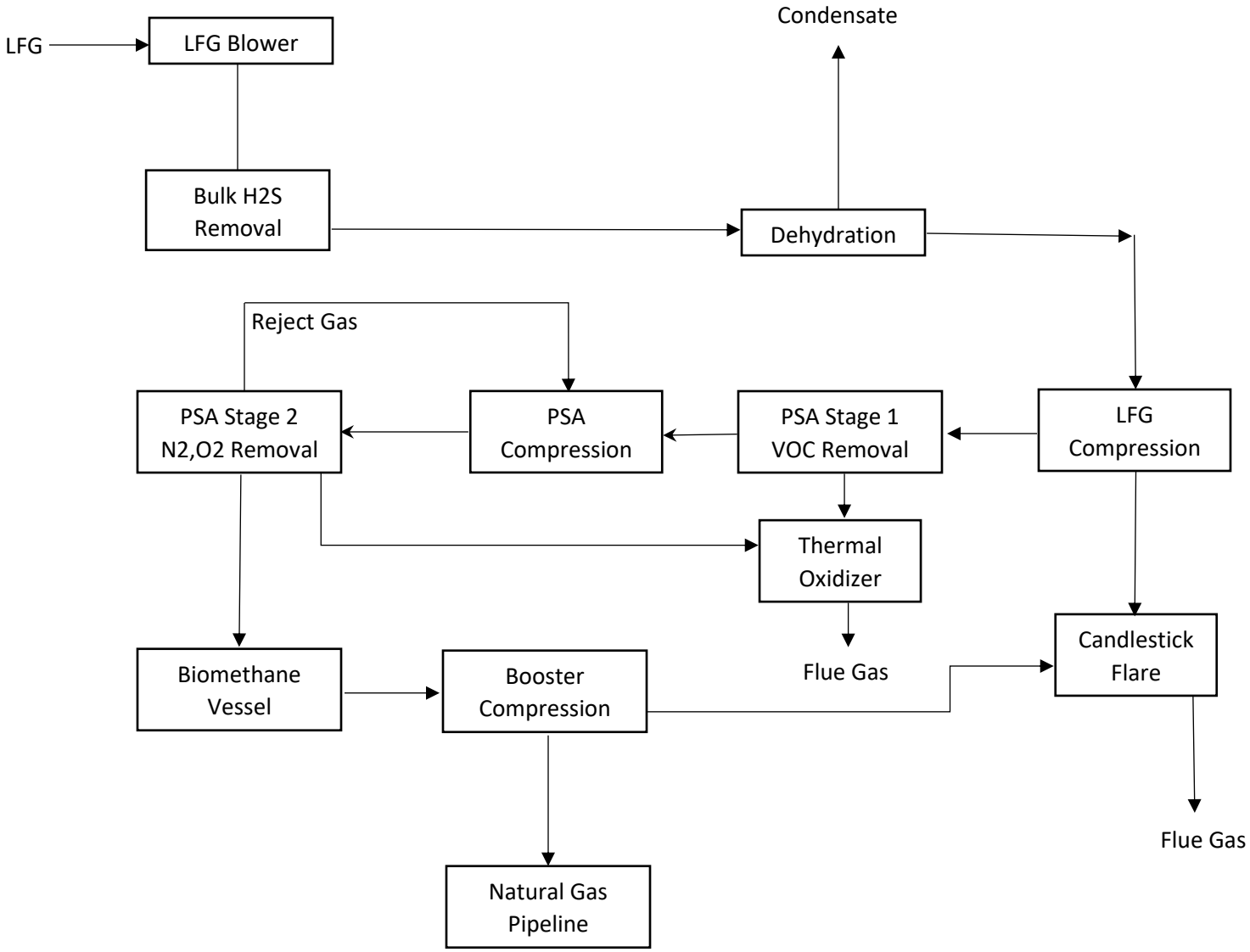
SHEET NO.	GA01
DWG NO.	
DATE	DEC 2022
PROJ NO.	22DBXXXXX

Appendix C

Process Flow Diagram


RAW
FEED
GAS
FEED
COMPRESSION
MOLECULAR GATE PSA
PRODUCT
COMPRESSION
PRODUCT
GAS
(BY OTHERS)
CHILLER
PACKAGE
VACUUM
COMPRESSION
WASTE TO
FLARE / TOX
(BY OTHERS)


Natural
Gas
Jenbacher
Generators
Electricity


LFG
LFG Blower
Condensate
Bulk H2S Removal
Dehydration
Reject Gas
PSA Stage 2 N2,O2 Removal
PSA Compression
PSA Stage 1 VOC Removal
LFG Compression
Thermal Oxidizer
Flue Gas
Biomethane Vessel
Booster Compression
Candlestick Flare
Flue Gas
Natural Gas Pipeline

Appendix D

Form DEP 7007GG

Emission Calculations

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: **Owensboro RNG, LLC**

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

Permit #: **V-23-025**

Agency Interest (AI) ID: **APE20230001**

Date: **5/25/2023**

Section GG.1: General Information - Control Equipment

Control Device ID #	Control Device Name	Cost	Manufacturer	Model Name/ Serial #	Date Installed	Inlet Gas Stream Data For All Control Devices					Inlet Gas Stream Data For Condensers, Adsorbers, Afterburners, Incinerators, Oxidizers Only			Equipment Operational Data For All Control Devices		
						Temperature (°F)	Flowrate (scfm @ 68°F)	Average Particle Diameter (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 (%)
1	Thermal Oxidizer		Perrenial Energy	FL-72X60-45_TP	2023	1600-1800	883	N/A	N/A	N/A	0.04	See Appendix C	Blower	N/A	See GG.12	See GG.12
2	Open Flare		Perrenial Energy	FL-12-C	2023	1400	1893	N/A	N/A	N/A	N/A	N/A	N/A	N/A	See GG.12	See GG.12

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)*
2	RNG Facility Open flare is designed to control tail gas or excess gas RNG facility cannot use. Open flare will be limited to 2000 hours/year	nonassisted	2000	507	98	76

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)	
1	RNG Facility Thermal oxidizer is used to control waste gas after treatment.	Oxidizer	1	11.8	72 in. diameter lower, combustion chamber with a 58 in. diameter stack exhaust extension, 45 ft. O.A.H.		1600-1800	N/A	N/A	nat gas	0.00105	5460	0	0	N/A	N/A	See GG.12

Section GG.12: Notes, Comments, and Explanations

Regulated Air Pollutants controlled include CO, NOx, SO2, PM/PM10/PM2.5, VOC, and HAPs.

The thermal oxidizer and open flare have a flow capacity of 2,500 scfm each. Mass balance of 2000 scfm raw gas to RNG plant yields max ~2000 scfm off spec gas to open flare or ~883 scfm tail gas to TOX. Supplemental natural gas to open flare 2 scfm. Supplemental natural gas to TOX 78 scfm.

Waste gas and tail gas are comprised of treated landfill gas that does not meet pipeline quality.

Maximum operation of each control device would occur only if the RNG facility is shut down or experiences a malfunction.

Emissions Summary (tons per year)

Emission Unit	NMOC	VOC	CO	NOx	SOx	PM10	HAPs
Open Flare - (2000 hr/yr limit)	0.32	0.13	20.73	4.55	6.09	1.03	0.55
Open Flare - Supplemental Fuel	0.00	0.00	0.04	0.01	0.01	0.00	0.00
TOX	0.71	0.28	17.08	5.12	10.02	1.45	0.22
TOX - Supplemental Fuel	0.06	0.02	6.24	1.37	0.17	0.34	0.09
Generators		11.27	66.47	33.24	0.06	3.59	0.41

Worse-Case*	**0.77**	**11.57**	**89.79**	**39.73**	**10.25**	**5.38**	**0.96**

**Flare and TOX will not operate at the same time, so worse-case emissions are based on the higher of the two control devices.*

Calculation of Stack Emissions from Open Flare

Emissions Summary

	tons/yr	lbs/hr
CO	**20.7**	**20.7**
NOx	**4.5**	**4.55**
PM10	**1.03**	**1.03**
SO2	**6.09**	**6.09**
VOC	**0.13**	**0.13**
NMOC	**0.32**	**0.32**
HAP (T)	**0.55**	**0.55**
HAP (S)	**0.49**	**0.49**

Site Details		
Flare Inlet Flow - wet	2,000	scfm
Flare Inlet Flow - dry (calculated)	1,840	scfm
Heat Input	66.9	MMBtu/hr
Hours of Operation - LIMITED	2,000	hours/yr

facility requested operational limit

Standards & Assumptions		
Standard Temperature	59	deg F
Absolute Temperature	519	R
Standard Pressure	1	atm
Universal Gas Constant	0.7302	atm-ft^3/lb-mol-R
Assumed VOC conc of NMOC	39%	
Methane Heating Value	1,013	btu/scf
Methane Inlet Flow - dry	1,012	scfm
LFG Moisture	8%	
LFG Methane Content	55%	
LFG Heating Value	557	btu/scf
LFG Temperature	77	deg F

Conversions	
deg F to Rankine	459.676
million	1.00E+06
min/hr	60
lbs/ton	2,000
lbs/kg	2.205
ppm	1.00E-06

Flare Parameters		
Base Elevation	100	ft
Tip Height	30	ft
Tip Diameter	1.5	ft
Design Temperature	1400	deg F
Flare Exhaust Flow	2069	scfm
Flare Exhaust Velocity	19.52	ft/sec

Pollutant	**Emission Factor[1]**		**Stack Emissions**	
	(lb/MMBtu)	**(lb/MM dscf CH4)**	**(lb/hr)**	**(tons/yr)**
CO	0.31		20.73	20.73
NOx	0.068		4.55	4.55
PM10		17	1.03	1.03

1 - Emission factors from AP-42 5th Ed., "Compilation of Air Pollutant Emissions Factors, Vol. 1 - : Stationary Point and Area Sources," Section 13.5 Industrial Flares, Tables 13.5-1 (NOx) and 13.5-2 (CO) dated Feb. 2018. PM emission factor from Section 2.4 Municipal Solid Waste Landfills, Table 2.4-5 dated Nov. 1998. It can be assumed PM2.5 = PM10.

Pollutant	HAPs	Mol Wt (lb/lbmol)	Default Conc[2] (ppmv)	Control Eff[3] (%)	Stack Emissions (lb/hr)	(tons/yr)
1,1,1-Trichloroethane (methyl chloroform)	Y	133.41	0.48	98%	4.06E-04	4.06E-04
1,1,2,2-Tetrachloroethane	Y	167.85	1.11	98%	1.18E-03	1.18E-03
1,1-Dichloroethane (ethylidene dichloride)	Y	98.97	2.35	98%	1.47E-03	1.47E-03
1,1-Dichloroethene (vinylidene chloride)	Y	96.94	0.2	98%	1.23E-04	1.23E-04
1,2-Dichloroethane (ethylene dichloride)	Y	98.96	0.41	98%	2.57E-04	2.57E-04
1,2-Dichloropropane (propylene dichloride)	Y	112.99	0.18	98%	1.29E-04	1.29E-04
2-Propanol (isopropyl alcohol)		60.11	50.1	91%	8.59E-02	8.59E-02
Acetone		58.08	7.01	91%	1.16E-02	1.16E-02
Acrylonitrile	Y	53.06	6.33	98%	2.13E-03	2.13E-03
Benzene	Y	78.11	1.91	98%	9.45E-04	9.45E-04
Bromodichloromethane		163.83	3.13	91%	1.46E-02	1.46E-02
Butane		58.12	5.03	91%	8.34E-03	8.34E-03
Carbon disulfide	Y	76.13	0.58	100%	0.00	0.00
Carbon tetrachloride	Y	153.84	0.004	98%	3.90E-06	3.90E-06
Carbonyl sulfide	Y	60.07	0.49	100%	0.00	0.00
Chlorobenzene	Y	112.56	0.25	98%	1.78E-04	1.78E-04
Chlorodifluoromethane		86.47	1.3	91%	3.21E-03	3.21E-03
Chloroethane (ethyl chloride)	Y	64.52	1.25	98%	5.11E-04	5.11E-04
Chloroform	Y	119.39	0.03	98%	2.27E-05	2.27E-05
Chloromethane		50.49	1.21	91%	1.74E-03	1.74E-03
Dichlorobenzene	Y	147	0.21	98%	1.96E-04	1.96E-04
Dichlorodifluoromethane		120.91	15.7	91%	5.41E-02	5.41E-02
Dichlorofluoromethane		102.92	2.62	91%	7.69E-03	7.69E-03
Dichloromethane (methylene chloride)	Y	84.94	14.3	98%	7.70E-03	7.70E-03
Dimethyl sulfide (methyl sulfide)		62.13	7.82	100%	0.00	0.00
Ethane		30.07	889	91%	7.62E-01	7.62E-01
Ethanol		46.08	27.2	91%	3.57E-02	3.57E-02
Ethyl mercaptan (ethanethiol)		62.13	2.28	100%	0.00	0.00
Ethylbenzene	Y	106.16	4.61	98%	3.10E-03	3.10E-03
Ethylene dibromide		187.88	0.001	91%	5.36E-06	5.36E-06
Fluorotrichloromethane		137.38	0.76	91%	2.98E-03	2.98E-03
Hexane	Y	86.18	6.57	98%	3.59E-03	3.59E-03
Hydrogen sulfide		34.08	35.5	100%	0.00	0.00
Mercury (total)	Y	200.61	2.92E-04	98%	3.71E-07	3.71E-07
Methyl ethyl ketone		72.11	7.09	91%	1.46E-02	1.46E-02
Methyl isobutyl ketone	Y	100.16	1.87	98%	1.19E-03	1.19E-03
Methyl mercaptan		48.11	2.49	100%	0.00	0.00
Pentane		72.15	3.29	91%	6.77E-03	6.77E-03
Perchloroethylene (tetrachloroethylene)	Y	165.83	3.73	98%	3.92E-03	3.92E-03
Propane		44.09	11.1	91%	1.40E-02	1.40E-02
t-1,2-dichloroethene		96.94	2.84	91%	7.85E-03	7.85E-03
Toluene	Y	92.13	39.3	98%	2.29E-02	2.29E-02
Trichloroethylene (trichloroethene)	Y	131.4	2.82	98%	2.35E-03	2.35E-03
Vinyl chloride	Y	62.5	7.34	98%	2.91E-03	2.91E-03
Xylenes	Y	106.16	12.1	98%	8.14E-03	8.14E-03
Hydrogen chloride	Y	36.5	42	0%	4.86E-01	4.86E-01
NMOC (as hexane)		86.18	595	98%	0.32	0.32
VOC			232.05	98%	0.13	0.13
SO2 (assume 100% conversion to SO2)		64.066	300	0%	6.09	6.09

2 - Concentrations of LFG constituents from AP-42 5th Ed., "Compilation of Air Pollutant Emissions Factors, Vol. 1 - : Stationary Point and Area Sources," Section 2.4 Municipal Solid Waste Landfills, Table 2.4-1 dated Nov. 1998. HCl is a product of combustion, emissions estimated based on Section 2.4.4 discussion. Use site-specific concentrations if known.

3 - AP-42 gives ranges for control efficiencies . Control efficiency ranges from AP-42 - for halogenated compounds 91-99.7% and for non-halogenated compounds 38-91%. Conservative values assumed. Assume 100% of sulfur compounds converted to SO2.

Calculation of Stack Emissions from Open Flare

Emissions Summary

	tons/yr	lbs/hr
CO	0.0	0.0
NOx	0.0	0.01
PM10	0.00	0.00
SO2	0.01	0.01
VOC	0.00	0.00
NMOC	0.00	0.00
HAP (T)	0.00	0.00
HAP (S)	0.00	0.00

Site Details		
Flare Inlet Flow - wet	2	scfm
Flare Inlet Flow - dry (calculated)	2	scfm
Heat Input	0.1	MMBtu/hr
Hours of Operation	2,000	hours/yr

Standards & Assumptions		
Standard Temperature	59	deg F
Absolute Temperature	519	R
Standard Pressure	1	atm
Universal Gas Constant	0.7302	atm-ft^3/lb-mol-R
Assumed VOC conc of NMOC	39%	
Methane Heating Value	1,013	btu/scf
Methane Inlet Flow - dry	2	scfm
Natural Gas Moisture Content	0%	
Natural Gas Methane Content	97%	
Natural Gas Heating Value	982	btu/scf
Natural Gas Temperature	77	deg F

Conversions	
deg F to Rankine	459.676
million	1.00E+06
min/hr	60
lbs/ton	2,000
lbs/kg	2.205
ppm	1.00E-06

Flare Parameters		
Base Elevation	100	ft
Tip Height	30	ft
Tip Diameter	1.5	ft
Design Temperature	1400	deg F
Flare Exhaust Flow	2	scfm
Flare Exhaust Velocity	0.02	ft/sec

Pollutant	Emission Factor[1]		Stack Emissions	
	(lb/MMBtu)	(lb/MM dscf CH4)	(lb/hr)	(tons/yr)
CO	0.31		0.04	0.04
NOx	0.068		0.01	0.01
PM10		17	0.00	0.00

1 - Emission factors from AP-42 5th Ed., "Compilation of Air Pollutant Emissions Factors, Vol. 1 - : Stationary Point and Area Sources," Section 13.5 Industrial Flares, Tables 13.5-1 (NOx) and 13.5-2 (CO) dated Feb. 2018. PM emission factor from Section 2.4 Municipal Solid Waste Landfills, Table 2.4-5 dated Nov. 1998. It can be assumed PM2.5 = PM10.

Pollutant	HAPs	Mol Wt (lb/lbmol)	Default Conc[2] (ppmv)	Control Eff[3] (%)	Stack Emissions (lb/hr)	(tons/yr)
1,1,1-Trichloroethane (methyl chloroform)	Y	133.41	0.48	98%	4.06E-07	4.06E-07
1,1,2,2-Tetrachloroethane	Y	167.85	1.11	98%	1.18E-06	1.18E-06
1,1-Dichloroethane (ethylidene dichloride)	Y	98.97	2.35	98%	1.47E-06	1.47E-06
1,1-Dichloroethene (vinylidene chloride)	Y	96.94	0.2	98%	1.23E-07	1.23E-07
1,2-Dichloroethane (ethylene dichloride)	Y	98.96	0.41	98%	2.57E-07	2.57E-07
1,2-Dichloropropane (propylene dichloride)	Y	112.99	0.18	98%	1.29E-07	1.29E-07
2-Propanol (isopropyl alcohol)		60.11	50.1	91%	8.59E-05	8.59E-05
Acetone		58.08	7.01	91%	1.16E-05	1.16E-05
Acrylonitrile	Y	53.06	6.33	98%	2.13E-06	2.13E-06
Benzene	Y	78.11	1.91	98%	9.45E-07	9.45E-07
Bromodichloromethane		163.83	3.13	91%	1.46E-05	1.46E-05
Butane		58.12	5.03	91%	8.34E-06	8.34E-06
Carbon disulfide	Y	76.13	0.58	100%	0.00	0.00
Carbon tetrachloride	Y	153.84	0.004	98%	3.90E-09	3.90E-09
Carbonyl sulfide	Y	60.07	0.49	100%	0.00	0.00
Chlorobenzene	Y	112.56	0.25	98%	1.78E-07	1.78E-07
Chlorodifluoromethane		86.47	1.3	91%	3.21E-06	3.21E-06
Chloroethane (ethyl chloride)	Y	64.52	1.25	98%	5.11E-07	5.11E-07
Chloroform	Y	119.39	0.03	98%	2.27E-08	2.27E-08
Chloromethane		50.49	1.21	91%	1.74E-06	1.74E-06
Dichlorobenzene	Y	147	0.21	98%	1.96E-07	1.96E-07
Dichlorodifluoromethane		120.91	15.7	91%	5.41E-05	5.41E-05
Dichlorofluoromethane		102.92	2.62	91%	7.69E-06	7.69E-06
Dichloromethane (methylene chloride)	Y	84.94	14.3	98%	7.70E-06	7.70E-06
Dimethyl sulfide (methyl sulfide)		62.13	7.82	100%	0.00	0.00
Ethane		30.07	889	91%	7.62E-04	7.62E-04
Ethanol		46.08	27.2	91%	3.57E-05	3.57E-05
Ethyl mercaptan (ethanethiol)		62.13	2.28	100%	0.00	0.00
Ethylbenzene	Y	106.16	4.61	98%	3.10E-06	3.10E-06
Ethylene dibromide		187.88	0.001	91%	5.36E-09	5.36E-09
Fluorotrichloromethane		137.38	0.76	91%	2.98E-06	2.98E-06
Hexane	Y	86.18	6.57	98%	3.59E-06	3.59E-06
Hydrogen sulfide		34.08	35.5	100%	0.00	0.00
Mercury (total)	Y	200.61	2.92E-04	98%	3.71E-10	3.71E-10
Methyl ethyl ketone		72.11	7.09	91%	1.46E-05	1.46E-05
Methyl isobutyl ketone	Y	100.16	1.87	98%	1.19E-06	1.19E-06
Methyl mercaptan		48.11	2.49	100%	0.00	0.00
Pentane		72.15	3.29	91%	6.77E-06	6.77E-06
Perchloroethylene (tetrachloroethylene)	Y	165.83	3.73	98%	3.92E-06	3.92E-06
Propane		44.09	11.1	91%	1.40E-05	1.40E-05
t-1,2-dichloroethene		96.94	2.84	91%	7.85E-06	7.85E-06
Toluene	Y	92.13	39.3	98%	2.29E-05	2.29E-05
Trichloroethylene (trichloroethene)	Y	131.4	2.82	98%	2.35E-06	2.35E-06
Vinyl chloride	Y	62.5	7.34	98%	2.91E-06	2.91E-06
Xylenes	Y	106.16	12.1	98%	8.14E-06	8.14E-06
Hydrogen chloride	Y	36.5	42	0%	4.86E-04	4.86E-04
NMOC (as hexane)		86.18	595	98%	0.00	0.00
VOC			232.05	98%	0.00	0.00
SO2 (assume 100% conversion to SO2)		64.066	300	0%	0.01	0.01

2 - Concentrations of LFG constituents from AP-42 5th Ed., "Compilation of Air Pollutant Emissions Factors, Vol. 1 - : Stationary Point and Area Sources," Section 2.4 Municipal Solid Waste Landfills, Table 2.4-1 dated Nov. 1998. HCl is a product of combustion, emissions estimated based on Section 2.4.4 discussion. Use site-specific concentrations if known.

3 - AP-42 gives ranges for control efficiencies . Control efficiency ranges from AP-42 - for halogenated compounds 91-99.7% and for non-halogenated compounds 38-91%. Conservative values assumed. Assume 100% of sulfur compounds converted to SO2.

THERMAL OXIDIZER AIR EMISSIONS CALCULATOR

CAS NUMBERS	HAZARDOUS AIR POLLUTANTS (HAPS) [1]	Molecular Weight (g/Mol)	Concentration of Compounds Found in LFG [2] (ppmv)	Total Pollutant Flow Rate (tons/yr)	LFG Destruction System Efficiency [3] (%)	Emissions from TOX (lbs/yr)	Emissions from TOX (tons/yr)
71-55-6	1,1,1-Trichloroethane (methyl chloroform)	133.42	0.1680	0.03	98.0%	1.24	6.21E-04
79-34-5	1,1,2,2-Tetrachloroethane	167.85	0.0700	0.02	98.0%	0.65	3.26E-04
75-34-3	1,1-Dichloroethane (ethylidene dichloride)	98.97	0.7410	0.10	98.0%	4.06	2.03E-03
75-35-4	1,1-Dichloroethene (vinylidene chloride)	96.94	0.0920	0.01	98.0%	0.49	2.47E-04
107-06-2	1,2-Dichloroethane (ethylene dichloride)	98.96	0.1200	0.02	98.0%	0.66	3.29E-04
78-87-5	1,2-Dichloropropane (propylene dichloride)	112.98	0.0230	0.00	98.0%	0.14	7.20E-05
107-13-1	Acrylonitrile	53.06	0.0360	0.00	98.0%	0.11	5.29E-05
71-43-2	Benzene	78.11	0.9720	0.11	98.0%	4.21	2.10E-03
75-15-0	Carbon disulfide	76.13	0.3200	0.03	98.0%	1.35	6.75E-04
56-23-5	Carbon tetrachloride	153.84	0.0070	0.00	98.0%	0.06	2.98E-05
463-58-1	Carbonyl sulfide	60.07	0.1830	0.02	98.0%	0.61	3.05E-04
108-90-7	Chlorobenzene	112.56	0.2270	0.04	98.0%	1.42	7.08E-04
75-00-3	Chloroethane (ethyl chloride)	64.52	0.2390	0.02	98.0%	0.85	4.27E-04
67-66-3	Chloroform	119.39	0.0210	0.00	98.0%	0.14	6.95E-05
74-87-3	Chloromethane (methyl chloride)	50.49	0.2490	0.02	98.0%	0.70	3.48E-04
106-46-7	Dichlorobenzene (1,4-Dichlorobenzene)	147.00	1.6070	0.33	98.0%	13.09	6.54E-03
75-09-2	Dichloromethane (methylene chloride)	84.94	3.3950	0.40	98.0%	15.98	7.99E-03
100-41-4	Ethylbenzene	106.16	6.7890	1.00	98.0%	39.93	2.00E-02
106-93-4	Ethylene dibromide (1,2-Dibromoethane)	187.88	0.0460	0.01	98.0%	0.48	2.39E-04
110-54-3	Hexane	86.18	2.3240	0.28	98.0%	11.10	5.55E-03
7647-01-0	Hydrochloric acid	36.50	42.0000	2.12	98.0%	84.94	4.25E-02
7439-97-6	Mercury (total)	200.61	0.0003	0.00	--	0.16	8.11E-05
108-10-1	Methyl isobutyl ketone	100.16	0.7500	0.10	98.0%	4.16	2.08E-03
127-18-4	Perchloroethylene (tetrachloroethylene)	165.83	1.1930	0.27	98.0%	10.96	5.48E-03
108-88-3	Toluene	92.13	25.4050	3.24	98.0%	129.69	6.48E-02
79-01-6	Trichloroethylene (trichloroethene)	131.38	0.6810	0.12	98.0%	4.96	2.48E-03
75-01-4	Vinyl chloride	62.50	1.0770	0.09	98.0%	3.73	1.86E-03
1330-20-7	Xylenes	106.16	16.5820	2.44	98.0%	97.54	4.88E-02
	TOTAL HAPS			10.83		433.4	0.22
CRITERIA AIR POLLUTANTS							
Volatile Organic Compounds (VOCs) as Hexane [5]		86.17	232	27.69	99%	554	0.28
Oxides of Nitrogen (NOx)						10,249	5.12
Carbon Monoxide (CO)						34,164	17.08
Particulate Matter (PM10)						2,904	1.45
Sulfur Dioxide		64.01	113	10.02	0%	20,039	10.02

NOTES:

(1) Hazardous air pollutants (HAPs) as listed as being present in landfill gas (LFG) in USEPA AP-42 dated 11/98 on Table 2.4-1.

(2) Average concentration of compounds found in LFG based on "Waste Industry Air Coalition Comparison of Recent Landfill Gas Analyses with Historic AP-42 Values." , except for Mercury and HCl,
which uses values listed in AP-42, Tables 2.4-1 and 2.4-2.

(3) TOX supplier cited VOC destruction efficiency is 98%.

(4) NMOCs are assumed to be 595 ppmv per AP-42 Table 2.4-2.

(5)VOCs are assumed to be 39% by weight of the NMOC concentrations assumed per AP-42.

(6) SOx emissions are based on limiting the H2S ppmv into the RNG Plant to 50 ppmv, and conservatively assuming that 100% of the H2S reports to the TOX. Then, 100% of the H2S is converted to SO2.

(7) NOx emission rate is 0.06 lbs/MMBtu and CO emission rate is 0.20 lbs/MMBtu per TOX supplier.

(8) LFG flare particulate emissions are cited as 17 lbs/1,000,000 scf of methane on AP-42 Table 2.4-5, which is equilvalent to 0.017 lbs/MMBtu, since methane is 1,000 Btu scf.

RNG PLANT DESIGN CONDITIONS		
TOX Capacity (Waste Gas Plus Supplemental Fuel at 100% Design Capacity)	19.5	MMBtu/hr
Minimum TOX Destruction Efficiency	98	%
LFG Inlet to RNG Plant (at 100% Design Capacity)	2,000	cfm

CONVERSIONS

ton conversion	2000	lbs/ton
lb conversion	453.6	gram/lb
mol conversion	23.69	mole/liter at 60 degrees F and 1 Atm
cf conversion	28.32	liters/cf
MMBtu conversion	1,000,000	Btu/MMBtu

HAPs/NMOCs/HAPs/H2S to TOX CALCULATION FORMULA

Total Pollutant Mass to TOX in Tons/Year) = ((Molecular Weight of Compound [grams/mole])*(Concentration of Compound [ppmv]/1,000,000)*(Total LFG [cfm])
*(60 minutes/hour*24 hours/day*365 days)*(1 ton/2000 lb)*(1lb /453.6grams)*(1mole/23.69 liters)*(28.32 liters/1 cf)) -- Conservatively Assumes all Inlet Pollutants Report to TOX and 100% Uptime

EMISSIONS FROM TOX IN TONS/YEAR

Emissions from TOX in tons/year = (Total Pollutant Mass to TOX in Tons/Year)*(1 - TOX Destruction Efficiency)

CRITERIA AIR POLLUTANTS (NOx, CO and PM 10 CALCULATION FORMULA

Emissions (lb/day) = TOX Rating (MMBtu/hr)* Emission Factor (lbs/Mmbtu)*24 hours/day

Calculation of Stack Emissions from TOX - Supplemental Natural Gas

Emissions Summary

	tons/yr	lbs/hr
CO	**6.2**	**1.4**
NOx	**1.4**	**0.31**
PM10	**0.34**	**0.08**
SO2	**0.17**	**0.04**
VOC	**0.02**	**0.00**
NMOC	**0.06**	**0.01**
HAP (T)	**0.09**	**0.02**
HAP (S)	**0.08**	**0.02**

Site Details		
Flare Inlet Flow - wet	78	scfm
Flare Inlet Flow - dry (calculated)	78	scfm
Heat Input	4.6	MMBtu/hr
Hours of Operation	8,760	hours/yr

Standards & Assumptions		
Standard Temperature	59	deg F
Absolute Temperature	519	R
Standard Pressure	1	atm
Universal Gas Constant	0.7302	atm-ft^3/lb-mol-R
Assumed VOC conc of NMOC	39%	
Methane Heating Value	1,013	btu/scf
Methane Inlet Flow - dry	76	scfm
Natural Gas Moisture Content	0%	
Natural Gas Methane Content	97%	
Natural Gas Heating Value	982	btu/scf
Natural Gas Temperature	77	deg F

Conversions	
deg F to Rankine	459.676
million	1.00E+06
min/hr	60
lbs/ton	2,000
lbs/kg	2.205
ppm	1.00E-06

Flare Parameters		
Base Elevation	100	ft
Tip Height	30	ft
Tip Diameter	1.5	ft
Design Temperature	1400	deg F
Flare Exhaust Flow	81	scfm
Flare Exhaust Velocity	0.76	ft/sec

Pollutant	**Emission Factor[1]**		**Stack Emissions**	
	(lb/MMBtu)	**(lb/MM dscf CH4)**	**(lb/hr)**	**(tons/yr)**
CO	0.31		1.42	6.24
NOx	0.068		0.31	1.37
PM10		17	0.08	0.34

1 - Emission factors from AP-42 5th Ed., "Compilation of Air Pollutant Emissions Factors, Vol. 1 - : Stationary Point and Area Sources," Section 13.5 Industrial Flares, Tables 13.5-1 (NOx) and 13.5-2 (CO) dated Feb. 2018. PM emission factor from Section 2.4 Municipal Solid Waste Landfills, Table 2.4-5 dated Nov. 1998. It can be assumed PM2.5 = PM10.

Pollutant	HAPs	Mol Wt (lb/lbmol)	Default Conc[2] (ppmv)	Control Eff[3] (%)	Stack Emissions (lb/hr)	(tons/yr)
1,1,1-Trichloroethane (methyl chloroform)	Y	133.41	0.48	98%	1.58E-05	6.93E-05
1,1,2,2-Tetrachloroethane	Y	167.85	1.11	98%	4.60E-05	2.02E-04
1,1-Dichloroethane (ethylidene dichloride)	Y	98.97	2.35	98%	5.75E-05	2.52E-04
1,1-Dichloroethene (vinylidene chloride)	Y	96.94	0.2	98%	4.79E-06	2.10E-05
1,2-Dichloroethane (ethylene dichloride)	Y	98.96	0.41	98%	1.00E-05	4.39E-05
1,2-Dichloropropane (propylene dichloride)	Y	112.99	0.18	98%	5.03E-06	2.20E-05
2-Propanol (isopropyl alcohol)		60.11	50.1	91%	3.35E-03	1.47E-02
Acetone		58.08	7.01	91%	4.53E-04	1.98E-03
Acrylonitrile	Y	53.06	6.33	98%	8.30E-05	3.64E-04
Benzene	Y	78.11	1.91	98%	3.69E-05	1.61E-04
Bromodichloromethane		163.83	3.13	91%	5.70E-04	2.50E-03
Butane		58.12	5.03	91%	3.25E-04	1.42E-03
Carbon disulfide	Y	76.13	0.58	100%	0.00	0.00
Carbon tetrachloride	Y	153.84	0.004	98%	1.52E-07	6.66E-07
Carbonyl sulfide	Y	60.07	0.49	100%	0.00	0.00
Chlorobenzene	Y	112.56	0.25	98%	6.95E-06	3.05E-05
Chlorodifluoromethane		86.47	1.3	91%	1.25E-04	5.48E-04
Chloroethane (ethyl chloride)	Y	64.52	1.25	98%	1.99E-05	8.73E-05
Chloroform	Y	119.39	0.03	98%	8.85E-07	3.88E-06
Chloromethane		50.49	1.21	91%	6.79E-05	2.98E-04
Dichlorobenzene	Y	147	0.21	98%	7.63E-06	3.34E-05
Dichlorodifluoromethane		120.91	15.7	91%	2.11E-03	9.25E-03
Dichlorofluoromethane		102.92	2.62	91%	3.00E-04	1.31E-03
Dichloromethane (methylene chloride)	Y	84.94	14.3	98%	3.00E-04	1.31E-03
Dimethyl sulfide (methyl sulfide)		62.13	7.82	100%	0.00	0.00
Ethane		30.07	889	91%	2.97E-02	1.30E-01
Ethanol		46.08	27.2	91%	1.39E-03	6.11E-03
Ethyl mercaptan (ethanethiol)		62.13	2.28	100%	0.00	0.00
Ethylbenzene	Y	106.16	4.61	98%	1.21E-04	5.30E-04
Ethylene dibromide		187.88	0.001	91%	2.09E-07	9.15E-07
Fluorotrichloromethane		137.38	0.76	91%	1.16E-04	5.09E-04
Hexane	Y	86.18	6.57	98%	1.40E-04	6.13E-04
Hydrogen sulfide		34.08	35.5	100%	0.00	0.00
Mercury (total)	Y	200.61	2.92E-04	98%	1.45E-08	6.34E-08
Methyl ethyl ketone		72.11	7.09	91%	5.69E-04	2.49E-03
Methyl isobutyl ketone	Y	100.16	1.87	98%	4.63E-05	2.03E-04
Methyl mercaptan		48.11	2.49	100%	0.00	0.00
Pentane		72.15	3.29	91%	2.64E-04	1.16E-03
Perchloroethylene (tetrachloroethylene)	Y	165.83	3.73	98%	1.53E-04	6.70E-04
Propane		44.09	11.1	91%	5.44E-04	2.38E-03
t-1,2-dichloroethene		96.94	2.84	91%	3.06E-04	1.34E-03
Toluene	Y	92.13	39.3	98%	8.95E-04	3.92E-03
Trichloroethylene (trichloroethene)	Y	131.4	2.82	98%	9.16E-05	4.01E-04
Vinyl chloride	Y	62.5	7.34	98%	1.13E-04	4.97E-04
Xylenes	Y	106.16	12.1	98%	3.17E-04	1.39E-03
Hydrogen chloride	Y	36.5	42	0%	1.89E-02	8.30E-02
NMOC (as hexane)		86.18	595	98%	0.01	0.06
VOC			232.05	98%	0.00	0.02
SO2 (assume 100% conversion to SO2)		64.066	49.65	0%	0.04	0.17

2 - Concentrations of LFG constituents from AP-42 5th Ed., "Compilation of Air Pollutant Emissions Factors, Vol. 1 - : Stationary Point and Area Sources," Section 2.4 Municipal Solid Waste Landfills, Table 2.4-1 dated Nov. 1998. HCl is a product of combustion, emissions estimated based on Section 2.4.4 discussion. Use site-specific concentrations if known.

3 - AP-42 gives ranges for control efficiencies . Control efficiency ranges from AP-42 - for halogenated compounds 91-99.7% and for non-halogenated compounds 38-91%. Conservative values assumed. Assume 100% of sulfur compounds converted to SO2.

Natural Gas Generators - 2 Jenbacher 1250 kW Generators

Design Capacity - Each Generator

1250	kW
1721	bhp
10720	MBTU/hr
8760	hr/yr

Pollutant	Emission Point Type	Emission Factors		Estimated Emissions		for 2 Generators
		(g/bhp-hr)[1]	(lb/MMBTU)[2]	(lb/hr)	(tons/yr)	(tons/yr)
CO	Stack	2.0		7.59	33.24	66.47
NOx	Stack	1.0		3.79	16.62	33.24
PM10	Stack		0.0382	0.41	1.79	3.59
SO2	Stack		0.000588	0.01	0.03	0.06
VOC	Stack		0.12	1.29	5.63	11.27
HAPs	Stack		0.0043662	0.05	0.21	0.41

(2) Emission factors were obtained from AP-42 5th Edition - Section 3.23 Natural Gas Fired Reciprocating Engines (07/00).

Division for Air Quality

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

DEP7007EE

Internal Combustion Engines

___ Section EE.1: General Information
___ Section EE.2: Operating Information
___ Section EE.3: Design Information
___ Section EE.4: Fuel Information
___ Section EE.5: Emission Factor Information
___ Section EE.6: Notes, Comments, and Explanations

Additional Documentation

___ Complete DEP7007AI, DEP7007N, DEP7007V, and DEP7007GG

___ Attach EPA certification of the engine

Source Name: **Owensboro RNG**

KY EIS (AFS) #: **21-059-00269**

Permit #: **V-23-025**

Agency Interest (AI) ID: **178066**

Date: **3/6/2024**

Section EE.1: General Information

Emission Unit #	Emission Unit Name	Control Device ID	Stack ID	Manufacturer	Model Number	Model Year	Date of Manufacture	Proposed/Actual Date of Construction Commencement *(MM/YYYY)*	Date Reconstructed/ Modified	List Applicable Regulations
EU 03	Generator 1	N/A	3	Jenbacher	JGS 416 GS-N.L	2023	2023	04/2024	2024	NSPS IIII
EU 04	Generator 2	N/A	4	Jenbacher	JGS 416 GS-N.L	2023	2023	04/2024	2024	NSPS IIII

Section EE.2: Operating Information

Emission Unit #	Engine Purpose (Identify if Non-Emergency, Emergency,Fire/Water Pump, Black-start engine for combustion turbine, Engine Testing)	Hours Operated	Is this engine a rental? *(Yes/No)*	Rental Time Period *(hrs)*	Alternate Operating Scenarios (Describe any operating scenarios in which the engine may be used in a different configuration)
EU 03	Power	8760	No	0	
EU 04	Power	8760	No	0	

Section EE.3: Design Information

Emission Unit #	Engine Type (Identify all that apply: Commercial, Institutional, Stationary, Non-Road)	Ignition Type (Identify if either Compression or Spark Ignition)	Engine Family (Identify all that apply: 2-stroke, 4-stroke, Rich Burn, Lean Burn)	Maximum Engine Power *(bhp)*	Maximum Engine Speed *(rpm)*	Total Displacement *(L)*	Number of Cylinders
EU 03	Stationary	Compression	4-stroke	1721	1.8	0.04888	16
EU 04	Stationary	Compression	4-stroke	1721	1.8	0.04888	16

Section EE.4: Fuel Information

Emission Unit #	Identify if Primary, Secondary, or Tertiary Fuel	Fuel Type (Identify if Diesel, Gasoline, Natural Gas, Liquefied Petroleum Gas (LPG), Landfill/Digester Gas, or Other)	Fuel Grade	Percent Time Used *(%)*	Maximum Fuel Consumption	Heat Content	Sulfur Content *(%)*	SCC Code	SCC Units
EU 03	Primary	Natural Gas		100%	5,934 BTU/bhp hr	917 BTU/scf	0		
EU 04	Primary	Natural Gas		100%	5,934 BTU/bhp hr	917 BTU/scf	0		

Section EE.5: Emission Factor Information

Emission factors expressed here are based on the potential to emit.

Emission Unit #	Fuel	Pollutant	Emission Factor	Emission Factor Units	Source of Emission Factor
EU 03	Natural Gas	See attached emission calculations	See attached emission calculations	See attached emission calculations	See attached emission calculations
EU 04	Natural Gas	See attached emission calculations	See attached emission calculations	See attached emission calculations	See attached emission calculations

Section EE.6: Notes, Comments, and Explanations

None

JENBACHER

Technical Description

Genset

JGS 416 GS-N.L

with Island Operation

no special Grid Code

PRJ-9398

Similar to TSR # 4022

Electrical output 1250 kW el.

Emission values

NOx < 250 mg/Nm³ (5% O2) | < 95 mg/Nm³ (15% O2)

JENBACHER

0.01 Technical Data (at genset)

			100%	75%	50%
Power input	[2]	MBTU/hr	10.209	7.845	5.531
Gas volume	*)	SCFH	11133	8555	6032
Mechanical output	[1]	bhp	1.721	1.290	861
Electrical output	[4]	kW el.	1.250	935	620
Heat to be dissipated (calculated with Glycol 30%)	**[5]**				
~ Intercooler 1st stage (Engine jacket water cooling circuit)	[9]	MBTU/hr	843	437	131
~ Intercooler 2nd stage (Low Temperature circuit)		MBTU/hr	255	180	110
~ Lube oil (Engine jacket water cooling circuit)		MBTU/hr	607	529	457
~ Jacket water		MBTU/hr	1.037	935	802
~ Surface heat	ca. [7]	MBTU/hr	337	~	~
Spec. fuel consumption of engine electric	[2]	BTU/kWel. hr	8.170	8.389	8.928
Spec. fuel consumption of engine	[2]	BTU/bhp.hr	5.934	6.081	6.424
Lube oil consumption	ca. [3]	gal/hr	0,08	~	~
Electrical efficiency			41,8%	40,7%	38,2%
Fuel gas LHV		BTU/scft	917		

*) approximate value for pipework dimensioning
[_] Explanations: see 0.10 - Technical parameters

All heat data is based on standard conditions according to attachment 0.10. Deviations from the standard conditions can result in a change of values within the heat balance and must be taken into consideration in the layout of the cooling circuit/equipment (intercooler; emergency cooling; ...).

JENBACHER

Main dimensions and weights (at genset)

Length	in	~ 220
Width	in	~ 80
Height	in	~ 90
Weight empty	lbs	~ 27.380
Weight filled	lbs	~ 28.810

Connections

Jacket water inlet and outlet	in/lbs	3"/145
Exhaust gas outlet [C]	in/lbs	12"/145
Fuel Gas (at genset) [D]	in/lbs	5"/232
Water drain ISO 228	G	½"
Condensate drain	in	~
Safety valve - jacket water ISO 228 [G]	in/lbs	2x1½"/2.5
Lube oil replenishing (pipe) [I]	in	1,1
Lube oil drain (pipe) [J]	in	1,1
Jacket water - filling (flex pipe) [L]	in	0,5
Intercooler water-Inlet/Outlet 1st stage	in/lbs	3"/145
Intercooler water-Inlet/Outlet 2nd stage [M/N]	in/lbs	2½"/145

Output / fuel consumption

ISO standard fuel stop power ICFN	bhp	1.721
Mean effe. press. at stand. power and nom. speed	psi	254
Fuel gas type		Natural gas
Based on methane number | Min. methane number	MN	94 | 75 d)
Compression ratio	Epsilon	12,5
Min./Max. fuel gas pressure at inlet to gas train	psi	1,16 - 7,25 c)
Max. rate of gas pressure fluctuation	psi/sec	0,145
Maximum Intercooler 2nd stage inlet water temperature	°F	113
Spec. fuel consumption of engine	BTU/bhp.hr	5.934
Specific lube oil consumption	g/bhp.hr	0,15
Max. Oil temperature	°F	~ 185
Jacket-water temperature max.	°F	~ 203
Filling capacity lube oil (refill)	gal	~ 95

c) Lower gas pressures upon inquiry
d) based on methane number calculation software AVL 3.2 (calculated without N2 and CO2)

JENBACHER

0.02 Technical data of engine

Manufacturer		JENBACHER
Engine type		J 416 GS-E802
Working principle		4-Stroke
Configuration		V 70°
No. of cylinders		16
Bore	in	5,71
Stroke	in	7,28
Piston displacement	cu.in	2.983
Nominal speed	rpm	1.800
Mean piston speed	in/s	437
Length	in	144
Width	in	59
Height	in	82
Weight dry	lbs	14.991
Weight filled	lbs	16.391
Moment of inertia	lbs-ft²	320,41
Direction of rotation (from flywheel view)		left
Radio interference level to VDE 0875		N
Starter motor output	kW	7
Starter motor voltage	V	24

Thermal energy balance

Power input	MBTU/hr	10.209
Intercooler	MBTU/hr	1.098
Lube oil	MBTU/hr	607
Jacket water	MBTU/hr	1.037
exhaust when cooling down 356 °F	MBTU/hr	1.884
exhaust when cooling down 212 °F	MBTU/hr	2.453
Surface heat	MBTU/hr	188

Exhaust gas data

Exhaust gas temperature at full load	[8]	°F	817
Exhaust gas temperature at bmep= 13,5 [psi]	[8]	°F	~ 862
Exhaust gas temperature at bmep= 126,9 [psi]	[8]	°F	~ 912
Exhaust gas mass flow rate, wet		lbs/hr	15.340
Exhaust gas mass flow rate, dry		lbs/hr	14.352
Exhaust gas volume, wet		SCFH	194.224
Exhaust gas volume, dry		SCFH	174.554
Max.admissible exhaust back pressure after engine		psi	0,870

Combustion air data

Combustion air mass flow rate	lbs/hr	14.864
Combustion air volume	SCFM	3.071
Max. admissible pressure drop at air-intake filter	psi	0,145

base for exhaust gas data: natural gas: 100% CH4; biogas 65% CH4, 35% CO2

Sound pressure level

Aggregate a)		dB(A) re 20µPa		100	
31,5	Hz	dB		87	
63	Hz	dB		91	
125	Hz	dB		100	
250	Hz	dB		98	
500	Hz	dB		96	
1000	Hz	dB		91	
2000	Hz	dB		90	
4000	Hz	dB		93	
8000	Hz	dB		91	
Exhaust gas b)		dB(A) re 20µPa		113	
31,5	Hz	dB		101	
63	Hz	dB		111	
125	Hz	dB		116	
250	Hz	dB		105	
500	Hz	dB		102	
1000	Hz	dB		96	
2000	Hz	dB		108	
4000	Hz	dB		107	
8000	Hz	dB		104	

Sound power level

Aggregate	dB(A) re 1pW	120
Measurement surface	ft²	1.130
Exhaust gas	dB(A) re 1pW	121
Measurement surface	ft²	67,60

a) average sound pressure level on measurement surface in a distance of 3.28ft (converted to free field) according to DIN 45635 and ISO 3744, precision class 3.
b) average sound pressure level on measurement surface in a distance of 3.28ft according to DIN 45635 and ISO 3744, precision class 2.

The spectra are valid for aggregates up to bmep=232,060384 psi. (for higher bmep add safety margin of 1dB to all values per increase of 15 PSI pressure).
Engine tolerance ± 3 dB

JENBACHER

*0.03 Technical data of generator

Manufacturer		STAMFORD e)
Type		S7L1D-E4 e)
Type rating	kVA	1.969
Driving power	bhp	1.721
Ratings at p.f.= 1.0	kW	1.250
Ratings at p.f. = 0,8	kW	1.239
Rated output at p.f. = 0,8	kVA	1.549
Rated reactive power at p.f. = 0,8	kVAr	930
Rated current at p.f. = 0,8	A	1.863
Frequency	Hz	60
Voltage	V	480
Speed	rpm	1.800
Permissible overspeed	rpm	2.250
Power factor (lagging - leading) (UN)		0,8 - 0,95
Efficiency at p.f.= 1.0		97,4%
Efficiency at p.f. = 0,8		96,6%
Moment of inertia	lbs-ft²	951,26
Mass	lbs	7.196
Radio interference level to EN 55011 Class A (EN 61000-6-4)		N
Cable outlet		left
Ik'' Initial symmetrical short-circuit current	kA	20,48
Is Peak current	kA	52,12
Insulation class		H
Temperature rise (at driving power)		F
Maximum ambient temperature	°F	104

Reactance and time constants at rated output (saturated)

xd direct axis synchronous reactance	p.u.	1,720
xd' direct axis transient reactance	p.u.	0,130
xd'' direct axis sub transient reactance	p.u.	0,090
x2 negative sequence reactance	p.u.	0,120
Td'' sub transient reactance time constant	ms	17
Ta Time constant direct-current	ms	28
Tdo' open circuit field time constant	s	4,29

e) JENBACHER reserves the right to change the generator supplier and the generator type. The contractual data of the generator may thereby change slightly. The contractual produced electrical power will not change.

JENBACHER

connection variant 1K

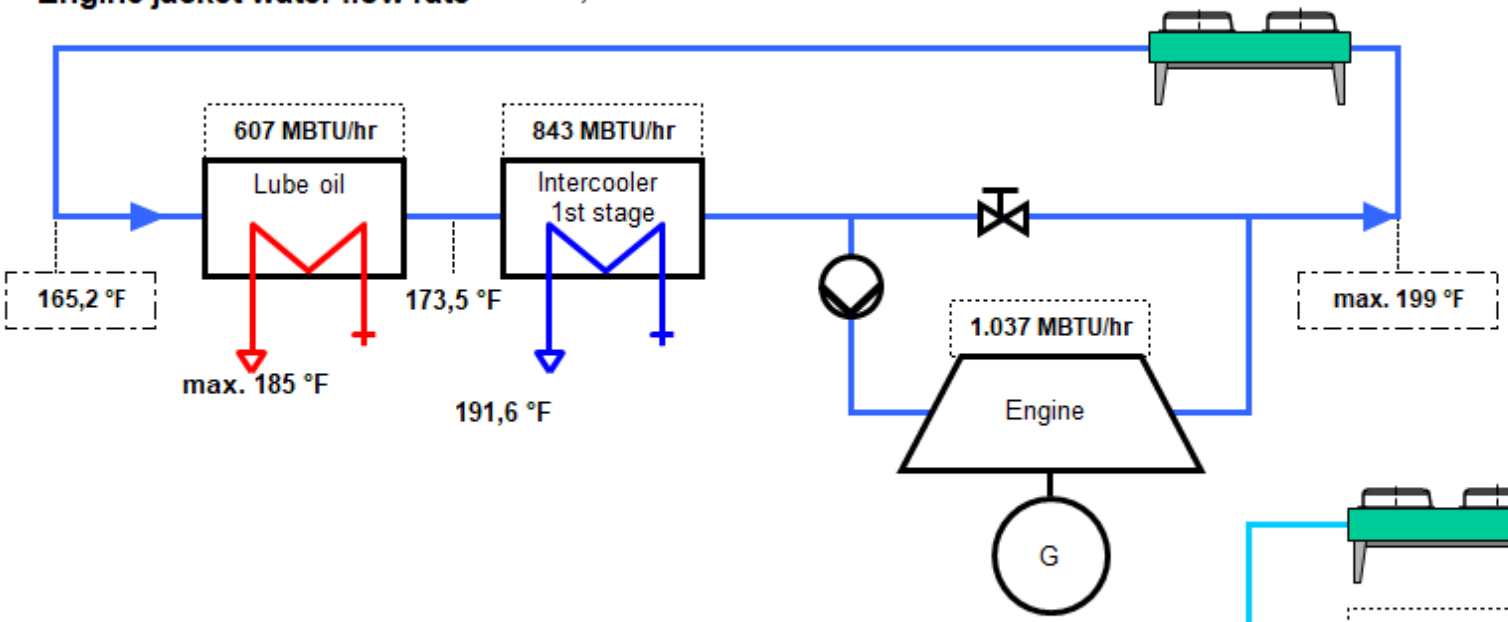
J 416 GS-E802

Engine jacket water cooling circuit (calculated with Glycol 30%)

Heat to be dissipated = **2.488 MBTU/hr**

(+12/-8 % tolerance)

Engine jacket water flow rate = **159,4 GPM**

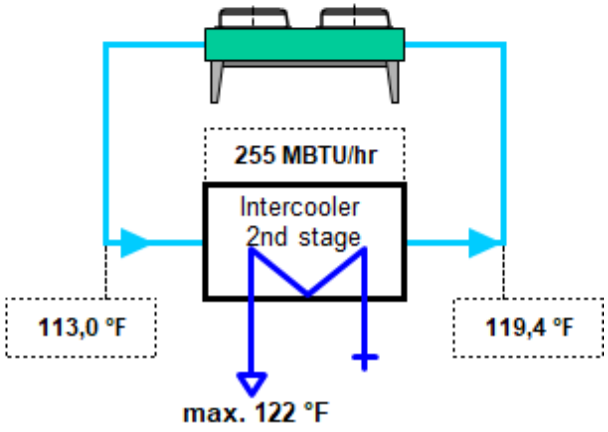


Low Temperature circuit (calculated with Glycol 30%)

Heat to be dissipated = **255 MBTU/hr**

(+12/-8 % tolerance)

Cooling water flow rate = **88,1 GPM**



0.05 Cooling water circuit

Oil - heat (Engine jacket water cooling circuit)

Nominal output	MBTU/hr	607
Max. Oil temperature	°F	185
Loss of nominal pressure of engine jacket water	psi	7,25
Safety valve - max press. set point	psi	36,26

Engine jacket water - heat (Engine jacket water cooling circuit)

Nominal output	MBTU/hr	1.037
Max. engine jacket water temperature (outlet engine)	°F	199
Engine jacket water flow rate	GPM	159,4
Safety valve - max press. set point	psi	36,26

Mixture Intercooler (1st stage) (Engine jacket water cooling circuit)

Nominal output	MBTU/hr	843
Max. inlet cooling water temp. (intercooler)	°F	173,5
Design pressure of cooling water / (max. operating pressure)	lbs	145
Loss of nominal pressure of engine jacket water	psi	4,35
Safety valve - max press. set point	psi	36,26

Mixture Intercooler (2nd stage) (Low Temperature circuit)

Nominal output	MBTU/hr	255
Max. inlet cooling water temp. (intercooler)	°F	113
Aftercooler water flow rate	GPM	88,1
Design pressure of cooling water / (max. operating pressure)	lbs	145
Intercooler water pressure drop	psi	11,60
Safety valve - max press. set point	psi	36,26

The final pressure drop will be given after final order clarification and must be taken from the P&ID order documentation.

0.10 Technical parameters

All data in the technical specification are based on engine full load (unless stated otherwise) at specified temperatures as well as the methane number and subject to technical development and modifications. For isolated operation an output reduction may apply according to the block load diagram. Before being able to provide exact output numbers, a detailed site load profile needs to be provided (motor starting curves, etc.).

All pressure indications are to be measured and read with pressure gauges (psi.g.).

[1] At nominal speed and standard reference conditions ICFN according to ISO 3046-1, respectively.
[2] According to ISO 3046-1, respectively, with a tolerance of +**5** %.
Efficiency performance is based on a new unit (immediately upon commissioning).Effects of degradation during normal operation can be mitigated through regular service and maintenance work.

[3] Average value between oil change intervals according to maintenance schedule, without oil change amount
[4] At p. f. = 1.0 according to IEC 60034-1:2017 with relative tolerances, all direct driven pumps are included
[5] Total output with a tolerance of +12/-8 %
[6] According to above parameters [1] through [5]
[7] As a guiding value at p.f. 0.8 and only valid for (engine, generator, TCM). Other peripheral equipment is not considered.
[8] Exhaust temperature with a tolerance of ±8 %
Note: an optimized operating mode to minimize methane slip can result in changed exhaust gas data (exhaust gas temperature, NOx emissions, etc.) and must be taken into account in the design of the exhaust gas aftertreatment
[9] Mixture temperature at:
If the engine is designed for intake air temperatures of > 95°F, then the stated mixture heat of the 1st stage is to be increased from 86°F in 2%/°F increments. The additional temperature must be added to the resulting full load point.

Radio interference level
The ignition system of the gas engines complies the radio interference levels of CISPR 12 and EN 55011 class B, (30-75 MHz, 75-400 MHz, 400-1000 MHz) and (30-230 MHz, 230-1000 MHz), respectively.

Definition of output
- ISO-ICFN continuous rated power:
  Net break power that the engine manufacturer declares an engine is capable of delivering continuously, at stated speed, between the normal maintenance intervals and overhauls as required by the manufacturer. Power determined under the operating conditions of the manufacturer's test bench and adjusted to the standard reference conditions.
- Standard reference conditions:

Barometric pressure:	14.5 psi (1000 mbar) or 328 ft (100 m) above sea level
Air temperature:	77°F (25°C) or 298 K
Relative humidity:	30 %

- Volume values at standard conditions (fuel gas, combustion air, exhaust gas)
  Pressure: 1 atmosphere (1013.25 mbar)
  Temperature: 32°F (0°C)

Loss of engine performance

a) Performance reduction due to gas quality

If the reference methane number is not reached and the knock control responds, the ignition timing at full performance is adjusted in conjunction with the engine management system; only then is performance reduced.

H2 admixtures in the range of 3–5 Vol% into the natural gas network are generally regarded as non-critical. Prerequisites for this are rates of change according to TA 1000-0300, as well as the knock resistance (minimum methane number) of the natural gas-H2 mixture according to the specification. For reliable compliance with required NOx emissions, the JENBACHER LEANOX^{plus} control is recommended (measurement of NOx emissions and correction of the LEANOX controller). Higher H2 addition rates into the natural gas network must be assessed on a project-specific basis.

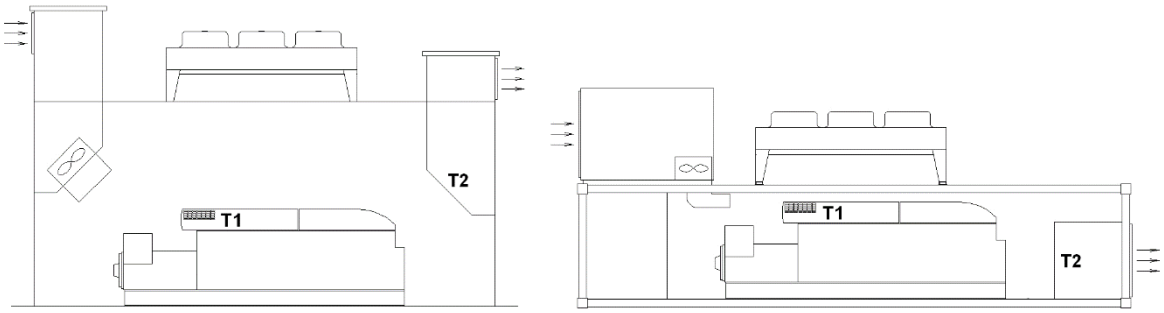
b) Performance reduction due to voltage and frequency limits

If the voltage and frequency limits for generators specified in IEC 60034-1 Zone A are exceeded, performance is reduced.

c) Performance reduction due to environmental conditions

Standard rating of the engines is for an installation at an altitude ≤ 1640 **ft** and combustion air temperature ≤ 86 **°F** (T1)

Engine room outlet temperature: **122°F** (T2) -> engine stop



The minimum recommended air change ratio (C) must be observed to maintain the required air quality and prevent unwanted gas accumulations (refer to Section ⇨ Potentially explosive Atmospheres as per TA1100-0110). The calculation is based on TA 1100-0110 and is C_{min}= 50h^{-1} for JENBACHER modules.

Parameters for the operation of JENBACHER gas engines

The genset fulfills the limits for mechanical vibrations according to ISO 8528-9.

The following "Technical Instruction of JENBACHER" forms an integral part of a contract and must be strictly observed: **TA 1000-0004, TA 1100 0110, TA 1100-0111**, and **TA 1100-0112.**

Transport by rail should be avoided. See **TA 1000-0046** for further details

Failure to adhere to the requirements of the above-mentioned TA documents can lead to engine damage and may result in loss of warranty coverage.

Ready for H2 means a possible adaptation up to 100vol% H2 operation. Performance data, timeline and costs can be determined on a project-specific basis.

Parameters for the operation of control unit and the electrical equipment
Relative humidity 50% by maximum temperature of 104°F.
Altitude up to 2000m above the sea level.

0.20 Mode of Operation

Pure Island Mode
The genset is operating as standalone solution, or together with other power generation equipment, connected to a load without any connection to the utility. The unit(s) can perform "Black-out" start without external auxiliary power supply to the "dead busbar". A single unit is controlled by the dedicated genset controller DIA.NE XT4, for multiple units a higher-level control system needs to be provided either by JENBACHER or the customer to synchronize the gensets among each other.

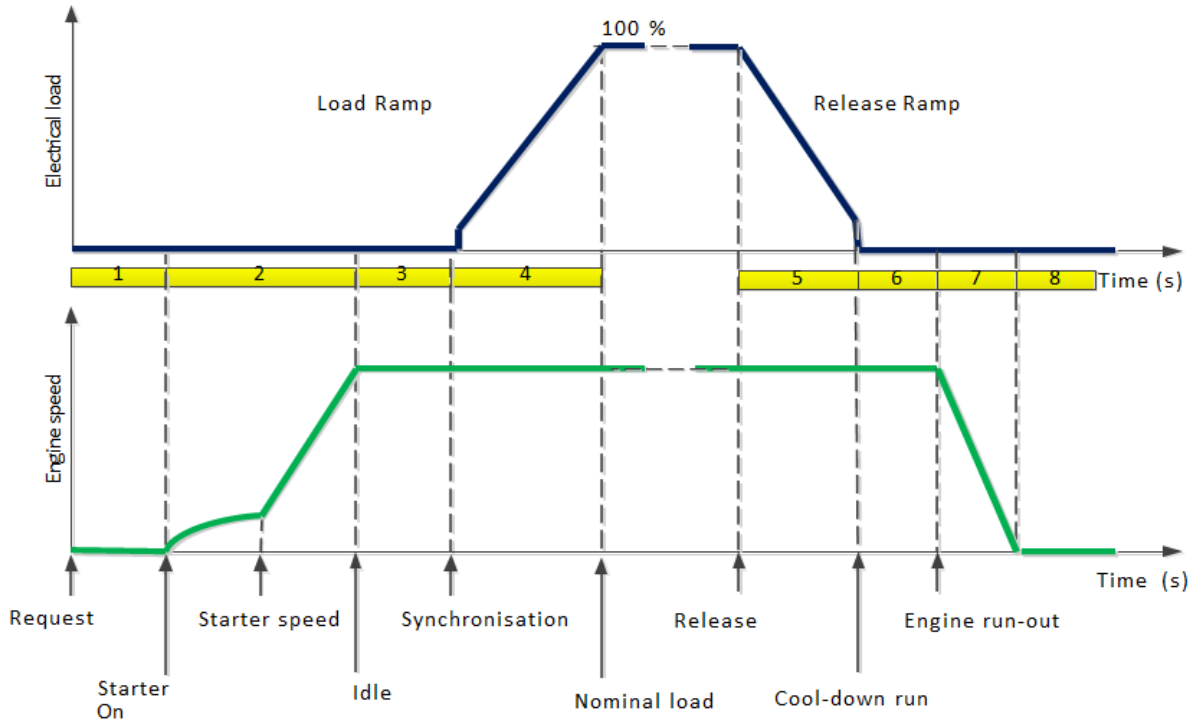
The load adding and shedding capabilities of the genset documented in
- TA 2108-0031 - general island operation
- TA 2108-0027 for type 2 engines
- TA 2108-0025 for type 3 engines
- TA 2108-0029 for type 4 engines
- TA 2108-0026 for type 6 engines
- TA 2108-0032 for type 9 engines

needs to be considered by the customer in order to ensure proper operation of the equipment.

0.20.01 Guide values for genset - start/stop times and el. load ramps

Basic boundary conditions for engine start:

Engine conditions	Oil temperature (°C / °F)	Cooling-water temperature (°C / °F)
Fast start release	> 27 / 80.6	> 55 / 131
Start enable automatic start		> 37 / 98.6
synchronization release		> 55 / 131



The following time data of the individual start sections up to the nominal load are **guideline values** for a fully automatic start under preheated conditions for mains parallel operation. Only the total start time is observed under the various engine conditions. The individual time periods specified in the table therefore do not necessarily add up to the specification of the total start time in mains parallel operation.

Deviations are possible for special designs.

	J208	Type 3	Type 4	Type 612 – 620	J624
(1) Start preparation [1] *)	0	0	20	70	90
(2) Engage starter until reaching nominal speed [s] *)	20	20	25	40	40
(3) Synchronisation [s] *) **)	1-50	1 – 50	1 – 50	1 – 50	1 – 50
(4) Load application up to nominal load [s] *) **)	180	180	180	160	160
Total start-up time from request to nominal load [s]	<300	<300	<300	<300	<330

The following **times for unloading the engine** are guide values for engine/generator combination inertia constant H<1 kWs/kVA (with LS, CGT, TDPS generators) and the hot operating condition.

(5) Load reduction ramp [s]	160	160	160	160	120
(6) Cool-down run [s]	60	60	60	10	10
(7) Run-down [s]	60	60	60	60	60
Total time from nominal load to run-down time [s]	280	280	280	220	180
(8A) gas tightness control [s]	<100	<100	<100	<100	<100
(8B) Flushing time exhaust tract after shutdown [s]				100	100
(8C) Flushing time exhaust tract after shutdown with SD and WT [s]				180	300
(8D) Flushing time exhaust tract after shutdown with SD, WT, SCR and greenhouse [s]				225	400
(8E) Blocking time for restart [s]	30	30	30	30	30

*) The times for start-up preparation and synchronisation can vary greatly and depend on project specifications.
****) Fast start function and faster load ramps are available on request.**

The table shows the waiting time between stopping the engine and starting it again, with the gas tightness check (8A), exhaust gas scavenging (8B-D) and blocking time (8E) being carried out in parallel. The flushing times can be extended project-specifically depending on the exhaust system.
It should also be noted that the exhaust gas purge must be performed after each unsuccessful start attempt once the gas valve has been opened. (SD = silencer, WT = heat exchanger)

0.30 General information for connection to the public mains

Technical Instruction TA 1530-0188 describes the - possibly optional - functions and parameters for complying with the boundary conditions defined in the country-specific "Grid Codes".

Network operator-dependent requirements must always be coordinated with JENBACHER.

0.30.10 Generator operating range in mains parallel operation

Frequency:
Normal operation fn +/-2% - without power output reduction
Extended operation: fn +4/-6%- with power output reduction between 2 – 10%/Hz
Frequency-measurement resolution: <= 10mHz (resolution)
Generator - voltage range: +/-10% of generator Un
Generator power factor cos phi at the generator terminals: as specified in "0.03 Generator technical data"

FRT (Fault Ride Through) – capability: at mains connection point
Profile 1: 150ms/30%Un (applies to natural gas and biogas)
Profile 2 (150ms/5%Un) and Profile 3 (250ms/5%Un) upon request.

Requirement:
- mains short-circuit power must be at least 5 x SrE or 50MVA
- FRT capability of the onsite auxiliaries

Extended project requirements and country-specific design are optionally possible after consultation and approval with JENBACHER.

0.30.20 Possible mains operator requests

To protect the generating unit in mains parallel operation, appropriate mains protection monitoring functions are necessary to disconnect the generator from the mains in case of a mains fault.

The mains operator-dependent specifications such as e.g.: voltage and frequency range, active power limitation, load ramps, reactive power limitation and control, protection concept, necessary certification or declarations, process data and interfaces are to be specified in project enquiries and must be agreed with JENBACHER before conclusion of the contract.

- Selectivity assessment, protection tests and recurring tests: on-site by the system operator
- Control power provision via pool operator: on request e.g. primary, secondary, tertiary
- Black start capability and countering in own use: on request
- Power generation system (EZA) controller or central control: on-site or possible on request
- Process data scope / remote control:
  - System data must be provided by the connectee for the mains operator.
  - Remote control interface to the mains operator: on-site
  - Interface specification!

Billing measurements - installation, operation, maintenance and remote data transmission: on-site.

Models of genset and generator: simplified models executed as effective value models for mains parallel operation optionally available.

Model formats: Powerfactory, or PSS/E (as of PP23)
Validated genset models in Powerfactory according to FGW TR3, TR4 and TR8 by a body accredited for this purpose according to DIN EN ISO/IEC 17065

Functional scope of the models in mains parallel operation:
- static voltage stability
- dynamic mains support
- Provision of reactive power
- Behaviour at active power setpoint
- Active power adjustment in the event of overfrequency and underfrequency (LFSM-O, LFSM-U)
- Protective devices and settings

0.30.20.01 Active power adjustment in the event of overfrequency and underfrequency

The following functions are available:
- LFSM-U: Limited Frequency Sensitive Mode - Underfrequency
- LFSM-O: Limited Frequency Sensitive Mode - Overfrequency
- FSM

Reduced power output at overfrequency: (LFSM-O function)
The frequency threshold is freely adjustable from fn + (200 - 500mHz) and the static from 2% to 12%.
Unless the relevant mains operator specifies otherwise for the LFSM-O mode, a threshold of fn + 200mHz and a static of 5% is set.

Power increase in the event of underfrequency (LFSM-U function) – (OPTIONAL as of XT4.5)
activated according to the mains operator's specifications
The frequency-sensitive active power feed-in has the effect that the generating plant
also moves permanently up and down on the frequency characteristic curve ("driving on the characteristic curve") in the frequency range between fn - 200mHz (unless otherwise specified by the mains) and fn - 2.5Hz with regard to its maximum possible active power feed-in.
The prerequisite for this is a corresponding power setpoint.

Reduced power output at underfrequency:
below 98% of fn, reduction by standard 10% of maximum capacity per Hz. Reduction up to maximum fn - 6%.
Lower reduction ramps of 2 - 10%/Hz on request
The FSM function is available as an option

The power generation system is capable of continuing to operate at this minimum power when the minimum power for controllable operation is reached.

Division for Air Quality

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

DEP7007EE

Internal Combustion Engines

___ Section EE.1: General Information
___ Section EE.2: Operating Information
___ Section EE.3: Design Information
___ Section EE.4: Fuel Information
___ Section EE.5: Emission Factor Information
___ Section EE.6: Notes, Comments, and Explanations

Additional Documentation

___ Complete DEP7007AI, DEP7007N, DEP7007V, and DEP7007GG

___ Attach EPA certification of the engine

Source Name: **Owensboro RNG**

KY EIS (AFS) #: **21- 059-00269**

Permit #: **V-23-025**

Agency Interest (AI) ID: **178066**

Date: **3/6/2024**

Section EE.1: General Information

Emission Unit #	Emission Unit Name	Control Device ID	Stack ID	Manufacturer	Model Number	Model Year	Date of Manufacture	Proposed/Actual Date of Construction Commencement *(MM/YYYY)*	Date Reconstructed/ Modified	List Applicable Regulations
EU 03	Generator 1	N/A	3	Jenbacher	JGS 416 GS-N.L	2023	2023	04/2024	2024	NSPS IIII
EU 04	Generator 2	N/A	4	Jenbacher	JGS 416 GS-N.L	2023	2023	04/2024	2024	NSPS IIII

Emission Unit #	Emission Unit Name	Control Device ID	Stack ID	Manufacturer	Model Number	Model Year	Date of Manufacture	Proposed/Actual Date of Construction Commencement *(MM/YYYY)*	Date Reconstructed/ Modified	List Applicable Regulations

Section EE.2: Operating Information

Emission Unit #	Engine Purpose (Identify if Non-Emergency, Emergency,Fire/Water Pump, Black-start engine for combustion turbine, Engine Testing)	Hours Operated	Is this engine a rental? *(Yes/No)*	Rental Time Period *(hrs)*	Alternate Operating Scenarios (Describe any operating scenarios in which the engine may be used in a different configuration)
EU 03	Power	8760	No	0	
EU 04	Power	8760	No	0	

Section EE.3: Design Information

Emission Unit #	Engine Type (Identify all that apply: Commercial, Institutional, Stationary, Non-Road)	Ignition Type (Identify if either Compression or Spark Ignition)	Engine Family (Identify all that apply: 2-stroke, 4-stroke, Rich Burn, Lean Burn)	Maximum Engine Power *(bhp)*	Maximum Engine Speed *(rpm)*	Total Displacement *(L)*	Number of Cylinders
EU 03	Stationary	Compression	4-stroke	1721	1.8	0.04888	16
EU 04	Stationary	Compression	4-stroke	1721	1.8	0.04888	16

Section EE.4: Fuel Information

Emission Unit #	Identify if Primary, Secondary, or Tertiary Fuel	Fuel Type (Identify if Diesel, Gasoline, Natural Gas, Liquefied Petroleum Gas (LPG), Landfill/Digester Gas, or Other)	Fuel Grade	Percent Time Used *(%)*	Maximum Fuel Consumption	Heat Content	Sulfur Content *(%)*	SCC Code	SCC Units
EU 03	Primary	Natural Gas		100%	5,934 BTU/bhp hr	917 BTU/scf	0		
EU 04	Primary	Natural Gas		100%	5,934 BTU/bhp hr	917 BTU/scf	0		

Section EE.5: Emission Factor Information

Emission factors expressed here are based on the potential to emit.

Emission Unit #	Fuel	Pollutant	Emission Factor	Emission Factor Units	Source of Emission Factor
EU 03	Natural Gas	See attached emission calculations	See attached emission calculations	See attached emission calculations	See attached emission calculations
EU 04	Natural Gas	See attached emission calculations	See attached emission calculations	See attached emission calculations	See attached emission calculations

Section EE.6: Notes, Comments, and Explanations

None