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New Source Review Application Supporting Information Report

Sunnyside RNG, LLC
Yakima County, Washington

April 24, 2025

Prepared for

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Yakima, Washington

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Sunnyside Renewable Natural Gas, LLC
Yakima County, Washington

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Date:	April 24, 2025
Project No.:	2359001.010
File path:	P:\2359\001\.010\R\NSR_Supporting_Report_2025-04.docx
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LIST OF ABBREVIATIONS AND ACRONYMS

*.rec	receptor file
µg/m^3	microgram per cubic meter
AB	Assembly Bill
AC	activated carbon
AERMAP	AMS/EPA regulatory model terrain pre-processor
AERMET	AERMOD meteorological pre-processor
AERMOD	AMS/EPA regulatory model
AMS	American Meteorological Society
ASIL	acceptable source impact level
BACT	best available control technology
BPIP PRIME	Building Profile Input Program-Plume Rise Model Enhancements
Btu/scf	Btu per standard cubic foot
CAS	Chemical Abstracts Service
cfm	cubic feet per minute
CFR	Code of Federal Regulations
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	equivalent CO_2 emissions
CrVI	hexavalent chromium
DEEP	diesel engine exhaust particulate matter
Ecology	Washington State Department of Ecology
EPA	US Environmental Protection Agency
facility	Sunnyside RNG facility
GEP	Good Engineering Practice
GHG	greenhouse gas
H_2S	hydrogen sulfide
HAP	hazardous air pollutant
HC	hydrocarbon
hr	hour
IDEQ	Idaho Department of Environmental Quality
K	Kelvin
km	kilometer
Landau	Landau Associates, Inc.
lb	pound
m	meter
m/s	meters per second
MACT	maximum achievable control technology
MMBtu	million British thermal units

LIST OF ABBREVIATIONS AND ACRONYMS (CONTINUED)

MMBtu/hr ..... million British thermal units per hour
NAAQS ..... National Ambient Air Quality Standards
NAD83 ..... North American Datum of 1983
NCEI ..... National Centers for Environmental Information
NED ..... National Elevation Data
NESHAP ..... National Emission Standards for Hazardous Air Pollutants
NO_2 ..... nitrogen dioxide
NO_X ..... nitrogen oxides
NSPS ..... New Source Performance Standards
NSR ..... New Source Review
NTE ..... not-to-exceed
NWS ..... National Weather Service
O_2 ..... oxygen
PM ..... particulate matter
$PM_{2.5}$ ..... PM with an aerodynamic diameter less than or equal to 2.5 microns
PM_{10} ..... PM with an aerodynamic diameter less than or equal to 10 microns
ppm ..... parts per million
ppmvd ..... parts per million by volume dry
RCW ..... Revised Code of Washington
RICE ..... reciprocating internal combustion engine
RNG ..... renewable natural gas
scf ..... standard cubic feet/foot
scfm ..... standard cubic feet per minute
SIL ..... significant impact level
SO_2 ..... sulfur dioxide
SQER ..... small-quantity emission rate
SR ..... State Route
Sunnyside RNG ..... Sunnyside RNG, LLC
TAP ..... toxic air pollutant
tBACT ..... BACT for toxic air pollutants
Thiopaq ..... THIOPAQ®
tpy ..... tons per year
VOC ..... volatile organic compound
WAAQS ..... Washington Ambient Air Quality Standards
WAC ..... Washington Administrative Code
YRCAA ..... Yakima Regional Clean Air Agency

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1.0 SUMMARY

Sunnyside RNG, LLC (Sunnyside RNG) is proposing to build a new renewable natural gas (RNG) facility near Sunnyside, Washington (the facility; see Figure 1). Landau Associates, Inc. (Landau) prepared this document to support the submittal of a New Source Review (NSR) application for the new emission units, under air quality regulations promulgated by the Yakima Regional Clean Air Agency (YRCAA) and the Washington State Department of Ecology (Ecology). The facility will be developed on approximately 50 acres located approximately 2 miles south of Sunnyside, Washington along the west side of State Route (SR) 241.

The facility will produce approximately 1,800,000 million British thermal units (MMBtu) of RNG per year through anaerobic digestion of feedstocks delivered from several dairies located near the facility. Five anaerobic digester trains will convert feedstock into biogas, the biogas will be upgraded into RNG, and the RNG will be compressed and injected into the nearby Williams natural gas pipeline.

The emission units evaluated for this NSR application consist of the following:

- Two natural gas-fired boilers each with a heat input capacity of 24.13 MMBtu per hour (MMBtu/hr)
- One biogas upgrader with a Paques THIOPAQ® (Thiopaq) scrubbing system followed by granulated activated carbon (AC) beds
- One Tier 2-certified diesel-fired emergency generator set
- Four enclosed flares, for when the biogas upgrader system is not operational
- One cellulose grinder with a dust collection system
- Fugitive emissions from roadways and the processed digestate storage.

A site plan of the proposed facility is provided on Figure 2.

This NSR application supporting information report provides information about the proposed facility necessary for YRCAA to review and determine whether the proposed project satisfies NSR requirements.

The proposed facility will comply with all applicable federal and state emission standards, and each emission unit will employ best available control technology (BACT) for criteria pollutants and toxic air pollutants (tBACT). Potential emissions from each proposed emission unit were calculated using the findings from the BACT/tBACT analysis, vendor-provided emissions data, manufacturer guarantees, and emission factors developed by the US Environmental Protection Agency (EPA) and California's air toxics program (Ventura County Air Pollution Control District [VCAPCD] 2001).

Air dispersion modeling was conducted for criteria air pollutants and toxic air pollutants (TAPs). The model results demonstrate that ambient criteria pollutant concentrations attributable to the facility will not cause or contribute to a violation of the National Ambient Air Quality Standards (NAAQS). Additionally, the modeling results demonstrate that ambient TAP concentrations attributable to the facility will be less than applicable Washington acceptable source impact levels (ASILs).

2.0 INTRODUCTION

Landau prepared this NSR application supporting information report on behalf of Sunnyside RNG to request that YRCAA issue an Order of Approval that will allow construction and operation of an RNG facility under air quality regulations promulgated by YRCAA and Ecology. The facility will be located off of SR 241 near Sunnyside, Washington, on Yakima County Parcel Nos. 22090141404, 22090114007, and the eastern half of 22090113001. The facility will be located in an area designated as in attainment or unclassifiable for all NAAQS.

This NSR application supporting information report provides YRCAA with a project description, a summary of potential emissions from each emission unit, a regulatory analysis, and an air quality impact analysis. A completed YRCAA NSR application form is provided in Appendix A. A pre-application meeting was held on April 4, 2025 with Brandon Lamb and Elizel Reynoso with YRCAA, Kipp Curtis and Charles Martin with Sunnyside RNG, and Aimi Tanada, Shauna Burr, and Kat Baker with Landau to discuss the project and application contents. YRCAA indicated that to help facilitate their review and permit preparation, the application could include draft permit conditions for YRCAA consideration. The draft permit conditions are included in Appendix D.

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3.0 PROJECT DESCRIPTION

3.1 Facility Description

The facility location is shown on Figure 1, and a site plan showing the locations of the facility emission units is provided on Figure 2. A simplified process flow diagram of facility equipment and operations is provided on Figure 3.

3.1.1 Feedstock Delivery and Handling

Facility feedstocks will include dairy manure slurry and cellulosic material. Incoming manure will be received at one of five "reception pits" and then pumped to five mix tanks. Each mix tank will feed a single digester line composed of four primary digesters operated in parallel or in series. Bales of cellulosic material will be delivered by truck and stored in the southwestern portion of the site. The size of the cellulosic material will be reduced using an electric grinder. Fugitive dust generated by the cellulose grinding process will be captured using an enclosure, dust pick-ups, and a dust collection system controlled by a baghouse. The cellulosic material will be transferred in a fully enclosed closed conveyor to three of the five mix tanks, which will contain a combined feedstock of the manure slurry and the cellulosic material.

Sunnyside RNG plans to pave all onsite areas and roadways with expected truck traffic. An unpaved area located in the northern portion of the property will have traffic only from employee and truck driver's personal vehicles.

3.1.2 Anaerobic Digesters

Five anaerobic digester trains, each of which will consist of four primary digester tanks (either in parallel or in series), will be located at the facility. Each digester tank will capture, store, and desulfurize the generated biogas through a methanogenesis process (Rother 2016). This process takes approximately 23 days to occur with the chosen feedstocks of manure slurry and agricultural residue. Each digester tank will have pressure relief valves that will operate in emergency situations when the pressure may reach an unsafe level in the digester tank. The collected biogas will be transported by pipeline to the biogas upgrading equipment. The final digestate will be pumped to one of two digestate buffer tanks before it is separated into fiber (solid) and thin (water) fractions by primary solids separation equipment. The fiber fraction will be stored under a covered area for up to 3 days before being loaded into trucks and shipped off site, while the thin fraction will be stored in one onsite covered lagoon.

There will be four enclosed flares on site to safely combust any excess biogas generated while the biogas upgrading plant and/or pipeline injection system is not operational. Sunnyside RNG has conservatively estimated that each flare will be used no more than 438 hours per year, which is based on the assumption that the biogas upgrading and/or pipeline injection equipment will be unavailable no more than 5 percent of the time on an annual basis.

3.1.3 Biogas Upgrading

Biogas leaving the anaerobic digester storage tank membranes will be chilled and transferred to the biogas upgrading plant. An amine-based gas upgrading system will be used. The lean amine solution absorbs carbon dioxide (CO_2), hydrogen sulfide (H_2S) and other acidic gases from the raw biogas. Raw biogas flows first through the absorption column, where the lean amine solution washes the biogas and absorbs the CO_2, H_2S, and other acidic gases. Scrubbed methane (99.9 percent pure) exits the top of the absorption column. Following dehydration using a liquid desiccant to remove water vapor, the methane will be compressed and injected into the natural gas pipeline.

The rich amine solution flows out the bottom of the column, then enters the scrubbing tower where it is boiled to strip the CO_2 and H_2S gases from the solution. Scrubbed lean amine solution is then recycled to the absorption tower to repeat the cycle. Appendix B has the Dow monoethanolamine safety data sheet, which is used in the amine solution. Tailgas emitted from the amine-based upgrading system will go through a Thiopaq scrubber, where the tailgas containing H_2S comes in contact with a wash solution to form an H_2S liquid that enters a bioreactor where the sulfide oxidizes into elemental sulfur. The detailed chemical reactions are available in the vendor literature provided in Appendix B. The Thiopaq system is expected to remove 99 percent of H_2S from the biogas upgrading system tailgas. Granulated AC beds will be used in series to further reduce the H_2S concentration in the Thiopaq scrubber tailgas before it is vented to the atmosphere.

3.1.4 Boilers and Emergency Generator

Sunnyside RNG plans to install two natural gas-fired hot water boilers to provide hot water for the anaerobic digesters and biogas upgrading plant. The maximum heat input capacity of each boiler will be 24.13 MMBtu/hr.

Back-up emergency power for the facility will be provided by a generator set powered by a 2,923 brake horsepower, diesel-fired, EPA Tier 2-certified engine. Total operation of the emergency generator will be limited to 80 hours per year.

4.0 AIR POLLUTANT EMISSION ESTIMATES

Criteria pollutant and TAP emissions were calculated for each emission unit proposed by Sunnyside RNG for the facility per the requirements of Washington Administrative Code (WAC) 173-400-103 and WAC 173-460-050. Worst-case short-term and annual maximum emission rates were calculated for criteria pollutants and TAPs based on peak hourly and annual operating scenarios.

The facility-wide criteria pollutant potentials-to-emit are summarized in Table 1. Facility-wide potential TAP emissions are summarized in Table 2 and compared with applicable small-quantity emission rates (SQERs) from WAC 173-460-150. Detailed emission calculations are provided in Appendix B.

Table 1: Potential Annual Emissions Summary

Pollutant	Boilers (tpy)	Biogas Upgrading & Scrubber (tpy)	Emergency Generator (tpy)	Enclosed Flares (tpy)	Straw Grinding (tpy)	Roadway Fugitives (tpy)	Project Total (tpy)
NO_X	2.2	--	1.7	3.5	--	--	7.5
CO	7.9	--	0.4	16.1	--	--	24.4
PM_{10}	1.6	--	0.06	0.4	0.44	1.8	4.2
$PM_{2.5}$	1.6	--	0.06	0.4	0.44	0.32	2.8
SO_2	0.1	--	0.001	13.2	--	--	13.4
VOCs	0.76	--	0.031	0.062	--	--	0.85
Total HAPs	0.02		0.02	0.004	--	--	0.04
CO_2e	24,748	81,780	136	9,236	--	--	115,900

Abbreviations and Acronyms:

CO = carbon monoxide
CO_2e= equivalent CO_2 emissions
HAP = hazardous air pollutant
NO_X = nitrogen oxides
$PM_{2.5}$ = particulate matter with an aerodynamic diameter less than or equal to 2.5 microns
PM_{10} = particulate matter with an aerodynamic diameter less than or equal to 10 microns
SO_2 = sulfur dioxide
tpy = tons per year
VOCs = volatile organic compounds

Table 2: Project Emissions Compared to Small-Quantity Emission Rates

Pollutant	CAS No.	Averaging Period	Emission Rate (lbs/averaging period)	SQER (a) (lbs/averaging period)	Modeling Required?
Nitrogen Dioxide	10102-44-0	1-hr	38	0.87	Yes
Carbon Monoxide	630-08-0	1-hr	80	43	Yes
Sulfur Dioxide	7446-09-05	1-hr	60	1.2	Yes
Diesel Engine Exhaust Particulate Matter	DPM	year	51	0.54	Yes
1,3-Butadiene	106-99-0	year	2.6	5.4	--
Acetaldehyde	75-07-0	year	11	60	--
Acrolein	107-02-8	24-hr	0.02	0.026	--
Ammonia	7664-41-7	24-hr	33.54	37	--
Arsenic	7440-38-2	year	0.019	0.049	--
Benzene	71-43-2	year	5	21	--
Cadmium	7440-43-9	year	0.018	0.039	--
Chlorobenzene	108-90-7	24-hr	1.5E-05	74	--
Chromium VI	18540-29-9	year	1.2E-03	0.00065	Yes
Copper	7440-50-8	1-hr	3.1E-04	0.19	--
Ethylbenzene	100-41-4	year	3.7	65	--
Formaldehyde	50-00-0	year	26.9	27	--
Hexane	110-54-3	24-hr	0.03	52	--
Hydrogen Chloride	7647-01-0	24-hr	0.014	0.67	--
Hydrogen Sulfide	7783-06-4	24-hr	18.52	0.15	Yes
Lead	7439-92-1	year	0.10	14	--
Manganese	7439-96-5	24-hr	2.3E-04	0.022	--
Mercury	7439-97-6	24-hr	1.5E-04	0.0022	--
Naphthalene	91-20-3	year	0.4	4.8	--
Nickel	7440-02-0	year	0.046	0.62	--
Propylene	115-07-1	24-hr	3.6	220	--
Selenium	7782-49-2	24-hr	1.6E-04	1.5	--
Toluene	108-88-3	24-hr	0.19	370	--
Xylene	1330-20-7	24-hr	0.135	16	--

Notes:
(a) Small-quantity emission rates from WAC 173-460-150.
CAS = Chemical Abstracts Service
lbs = pounds

4.1 Boiler Emissions

The two natural gas boilers will be Cleaver Brooks CB boilers, or equivalent. Manufacturer-provided highest not-to-exceed (NTE) emission rates were used to calculate criteria pollutant emissions. Equivalent NO_X and CO exhaust concentrations that were also provided by the manufacturer are reflected in the proposed BACT levels summarized in Section 5.2. Greenhouse gas (GHG) emissions were calculated using natural gas combustion emission factors from the EPA's Mandatory GHG Reporting Rule (Title 40 Part 98, Subpart C of the Code of Federal Regulations [CFR]). TAP emissions were calculated using emission factors from California's air toxics program (Assembly Bill [AB] 2588; VCAPCD 2001) for natural gas combustion units with a maximum heat input capacity between 10 and 100 MMBtu/hr.

Hourly emissions were based on maximum-rated firing rates, daily emissions were based on continuous operation (i.e., 24 hours/day) at the maximum hourly rate, and annual emissions were based on continuous annual operation (i.e., 8,760 hours/year), also at the maximum hourly rate.

4.2 Biogas Upgrading Emissions

There are no combustion emissions associated with the biogas upgrading system. Heat for the biogas upgrading plant systems will be provided by boilers. Tailgas from the biogas upgrading plant will be treated by a Thiopaq bioscrubber system in series with AC beds to reduce H_2S concentrations in the vent stream to less than 9 parts per million (ppm).

Hourly emissions were based on vendor design specifications for exhaust flow rate and H_2S concentration, daily emissions were based on continuous operation (i.e., 24 hours/day), and annual emissions were based on continuous annual operation (i.e., 8,760 hours/year.)

4.3 Emergency Generator Emissions

The EPA Tier 2-certified emergency generator will be a Kohler KD2000 powered by an EPA Tier 2-certified, diesel-fired engine, or equivalent. Manufacturer-reported NTE generator emission factors for CO, NO_X, and particulate matter (PM) were used to calculate emission rates. Additionally, the manufacturer-provided hydrocarbon (HC) emission factor was assumed to be equivalent to a total VOC emission factor.

Emissions of diesel engine exhaust particulate matter (DEEP) were conservatively assumed to be equal to the NTE PM emission factors provided by the manufacturer. The emission factors for PM_{10} and $PM_{2.5}$ include both "front-half" (i.e., filterable PM) and "back-half" (i.e., condensable PM) emissions. The filterable PM estimate is equal to the manufacturers' NTE emission factor for PM. An estimate of condensable PM is assumed to be equal to the NTE HC emission factor provided by the manufacturer. The SO_2 emission rate was calculated using an emission factor formula from the EPA's AP-42, Volume I, Chapter 3.4 (Large Stationary Diesel and All Stationary Dual-Fuel Engines; EPA 1996), and the maximum sulfur content of the fuel, ultra-low sulfur diesel, which has a maximum sulfur content of 15 ppm by weight.

GHG emissions were calculated using diesel fuel combustion emission factors from the EPA's Mandatory GHG Reporting Rule (40 CFR 98, Subpart C), and TAP emissions were calculated using emission factors from California's air toxics program (AB 2588; VCAPCD 2001) for diesel-fired internal combustion engines.

Hourly emissions were based on the maximum engine power rating and maximum fuel usage rate with testing limited to no more than 30 minutes, daily emissions were based on one 30-minute test per day, and annual emissions were based on a maximum of 80 hours per year of non-emergency usage and emergency usage.

4.4 Flare Emissions

Four enclosed flares will be used to safely combust excess biogas generated by the anaerobic digester lines when the biogas upgrading plant and/or the injection system is not operating. The peak hourly biogas production rate is 6,015 standard cubic feet (scf) per minute combined. The generated biogas is expected to contain H_2S at a maximum concentration of 991 ppm, CO_2 at an average concentration of 44.49 percent, and have an average heat content of 655 Btu per standard cubic foot (Btu/scf).

Flare SO_2 emissions were calculated assuming that all H_2S in the biogas would be oxidized to SO_2. NO_X and CO emissions from biogas flaring were calculated using emission factors from the EPA's AP-42, Volume I, Chapter 13.5 (Industrial Flares; EPA 2018). All remaining criteria pollutant emissions from biogas flaring were calculated using emission factors from the EPA's AP-42, Volume I, Chapter 1.4 (External Natural Gas Combustion; EPA 1998). GHG emissions were calculated using natural gas combustion emission factors from the EPA's Mandatory GHG Reporting Rule (40 CFR 98, Subpart C) and the assumed average CO_2 concentration in the biogas. TAP emissions were calculated using emission factors from California's air toxics program (AB 2588; VCAPCD 2001) for natural gas combustion sources with a maximum heat input capacity between 10 and 100 MMBtu/hr. Flaring emission factors for petroleum refining were not used because they are not representative of biogas flaring.

Hourly emissions were based on flaring a maximum of 6,027 standard cubic feet per minute (scfm) of biogas in an hour total, approximately 1,507 scfm per flare, daily emissions were based on continuous flaring (i.e., 24 hours/day) at the maximum hourly rate, and annual emissions were based on flaring for 438 hours/year (i.e., 5 percent of the year) at the maximum hourly rate per flare and 1,752 hours/year total.

4.5 Cellulose Grinding Emissions

The size of cellulose material delivered to the facility will be reduced using an electric grinder within an enclosed structure. A fan will be used to keep the structure under negative pressure, and the exhaust from the structure will be filtered through a dust collection system located outside of the structure. Dust collector exhaust emissions were calculated using the maximum daily cellulose processing rate (200 tons/day) and a representative PM emission factor from the EPA's AP-42, Volume I, Chapter 9.9.1 (Grain Elevators and Processes; EPA 2003) that reflects control by a baghouse. PM_{10} and $PM_{2.5}$ emissions were

conservatively assumed to be equivalent to PM emissions. Annual emissions were based on continuous operation (i.e., 365 day/year). The baghouse was assumed to achieve 99.9 percent control efficiency at a minimum.

4.6 Roadway Emissions

Fugitive dust from paved roadways was calculated using site-specific truck traffic information (i.e., vehicle weight and vehicle miles traveled), assumed road surface silt content, and emission factors from the EPA's AP-42, Volume I, Chapters 13.2.1 (Paved Roads; EPA 2011). Sunnyside RNG will implement dust minimization techniques (e.g., trackout minimization and onsite vehicle speed limits) to reduce fugitive dust emissions from onsite roadways. An overall control efficiency of 70 percent was applied to account for the combined dust minimization techniques.

Fugitive dust from unpaved roads were calculated using the same site-specific traffic information and assuming for the same dust minimization techniques. Unpaved roadway emission factors are based on the EPA's AP-42 Volume 1, Chapter 13.2.2 (Unpaved Roads; EPA 2006) and a surface silt content of 48 percent was used due to the higher silt content found in Yakima soils (Kuhns et al. 2010).

4.7 Solid Digestate Storage Emissions

After digestate solids separation, the fiber fraction will be stored in a covered building for up to 3 days before being loaded into trucks and shipped off site. There is expected to be a small amount of fugitive ammonia emissions during storage that stems from the amount of nitrogen in the solids digestate and natural volatilization during the storage. An academic study seeking to measure the ammonia emissions from anaerobic digesting activities was used as a basis to estimate the fugitive ammonia emissions from the volatilization from the fiber storage (Bell et al. 2016).

The study provides an equation to estimate volatilized ammonia emissions based on a regression of variables including substrate temperature, air exchange, and NH4-N content. For the facility, the substrate temperature was conservatively assumed to be the high average of the hottest month at the site, which is 92.4 degrees Fahrenheit in July. The air exchange rate in the building was assumed to be 2 per hour, and the NH4-N content is 3.9 grams per kilogram based on an analysis of the site's specific incoming slurry and straw data provided in Appendix B. An ammonia volatilization rate of 484 milligrams per square meter per hour was calculated. Using the 1,100 square meter surface area of the solids pile, the total hourly emission rate for ammonia was calculated at 1.2 pounds per hour. Daily emissions were based on continuous storage (i.e., 24 hours/day) at the maximum hourly rate, and annual emissions were based on continuous storage (i.e., 8,760 hours/year) at the maximum hourly rate.

5.0 EMISSION STANDARD COMPLIANCE

5.1 Compliance with State and Federal Regulations

The RNG facility will comply with the following applicable air regulations, in accordance with the federal and state Clean Air Acts. These requirements are adopted by reference in YRCAA Regulation 1 and specified in:

- Chapter 70.94 Revised Code of Washington (RCW) (Washington Clean Air Act)
- Chapter 173-400 WAC (General Regulations for Air Pollution Sources)
- Chapter 173-460 WAC (Controls for New Sources of Toxic Air Pollutants; updated December 30, 2019)
- 40 CFR Part 60 (New Source Performance Standards)
- 40 CFR Part 63 (National Emission Standards for Hazardous Air Pollutants).

Specifically, the project includes sources of air contaminants and will follow applicable air contaminant regulations as listed in:

- RCW 70.94.152
- WAC 173-400-113
- WAC 173-460-040.

The area in which the project is located is in attainment, or unclassifiable, of all federal Clean Air Act criteria pollutants. Facilities that produce more than 100 tpy of any criteria pollutant, 10 tpy of an individual HAP, or 25 tpy of combined HAPs are considered major sources under the federal regulation 40 CFR Part 70 and the state regulation WAC 173-410 et seq. Potential-to-emit estimates provided in Section 4.0 demonstrate that the facility will emit:

- Less than 100 tpy of any criteria pollutant (PM, CO, SO_2, VOCs, and nitrogen dioxide [NO_2])
- Less than 10 tpy of any individual HAP
- Less than 25 tpy of combined HAPs.

As a result, a Title V operating permit is not required. Likewise, a Prevention of Significant Deterioration NSR pre-construction permit is not required because emissions of all federally regulated NSR pollutants will be less than the major source threshold of 250 tpy.

5.2 Best Available Control Technology

BACT/tBACT is required as part of NSR and is intended to minimize criteria pollutant and TAP emissions. BACT is an emission limitation based on the maximum degree of reduction that can be feasibly achieved for each air pollutant emitted from any new or modified stationary source. Washington guidance for BACT determinations indicates using either presumptive BACT or a “top-down” approach (Ecology

2021). As part of the pre-application meeting for the prior permit with YRCAA on April 4, 2025, Sunnyside RNG discussed presumptive BACT for the new emission units associated with the RNG facility. A summary of presumptive BACT for each emission unit is summarized in Table 3.

Table 3: Proposed BACT/tBACT for Project

Pollutant	Proposed BACT/tBACT
Boilers	
NO_X	9 ppmvd @ 3 percent O_2
CO	50 ppmvd @ 3 percent O_2
VOC/TAPs	Good Combustion Practices
Biogas Upgrading	
H_2S	9 ppmvd through operation of Thiopaq scrubber and activated carbon beds
Emergency Generator	
Criteria/TAPs	EPA Tier 2 Emission Certification, Good Combustion Practices, and Ultra-Low Sulfur Diesel
Backup Flares	
Criteria/TAPs	Enclosed flares and Good Combustion Practices
Straw Grinding	
$PM_{10}/PM_{2.5}$	Baghouse 99.9 percent control efficiency

Abbreviations and Acronyms:
O_2 = oxygen
ppmvd = parts per million by volume dry

5.3 New Source Performance Standards

New Source Performance Standards (NSPS) are nationally uniform standards that apply to specific categories of stationary sources constructed, modified, or reconstructed after the standard was proposed. NSPS are found in 40 CFR 60. NSPS usually represent a minimum level of control that is required for a new source.

The following NSPS were evaluated to assess applicability to the facility emission units:

- **40 CFR Part 60 Subpart Dc (Small Industrial-Commercial-Institutional Steam-Generating Units)**

  NSPS Subpart Dc applies to each steam-generating unit that is constructed after June 9, 1989 and has a maximum design heat input capacity of between 10 and 100 MMBtu/hr. This subpart is applicable to the proposed natural gas-fired boilers because the proposed boilers each have maximum heat input capacity of 24.13 MMBtu/hr.

  The natural gas-fired boiler is subject to the requirements of this subpart, including monitoring and recording natural gas fuel usage. There are no applicable PM standards for natural gas-fired boilers. Sunnyside RNG will submit the required notification and maintain all records as necessary to demonstrate compliance with this subpart.

- **40 CFR Part 60 Subpart Kb (Volatile Organic Liquid Storage Vessels)**

  NSPS Subpart Kb applies to each storage vessel with a capacity greater than 75 cubic meters that is used to store volatile organic liquids and is constructed after July 23, 1984. This subpart does not apply because the anaerobic digester tanks will not be used to store volatile organic liquids.

- **40 CFR Part 60 Subpart IIII (Stationary Compression Ignition Internal Combustion Engines)**

  NSPS Subpart IIII applies to owners and operators of stationary compression ignition engines that commence construction after July 11, 2005, and the engine is manufactured after April 1, 2006. The diesel generator will be subject to this subpart, and the facility will operate the engine in a manner that satisfies the definition of "emergency engine" in NSPS Subpart IIII. Therefore, under NSPS Subpart IIII, the generator must be manufactured and certified to meet federal Tier 2 emission limits in 40 CFR Part 89. The facility will install and operate a Tier 2-certified generator.

  The facility will conduct all notifications, generator maintenance, recordkeeping, and reporting required by NSPS Subpart IIII.

5.4 National Emission Standards for Hazardous Air Pollutants

Prior to the 1990 Clean Air Act Amendments, National Emission Standards for Hazardous Air Pollutants (NESHAP) were risk-based emission standards for eight HAPs. Under the provisions of Section 112 of the 1990 Clean Air Act Amendments, Congress required the EPA to regulate the emissions of 189 HAPs from all stationary and mobile sources. The EPA has promulgated regulations for specific industry categories that require controls tailored to the major sources of emissions and the HAPs of concern associated with that industry. The rules promulgated under Section 112 generally specify the maximum achievable control technology (MACT) that must be applied by a given industry category. Consequently, these rules are often called MACT standards.

There are two types of NESHAPs, one for "major" sources of HAP emissions and one for "area" sources of HAP emissions. Major sources are facilities that have the potential to emit more than 10 tons of a single HAP per year, or 25 tpy of all HAPs combined. Area sources are facilities that are not major sources. The facility will be an area source of HAP emissions.

The following NESHAPs were evaluated to determine their applicability to the facility emission units:

- **40 CFR Part 63 Subpart ZZZZ (NESHAP for Reciprocating Internal Combustion Engines [RICEs])**

  NESHAP Subpart ZZZZ establishes emission limits for stationary RICEs located at major and area sources of HAP emissions. The proposed diesel emergency generator engine satisfies NESHAP Subpart ZZZZ requirements by meeting the requirements of NSPS Subpart IIII.[1] There are no additional requirements for the engines under this subpart.

[1] 40 CFR 63.6590(c).

- **40 CFR Part 63 Subpart JJJJJJ (NESHAP for Industrial, Commercial, and Institutional Boiler Area Sources)**

  NESHAP Subpart JJJJJJ establishes emission limits for boilers located at an area source of HAP emissions. This subpart is not applicable to the proposed boilers because gas-fired boilers are not regulated under this subpart.[2]

[2] 40 CFR 63.11195(e).

6.0 AMBIENT AIR QUALITY IMPACT ANALYSIS

This section presents the air dispersion modeling methodology and results, as well as an assessment of compliance with the NAAQS and Washington Ambient Air Quality Standards (WAAQS) for criteria pollutants and to the Washington State screening thresholds for TAPs. Copies of the electronic modeling files prepared in support of the project will be provided to YRCAA via a file transfer site.

As discussed in the following subsections, the modeled ambient impacts expected from project emissions are either less than the significant impact levels (SILs) or less than the NAAQS and WAAQS, after summing with background concentrations. All model-predicted ambient TAP impacts are less than the ASILs.

6.1 Model Methodology and Assumptions

Air dispersion modeling was conducted in general accordance with the EPA's Revision to the Guideline on Air Quality Models: Adoption of a Preferred General Purpose (Flat and Complex Terrain) Dispersion Model and Other Revisions; Final Rule (EPA 2005). The AERMOD[3] modeling system was used in accordance with the EPA's Revision to the Guideline on Air Quality Models (EPA 2005) to estimate ambient pollutant concentrations beyond the site property boundary.

Ambient air impacts were modeled for all criteria pollutants and TAPs for which compliance was not demonstrated via emissions threshold screening. The most recent version of AERMOD (Version v24142) was used at the time the modeling was completed. AERMOD requires input from several pre-processors, described below, for meteorological parameters, downwash parameters, and terrain heights. AERMOD uses data from pre-processor programs (i.e., meteorology and terrain) as well as emission estimates and physical exhaust release point characteristics to predict ambient concentrations attributable to the proposed project. The model calculates concentrations based on various averaging times (e.g., 1 hour, 24 hours, annual, etc.) for a defined network of receptors; these concentrations are used to assess compliance with regulations that use ambient concentrations as criteria.

The AERMOD model was used to estimate the short-term impacts (i.e., 24-hour average or less) of $PM_{2.5}$, PM_{10}, NO_2, SO_2, CO, and H_2S emissions, and long-term impacts (i.e., annual average) of $PM_{2.5}$, NO_2, SO_2, DEEP, and hexavalent chromium (CrVI).

6.1.1 Stack Parameters

The locations of proposed emission units are shown on Figure 2. Table 4 summarizes the stack parameters associated with each emission unit including stack heights above grade in meters (m), exhaust temperatures in degrees Kelvin (K), exit velocities in meters per second (m/s), stack diameters in meters, and the orientation of the exhaust when it exits the stack.

[3] American Meteorological Society (AMS)/US Environmental Protection Agency (EPA) Regulatory Model.

Table 4: Point Source Stack Parameters

Stack ID	Description	UTM Coordinates (a)		Stack Height (m)	Exhaust Temp. (K)	Exhaust Velocity (m/s)	Stack Diameter (m)	Release Orientation
		Easting-X (m)	Northing-Y (m)					
BLR1	Boiler No. 1	730953.45	5131062.37	20	448	12.3	0.6	Vertical
BLR2	Boiler No. 2	730958.01	5131062.60	20	448	12.3	0.6	Vertical
THIO	Thiopaq Bioscrubber	731003.721	5131065.645	12.8	311	12.4	0.3	Vertical
EGEN	Emergency Generator	730954.00	5131077.72	10.7	773	37.1	0.5	Vertical
FLARE1	Enclosed Flare No. 1	731010.32	5131122.52	11	1,273	8.6	2.0	Vertical
FLARE2	Enclosed Flare No. 2	731010.529	5131116.065	11	1,273	8.6	2.0	Vertical
FLARE3	Enclosed Flare No. 3	731010.741	5131109.612	11	1,273	8.6	2.0	Vertical
FLARE4	Enclosed Flare No. 4	731010.954	5131103.301	11	1,273	8.6	2.0	Vertical
BAGH	Grinder Baghouse	730893.12	5130992.03	6.1	Ambient	21.2	0.6	Vertical

Notes:
(a) Universal Transverse Mercator, Zone 10, North American Datum of 1983 (NAD83)

Entrained dust emissions from trucks operated on paved and unpaved surfaces at the facility were represented in the modeling as volume sources using a methodology from the EPA's Haul Road Workgroup final report (EPA 2012). One hundred seventy-two (172) volume sources representing paved roads with initial release heights of 2.55 m, initial sigma-z values of 2.37 m, and initial sigma-y values of 4.19 m were included in the modeling to represent the fugitive PM emissions associated with onsite paved areas. Thirty-seven (37) volume sources representing unpaved roads with initial release heights of 1.53 m, initial sigma-z values of 1.42 m, and initial sigma-y values of 3.63 m were included in the modeling to represent the fugitive PM emissions associated with onsite unpaved areas.

6.1.2 Building Downwash

Building downwash occurs when the aerodynamic turbulence in the wake of buildings or structures causes exhaust from an elevated source (i.e., a stack) to mix with winds and be rapidly conveyed toward the ground, resulting in elevated ground-level pollutant concentrations. The software program Building Profile Input Program-Plume Rise Model Enhancements (BPIP PRIME) was used to determine

whether exhaust from emission units would be affected by nearby building structures. In general, a stack is considered to be affected by a given structure if the height of the stack is less than the height defined by the EPA's Good Engineering Practice (GEP) stack height methodology.

GEP stack height is defined as the height of the nearby structure(s) measured from the ground-level elevation at the base of the stack plus 1.5 times the lesser dimension, height, or projected width of the nearby structure(s). All exhaust stacks at the facility will be less than the calculated GEP heights, and, therefore, influenced by building downwash. To account for this potential building downwash,

parameters calculated by BPIP PRIME were provided as inputs to AERMOD. A summary of buildings and structures is provided in Table 5. Figure 4 shows the facility site plan with the labeled buildings and stack locations.

Table 5: Building and Structure Information

Building/Structure Description	Length (feet)	Width (feet)	Height (feet)
Digester Tanks (a)	--	80	83
Mix Tanks (b)	--	106	83
Amine Building	57	53	52
Solid Feedstock Buildings	121	55	26
Grindhouse	182	134	24
Maintenance Control Room	136	81	16
Fiber Storage	200	85	16
Boiler House	115	45	17

Notes:
(a) Digester tank diameter equal to 80 feet.
(b) Mix tank diameter equal to 106 feet.

6.1.3 Receptor Grid

To include the effects of terrain on calculated ambient concentrations, AERMOD requires information about the surrounding terrain. The AMS/EPA Regulatory Model Terrain pre-processor (AERMAP, Version 24142) was used to obtain the hill height scale and the base elevation for each receptor.

The receptor grid spacing increases with distance from the facility, as listed below:

- 12.5-m spacing along the ambient air boundary and from the property boundary to 150 m
- 25-m spacing from 150 m to 400 m
- 50-m spacing from 400 m to 900 m
- 100-m spacing from 900 m to 2,000 m
- 300-m spacing from 2,000 m to 4,500 m
- 600-m spacing from 4,500 m to 10,000 m.

AERMAP requires the use of topographic data to estimate surface elevations above mean sea level. Digital topographic data, in the form of National Elevation Data (NED) files, for the analysis region were obtained from the US Geological Survey national map downloader website (USGS 2025) and processed for use in AERMOD. The NED used for this project have a resolution of approximately 10 m (⅓ arc-second).

The implementation of AERMAP produces a receptor file (*.rec) that contains the calculated terrain elevations and hill height scales for each receptor. A separate *.rec file produced for each receptor spacing group was used as an input file provided to AERMOD.

6.1.4 Meteorology

The AERMOD meteorological pre-processor (AERMET, Version 24142) is the meteorological pre-processor model that calculates boundary-layer parameters for use in AERMOD. AERMET is used to process formatted meteorological data from observation stations and to generate two input files for the AERMOD model: the Surface File with hourly boundary-layer parameter estimates; and the Profile File with multi-level observations of wind speed, wind direction, temperature, and standard deviations of fluctuating wind components. The meteorological observation data processed by AERMET in support of this project are described below.

- National Weather Service (NWS) hourly surface observations from Yakima Air Terminal in Yakima, Washington located near the RNG Sunnyside site were used for this analysis. Five years (i.e., January 1, 2020 through December 31, 2024) of hourly surface data were processed using AERMET. AERMINUTE was run to reduce the instance of "calms." A potential concern related to the use of meteorological data for dispersion modeling is the high incidence of "calms," or periods of time with wind speeds that are less than the wind speed sensor's level of detection. NWS and Federal Aviation Administration data coding defines a wind speed of less than 3 knots as "calm" and assigns a value of 0 knots. This results in an overestimation of the occurrence of calm conditions. Similarly, if the wind direction varies by more than 60 degrees during a 2-minute period and the wind speed is 6 knots or less, the wind direction is reported as "missing." AERMINUTE reprocesses Automated Surface Observing System 1-minute wind data at a lower threshold and calculates hourly average wind speed and directions to supplement the standard hourly data processed using AERMET.
- NWS twice-daily upper air soundings were obtained from the Spokane International Airport station in Spokane, Washington. Five years (i.e., January 1, 2020 through December 31, 2024) of upper air data were processed using AERMET.
- Surface characteristics, specifically albedo, Bowen ratio, and surface roughness, are used by AERMET to calculate the parameters required by AERMOD. Albedo is a measure of the solar radiation reflected by earth into space. The Bowen ratio is an evaporation-related measurement defined as the ratio of sensible heat to latent heat. The surface roughness length is the theoretical height above ground where the wind speed becomes zero.
- AERSURFACE Version 24142 and land-use data from the 2021 National Land Cover Database (USGS 2023) were used to calculate the albedo, Bowen ratio, and surface roughness in the area surrounding the surface observation site. AERSURFACE calculates the fraction of each land-use type within each of 12 equal sectors (i.e., 30 degrees each) centered on the surface observation station. Default study radii of 1 kilometer (km) for surface roughness and 10 km for the Bowen ratio and albedo were used. Default month assignments were used for the four seasonal categories used by AERSURFACE, which are as follows: 1) midsummer with lush vegetation; 2) autumn with unharvested cropland; 3) winter with continuous snow; and 4) transitional spring with partial green coverage or short annuals. The surface data were from an airport location.

- Monthly precipitation data for Yakima Airport were obtained from the National Centers for Environmental Information (NCEI) database (NCEI 2025) for each year of meteorological data used (i.e., January 1, 2020 through December 31, 2024). The monthly precipitation values from the 5 years of data used were compared with 30th percentile and 70th percentile precipitation values for the past 30 years to determine the conditions for each month based on "dry" (i.e., less than the 30th percentile), "average" (i.e., between the 30th and 70th percentiles), or "wet" (i.e., greater than the 70th percentile).

6.1.5 NO_X to NO_2 Conversion

Ambient NO_2 concentrations were calculated by AERMOD using the ARM2 option. The ARM2 option is based on applying an ambient ratio of NO_2/NO_X to a modeled NO_X concentration to estimate ambient NO_2 concentrations. The ARM2 parameters used for all proposed combustion sources were as follows:

- Default NO_2/NO_X upper ratio of 0.9
- Default NO_2/NO_X lower ratio of 0.5.

6.1.6 Background Concentration

This evaluation includes background concentrations contributed by existing regional and local background sources. Regional background concentrations were obtained from NW AIRQUEST through the Idaho Department of Environmental Quality website (IDEQ 2025). Regional and local background concentrations were added to the modeled project concentrations to estimate the projected cumulative concentrations for those pollutants and averaging periods with results above the SIL.

6.1.7 First-Tier Screening of Toxic Air Pollutant Impacts

A first-tier TAP assessment includes a comparison of expected maximum emission rates with the SQERs and, for TAPs with emission rates that exceed the SQERs, a comparison of predicted maximum ambient concentrations with the ASILs. Table 2 shows the facility-wide emission rates for each TAP expected to be released by the facility and compares each emission rate with the corresponding SQER. A SQER is an emission rate threshold, below which YRCAA does not require an air quality impact assessment for the corresponding TAP. As shown in Table 2, maximum facility-wide emissions of NO_2, SO_2, DEEP, CrVI, and H_2S are expected to be greater than their corresponding SQERs, so an ambient impact analysis was completed for those TAPs.

6.2 Predicted Criteria Pollutant Ambient Concentrations

The results of the criteria pollutant SIL analysis are provided in Table 6. As shown in Table 6, the model-predicted annual NO_2 and short-term CO concentrations are less than the applicable SILs and are therefore assumed to not have the potential to cause or contribute to an exceedance of an ambient standard. For all other criteria pollutants, averaged over the periods indicated in Table 6, a cumulative NAAQS analysis is required to assess compliance with the corresponding ambient standards.

Table 6: Results for Significant Impact Level Analysis

Pollutant	Averaging Period (a)	Maximum Modeled Concentration ($\mu g/m^3$)	Significant Impact Level ($\mu g/m^3$)	Cumulative NAAQS Analysis Required
$PM_{2.5}$	24-hour*	6.8	1.2	**Yes**
	Annual	1.8	0.2	**Yes**
PM_{10}	24-hour	69.7	5	**Yes**
NO_2	1-hour*	144.1	7.5	**Yes**
	Annual	0.7	1	No
SO_2	1-hour*	194.8	7.8	**Yes**
	3-hour	147.5	25	**Yes**
CO	1-hour	279.9	2,000	No
	8-hour	108.7	500	No

Notes:

(a) Unless otherwise stated, the design value is the maximum overall result predicted by the model. The design value for those indicated with an asterisk (*) is the maximum 5-year average of the modeled concentration at each receptor.

Abbreviations and Acronyms:

$\mu g/m^3$ = micrograms per cubic meter

The results of the criteria pollutant cumulative impact analysis are provided in Table 7. The model-predicted ambient impacts plus background for all criteria pollutants and averaging periods are less than the NAAQS, which indicates that the proposed project does not have the potential to cause or contribute to an exceedance of an ambient standard.

Table 7: Results for Cumulative Analysis

Pollutant	Averaging Period	Modeled Design Concentration ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	Total Impact ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
$PM_{2.5}$	24-hour (a)	4.3	27	31.3	35
	Annual (b)	1.7	7.1	8.8	9
PM_{10}	24-hour (c)	44.2	79	123.2	150
NO_2	1-hour (a)	137.8	49	186.8	188
SO_2	1-hour (d)	181.7	12.1	193.8	200
	3-hour (e)	117.5	17	134.5	1,300

Notes:

(a) Maximum of 5-year average of 8th-highest modeled concentrations for each receptor modeled.

(b) Maximum of 5-year average of maximum modeled concentrations for each receptor modeled.

(c) Maximum of 6th-highest modeled concentrations for a 5-year period.

(d) Maximum of 5-year average of 4th-highest modeled concentrations for each receptor modeled.

(e) Maximum of highest modeled concentrations for a 5-year period.

6.3 Predicted Toxic Air Pollutant Ambient Concentrations

The first-tier ambient concentration screening analyses are summarized in Table 8. These screening analyses were conducted for TAPs with expected maximum emission rates that exceed the applicable SQERs (see Table 2). As shown in Table 8, all maximum modeled ambient concentrations are less than the applicable ASILs.

Table 8: Results for Toxic Air Pollutant Analysis

TAP	CAS No.	Averaging Period	Maximum Modeled Impact ($\mu g/m^3$)	ASIL (a) ($\mu g/m^3$)
NO_2	10102-44-0	1-hr	144.1	470
SO_2	7446-09-05	1-hr	194.8	660
DEEP	DPM	year	0.0030	0.0033
CrVI	18540-29-9	year	7.00E-08	4.00E-06
H_2S	7783-06-4	24-hr	1.9	2

Notes:
(a) ASIL values from WAC 173-460-150

7.0 USE OF THIS REPORT

This report has been prepared for the exclusive use of Sunnyside RNG, LLC and applicable regulatory agencies for specific application to the Sunnyside RNG, LLC renewable natural gas facility project. No other party is entitled to rely on the information, conclusions, and recommendations included in this document without the express written consent of Landau. Further, the reuse of information, conclusions, and recommendations provided herein for extensions of the project or for any other project, without review and authorization by Landau, shall be at the user's sole risk. Landau warrants that within the limitations of scope, schedule, and budget, our services have been provided in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions as this project. Landau makes no other warranty, either express or implied.

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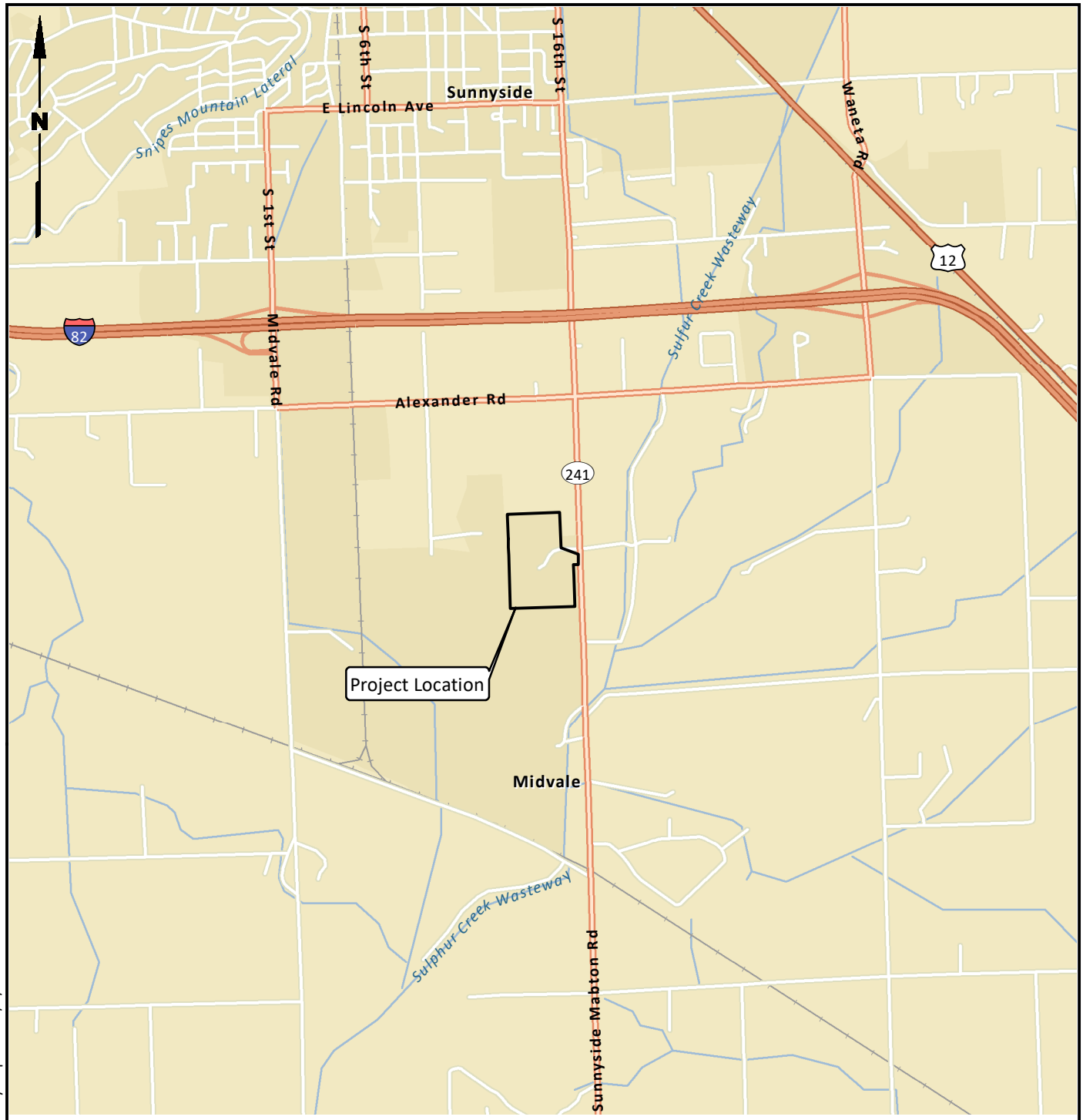

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Sunnyside RNG Facility Yakima County, Washington	**Vicinity Map**	Figure 1

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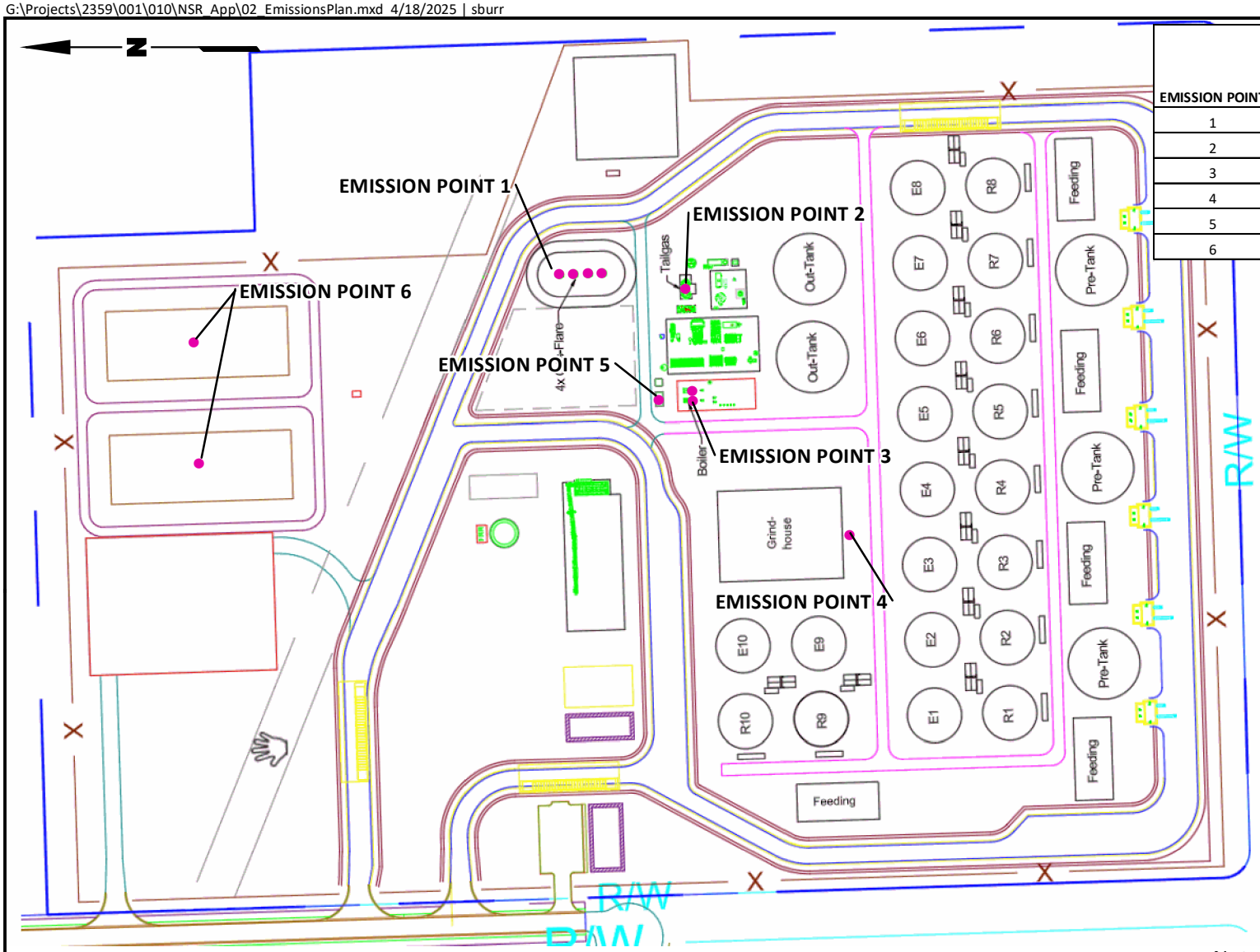

EMISSION POINT	DESCRIPTION	APPROXIMATE DISTANCE FROM PROPERTY BOUNDARY (FEET)
1	FLARES	112
2	TAIL GAS	277
3	BOILERS	427
4	GRINDER BAGHOUSE	505
5	GENERATOR	432
6	FIBER STORAGE FUGITIVES	65

Legend

- Emission Points

Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 225 450

Scale in Feet

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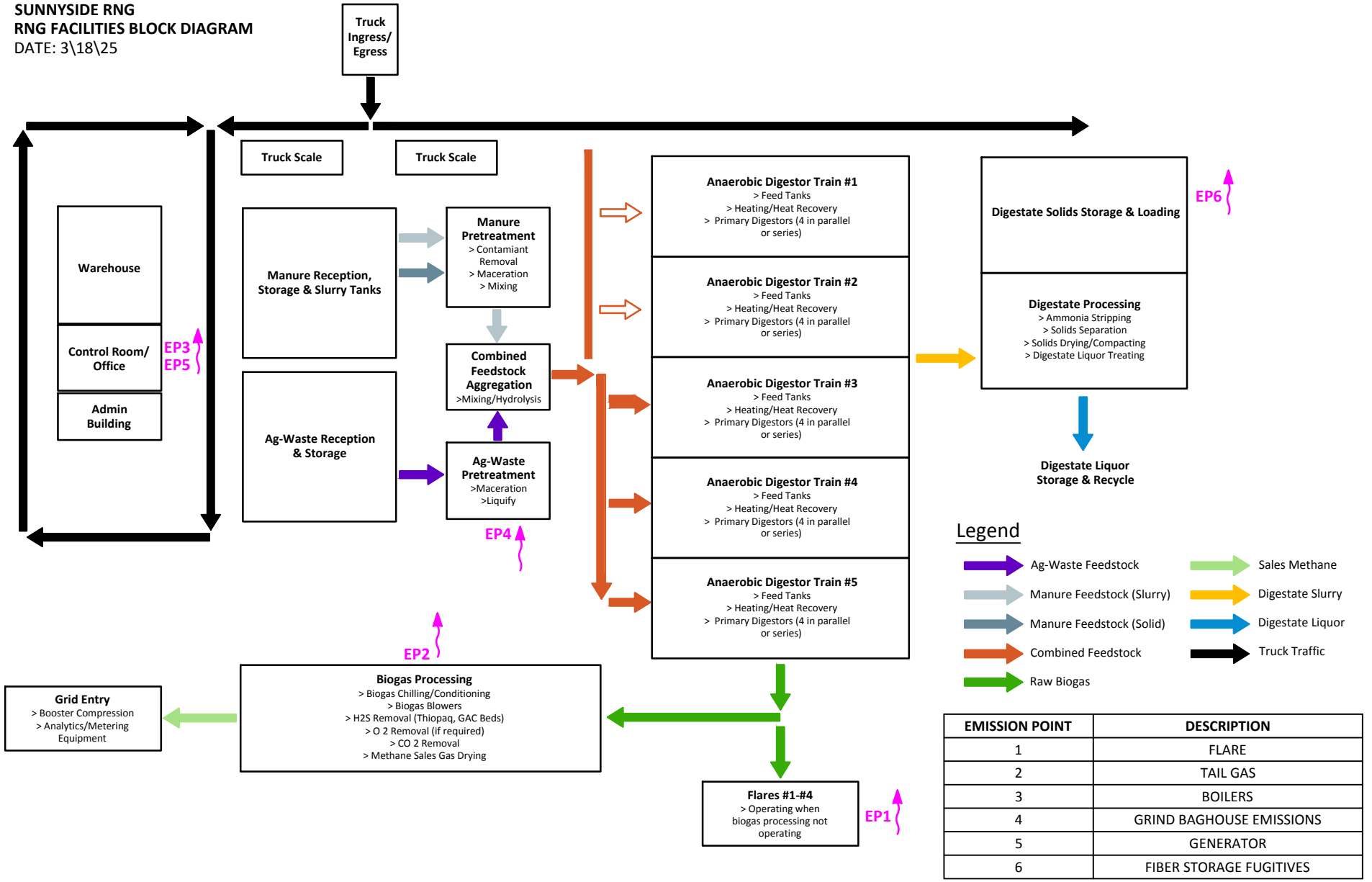
Sunnyside RNG Facility
Yakima County, Washington

Emissions Plan Overall Layout

Figure 2

SUNNYSIDE RNG
RNG FACILITIES BLOCK DIAGRAM
DATE: 3\18\25



EMISSION POINT	DESCRIPTION
1	FLARE
2	TAIL GAS
3	BOILERS
4	GRIND BAGHOUSE EMISSIONS
5	GENERATOR
6	FIBER STORAGE FUGITIVES

Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

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Sunnyside RNG Facility
Yakima County, Washington

Simplified Process Flow Diagram

Figure 3

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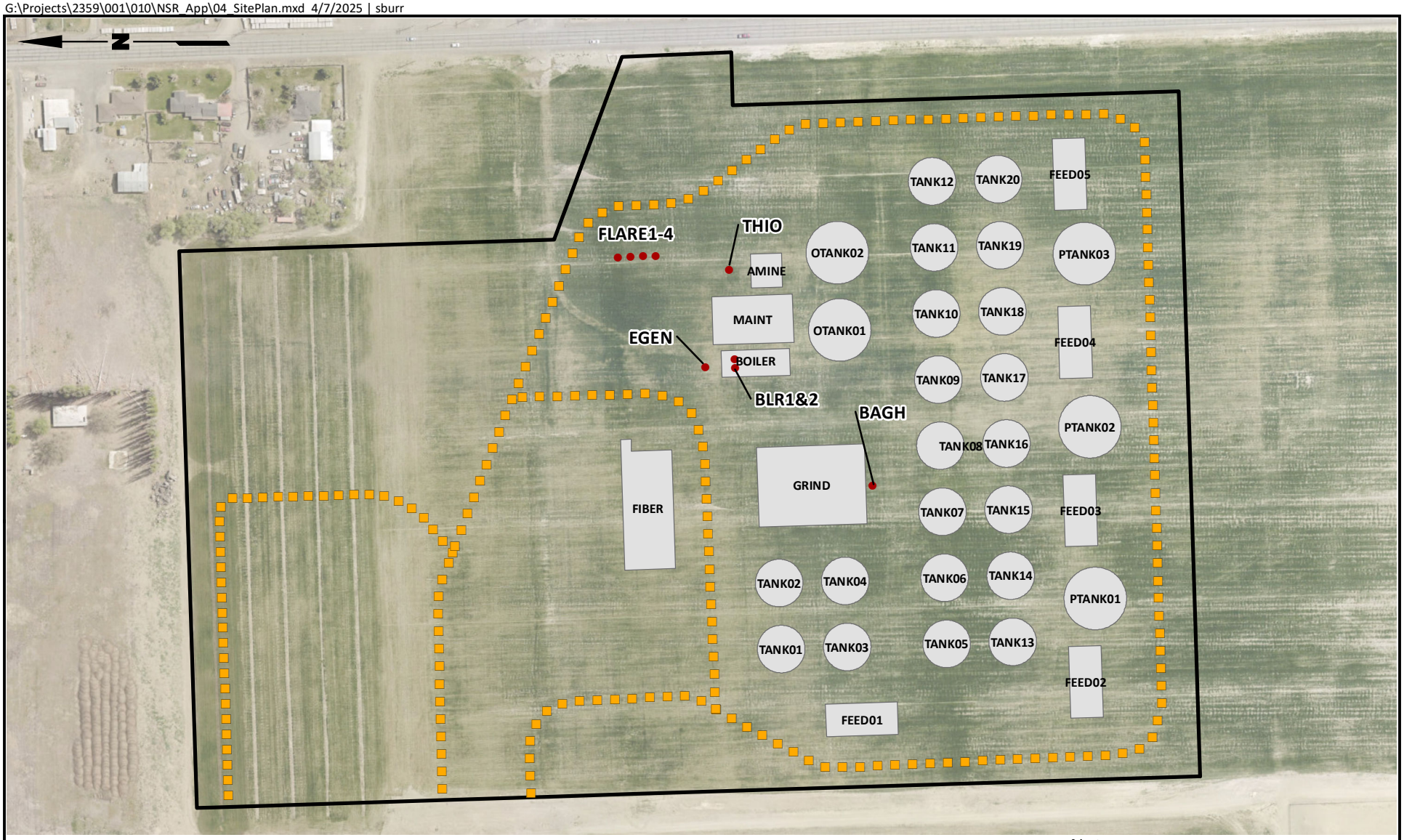

Legend

- Volume Source Locations
- Point Source Locations
- Buildings/Structures
- Property Boundary

0 225 450

Scale in Feet

Data Source: Esri World Imagery.

Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

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Sunnyside RNG Facility
Yakima County, Washington

Facility Site Plan

Figure 4

APPENDIX A

New Source Review Application Form

Yakima Regional Clean Air Agency
INSTRUCTIONS FOR PERMIT APPLICATION

Use this sheet as a checklist to determine when your application is substantially complete.

☞ Each PERMIT APPLICATION for the construction, installation or establishment of a new air contaminant source, or modification of existing air pollution source or control equipment or permit, needs to be accompanied by the following information to be considered complete:

Included	N/A	
☑	☐	Process flow sheets and equipment layout diagrams.
☑	☐	Control equipment manufacturer, model number, size, serial numbers (for each piece of control equipment).
☑	☐	Quantify average and maximum hourly throughput values, average yearly totals, and maximum concentrations for each pollutant.
☑	☐	Applicant's calculation of the kinds and amounts of emissions for each emission point, materials handling operation or fugitive category (both controlled and uncontrolled).
☑	☐	Plot plan including identification of proposed emission points to the atmosphere, distance to property boundaries, height of buildings and stack height above ground level.
☑	☐	Identification of raw materials and/or product specifications (physical and chemical properties) and typical ranges of operating conditions as related to each emission point (toxic air contaminants require a separate summary); Material Safety Data Sheets (MSDS) should be included in the PERMIT APPLICATION for all compounds used.
☑	☐	Identification of the methods/equipment proposed for prevention/control of emissions to the atmosphere.
☑	☐	Information sufficient to demonstrate the ability of the emission controls proposed as being consistent with those provided in the applicable regulations (BACT/NSPS/RACT/NESHAPS/LAER analysis). See attached worksheet for typical layout of BACT analysis information.
☐	☑	The kinds and amounts of emission offset credits proposed for assignment when operations are within a non-attainment boundary (see WAC 173-400-120 and 131).
☑	☐	Estimates of the proposed project ambient impact under average and least favorable conditions where pertinent to PSD (WAC 173-400-720) or Toxic Air Pollutants (WAC 173-460) requirements.
☑	☐	Additional information, evidence, or documentation as required by the Board of Directors, or the Control Officer, to show that the proposed project will meet federal, state and local air pollution control regulations.
☐	☑	For applications that include equipment that has previously been approved, authorized or registered, a lapse is considered to have occurred if the registration fees are delinquent for more than one calendar year or the source has not operated within five years prior to the receipt of any required PERMIT APPLICATION (WAC 173-400-110).
☐	☑	Applications that include previously approved or authorized equipment require that additional information regarding previous owners or approvals be provided so that YRCAA records can be updated. Equipment registered and/or approved for a given company cannot be authorized without a legal name change, purchase of company or equipment, or a legal contract or subcontract to do business with or for the approved source. Responsibility for operation of authorized equipment rests with the registered source.
☑	☐	All applications need to be accompanied with a completed SEPA checklist or SEPA determination. YRCAA may process the SEPA determination, if no other agency has done it. In this case a SEPA checklist with the proper fees must be submitted with the NSR application.

☞ The application transmittal shall conform to YRCAA review requirements wherever possible as detailed in the General Regulations for Air Pollution Sources (WAC 173-400).

☞ Each drawing, document, or other form of transmittal considered by the applicant to be proprietary and confidential must be suitably identified as confidential in red ink, and signed and dated by the applicant or its agent. Be aware that YRCAA follows the requirements in 40 CFR 2 for determination of confidentiality. YRCAA may not process company sensitive information as confidential.

☞ Orders of Approval (to construct, modify, or install) are issued for specific equipment or processes described in the application. Changes to the processes or control equipment are not allowed without new source review (Permit Application and Permit) if these changes result in an emission of a different type or an increase in emissions (WAC 173-400-110). Process equipment changes that result in decreased emissions require notification to YRCAA.

☞ The SIC code is identified as the four digit major group classification in the 1987 Standard Industrial Code Classification Manual listing of SIC codes can be obtained for free from the internet.

☞ Mail or deliver in person the completed application package to:

Yakima Regional Clean Air Agency
186 Iron Horse Court, Suite 101
Yakima, WA 98901-2303

☞ **Application fees must accompany application for the application to be considered complete. An invoice will be sent out for the Engineering review after final decision on the application. Make checks payable to "Yakima Regional Clean Air Agency" or "YRCAA".**

☞ **The PERMIT APPLICATION package submitted must be complete. All applications are screened for completeness before processing. Applicants submitting incomplete application packages will be notified of their incomplete status and may result in a delay in processing the application.**

Yakima Regional Clean Air Agency

PERMIT APPLICATION / NEW SOURCE REVIEW

BACT ANALYSIS WORKSHEET

Facility Name: Sunnyside RNG **Date:** April 24, 2025

CONTROL ALTERNATIVE	EMISSIONS [lbs/hr] & [tons/yr]	EMISSIONS REDUCTION (a) [tons/yr]	INSTALLED CAPITAL COST (b) [$]	TOTAL ANNUALIZED COST (c,g) [$]	AVERAGE COST EFFECTIVENESS OVER BASELINE (d) [$/ton]	INCREMENTAL COST EFFECTIVENESS (e) [$/ton]	ENERGY INCREASE OVER BASELINE (f) [mmBtu/yr]	TOXICS IMPACT [Yes/No]	ADVERSE ENVIRONMENTAL IMPACT [Yes/No]
1)									
2)									
3)									
4)									
5) Uncontrolled Baseline (worst case - no controls)									

(a) Emissions reduction over baseline control level.
(b) Installed capital cost relative to baseline.
(c) Total annualized cost (capital, direct, and indirect) of purchasing, installing, and operating the proposed control alternative. A capital recovery factor approach using a real interest rate (i.e., absent inflation) is used to express capital costs in present-day annual costs.
(d) Average cost effectiveness over baseline is equal to total annualized cost for the control option divided by the emissions reductions resulting from the uncontrolled baseline.
(e) The optional incremental cost effectiveness criterion is the same as the average cost effectiveness criteria except that the control alternative is considered relative to the next most stringent alternative rather than the baseline control alternative.
(f) Energy impacts are the difference in total project energy requirements with the control alternative uncontrolled baseline expressed in equivalent millions of Btus per year.
(g) Assumptions made on catalyst life may have a substantial affect upon cost effectiveness.

Notes:

The number of alternatives to be evaluated will vary depending on application.
Values for each variable should be provided as they are applicable. Use N/A if not applicable.
Emission rates are the expected or predicted emission rates.
Calculations should provide for a range of alternatives.
Emissions reduction should use estimated efficiency if actual efficiency is unknown - should so state.
Attach worksheets as necessary to substantiate above values.

YAKIMA REGIONAL CLEAN AIR AGENCY

186 Iron Horse Court, Suite 101. Yakima, WA. 98901
Phone: (509) 834-2050 Fax: (509) 834-2060
Website: http://www.yakimacleanair.org

Filing Fee: $400.00*

***Pursuant to WAC 173-400-111(1) (e)-an application is not complete until the permit application filling fee required by YRCAA has been paid.**

OFFICAL USE ONLY

YRCAA NSR No: _____ Date Fee Paid: _____

Received by: _____ Filing Fee: **$400.00**

☐ YRCAA is the lead agency for the SEPA process. Processing Fee $400.00

Review of the application will not begin, until the application filling fee is paid. A surcharge fee for the time required for preparing and processing the application for approval will be invoiced after the permit to operate is issued.

New Source Review (NSR) Application General

Stationary/Permanent Source

INSTALLATION OR ESTABLISHMENT OF NEW AIR CONTAMINANT SOURCES

NSR Application is Required for Construction, Installation or Establishment of an Air Pollution Source
Or
Replacement or Substantial Alteration of Emission Control Technology on an Air Pollution Source or Equipment

I. General Information:

BUSINESS NAME Sunnyside RNG, LLC

NATURE OF BUSINESS Renewable Natural Gas Production

MAILING ADDRESS 1000 S Hwy 395, Ste A #506, Hermiston, OR 97838

FACILITY ADDRESS (if different): Parcels No. 22090141404, 22090114007, and 22090113001

PHONE and FAX NUMBERS ( ) (541) 969 2913 Email: kipp.curtis@pacificag.com

TYPE OF PROCESS, EQUIPMENT, OR APPARATUS Natural Gas-Fired Boilers, Emergency Generator, Anaerobic Digesters, Biomass Grinder, RNG Upgrader, and Backup Enclosed Flares

LIST OF AIR CONTAMINANT(S) WHICH WILL BE PRODUCED AND/OR CONTROLLED Natural Gas Combustion Emissions, Diesel Combustion Emissions, Process Vent from RNG Upgrader, Particulate from Grinding, Emissions from Biogas flaring. All emissions will comply with BACT/tBACT.

ESTIMATED STARTING DATE: Begin construction in 2025

ESTIMATED COMPLETION DATE: 2027

Mitigated Determination of Non-Significance (MDNS) issued June 22, 2023.

Compliance with SEPA (State Environmental Policy Act) - Check One of the Options Below:

- ☒ A DNS or EIS has been Issued by Another Agency for this Project and a Copy is Attached.
- ☐ If no DNS or EIS Exists for this Project, a Completed Checklist for this Project and the SEPA Processing Fee are Attached. *YRCAA SEPA checklist is available by phone, or by our website.*
- ☐ The city/county has established an exemption for this project.
- ☐ I certify that the SEPA has been satisfied or this project is exempt:

June 22, 2023 *by* City of Sunnyside Washington, Planning and Community Development
Date *Government Agency*

Previous NSR/Air Permits Number issued by YRCAA for the Facility, if any N/A

Describe Input to Output Process (Attach drawings, schematics, prints, or block diagrams) Process Description and Simplified Process Flow diagram are enclosed with the NSR Application

ESTIMATED COSTS: OF BASIC SOURCE EQUIPMENT $ To be determined

OF CONTAMINANT CONTROL APPARATUS $ To be determined

Process: Production Output per Year (tons, pounds, etc) ~1,800,000 MMBtu methane/year

Maximum Output per Hour (tons, pounds, etc) ~205 MMBtu methane/hour

Percentage of Production (%)

Dec - Feb 25 Mar – May 25

Jun - Aug 25 Sep – Nov 25

Operating Schedule: Hrs/Day 24 Days/Wk 7 Wks/Yr 52

II. Emissions Estimations and Calculations:

1. Criteria Pollutants (gr/dscf, tons/yr, lbs/hr., ppm, etc.)

Particulate (PM_{10},$PM_{2.5}$) 3.4 lb/hr and 4.2 tons/yr PM10; 3.0 lb/hr and 2.8 tons/yr PM2.5

Volatile Organic Compounds 0.84 lb/hr and 0.85 tons/yr

Nitrogen Oxides 38.5 lb/hr and 7.5 tons/yr

Sulfur Oxides 60.5 lb/hr and 13.4 tons/yr

Carbon Monoxide 80.1 lb/hr and 24.4 tons/yr

Lead 0.10 lb/yr

2. Toxic Air Pollutants (Name) — Quantity (in gr/dscf, tons/yr, lbs/hr. ppm, etc.)

See Table 2 in NSR Application and Appendix B for full list of TAPs.

3. Fugitive Pollutants (Source) | Quantity (in gr/dscf, tons/yr, lbs/hr. ppm, etc.)

Paved and Unpaved Roadways | 1.8 tons/yr PM10 and 0.32 tons/yr PM2.5

4. Air Pollution Modeling

Results Less than all applicable SILs, NAAQS and ASILs

Computer Printout Attached? ☑Yes ☐No

III. Emission Data:

1. Stack

Height (Feet) 20 (Boilers) Inside Diameter (feet) 2 (Boilers)

Gas Exit Temp (degrees F) 346 (Boilers) Gas Exit Velocity (ft/min) 2,419 (Boilers)

Flow Rate (cfm) 7,598 (Boilers)

Shared Stack? If a shared stack, identify process (es) or point(s) which share the stack.

Distance from Stack to Property Line 425 feet

2. Discharge Point or points (if no stack or other than stack) **See Table 4 in NSR Application for all stacks**

Height (feet)_____ Inside Diameter (feet)_____

Gas Exit Temp (degrees F)_____ Gas Exit Velocity (ft/min)_____

Flow Rate (cfm) _____

Shared discharge point? If a shared discharge point, identify process (es) or point(s) which share the discharge point. _____

Distance from discharge point to Property Line _____

3. Fuel

Type Natural Gas % Sulfur 0.0015%

% Ash Negligible Unit of Measure (gal./cu.ft./etc.) scf/gal

BTU per Unit of Measure 1,020 / 139,000 Consumption Units per Year See Appendix B

Maximum Consumption Units per Hour See Appendix B

4. Building Dimensions **See Table 5 in NSR Application for all building dimensions**

Height (feet)_____ Length (feet)_____ Width (feet)_____

IV. Air Pollution Control Equipment:

Baghouse

Type Kice Model #, Serial # R132-10N (or equivalent)

Efficiency 99.9 $PM_{2.5}$: 99.9 and PM_{10}: 99.9

Bag Height (feet) 4.5 (estimate) Bag Diameter (feet) 0.83 (estimate)

Filter Area (feet squared) 1,555 (estimate) Blower Flow Rate (cfm) 11,000 (estimate)

Filter Media Felt Dimensions (feet) 20 exhaust stack

Discharge Area Dimensions (feet) 1.83 diameter

Cleaning Mechanism (shake) (air psi) Compressed Air (10-15 psig)

Other Data

Scrubber

Type Not applicable Model #, Serial #

Efficiency

Gas Differential Pressure (psi) Liquor Differential Pressure (psi)

Liquor Flow (gpm) Discharge Area Dimensions ($feet^2$)

Gas Flow (cfm) Other Data

Cyclone

Type Not applicable Model #, Serial #

Efficiency $PM_{2.5}$: and PM_{10}:

Gas Flow (cfm) Discharge Area Dimensions ($feet^2$)

Other Data

Precipitator

Type Not applicable Model #, Serial #

Efficiency

Gas Flow (cfm) Gas Velocity (ft/sec)

Residence Time Gas Differential Pressure (psi)

Precipitation Rate (ft/sec) Discharge Area Dimensions ($feet^2$)

Other Data

Ad/Absorp

Type Not applicable Model #, Serial #

Efficiency

Gas Flow Gas Velocity (ft/sec)

Gas Temp (degree F) Bed Volume (ft^3)

Bed Dimensions (feet) Capacity (hours)

Contaminant (lb/day) Regeneration time (hours)

Other Type _____ Model #, Serial #_____

Efficiency _____

Gas Flow (cfm)_____ Discharge Area Dimensions (feet)_____

Other Data _____

V. Additional Information:

1. Attach Related Information on Chemicals or Materials that will be emitted. (MSDS Sheets, Company Information, etc.)

   Note: Indicate how much quantity are used per MSDSs

   ■ Yes ☐ No, if not why? SDS attached in Appendix C

2. Fugitive Dust Control Plan (Attach if Necessary)
3. Attach Operation and Maintenance Manual of Pollution Control Equipment.

   ☐ Yes ■ No, if not, why? Control equipment not purchased yet
4. Attach Vendor Information or Manufacturer's Instructions on Pollution Control Equipment.

   ■ Yes ☐ No, if not, why? _____

APPLICANT: I hereby certify that the information contained in this application, including supplemental forms and data, when required, is, to the best of my knowledge, complete and correct. I also agree to all fees for processing this permit and grant permission for YRCAA staff to enter the premises for inspection.

Signature kipp curtis Digitally signed by kipp curtis Date: 2025.04.24 13:24:41 -07'00' Date 4/24/25

Title Vice President- Pacific Ag/Pacific Ag Renewables Date _____

Name and Title of Individual Filling out Form:

Name (print) Kipp Curtis

Signature kipp curtis Digitally signed by kipp curtis Date: 2025.04.24 13:27:12 -07'00'

Name and Title of Contact Person, if Different than Above:

Name _____

Title _____

Name and Title of the Responsible Official for the permit, if Different than Above:

Name _____

Title _____

Planning & Community Development
818 East Edison Avenue
Sunnyside, Washington 98944
(509) 837-7999 Office, (509) 836-6383 Fax

Mitigated Determination of Non-significance
RCW 197-11-350

1. **Description of Proposal:** Pacific Ag has proposed development of an approximately 50-acre digester within the Port of Sunnyside's (the "Port") Midvale Industrial Park in the Heavy Industrial (M- 2) zoning district.

2. **Property Owners:** Sunnyside RNG, LLC
   1000 S. Hwy 395, Suite A506
   Hermiston, OR 97838

3. **Location of Proposal:** Vicinity of 2711 and 334 Sunnyside Mabton Highway.
4. **Parcel Number(s):** 220901-13001, -44401, & -41404

5. **Lead Agency**: City of Sunnyside

6. **File Number:** 2023-0200

7. **Findings:**
   The SEPA Environmental Review Application was mailed to SEPA agencies on May 17, 2023; several comments were received and have been incorporated into the MDNS.
   A. The Department of Archaeology and Historic Preservation (DAHP) provided comments expressing concern and requesting conditions for an inadvertent discovery plan be established prior to the issuance of building permits.
      i. Staff Response – a condition for an Inadvertant Discovery Plan has been added as a condition to the MDNS.
   B. The Washington State Department of Ecology provided the following comments “Water Quality - Project with Potential to Discharge Off-Site
      If your project anticipates disturbing ground with the potential for stormwater discharge off-site, the NPDES Construction Stormwater General Permit is recommended. This permit requires that the SEPA checklist fully disclose anticipated activities including building, road construction and utility placements. Obtaining a permit may take 38-60 days.
      The permit requires that a Stormwater Pollution Prevention Plan (Erosion Sediment Control Plan) shall be prepared and implemented for all permitted construction sites. These control measures must be able to prevent soil from being carried into surface water and storm drains by stormwater runoff. Permit coverage and erosion control measures must be in place prior to any clearing, grading, or construction.

In the event that an unpermitted Stormwater discharge does occur off-site, it is a violation of Chapter 90.48 RCW, Water Pollution Control and is subject to enforcement action.
Solid Waste Management - This project involves a solid waste handling facility that is regulated under WAC 173-350. Please contact your local County Health Department to find out what requirements pertain to the project, and whether a solid waste permit is required. If you believe your facility meets the criteria for permit exemption from WAC 173-350, please fill out a notice of intent form and submit it to Ecology."

i. Staff Response - The proposed development shall work with the Washington State Department of Ecology and acquire all necessary permits for development prior to the issuance of an City of Sunnyside development permits being issued.

C. The Washington State Department of Transportation provided the following comments:
"The subject project is adjacent to State Route 241 (SR 241), a Class 2 managed access highway with a posted speed limit of 55 miles per hour. According to our records, the property has a permitted access at milepost (MP) 5.52, and three grandfathered approaches at MP 5.61, 5.71, and 5.75. As a condition of development approval, these approaches must be removed…
Any proposed lighting should be directed down towards the site, and away from SR 241.
All loads transported on WSDOT rights-of-way must be within the legal size and load limits or have a valid oversize and/or overweight permit.
It is the applicant's responsibility to keep and maintain SR 241 free of debris.

i. Staff Response - The proposed development shall maintain WSDOT right-of-way. Additionally, as part of the proposed project, the applicant, City of Sunnyside, and Port of Sunnyside will be working collaboratively to install, improve, and expand right-of-way for the proposed vehicle traffic this development will cause. A traffic report is on file with the City of Sunnyside and has been reviewed by WSDOT.

D. A letter was received from Jerry's Valley Meats generally opposing the proposed development and the proposed infrastructure development.

i. Staff Response - The proposed use is an outright approved use in the Heavy Industrial (M-2) zoning district. The applicant has indicated they are willing to cooperate with the City's conditions for development, and have filed all of the required permits. There is no reason or cause to deny this permit.

All comment letters have been added to the project file and can be viewed at Sunnyside City Hall at 818 E. Edison Ave.

8. **Determination:**
The Lead Agency for this proposal has determined that it will not have a probable significant adverse impact on the environment and an Environmental impact Statement (EIS) is not required under RCW 43.21C.030(2)(c), provided the measures listed below are taken to mitigate potential adverse impacts. This decision was made after careful review of the completed environmental checklist, and other information on file with the lead agency. This information (including all environmental documentation and a traffic study) is available to the public upon request and can be examined at our office during regular business hours. Environmental documents include: SEPA checklist, this preliminary threshold determination, and submitted materials.

9. **Identified Environmental Impacts and Mitigation Measures:**
Substantive authority to require mitigation for significant and non-significant impacts is derived from WAC 197-11-660City of Sunnyside Municipal code chapter 18.04-010 and, by reference, the policies contained in the City of Sunnyside Comprehensive Plan.

Archaeological Resources:
Based upon comments received from DAHP, there may be potential for cultural resources to be on site.

Mitigation Measure:
An Inadvertent Discovery Plan shall be created and submitted to the City of Sunnyside as part of the building permit package for the prosed development.

Stormwater:
Based on a variety of information, impacts to surface water by the development will most likely result unless stormwater is properly managed. Excavation, site development, road building and subsequent lot use, needs to be done in a manner that drainage facilities are not negatively impacted by site development and increased stormwater runoff.

Stormwater management is needed to minimize potential for negative effects of inadequately managed stormwater onto the public road system, and adjacent properties.

Mitigating Measures: a stormwater management plan is required to be submitted for review and approval by City of Sunnyside public works department prior to construction. The plan must meet the following design standards:

a) Stormwater retention or detention shall be provided. A professional engineer registered in the state of Washington shall design all drainage facilities and components. Drainage plans using best management practices and design requirements must be submitted to and approved by City of Sunnyside prior to grading or development.

b) Post development stormwater flow rates and volumes shall not exceed predevelopment conditions. The standard of full retention of the 25-year storm event generally meets the goal.
c) The depth to groundwater should be determined prior to planning the layout of stormwater facilities. If a stromwater infiltration facility will be used for the disposal of runoff, a permeability test should be conducted initially at the site to determine existing infiltration rates prior to the design stage.

Dust Control
Based on soil types in the area and the proposed disturbance to those soils combined with the typical winds in this area make for the possibility of large amounts of suspended particulate matter into the air.

Mitigation Measure:

Dust

a. A dust control plan must be filed with the Yakima Regional Clean Air Authority.

10. **Conclusion:**
The lead agency for this proposal has determined that it does not have a probable significant adverse impact on the environment. An environmental impact statement (EIS) is not required under RCW 43.21C.030(2)(c). This decision was made after review of a completed environmental checklist and other information on file with the lead agency. This information is available to the public on request.

11. **Appeal Period:** This MDNS is issued under WAC 197-11-340(2). The Lead Agency will not act on this proposal for 14 days from the date of issuance. Appeals may be submitted on this proposal to the address below.

12. **Contact:** For information on other issues relating to this proposal, contact Trevor Martin, at (509) 836-6393 or via email at tmartin@sunnyside-wa.gov.

13. **SEPA Responsible Official:** 

Trevor Martin, AICP

11. **Position Title**: Community and Economic Development Director
SEPA Responsible Official

12. **Address:** 818 E. Edison, Sunnyside, WA 98944

13. **Date:** June 22, 2023

APPENDIX B

Emission Calculations

Sunnyside RNG Project
Sunnyside, WA

Summary of Project Emissions

Pollutant	Units	Boilers	Upgrader & Thiopaq Scrubber	Emergency Generator	Flares	Grinder Baghouse	Roadway Fugitives	Digestate	Totals
NO_X	lb/hr	0.51	--	21.9	16.1	--	--	--	38.45
	tpy	2.2	--	1.7	3.52	--	--	--	7.49
CO	lb/hr	1.81	--	5.0	73	--	--	--	80.09
	tpy	7.9	--	0.40	16.1	--	--	--	24.4
PM_{10}	lb/hr	0.36	--	0.70	1.76	0.10	0.51	--	3.43
	tpy	1.6	--	0.056	0.386	0.44	1.77	--	4.24
$PM_{2.5}$	lb/hr	0.36	--	0.70	1.76	0.10	0.09	--	3.02
	tpy	1.6	--	0.056	0.386	0.44	0.32	--	2.78
SO_2	lb/hr	0.028	--	0.018	60	--	--	--	60.46
	tpy	0.125	--	0.0014	13.2	--	--	--	13.36
VOC	lb/hr	0.17	--	0.38	0.28	--	--	--	0.84
	tpy	0.76	--	0.031	0.062	--	--	--	0.85
CO_2e	tpy	24,748	81,780	136	9,236	--	--	--	115,900

Sunnyside RNG Project
Sunnyside, WA

Summary of Project Emissions

Toxic Air Pollutant Emissions

Pollutant	CAS	Averaging Period	Emissions (lb/ave. period)						De Minimis		SQER	
			Boilers	Upgrader & Thiopaq Scrubber	Emergency Generator	Flares	Digestate	Total	lb/period	< De Minimis	lb/period	> SQER
Nitrogen Dioxide	10102-44-0	1-hr	0.51	--	21.87	16.08	--	38	0.46	No	0.87	Yes
Carbon Monoxide	630-08-0	1-hr	1.81	--	4.99	73.29	--	80	1.1	No	43	Yes
Sulfur Dioxide	7446-09-05	1-hr	0.03	--	0.02	60.41	--	60	0.46	No	1.2	Yes
Diesel Particulate Matter	DPM	year	--	--	50.94	--	--	51	0.027	No	0.54	Yes
1,1,2,2-Tetrachloroethane	79-34-5	year	--	--	--	--	--	--	0.14	Yes	2.8	No
1,1,2-Trichloroethane	79-00-5	year	--	--	--	--	--	--	0.51	Yes	10	No
1,1-Dichloroethane	75-34-3	year	--	--	--	--	--	--	5.1	Yes	100	No
1,2-Dichloroethane	107-06-2	year	--	--	--	--	--	--	0.31	Yes	6.2	No
1,2-Dichloropropane	78-87-5	year	--	--	--	--	--	--	0.81	Yes	16	No
1,3-Butadiene	106-99-0	year	--	--	2.59	--	--	2.6	0.27	No	5.4	No
1,3-Dichloropropene	542-75-6	year	--	--	--	--	--	--	2	Yes	41	No
Acetaldehyde	75-07-0	year	1.28	--	9.34	0.31	--	11	3	No	60	No
Acrolein	107-02-8	24-hr	3.07E-03	--	2.53E-03	0.02	--	0.02	0.0013	No	0.026	No
Ammonia	7664-41-7	24-hr	--	--	--	--	33.54	33.5	1.9	No	37	No
Arsenic	7440-38-2	year	--	--	0.02	--	--	0.019	0.0025	No	0.049	No
Benzene	71-43-2	year	2.40	--	2.22	0.59	--	5	1	No	21	No
Benzo(b)flouranthene	205-99-2	year	--	--	--	--	--	--	0.045	Yes	0.89	No
Cadmium	7440-43-9	year	--	--	0.02	--	--	0.018	0.0019	No	0.039	No
Carbon Tetrachloride	56-23-5	year	--	--	--	--	--	--	1.4	Yes	27	No
Chlorobenzene	108-90-7	24-hr	--	--	1.49E-05	--	--	1.5E-05	3.7	Yes	74	No
Chloroethane	75-00-3	24-hr	--	--	--	--	--	--	110	Yes	2200	No
Chloroform	67-66-3	year	--	--	--	--	--	--	0.35	Yes	7.1	No
Chromium VI	18540-29-9	year	--	--	1.19E-03	--	--	1.2E-03	0.000033	No	0.00065	Yes
Chrysene	218-01-9	year	--	--	--	--	--	--	0.45	Yes	8.9	No
Copper	7440-50-8	1-hr	--	--	3.05E-04	--	--	3.1E-04	0.0093	Yes	0.19	No
Ethylbenzene	100-41-4	year	2.86	--	0.13	0.70	--	3.7	3.2	No	65	No
Ethylene Dibromide	106-93-4	year	--	--	--	--	--	--	0.014	Yes	0.27	No
Formaldehyde	50-00-0	year	5.10	--	20.58	1.25	--	27	1.4	No	27	No
Hexane	110-54-3	24-hr	0.01	--	2.00E-03	0.03	--	0.03	2.6	Yes	52	No
Hydrogen Chloride	7647-01-0	24-hr	--	--	0.01	--	--	0.014	0.033	Yes	0.67	No
Hydrogen Sulfide	7783-06-4	24-hr	--	3.10	--	15.42	--	18.52	0.0074	No	0.15	Yes
Lead	7439-92-1	year	--	--	0.10	--	--	0.10	10	Yes	14	No
Manganese	7439-96-5	24-hr	--	--	2.31E-04	--	--	2.3E-04	0.0011	Yes	0.022	No
Mercury	7439-97-6	24-hr	--	--	1.49E-04	--	--	1.5E-04	0.00011	No	0.0022	No
Methanol	67-56-1	24-hr	--	--	--	--	--	--	74	Yes	1500	No
Methylene Chloride	75-09-2	year	--	--	--	--	--	--	490	Yes	9800	No
Naphthalene	91-20-3	year	0.12	--	0.23	0.03	--	0.4	0.24	No	4.8	No
Nickel	7440-02-0	year	--	--	0.05	--	--	0.046	0.031	No	0.62	No
Phenol	108-95-2	24-hr	--	--	--	--	--	--	0.74	Yes	15	No
Propylene	115-07-1	24-hr	0.60	--	0.03	2.95	--	3.6	11	Yes	220	No
Selenium	7782-49-2	24-hr	--	--	1.64E-04	--	--	1.6E-04	0.074	Yes	1.5	No
Styrene	100-42-5	24-hr	--	--	--	--	--	--	3.2	Yes	65	No
Toluene	108-88-3	24-hr	0.03	--	0.01	0.15	--	0.19	19	Yes	370	No
Vinyl Chloride	75-01-4	year	--	--	--	--	--	--	0.92	Yes	18	No
Xylene	1330-20-7	24-hr	0.02	--	3.16E-03	0.11	--	0.135	0.82	Yes	16	No

Sunnyside RNG Project
Sunnyside, WA

Summary of Project Emissions

Hazardous Air Pollutant Emissions

Pollutant	CAS	Emissions (tpy)					
		Boilers	Thiopaq	EGEN	Flares	Digestate	Total
1,1,2,2-Tetrachloroethane	79-34-5	--	--	--	--	--	--
1,1,2-Trichloroethane	79-00-5	--	--	--	--	--	--
1,1-Dichloroethane	75-34-3	--	--	--	--	--	--
1,2-Dichloroethane	107-06-2	--	--	--	--	--	--
1,2-Dichloropropane	78-87-5	--	--	--	--	--	--
1,3-Butadiene	106-99-0	--	--	1.30E-03	--	--	1.30E-03
1,3-Dichloropropene	542-75-6	--	--	--	--	--	--
Acetaldehyde	75-07-0	6.42E-04	--	4.67E-03	1.57E-04	--	0.01
Acrolein	107-02-8	5.59E-04	--	2.02E-04	1.37E-04	--	8.99E-04
Arsenic	7440-38-2	--	--	9.54E-06	--	--	9.54E-06
Benz(a)anthracene	56-55-3	--	--	--	--	--	--
Benzene	71-43-2	1.20E-03	--	1.11E-03	2.94E-04	--	2.61E-03
Benzo(a)pyrene	50-32-8	--	--	--	--	--	--
Benzo(b)flouranthene	205-99-2	--	--	--	--	--	--
Benzo(k)fluoranthene	207-08-9	--	--	--	--	--	--
Cadmium	7440-43-9	--	--	8.94E-06	--	--	8.94E-06
Carbon Tetrachloride	56-23-5	--	--	--	--	--	--
Chlorobenzene	108-90-7	--	--	1.19E-06	--	--	1.19E-06
Chloroethane	75-00-3	--	--	--	--	--	--
Chloroform	67-66-3	--	--	--	--	--	--
Chromium VI	18540-29-9	--	--	5.96E-07	--	--	5.96E-07
Dibenz(a,h)anthracene	53-70-3	--	--	--	--	--	--
Ethylbenzene	100-41-4	1.43E-03	--	6.50E-05	3.50E-04	--	1.84E-03
Ethylene Dibromide	106-93-4	--	--	--	--	--	--
Formaldehyde	50-00-0	2.55E-03	--	0.01	6.24E-04	--	0.01
Hexane	110-54-3	9.53E-04	--	1.60E-04	2.34E-04	--	1.35E-03
Hydrogen Chloride	7647-01-0	--	--	1.11E-03	--	--	1.11E-03
Indeno(1,2,3-c,d)pyrene	193-39-5	--	--	--	--	--	--
Lead	7439-92-1	--	--	4.95E-05	--	--	4.95E-05
Manganese	7439-96-5	--	--	1.85E-05	--	--	1.85E-05
Mercury	7439-97-6	--	--	1.19E-05	--	--	1.19E-05
Methanol	67-56-1	--	--	--	--	--	--
Methylene Chloride	75-09-2	--	--	--	--	--	--
Naphthalene	91-20-3	6.22E-05	--	1.17E-04	1.52E-05	--	1.95E-04
Nickel	7440-02-0	--	--	2.32E-05	--	--	2.32E-05
Phenol	108-95-2	--	--	--	--	--	--
Selenium	7782-49-2	--	--	1.31E-05	--	--	1.31E-05
Styrene	100-42-5	--	--	--	--	--	--
Toluene	108-88-3	0.01	--	6.28E-04	1.35E-03	--	0.01
Vinyl Chloride	75-01-4	--	--	--	--	--	--
Xylene	1330-20-7	4.08E-03	--	2.53E-04	1.00E-03	--	0.01

0.04 Total HAP emissions (tpy)

Sunnyside RNG Project
Sunnyside, WA

Boiler Emission Calculations

Number of Boilers	2	boiler
Rated Boiler Size	600	hp
NG Heat Input per Boiler	24.13	MMBtu/hr
Annual Operating Hours	8,760	hrs/yr

		Emissions per Boiler		Total Emissions	
Criteria Air Pollutant	**Emission Factor [b] (lb/MMBtu)**	**Total Hourly Emissions (lb/hr)**	**Total Annual Emissions (tpy)**	**Total Hourly Emissions (lb/hr)**	**Total Annual Emissions (tpy)**
NOx [a]	0.011	0.25	1.1	0.51	2.2
CO [a]	0.038	0.90	4.0	1.81	7.9
SO2	0.0006	0.01	0.062	0.03	0.1
PM	0.0075	0.18	0.8	0.36	1.6
PM10	0.0075	0.18	0.8	0.36	1.6
PM2.5	0.0075	0.18	0.8	0.36	1.6
VOC	0.0036	0.09	0.4	0.17	0.8
CO2e [c]	117	2,825	12,374	5,650	24,748

Notes:

a - NOx and CO emissions from natural gas burners based on 9 ppmv and 50 ppmv, respectively.

b - Emission factors provided by Cleaver-Brooks.

c - GHG Emission factors from 40 CFR Part 98, Tables C-1 and C-2. CO_2e is calculated using the methodology in 40 CFR 98.2(b)(4) and Table A-1: CO_2e = S(GHG x GWP), where GHG is the mass emissions of each greenhouse gas and GWP is the global warming potential.

				Emissions per Boiler			Total Emissions		
Toxic Air Pollutant	**CAS**	**Emission Factor [a] (lb/MMBtu)**	**Emission Factor [a] (lb/MMscf)**	**Hourly Emissions [c] (lb/hr)**	**Daily Emissions [d] (lb/day)**	**Annual Emissions [e] (lb/yr)**	**Hourly Emissions [c] (lb/hr)**	**Daily Emissions [d] (lb/day)**	**Annual Emissions [e] (lb/yr)**
NO2 [b]	10102-44-0	0.011	--	2.53E-01	6.08E+00	2.22E+03	5.07E-01	1.22E+01	4.44E+03
SO_2 [b]	7446-09-05	5.9E-04	0.6	1.42E-02	3.41E-01	1.24E+02	2.84E-02	6.81E-01	2.49E+02
CO [b]	630-08-0	0.038	--	9.05E-01	2.17E+01	7.93E+03	1.81E+00	4.34E+01	1.59E+04
Benzene	71-43-2	5.7E-06	0.0058	1.37E-04	3.29E-03	1.20E+00	2.74E-04	6.58E-03	2.40E+00
Formaldehyde	50-00-0	1.2E-05	0.0123	2.91E-04	6.98E-03	2.55E+00	5.82E-04	1.40E-02	5.10E+00
Naphthalene	91-20-3	2.9E-07	0.0003	7.10E-06	1.70E-04	6.22E-02	1.42E-05	3.41E-04	1.24E-01
Acetaldehyde	75-07-0	3.0E-06	0.0031	7.33E-05	1.76E-03	6.42E-01	1.47E-04	3.52E-03	1.28E+00
Acrolein	107-02-8	2.6E-06	0.0027	6.39E-05	1.53E-03	5.59E-01	1.28E-04	3.07E-03	1.12E+00
Propylene	115-07-1	5.2E-04	0.5300	1.25E-02	3.01E-01	1.10E+02	2.51E-02	6.02E-01	2.20E+02
Toluene	108-88-3	2.6E-05	0.0265	6.27E-04	1.50E-02	5.49E+00	1.25E-03	3.01E-02	1.10E+01
Xylenes	1330-20-7	1.9E-05	0.0197	4.66E-04	1.12E-02	4.08E+00	9.32E-04	2.24E-02	8.16E+00
Ethylbenzene	100-41-4	6.8E-06	0.0069	1.63E-04	3.92E-03	1.43E+00	3.26E-04	7.83E-03	2.86E+00
Hexane	110-54-3	4.5E-06	0.0046	1.09E-04	2.61E-03	9.53E-01	2.18E-04	5.22E-03	1.91E+00

Notes:

a - Emission factors for toxic air pollutants from AB2588 Combustion Emission Factors, 10-100 MMBtu/hr (converted to lb/mmbtu using 1020 btu/scf) obtained from Ventura County Air Pollution Control District.

b - NOx, SO2, and CO emission factors from criteria pollutant calculations.

c - Hourly Emissions calculated using emission factors (lb/MMBtu) and heat input for the boiler.

d - Daily Emissions calculated using hourly emissions and 24 hours of operation per day.

e - Annual Emissions calculated using hourly emissions and 8,760 hours of operation per day.

Sunnyside RNG Project
Sunnyside, WA

Biogas Upgrader and THIOPAQ Bioscrubber

Process Flow	2662	scfm
Incoming Tail Gas	99.6	vol% CO2
Incoming Tail Gas	0.1	vol%CH4
Inlet Tail Gas H_2S	1381	mg/m³
Venting of H_2S	100	mg/m³
H_2S Emissions from GAC Bed	9.0	ppm
Annual Operating Hours	8,760	hrs/yr

Toxic Air Pollutant	CAS	Hourly Emissions [a] (lb/hr)	Daily Emissions [b] (lb/day)	Annual Emissions [b] (Tons/yr)
Hydrogen Sulfide [a]	7783-06-4	0.1291	3.10	0.566

Notes:

a - Hourly emissions calculated from maximum estimated concentration of vented H_2S.

b - Daily Emissions calculated using hourly emissions and 24 hours of operation per day; annual Emissions calculated using hourly emissions and 8,760 hours of operation per day.

Criteria Air Pollutant	Hourly Emissions [d] (lb/hr)	Annual Emissions [b] (tpy)
CO_2e [c]	18,671	81,780

Notes:

c - GHG Emission factors from 40 CFR Part 98, Tables C-1 and C-2. CO_2e is calculated using the methodology in 40 CFR 98.2(b)(4) and Table A-1: CO_2e = S(GHG x GWP), where GHG is the mass emissions of each greenhouse gas and GWP is the global warming potential. Also includes process CO2 passing through control system.

Sunnyside RNG Project
Sunnyside, WA

Enclosed Cellulosic Grinder with Process Cyclone and Dust Collector

Straw Processing	200	tons/day
Annual Operating Hours	365	days/yr

Criteria Air Pollutant	Emission Factor [a] (lb/ton)	Daily Average Hourly Emissions [b] (lb/hr)	Annual Emissions [b] (tpy)
PM	0.012	0.10	0.44
PM_{10}	0.012	0.10	0.44
$PM_{2.5}$	0.012	0.10	0.44

Notes:

a - Emission factors for shredding operation (controlled by baghouse) based on AP-42 Chapter 9.9.1 (Hammermill operations.) PM10 and PM2.5 conservatively set equal to PM emissions.

b - Hourly Emissions calculated using emission factors, hourly shredding throughput 200 tons/day; and annual emissions based on 365 days of operation per year.

Sunnyside RNG Project
Sunnyside, WA

Emergency Generator Kohler KD2000 Standby Tier 2 Engine
- ULSD Fuel

	Engine Specifications	
Testing Time	30 minutes/test	
Total Operating Hours	80 hour/year	
Gen. Set Output Rating	2,923 hp	(bhp, spec sheet)
Diesel Fuel Heat Content	139 MMBtu/Mgal	
Engine Information		
Exhaust Gas Volume Flow	17,586 cfm	
Maximum Fuel Use Rate	149.0 gal/hr	Source: Kohler KD2000.pdf
Exhaust Exit Diameter		
Exhaust Temperature	932 F	
Power Rating	2,180 ekW	

Pollutant Emissions

		Emission Factor				Emissions [g]		
CAS	**Compound**	**Testing g/kw-hr**	**lb/hp-hr**	**lb/mgal [c]**	**lb/mmBtu**	lb/hr	lb/day	lb/yr
10102-44-0	NOx [a]	--	--	--	--	2.19E+01	2.19E+01	3.50E+03
630-08-0	CO [a]	--	--	--	--	4.99E+00	4.99E+00	7.98E+02
PM	PM [a]	--	--	--	--	7.03E-01	7.03E-01	1.12E+02
PM10	PM10 [a]	--	--	--	--	7.03E-01	7.03E-01	1.12E+02
PM2.5	PM2.5 [a]	--	--	--	--	7.03E-01	7.03E-01	1.12E+02
7446-09-05	SO2 [b]	--	1.2E-05	--	--	1.77E-02	1.77E-02	2.84E+00
VOC	VOC [a]	--	--	--	--	3.84E-01	3.84E-01	6.15E+01
CO2	CO2 [e]	--	--	--	1.6E+02	1.69E+03	1.69E+03	2.70E+05
CH4	CH4 [e]	--	--	--	6.6E-03	6.85E-02	6.85E-02	1.10E+01
N2O	N2O [e]	--	--	--	1.3E-03	1.37E-02	1.37E-02	2.19E+00
CO2e	CO2e [f]	--	--	--	--	1.69E+03	1.69E+03	2.71E+05
106-99-0	1,3 Butadiene	--	--	0.2174	--	1.62E-02	1.62E-02	2.59E+00
75-07-0	Acetaldehyde	--	--	0.7833	--	5.84E-02	5.84E-02	9.34E+00
107-02-8	Acrolein	--	--	0.0339	--	2.53E-03	2.53E-03	4.04E-01
71-43-2	Benzene	--	--	0.1863	--	1.39E-02	1.39E-02	2.22E+00
108-90-7	Chlorobenzene	--	--	0.0002	--	1.49E-05	1.49E-05	2.38E-03
DPM	Diesel Engine Particulate [d]	--	--	--	--	3.18E-01	7.03E-01	5.09E+01
50-00-0	Formaldehyde	--	--	1.7261	--	1.29E-01	1.29E-01	2.06E+01
91-20-3	Naphthalene	--	--	0.0197	--	1.47E-03	1.47E-03	2.35E-01
115-07-1	Propylene	--	--	0.4670	--	3.48E-02	3.48E-02	5.57E+00
110-54-3	Hexane	--	--	0.0269	--	2.00E-03	2.00E-03	3.21E-01
108-88-3	Toluene	--	--	0.1054	--	7.85E-03	7.85E-03	1.26E+00
1330-20-7	Xylenes	--	--	0.0424	--	3.16E-03	3.16E-03	5.05E-01
100-41-4	Ethyl Benzene	--	--	0.0109	--	8.12E-04	8.12E-04	1.30E-01
7647-01-0	Hydrogen Chloride	--	--	0.1863	--	1.39E-02	1.39E-02	2.22E+00
7440-38-2	Arsenic	--	--	0.0016	--	1.19E-04	1.19E-04	1.91E-02
7440-43-9	Cadmium	--	--	0.0015	--	1.12E-04	1.12E-04	1.79E-02
18540-29-9	Chromium VI	--	--	0.0001	--	7.45E-06	7.45E-06	1.19E-03
7440-50-8	Copper	--	--	0.0041	--	3.05E-04	3.05E-04	4.89E-02
7439-92-1	Lead	--	--	0.0083	--	6.18E-04	6.18E-04	9.89E-02
7439-96-5	Manganese	--	--	0.0031	--	2.31E-04	2.31E-04	3.70E-02
7439-97-6	Mercury	--	--	0.0020	--	1.49E-04	1.49E-04	2.38E-02
7440-02-0	Nickel	--	--	0.0039	--	2.91E-04	2.91E-04	4.65E-02
7782-49-2	Selenium	--	--	0.0022	--	1.64E-04	1.64E-04	2.62E-02

notes:
a - NOx, CO, PM, and Hydrocarbon emission factors based on Tier 2 Not to Exceed Emission data from Kohler (maximum emissions across
b - Emission factors from AP-42 Section 3.4, Large Stationary Diesel and Duel-Fuel Engines (October 1996). Fuel sulfur content of ULSD is 0
c - Emission factors for toxic air pollutants from AB2588 Combustion Emission Factors for diesel internal combustion obtained
d - Diesel Engine Particulate emissions based on filterable PM only.
e - Greenhouse Gas emission factors from 40 CFR 98, Subpart C, Table C-1.
f - CO2e calculated based on global warming potential (GWP) for each Greenhouse gas: CO2 = 1; CH4 = 25; and N2O = 298 (40 CFR Part
g - Hourly emissions based on 2923 hp-hr/hr, fuel cosumption rate of 149.0 gal/hr, testing emission rate based on 30 minutes/test, one test per day, and annual emissions based on 80 hrs/yr.

Sunnyside RNG Project
Sunnyside, WA

Enclosed Flares

Flare Information		
Number of Flares	4	flares
Annual Operating Hours (upgrader downtime) [a]	438	hrs/yr
Flare Destruction Efficiency	98%	
Exhaust Flow (per Flare) [b]	97,145	Nm^3/hr
	57,177	scfm
Biogas Information		
Raw Biogas Heat Content	655	btu/scf
Raw Biogas H_2S Content	1,381	mg/m^3
	991	ppmv
Raw Biogas Carbon Content	34.60	vol% CO_2
	65.00	vol% CH_4
Hourly Peak Biogas Generation (Total)	10,225	Nm^3/hr
	6,015	scfm
Hourly Peak Biogas Generation (per Flare)	2,556	Nm^3/hr
	1,504	scfm
Hourly Heat Input (Total)	236	MMBtu/hr
Hourly Heat Input (per Flare)	59	MMBtu/hr/flare

Notes:

a - Assmues upgrder downtime of 5%.

b - Calculated based on the following equations:

$$\text{Exhaust Flow (per Flare)} = V \times (T + 273°K) \div 273°K$$
$$= 20833 \times (1000 + 273) \div 273$$
$$= 97{,}145\ Nm^3/hr$$

where:

$$\text{Exhaust Temperature (T)} = 1000\ °C$$
$$\text{Total Gas Volume per Flare (V)} = [\text{Peak Biogas Generation per Flare}] + [11\ m^3 \text{ of Combustion Air per } m^3 \text{ of } CH_4]$$
$$= 2556 + 11 \times 2556 \times 65\%$$
$$= 20{,}833\ Nm^3/hr$$

Sunnyside RNG Project
Sunnyside, WA

Enclosed Flares

Criteria Air Pollutant	Emission Factor [c]	Emissions per Flare		Total Emissions	
		Hourly Emissions [e]	Annual Emissions [e]	Hourly Emissions [e]	Annual Emissions [e]
	(lb/MMBtu)	(lb/hr)	(tpy)	(lb/hr)	(tpy)
NO_X [a]	0.0680	4.0	0.88	16.1	3.5
CO [a]	0.3100	18.3	4.0	73.3	16.1
SO_2 [b]	--	15.1	3.31	60.4	13.2
PM	0.0075	0.4	0.10	1.8	0.4
PM_{10}	0.0075	0.4	0.10	1.8	0.4
$PM_{2.5}$	0.0075	0.4	0.10	1.8	0.4
VOC [a]	0.0012	0.1	0.02	0.3	0.1
CO_2e [d]	117	10,544	2,309	42,174	9,236

Notes:

a - NOx, CO, and VOC emissions from AP-42 Section 13.5. VOC based on THC for enclosed ground flare (normal load).

b - Biogas combustion SO_2 emissions based on sulfur content and 100% conversion to SO_2.

c - Biogas combustion criteria pollutants based on natrual gas combustion from AP-42 Section 1.4, converted to lb/mmbtu using 1020 btu/scf.

d - GHG Emission factors from 40 CFR Part 98, Tables C-1 and C-2. CO_2e is calculated using the methodology in 40 CFR 98.2(b)(4) and Table A-1: CO_2e = S(GHG x GWP), where GHG is the mass emissions of each greenhouse gas and GWP is the global warming potential. Also includes process CO2 passing through control system.

e - Hourly Emissions calculated using emission factors (lb/MMBtu), 236.4 MMBtu/hr per flaring event; and annual emissions based on 438 hours of flaring per year.

Toxic Air Pollutant	CAS	Emission Factor [a]	Emission Factor [a]	Emissions per Flare			Total Emissions		
				Hourly Emissions [d]	Daily Emissions [e]	Annual Emissions [f]	Hourly Emissions [d]	Daily Emissions [e]	Annual Emissions [f]
NO_2 [b]	10102-44-0	0.068	--	4.02E+00	9.65E+01	1.76E+03	1.61E+01	3.86E+02	7.04E+03
SO_2 [b]	7446-09-05	--	--	1.51E+01	3.62E+02	6.61E+03	6.04E+01	1.45E+03	2.65E+04
CO [b]	630-08-0	0.310	--	1.83E+01	4.40E+02	8.03E+03	7.33E+01	1.76E+03	3.21E+04
Hydrogen Sulfide [c]	7783-06-4	--	--	1.61E-01	3.86E+00	7.04E+01	6.43E-01	1.54E+01	2.82E+02
Benzene	71-43-2	5.7E-06	5.80E-03	3.36E-04	8.07E-03	1.47E-01	1.34E-03	3.23E-02	5.89E-01
Formaldehyde	50-00-0	1.2E-05	1.23E-02	7.13E-04	1.71E-02	3.12E-01	2.85E-03	6.84E-02	1.25E+00
Naphthalene	91-20-3	2.9E-07	3.00E-04	1.74E-05	4.17E-04	7.61E-03	6.95E-05	1.67E-03	3.05E-02
Acetaldehyde	75-07-0	3.0E-06	3.10E-03	1.80E-04	4.31E-03	7.87E-02	7.19E-04	1.72E-02	3.15E-01
Acrolein	107-02-8	2.6E-06	2.70E-03	1.56E-04	3.76E-03	6.85E-02	6.26E-04	1.50E-02	2.74E-01
Propylene	115-07-1	5.2E-04	5.30E-01	3.07E-02	7.37E-01	1.35E+01	1.23E-01	2.95E+00	5.38E+01
Toluene	108-88-3	2.6E-05	2.65E-02	1.54E-03	3.69E-02	6.73E-01	6.14E-03	1.47E-01	2.69E+00
Xylenes	1330-20-7	1.9E-05	1.97E-02	1.14E-03	2.74E-02	5.00E-01	4.57E-03	1.10E-01	2.00E+00
Ethylbenzene	100-41-4	6.8E-06	6.90E-03	4.00E-04	9.60E-03	1.75E-01	1.60E-03	3.84E-02	7.01E-01
Hexane	110-54-3	4.5E-06	4.60E-03	2.67E-04	6.40E-03	1.17E-01	1.07E-03	2.56E-02	4.67E-01

Notes:

a - Emission factors for toxic air pollutants from AB2588 Combustion Emission Factors for external natural gas combustion, 10-100 MMBtu/hr (converted to lb/mmbtu using 1020 btu/scf) obtained from Ventura County Air Pollution Control District. Petroleum refinery flare VOC/HAP emission factors are not representative of combustion biogas.

b - NOx, SO2, and CO emission factors from criteria pollutant calculations.

c - H2S emissions based on 98% destruction of H2S in biogas.

d - Hourly Emissions calculated using emission factors (lb/MMBtu) and 236.4 MMBtu/hr.

e - Daily Emissions calculated using hourly emissions and 24 hours of operation per day.

f - Annual Emissions calculated using hourly emissions and 438 hours of flaring per year.

Sunnyside RNG Project
Sunnyside, WA

Fugitive dust from paved roadways.

							Veh. Wt.	Annual Emission Factors			Daily Controlled Emissions (70% Reduction)			Annual Controlled Emissions (70% Reduction)		
							W	E for PM	E for PM10	E for PM2.5	PM Emiss.	PM10 Emiss.	PM2.5 Emiss.	PM Emiss.	PM10 Emiss.	PM2.5 Emiss.
Source type	**Class**		**Trips/day**	**Trips/year**	**Miles/trip**	**VMT/year**	**(tons)**	**lbs/VMT**	**lbs/VMT**	**lbs/VMT**	**lb/day**	**lb/day**	**lb/day**	**tpy**	**tpy**	**tpy**
Feedstock Delivery Trucks	Paved	Loaded	125	35,750	0.40	14,452	52.75	1.59	0.32	0.08	24.11	4.82	1.18	3.45	0.69	0.17
	Paved	Empty	125	35,750	0.40	14,201	15	0.44	0.09	0.02	6.57	1.31	0.32	0.94	0.19	0.05
External Supplier Trucks	Paved	Loaded	2	520	0.16	85	40	1.20	0.24	0.06	0.12	0.02	0.01	0.02	0.00	0.00
	Paved	Empty	2	520	0.21	107	15	0.44	0.09	0.02	0.05	0.01	0.00	0.01	0.00	0.00
Fiber Export Truck	Paved	Loaded	19	4,940	0.21	1,015	52.75	1.59	0.32	0.08	1.86	0.37	0.09	0.24	0.05	0.01
	Paved	Empty	19	4,940	0.16	806	17.5	0.52	0.10	0.03	0.48	0.10	0.02	0.06	0.01	0.00
Straw Trucks	Paved	Loaded	11	2,860	0.16	467	52.75	1.59	0.32	0.08	0.86	0.17	0.04	0.11	0.02	0.01
	Paved	Empty	11	2,860	0.21	588	17.5	0.52	0.10	0.03	0.35	0.07	0.02	0.05	0.01	0.00
Sunnyside - Personal Vehicles	Paved	Loaded	17	5,356	0.02	119	2.5	0.07	0.014	0.003	0.01	0.00	0.00	0.00	0.00	0.00
	Paved	Empty	17	5,356	0.02	119	2.5	0.07	0.014	0.003	0.01	0.00	0.00	0.00	0.00	0.00
Truck Driver - Personal Vehicles	Unpaved	Loaded	17	5,148	0.13	655	2.5	10.05	4.06	0.41	6.52	2.63	0.26	0.99	0.40	0.04
	Unpaved	Empty	17	5,148	0.13	655	2.5	10.05	4.06	0.41	6.52	2.63	0.26	0.99	0.40	0.04
										Total Paved	**34.42**	**6.88**	**1.69**	**4.87**	**0.97**	**0.24**
										Total Unpaved	**13.04**	**5.27**	**0.53**	**1.97**	**0.80**	**0.08**
										Total	**47.46**	**12.15**	**2.22**	**6.85**	**1.77**	**0.32**

Paved Roads

The emission factors for vehicle traffic on paved roads at industrial sites were derived from AP-42, "Paved Roads", Section 13.2.1, January 2011.

Equation 2: E=k*(sL)^0.91*(W)^1.02*[1-P/(4*365)]

where:		PM	PM10	PM2.5	
k=	base emission factor (lb/VMT)	0.011	0.0022	0.00054	
sL=	road surface silt content (g/m2)	2.9	2.9	2.9	(upper range of corn mills, <500 ADT default at 0.6 g/m^2)
W=	average vehicle weight (tons)	---see values above---			
E=	Emission factor (lb/VMT)	---see values above---			

P= Number of Days with at least 0.01 inches of precipitation (57 days for Sunnyside, WA) - https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?wa8207

Unpaved Roads

The emission factors for vehicle traffic on unpaved roads at industrial sites were derived from AP-42, "Unpaved Roads", Section 13.2.2, November 2006.

Equation 1a: E=k*(s/12)^a*(W/3)^b*[(365-P)/365]

48% for pm10 conc from silt roads doc https://www.tandfonline.com/doi/full/10.1080/02786820903516844

where:		PM	PM10	PM2.5
k=	base emission factor (lb/VMT)	4.9	1.5	0.15
s=	surface material silt content (%) - mean cons	48	48	48
W=	average vehicle weight (tons)	---see values above---		
a=	empirical constant	0.7	0.9	0.9
b=	empirical constant	0.45	0.45	0.45
E=	Emission factor (lb/VMT)	---see values above---		

P= Number of Days with at least 0.01 inches of precipitation (57 days for Sunnyside, WA) - https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?wa8207

Sunnyside RNG Project
Sunnyside, WA

Ammonia emissions from Solid Digestate storage

Building Dimensions

Ammonia Emissions derived from Equation 9 from (a)
E=17.254* 1.060^TS*LD^0.274*TAN

						High average July	92.47
						Low average July	59.43
TS	Substrate Temperature	TS	33.59555556	C	conservatively hottest month	Average July temp	77.46
LD	Air Exchange Rate	LD	2		assumed, test value		
TAN	NH4-N Content	TAN	3.9	g/kg	Total Nitrogen	5	g/kg
					NH3 Content	1.1	g/kg
Ammonia	576.2	mg NH3/m2*h			NH4-N Content	3.9	g/kg
Surface Area	1,100.0	m2					
Total emissions	633,860.8	mg NH3/h					
Total emissions	633.9	g NH3/Hr					
Total emissions	1.4	lb/hr					

Toxic Air Pollutant	CAS	Hourly Emissions (lb/hr)	Daily Emissions [b] (lb/day)	Annual Emissions [c] (lb/yr)	Annual Emissions (tons/year)
Ammonia	7664-41-7	1.4E+00	3.4E+01	1.2E+04	6.1E+00

a. Calculated using formula from: Bell, M.W., etal. Ammonia emissions from an anaerobic digestion plant estimated using atmospheric measurements and dispersion modelling. Waste Management (2016), http://dx.doi.org/10.1016/j.wasman.2016.06.002
b - Daily Emissions calculated using hourly emissions and 24 hours of operation per day.
c - Annual Emissions calculated using hourly emissions and 8,760 hours of operation per day.

APPENDIX C

Equipment Specification Sheets

APPENDIX C

Ammonia Generation Sheet

Sunnyside RNG

222-024

Q: Do we have a Nitrogen / Ammonia Problem in the AD Process?

Answer: No we don't have an N-Issue here.

Justification:

Nitrogen has a negative effect on the Microbiome in an anaerobic digester mainly due to inhibiting the biochemic process of the bacteria if present in the NH4 form (Ammonia).

Limiting Level in a mesophilic AD process for NH4 is regarded to be: 3.000 ppm*L^{-1} NH4 (1)

How much Nitrogen do we expect in total?

Cow Slurry is indicated to contain an average of 45.9 kg/to TS (2)

The Client has in addition given the following Data:

- 14% TS
- 78% VS

Straw is indicated to contain an average of 6.0 kg/to TS (3)

The Client has in addition given the following Data:

- 90% TS
- 90% VS

WELTEC BIOPOWER has calculated the Nutrient content based on these findings as follows:

NPK

Nr.	Substrat	Menge [t/a]	Menge [t/d]	TS [%]	Benutzer Vorgabe - TS [%]	für Berechnungen verwendeter TS [%]	oDM / DM [%]	Input TS [t/Tag]	Input oTS [t/Tag]	N [kg/t] TS	TKN [t/a]	P2O5 [kg/t] TS	P2O5 [t/a]	K2O [kg/t] TS	K2O [t/a]
01	Rindergülle	105,000 t/a	287.67 t/d	14%		14.0 %	78%	40.27 t/d	31.41 t/d	45.882	674.5	20.000	294.0	57.647	847.4
02	Weizenstroh (gemahlen)	5,000 t/a	13.70 t/d	90%		90.0 %	90%	12.33 t/d	11.10 t/d	6.047	27.2	1.860	8.4	13.256	59.7
03															
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09															
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13															
14															
15															
16															
17	Wasser (klar)	12,500 t/a	34.25 t/d	0%		0.0 %	-	0.00 t/d	-	0.000	0.0	0.000	0.0	0.000	0.0
	Totals (ohne Rezirkulat)	122,500 t/a	335.62 t/d					52.60 t/d	42.51 t/d		702 t/a		302 t/a		907 t/a
	davon Flüssige Phase Separation (Rezirkulat)	-													
	Summe Ohne Rezirkulat	122,500 t/a													
	TKN	5 g/kg													

Figure 1: TKN calculation by WELTEC BIOPOWER

This calculation comes to the result, that we can expect a TOTAL Nitrogen content of 5g/kg or 5.000ppm

Now we must have a look in which chemical form Nitrogen is present.

The distribution between NH_3 and NH_4 (the most common forms) are determined by pH-Value and Temperature. (We ignore that some of the Nitrogen in the Digester is still bound on other organic molecules)

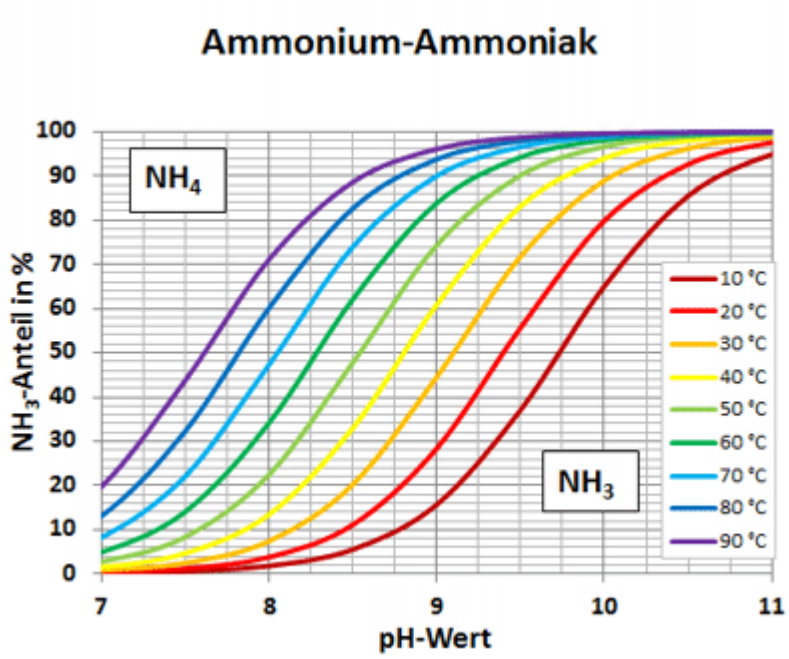


Figure 2: NH3 vs NH4 Balance pH/temp

For the AD process will be operating between 40°C and 50°C. This means we have to have a look at the area between the yellow and light green curve.

The digesters, under normal circumstances, operate in a pH-Value range between 7.2 and 8.

In conclusion we can assume that between 12% and 22% of the Total Nitrogen will be present as NH_3.

5.000 x 0.22 = 1.100 ppm of NH_3 can be anticipated in the substrate mix inside the digester.

This makes it reasonable to expect no inhibition of the biogas production by the present NH3.

The second factor we must look at is the possible inhibition resulting from undissociated NH_3.

The correlation between these is represented by the following equation:

$$c_{NH_3} = c_{NH_4} \cdot \frac{10^{pH}}{e^{\frac{6344}{273+T}} + 10^{pH}}$$

Equation 5.3: Calculation of ammonia concentration according to [5-30] (c_{NH_3} concentration of ammonia ($g \cdot l^{-1}$), c_{NH_4} concentration of ammonium ($g \cdot l^{-1}$), T temperature (°C))

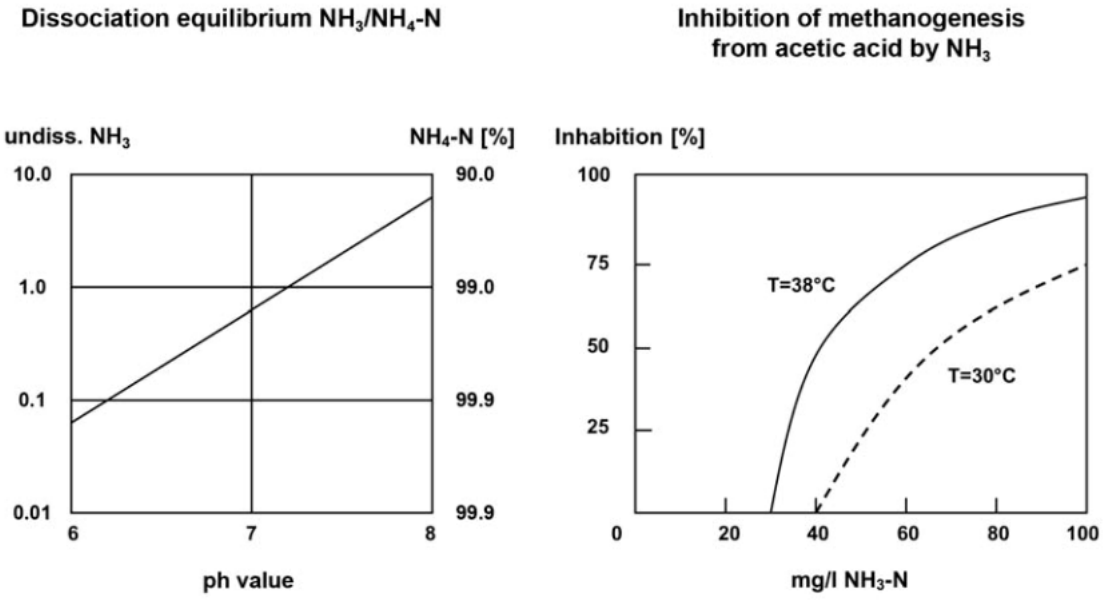


Figure 3:Inhibition of methanogenesis from acetic acid by NH3 (5)

As per this graph round about 2% of the NH_4 is indeed undissociated NH_3. In our case that's around 125ppm.

The Limiting Level for undiss. NH_3 is to be approx. 150ppm as per (4)[1]

Hence it is reasonable to also not expect an inhibition from the Level of undiss. NH_3.

[1] This experiment was conducted with anaerobic processing of sewage sludge, from domestic wastewater in mind. It is not clear how transferable the result really is towards biogas production in a CSTR Digester.

Literatur:

1. **McCarty, P.L.** *Anaerobic Waste Treatment Fundamentals.* 1964.

2. **Kuratorium für Technik und Bauwesen in der Landwirtschaft e.V.** *Substrate Analysis.* 2005.

3. **Bayrische Landesanstallt für Landwirtschaft.** 2008.

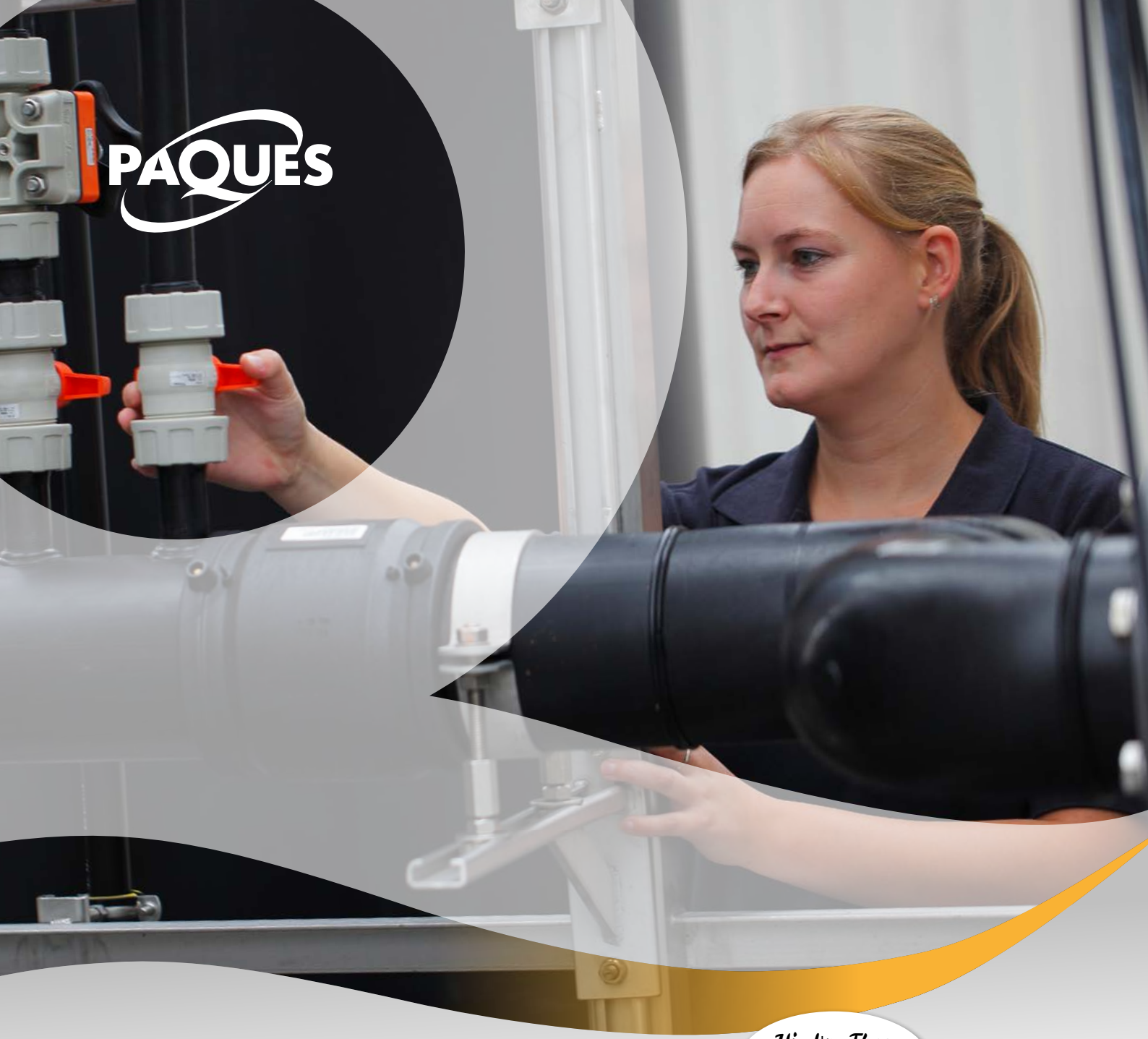
4. **McCarty, P.L. and McKinney.** Salt toxicity in anaerobic digestion. *Journal Water Pollution Control Federation, Washinton D.C.* 1961, Vol. 33, 399.

5. **Kroiss, H.** Anaerobe Abwasserreinigung. [Buchverf.] Technische Universität Wien. *Wiener Mitteilungen Bd. 62.* Wien : Technische Universität Wien, 1985.

APPENDIX C

Biogas Upgrading System Specifications and Safety Data Sheets

PAQUES



THIOPAQ®

Biogas desulfurization

Deep hydrogen sulfide removal from biogas at high uptime enables industries to meet stringent gas quality requirements.

revitalizing resources

Deep hydrogen sulfide removal

Biogas is an important renewable energy source. However, the gas originating from anaerobic digestion plants, anaerobic wastewater treatment plants and landfills often contains hydrogen sulfide (H_2S). Removal of H_2S is required for reasons of health, safety, environment and corrosion of equipment such as gas engines, boilers and piping.

The THIOPAQ® was developed by Paques in cooperation with universities, research institutes and customers. Fundamental and applied research into biological, physical and mechanical aspects of the system resulted in a cost-effective and reliable system.

Through continuous development Paques is able to provide every customer with a tailor-made gas treatment solution that enables the customer to transport biogas with reduced safety, environmental, and corrosion risks, and to fuel local gas-fired microgrids, or upgrade the gas to biomethane. Additionally, the elemental sulfur produced by the THIOPAQ® can be used as a high-quality fertilizer.

About THIOPAQ®

- Proven technology
  > 30 years operational experience
- > 300 THIOPAQ® references worldwide
- Continuous innovation
- In-house manufacturing and quality control
- Deep H_2S removal
- High uptime and reliable process
- Low total costs of ownership
- No air input in biogas
- Production of high-quality fertilizer

THIOPAQ®

Operation principle

The 'caustic' solution in the THIOPAQ® scrubber is continuously biologically regenerated. In the scrubber, the gas containing H_2S is brought into contact with the wash solution in counter-current. Absorption of H_2S under slightly alkaline conditions (pH 8-9) enables a chemical reaction with hydroxide ions:

$$H_2S_{gas} + OH^- \rightarrow HS^-_{liquid} + H_2O$$

In the bioreactor the sulfide is oxidised into elemental sulfur by autotrophic colorless sulfidogenic bacteria:

$$HS^-_{liquid} + \tfrac{1}{2}\, O_2 \rightarrow S^o + OH^-$$

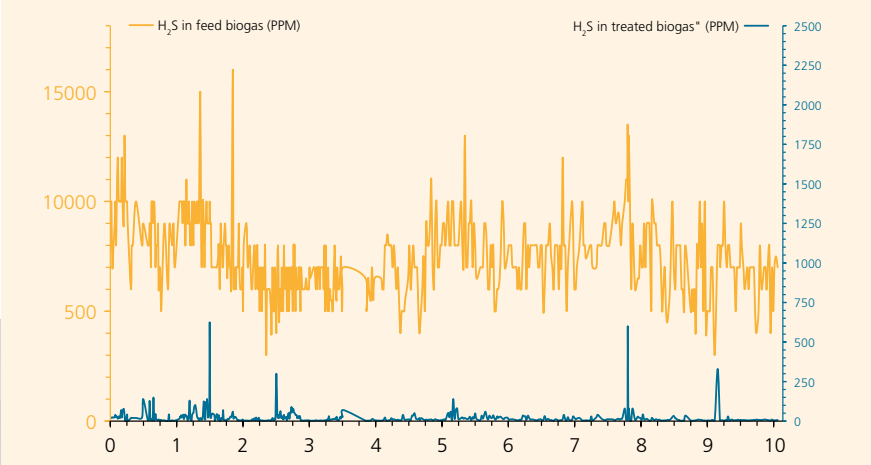
The hydroxide used in the scrubber is regenerated in the bioreactor. Since the wash solution entering the scrubber at the top is sulfide-free, a high concentration difference between the liquid and gas phase makes it possible to obtain a very high H_2S removal efficiency: exceeding 99.5%. Both the small bleed stream (consisting of sodium salts) and the produced sulfur are free of sulfide, so discharge is not a problem.

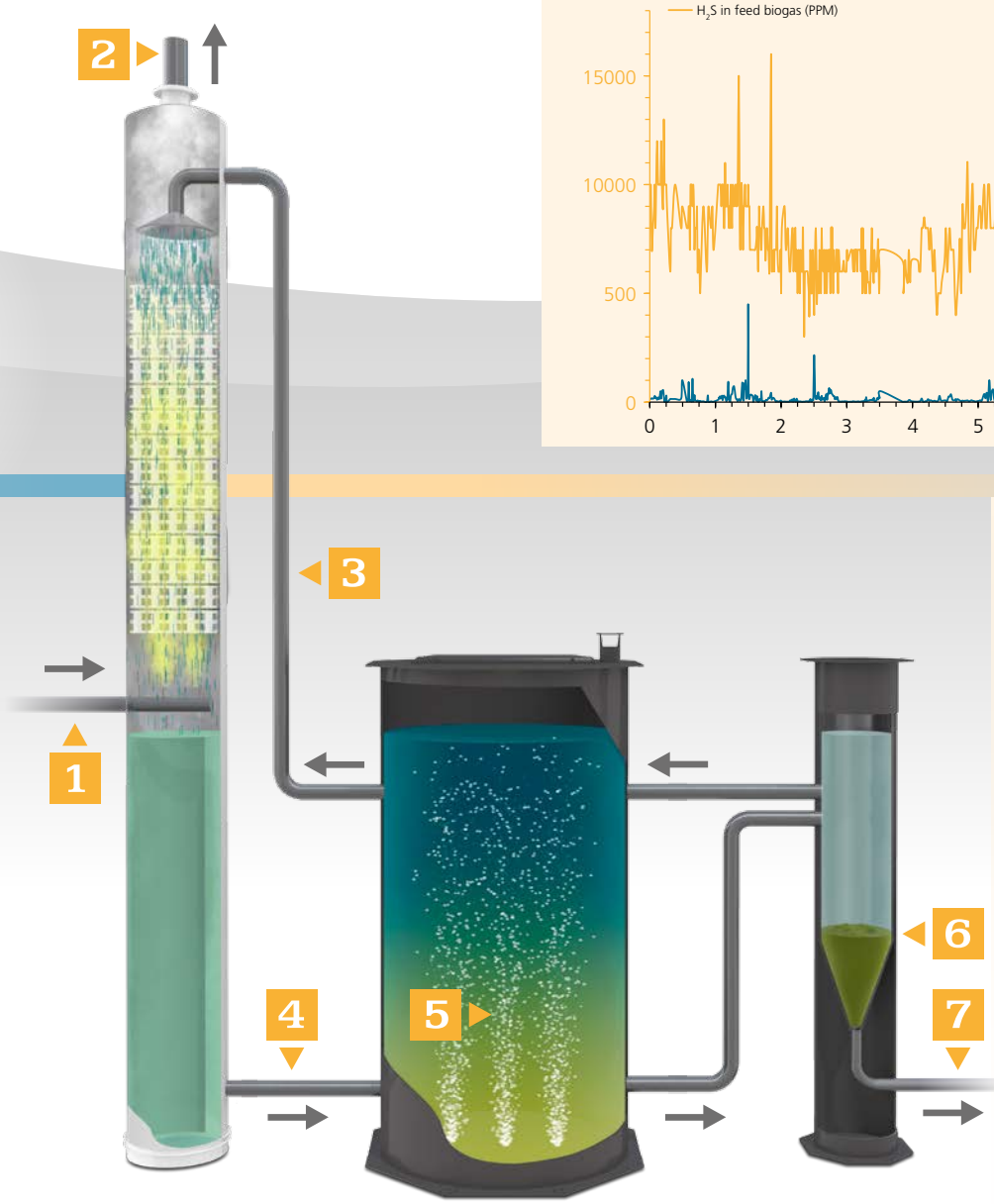
Application

The THIOPAQ® scrubber can be applied to a wide range of biogas streams containing H_2S and can be combined with all biological anaerobic systems. After treatment in the THIOPAQ® scrubber, the biogas can be used in a gas engine or boiler or can be transported and used to fuel a local gas-fired microgrid. Upgrading to biomethane, which can be brought into the gas distribution network or used as fuel for vehicles is another possibility.

- Gas flows from 50 to 2,500 Nm³/h
- Sulfur load up to 600 kg S/day
- Custom-made design for higher gas flows. References for > 10,000 Nm³/h and sulfur loads > 5 tons S/day

THIOPAQ®: influent independent, stable performance





THIOPAQ®: how it works

1. H_2S-rich gas in
2. Purified gas out
3. Alkaline wash solution, (absorbs H_2S from the gas)
4. Sulfide-rich solution from scrubber into bioreactor
5. Air for sulfur oxidation reaction (sulfide to elemental sulfur)
6. Sulfur separated
7. Elemental sulfur

Paques: leading in biological wastewater and gas treatment

For more than 40 years, Paques has been the world's leading company in the field of development and construction of cost-effective purification systems for water, wastewater and gases, based on innovative biotechnology. With over 3,000 reference installations worldwide, Paques has helped companies and municipalities succeed at to one of the major challenges of today: to reduce their water and carbon footprints and reclaim valuable resources.

The biogas produced by wastewater treatment plants can be used as green energy in boilers or gas engines. Beyond our headquarters in The Netherlands, Paques has subsidiaries and/or production locations in Russia, China, Brazil, Argentina, Colombia, India, Malaysia, Thailand, Vietnam, the United States and Canada. In many other countries, Paques is represented by licensed partners. This ensures our local presence and the best service for our clients worldwide.

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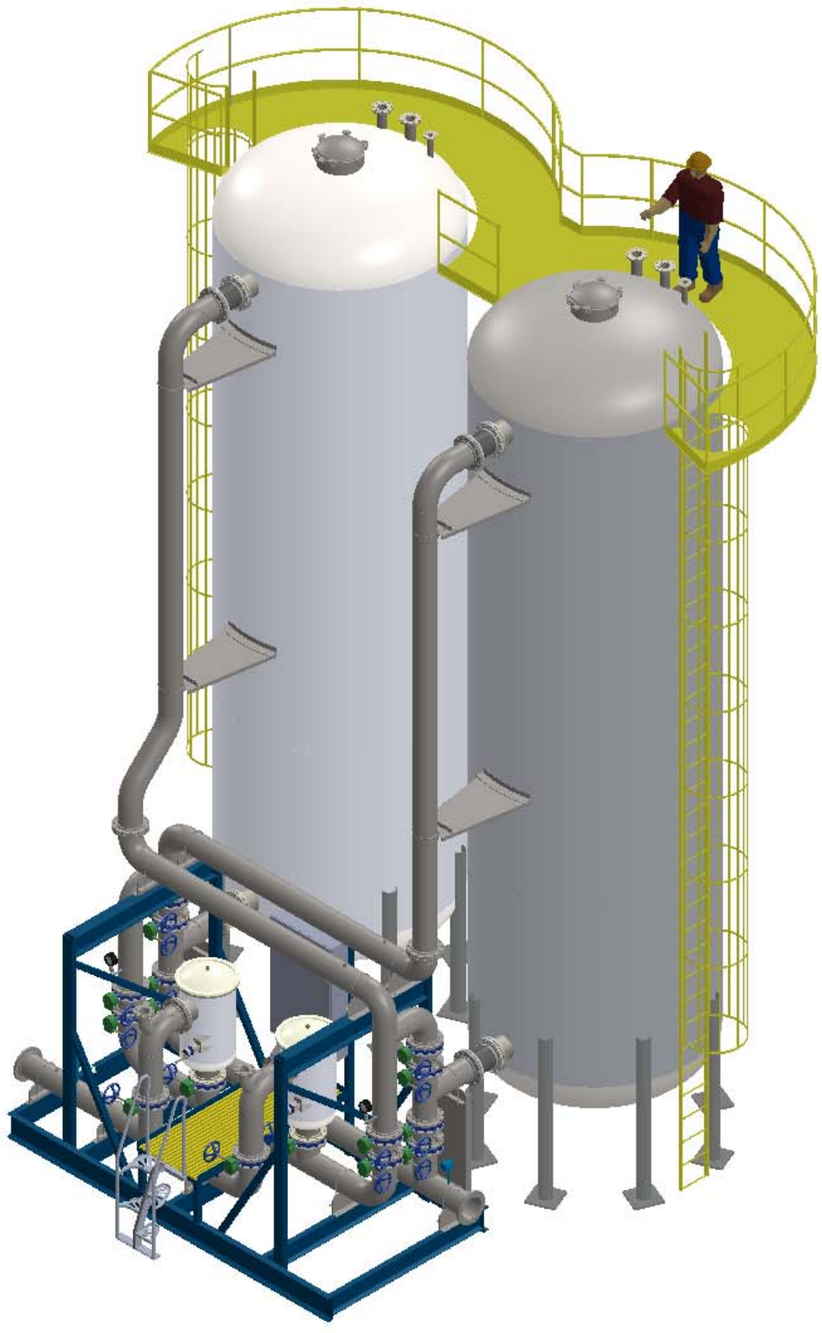
www.paquesglobal.com



GREENETEC - WA

H2S Treatment System General Arrangement

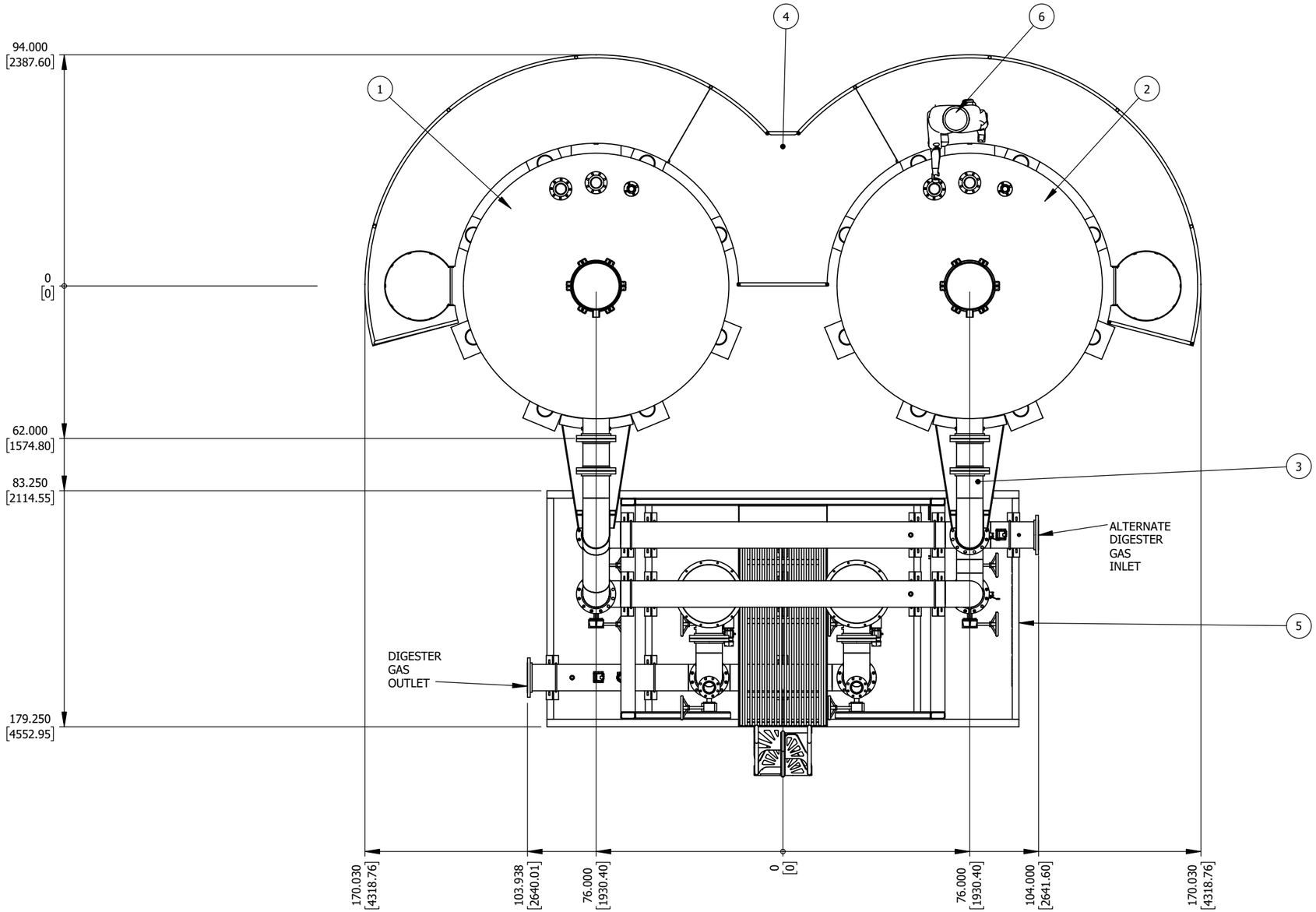
CLIENT:

DESIGN OFFICE:

BIOSPARK CLEAN ENERGY LLC
PO BOX 428
BYFIELD, MA 01922
www.biosparkusa.com

REVISION

CLIENT CONTRACT No.:	DRAWING No.:	SHEET
BIO201113	BIO201113 G100 04	1 / 5



DESIGN OFFICE

BIOSPARK CLEAN ENERGY LLC
PO BOX 428
BYFIELD, MA 01922
www.biosparkusa.com

H2S Treatment System General Arrangement

REVISION	DATE	NAME	CHANGES	REVISION

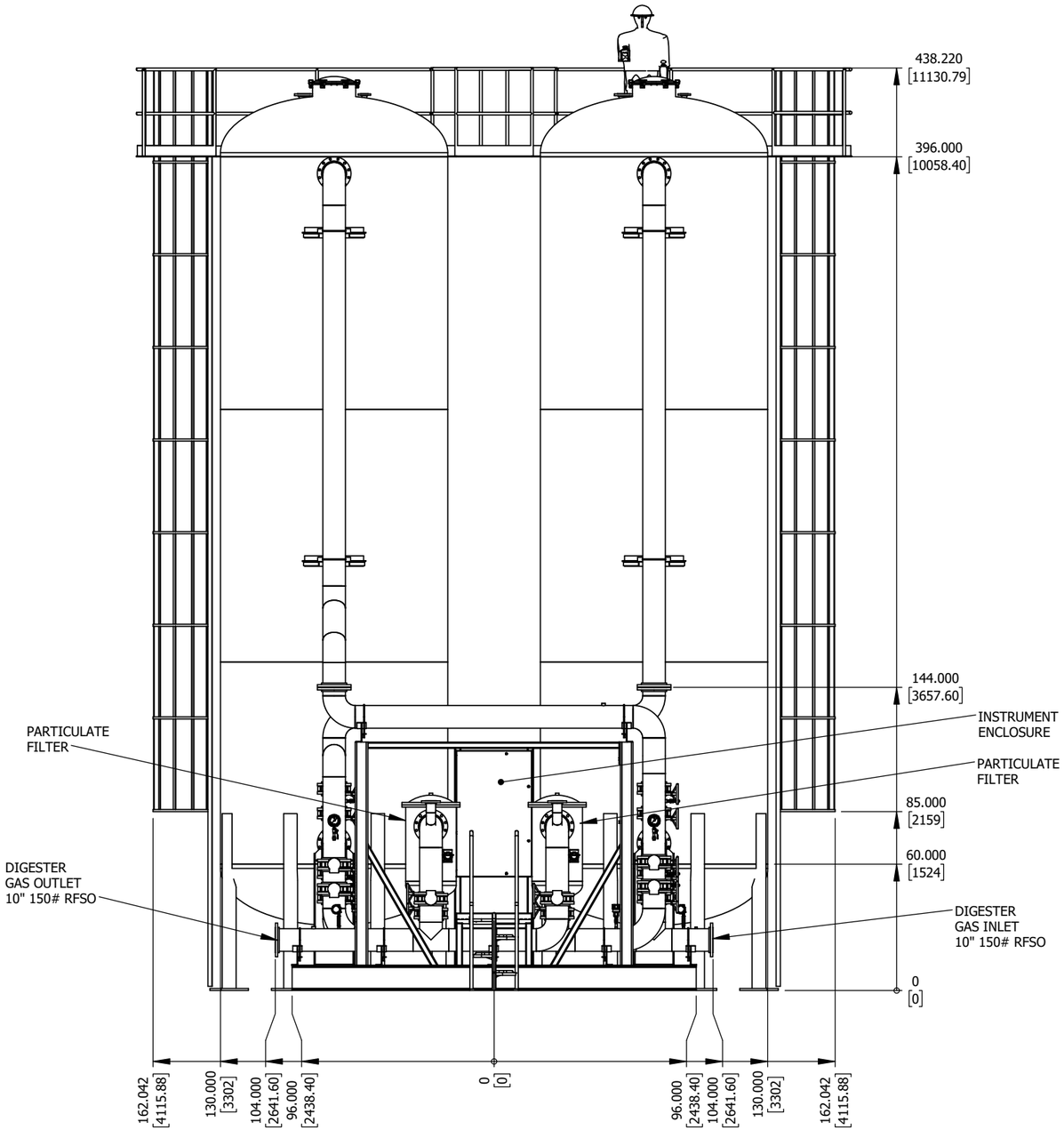
SCALE: 1:48

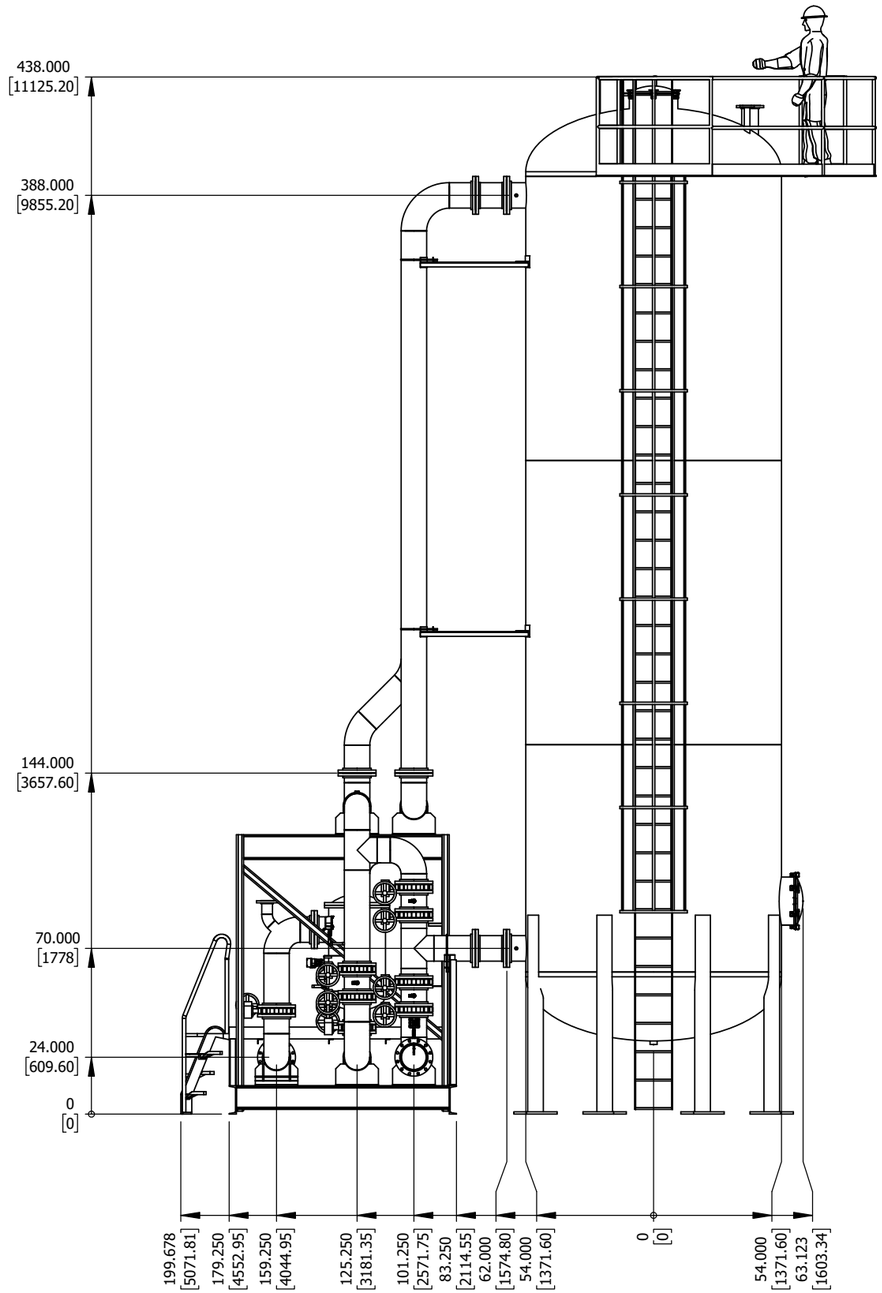
PROJECTION:

CONTRACT No.: BIO201113

DRAWING No.: BIO201113 G100 04

SHEET: 3 / 5





DESIGN OFFICE

BIOSPARK CLEAN ENERGY LLC
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BYFIELD, MA 01922
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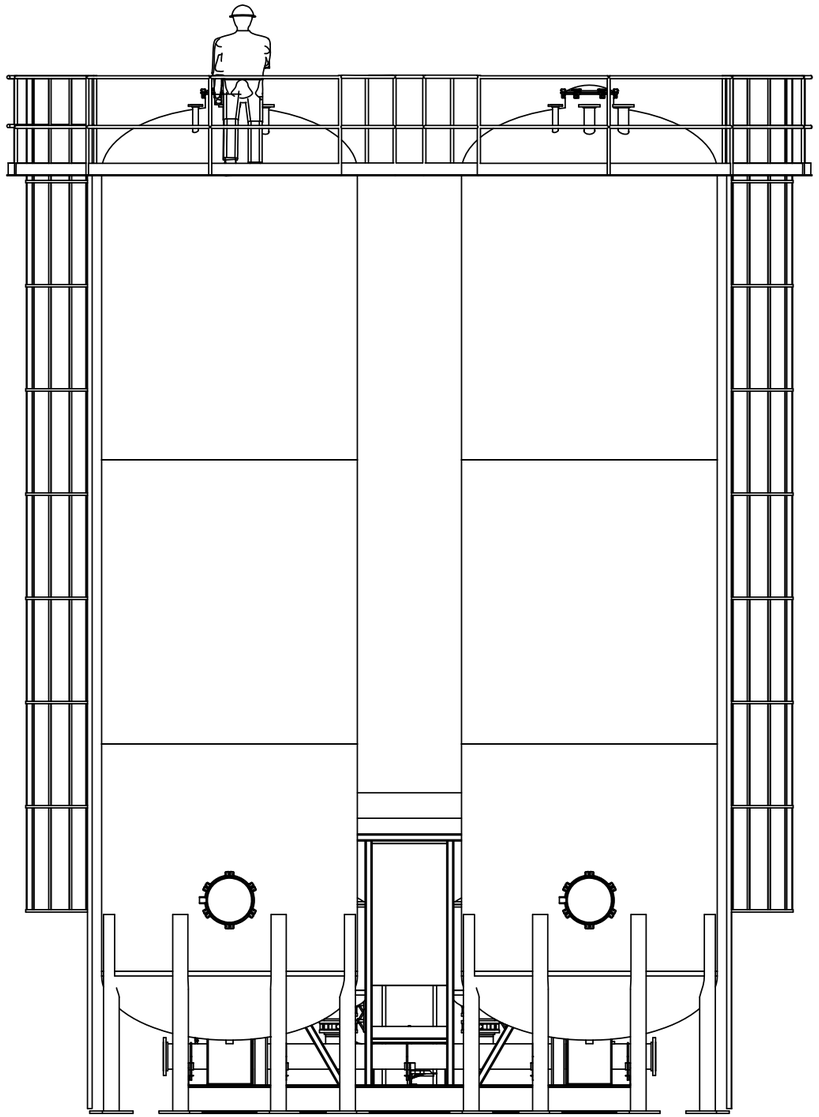
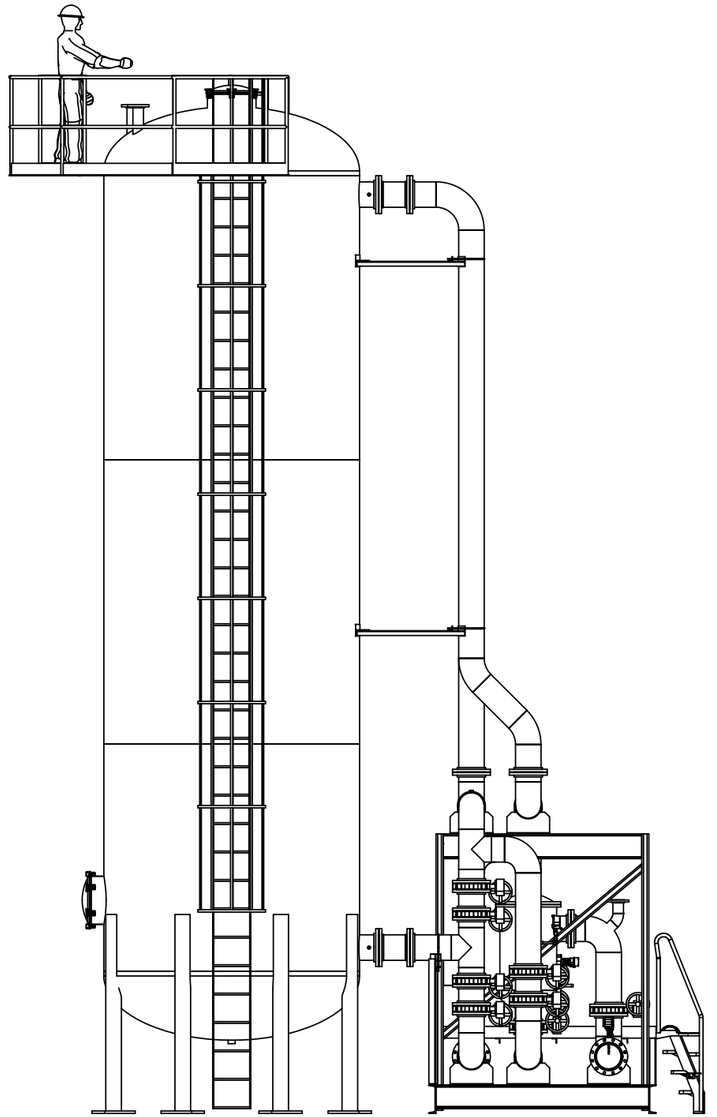
H2S Treatment System General Arrangement

REVISION	DATE	NAME	CHANGES	REVISION

SCALE:	PROJECTION:	CONTRACT No.:	DRAWING No.	SHEET
1:64		BIO201113	BIO201113 G100 04	4 / 5





DESIGN OFFICE

BIOSPARK CLEAN ENERGY LLC
PO BOX 428
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H2S Treatment System General Arrangement

REVISION	DATE	NAME	CHANGES	REVISION

SCALE: 1:64

PROJECTION:

CONTRACT No.: BIO201113

DRAWING No.: BIO201113 G100 04

SHEET: 5 / 5

Safety Data Sheet (SDS)		
Paques bv		
	Date: 09.10.2008	Revision: 04.03.2016
Name: Sulphur cake		

1. IDENTIFICATION OF THE MIXTURE AND OF THE COMPANY

1.1. IDENTIFICATION OF THE MIXTURE

Name	: Thiopaq Sulphur cake
Chemical name	: Biologically produced elemental Sulphur originating from biogas or natural gas.
REACH	: This product is a mixture and exempted from registration according to REACH Regulation (EC) No 1907/2006

1.2. USAGE

Application	: Raw material for production of fertilizer.

1.3. COMPANY

Name	: Paques bv
Address	: T. de Boerstraat 24 P.O. Box 52 8560 AB BALK (The Netherlands)
Telephone	: +31 (0) 514 608 500
Facsimile	: +31 (0) 514 603 342
E-mail	: services@paques.nl

Telephone in case of emergency: +31 (0) 620 705 748

---

2. HAZARDS IDENTIFICATION

2.1.1. Classification of the substance or mixture according to Regulation (EC) No 1272/2008

Classification: Skin Irrit. 2

2.1.2. Label elements of the substance or mixture according to Regulation (EC) No 1272/2008

Hazard pictogram(s):

Signal word(s): Warning

Hazard statement(s): H315 Causes skin irritation

Precautionary statement(s):
P264 Wash thoroughly after handling
P280 Wear protective gloves/protective clothing/eye
P302+P352 IF ON SKIN: Wash with plenty of soap and water
P321 Specific treatment (see … on this label)
P332+P313 If skin irritation occurs: Get medical advice/attention
P362 Take off contaminated clothing and wash before reuse

2.2 OTHER HAZARDS

The biomass in the substance can produce traces of hydrogen sulfide in the headspace. The substance does not meet the criteria for PBT or vPvB in accordance with Annex XIII of REACH.

3. COMPOSITION / INFORMATION ON INGREDIENTS

Cake from dewatered Sulphur slurry, natural excreted products and (micro) nutrient salts with process water. Cake contains 35 % water and approximately 65 % solids (biologically formed elemental sulphur particles). The cake can release traces of hydrogen sulphide in the headspace under anoxic conditions.

3.1. SUBSTANCES

Not applicable.

3.2. MIXTURES

Aqueous mixture with dangerous components listed below:

Component name	Conc.	CAS no.	EC no.	REACH no.	Classification
Sulphur	65%	7704-34-9	231-722-6	01-2119487295-27-xxxx	*Regulation (EC) No 1272/2008* Skin Irrit. 2; H315
Sodium Hydrogen Sulphide	< 0.01%	16721-80-5	240-778-0	Not available	*Regulation (EC) No 1272/2008* Acute Tox. 3; H301 Skin corr. 1B; H314 Met. Corr. 1; H290 Eye Dam. 1; H318 Aquatic Acute 1; H400

3.3 ADDITIONAL INFORMATION

All percentages given by weight unless stated otherwise.
Full text of H-phrases: see section 16

4. FIRST AID MEASURES

4.1. DESCRIPTION OF FIRST AID MEASURES

General information: In all cases, consult a doctor.
Never give anything by mouh to an unconscious person.

	Symptoms of poisoning may even occur after several hours; therefore medical observation for at least 48 hours afer the accident.
After inhalation:	Supply fresh air and consult a doctor/medical service. In case of unconsciousness place patient stably in side position for transportation. Suffocation hazard by H_2S poisoning (very toxic by inhalation)
After skin contact:	Wash immediately with water and soap. Rinse thoroughly. If skin irritation continues or rash occurs, seek medical advice and attention.
After eye contact:	Rinse immediately with plenty of water for 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Take victim to an ophtalmologist if irritation persists.
After swallowing:	Rinse mouth with water. Do not induce vomiting. If victim conscious and alert, give 1-2 glasses of water to drink. Consult a doctor/medical service if you feel unwell. Ingestion of large quantities: immediately to hospital.

4.2. MOST IMPORTANT SYMPTOMS AND EFFECTS< BOTH ACUTE AND DELAYED
No further relevant information available.

4.3. INDICATION OF IMMEDIATE MEDICAL ATTENTION AND SPECIAL TREATMENT
Treat symptomatically. For specialist advice physicians should contact the anti poison control centre

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5. FIREFIGHTING MEASURES

5.1. EXTINGUISHING MEDIA

Suitable extinguishing agents:	CO2, powder or water spray. Fight larger fires with water spray or alcohol resistant foam.
Unsuitable:	Water with full jet

5.2. SPECIAL HAZARDS ARISING FROM THE SUBSTANCE OR MIXTURE
Under oxygen-free conditions some H2S can be formed from the anaerobic conversion of Sulphur components present in the liquid phase of the cake. If the cake is stored in a closed container this might result in elevated hydrogen Sulphide concentrations in the head space. The expected maximum concentration will be 0.01%, which could result in eye irritation and irritation of respiratory tract.

5.3. ADVICE FOR FIREFIGHTERS

Protective equipment:	Standard protective clothing for firefighters. Wear self-contained respiratory protective device.

6. ACCIDENTAL RELEASE MEASURES

6.1. PERSONAL PRECAUTIONS, PROTECTIVE EQUIPMENT AND EMERGENCY PROCEDURES

Wear protective equipment. Keep unprotected persons away. Ensure adequate ventilation. Use suitable protective equipment (see Chapter 8).

6.2. ENVIRONMENTAL PRECAUTION

Do not allow to enter sewers/ surface or ground water.

6.3. METHOD AND MATERIAL FOR CONTAINMENT AND CLEANING UP

Shut off leaks if without risk. Pick up mechanically. Dispose contaminated material as waste according to item 13.

6.4. REFERENCE TO OTHER SECTIONS

See Section 7 for information on safe handling.
See Section 8 for information on personal protection equipment.
See Section 13 for disposal information

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7. HANDLING AND STORAGE

7.1. PRECAUTION FOR SAFE HANDLING

Open and handle receptacle with care. Ensure good ventilation/exhaustion at the workplace. Wear mask and H2S detection; Wear mask and H2S detection, if the cake is stored in a closed container the headspace might contain up to 0.01% of H2S.

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7.2. STORAGE

Store at +5°C to +40°C.
Do not store in direct sunlight.
Store in closed containers, or in plastic bags, not in the proximity of heat or ignition source. It is recommended to use containers or big bags with a water tight lining (< 40^{o}C). Do not store together with acids.
Apply to local rules.
Handle in well ventilated spaces.
After use or opening containers should be emptied completely or filled up (> 90%) with water in order to minimize headspace.

7.3. PACKAGING MATERIALS

Suitable packaging materials:	Polyester Plastics Steel with rubber or plastic lining
Special demands to packaging materials:	Closable Correctly marked Apply to governmental rules

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8. EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1. CONTROL PARAMETERS

· **Ingredients with limit values that require monitoring at the workplace:**	
7783-06-4 hydrogen sulphide	
WEL	Short-term value: 14 mg/m³, 10 ppm Long-term value: 7 mg/m³, 5 ppm

· **DNELs**		
16721-80-5 sodium hydrogensulphide		
Inhalative	DNEL (Long Term; Local)	1 mg/m³ (Workers)
	DNEL (Long Term; Systemic)	8 mg/m³ (Workers)
	DNEL (Short Term; Local)	2 mg/m³ (Workers)

· **PNECs**	
16721-80-5 sodium hydrogensulphide	
PNEC	0.00027 mg/l (Freshwater)
	0.27 mg/l (Seawater)
	0.0176 mg/kg dwt (Freshwater Sediment)
	0.0176 mg/kg dwt (Seawater Sediment)
	0.016 mg/l (Sewage Water Treatment Plant)
	0.00027 mg/l (Water (intermittent emission))

8.2. EXPOSURE CONTROLS

Personal protective equipment:

Hand protection: Gloves.

Material selection gloves: Good resistance gives:butyl rubber,nitrile rubber,PVC.
Take advice to your gloves' supplier

Eye protection : Protective goggles (EN166).

Skin and body protection: Wear suitable protective clothing (EN340).

Respiratory protection: In case of brief exposure or low pollution use respiratory filter device.
In case of intensive or longer exposure use self-contained respiratory protective device.
Short-term filter device: ABEK

Ventilation: Provide sufficient mechanical (general and/or local exhaust) ventilation to mainain exposure below level of overexposure.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1. PHYSICAL STATE

Aggregation	: Cake
Odour	: Slight smell of rotten eggs
Colour	: White/yellow/grey viscous liquid (solids in suspension) or cake/clumps
Solubility	: Dispersible in water
Other properties	: Colloidal
Toxicity	: None

9.2. DATA PHYSICAL PROPERTIES

Boiling point	: > 100 °C
Density	: 1.4 kg/litre
Acidity (pH)	: 7 to 9.5

9.3 BIOLOGICAL DATA

Pathogenic bacteria: No E-coli or pathogenic organisms (those that can harm humans) are present.

10. STABILITY AND REACTIVITY

10.1. REACTIVITY

Stable at ambient temparures and under normal conditions of use.

10.2. CHEMICAL STABILITY

The product is stable if used and stored according to specifications.

10.3. POSSIBILITY OF HAZARDOUS REACTIONS

No dangerous reactions known.

10.4. CONDITIONS TO AVOID

Keep from heat sources/open flames/hot surfaces/ sparks and electrostatic charges.
Avoid sparks when opening the container.
Empty containers completely. Avoid contact with acids.

10.5. INCOMPATIBLE MATERIALS

Avoid contact with strong acids

10.6. HAZARDOUS DECOMPOSITION PRODUCTS

Under oxygen-free conditions some H2S can be formed from the anaerobic conversion of Sulphur components present in the liquid phase of the cake. If the cake is stored in a closed container this might result in elevated hydrogen sulphide concentrations in the head space. The expected maximum concentration will be 0.01%, which could result in eye irritation and irritation of respiratory tract.

11. TOXICOLOGICAL INFORMATION

11.1. ACUTE TOXICITY

Based on available data acute toxic effects are not expected. Under oxygen-free conditions some H2S can be formed from the anaerobic conversion of sulphur components present in the liquid phase of the cake. If the cake is stored in a closed container this might result in elevated hydrogen sulphide concentrations in the head space. The expected maximum concentration will be 0.01%, which could result in eye irritation and irritation of respiratory tract.

· **LD/LC50 values relevant for classification:**

ATE (Acute Toxicity Estimates)

Oral	LD50	7888 mg/kg (rat)
Dermal	LD50	66667 mg/kg
Inhalative	LC50/4 h	181 mg/l (rat)

7704-34-9 sulfur

Oral	LD50	> 2000 mg/kg (rat) (OECD 401)
Dermal	LD50	> 2000 mg/kg (rat) (OECD 402)
Inhalative	LC50/4 h	> 5.43 mg/l (rat) (OECD 403)

16721-80-5 sodium hydrogensulphide

Oral	LD50	105 mg/kg (rat) (OECD 401)

· **Primary irritant effect:**

· **on the skin:**

7704-34-9 sulfur

Irritation of skin	Skin Corrosion	+ (rabbit) (OECD 404) Irritating

· **on the eye:**

7704-34-9 sulfur

Irritation of eyes	Eye Corrosion	- (rabbit) (OECD 405) not irritating

16721-80-5 sodium hydrogensulphide

Irritation of eyes	Eye Corrosion	+ (rabbit) (OECD 405) Irreversible effects on the eye

· **Respiratory tract:** Not applicable.

· **Ingestion:** Not applicable.

· **Sensitisation:**

7704-34-9 sulfur

Irritation of skin	Skin Sensibilisation	- (Guinea Pigs) (OECD 406) not sensitizing

Additional toxicological information:

The product is not subject to classification according to the calculation method of the General EU Classification Guidelines for Preparations as issued in the latest version.

When used and handled according to specifications, the product does not have any harmful effects to our experience and the information provided to us.

· **Specific Target Organ Toxicity (STOT) single exposure:** Not applicable.	
· **Specific Target Organ Toxicity (STOT) repeated exposure:**	
7704-34-9 sulfur	
Oral	NOAEL (rep dose tox) | 1000 mg/kg bw/day (rat) (OECD 408)
· **Repeated dose toxicity**	
7704-34-9 sulfur	
Dermal	NOAEL (rep dose) | 400 mg/kg (rat) (OECD 410)
· **CMR effects (carcinogenity, mutagenicity and toxicity for reproduction)**	
· **Study results:**	
7704-34-9 sulfur	
Mutagenicity	- (rabbit) (OECD 471) negative without metabolic activation all strains tested negative with metabolic activation all strains tested

12. ECOLOGICAL INFORMATION

12.1. AQUATIC TOXICITY

This product is not classified as dangerous for the environment.

7704-34-9 sulfur	
EC50 (48h)	> 0.0005 mg/l (Daphnia Magna) (OECD 203) NOEC (48h): > 5 µg/l
NOEC (21d)	> 100 mg/l (Daphnia Magna) (OECD 211)
NOEC (72h)	> 0.005 mg/l (algae) (OECD 201)
NOEC (96h)	> 0.005 mg/l (Forel (oncorhynchus mykiss)) (OECD 203)
16721-80-5 sodium hydrogensulphide	
LL50 (96h)	0.1 mg/l (fish) ((H2S); OECD 203) species: Leporinus affinis
NOEC	0.002 mg/l (Lepomis Macrochirus) (EPA 440/5-86-001) LOEC (46d): 0.0014 mg/l

12.2. PERSISTENCE AND DEGRADABILITY

No further relevant information available.

12.3. BIOACCUMULATIVE POTENTIAL
No further relevant information available.

12.4. MOBILITY IN SOIL
No further relevant information available

General notes:
Water hazard class 1 (German Regulation) (Self-assessment): slightly hazardous for water. Do not allow undiluted product or large quantities of it to reach ground water, water course or sewage system.

12.5. RESULTS OF PBT AND VPVB ASSESSMENT
PBT:
Does not meet the specific criteria detailed in Annex XIII of Regulation 1907/2006 and the substance is not considered as a PBT
VPVB:
Does not meet the specific criteria detailed in Annex XIII of Regulation 1907/2006 and the substance is not considered as a vBvT

12.6. OTHER ADVERSE EFFECTS AND BIOLOGICAL DATA
No further relevant information available.

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13. DISPOSAL CONSIDERATIONS

Clean up spilled product.
Collect product as much as possible in clean containers for reuse.
Rinse remaining material with lots of water.
This product is not classified as dangerous waste material.
Offer surplus to a licensed disposal company.
Do not dump in surface water or sewage.

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14. TRANSPORT INFORMATION

In accordance with ADR / RID / IMDG / IATA / AND

14.1. UN NUMBER
Not regulated for transport

14.2. UN PROPER SHIPPING NAME
Not applicable

14.3. TRANSPORT HAZARD CLASS(ES)
Not applicable

14.4. PACKING GROUP
Not applicable

14.5. ENVIRONMENTAL HAZARDS
Other information : No supplementary information available.

14.6. SPECIAL PRECAUTIONS FOR USER

14.6.1. Overland transport
No additional information available

14.6.2. Transport by sea
No additional information available

14.6.3. Air transport
No additional information available

14.7. TRANSPORT IN BULK ACCORDING TO ANNEX II OF MARPOL 73/78 AND THE IBC CODE
Not applicable

15. REGULATORY INFORMATION

15.1. LABELLING ACCORDING TO EG GUIDELINES
Symbol: Irritating

16. OTHER INFORMATION

Version	: 2015v1
Revision date	: 22-01-2015
Date of issue	: 09-10-2008
Supersedes	: 27-06-2012
Indication of changes	: several

Data sources : BIG-database
ECHA Website: Information on Registered Substances
Handbook of Chemistry and Physics CRC Press Inc
Information from suppliers.

Abbreviations and acronyms : CLP = Classification, labelling and packaging
NOEC: No Observed Effect Concentration
DNEL = Derivative No Effect Level
PNEC = Predicted No Effect Concentration
IC50: Inhibition Concentration, 50 %
LC50: Lethal concentration, 50 percent
LD50: Lethal dose, 50 percent
Met. Corr. 1: corrosive to metals, Hazard Category 1
Acute Tox. 3: Acute toxicity, Hazard Category 3
Skin Corr. 1B: Skin corrosion/irritation, Hazard Category 1B
Skin Irrit. 2: Skin corrosion/irritation, Hazard Category 2
Eye Dam. 1: serious eye damage/eye irritation, Hazard Category 1
Aquatic acute 1: hazardous to the aquatic environment, Hazard Category 1
ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road
IMDG: International Maritime Code for Dangerous Goods
IATA: International Air Transport Association
GHS: Globally Harmonised System of Classification and Labelling of Chemicals
EINECS: European Inventory of Existing Commercial Chemical Substances
ELINCS: European List of Notified Chemical Substances
CAS: Chemical Abstracts Service (division of the American Chemical Society)
REACH: Registration, evaluation and autorisation of chemicals.

Training advice : Before using/handling the product one must read carefully the SDS.

Full text of, H- and EUH-phrases:

H290	May be corrosive to metals
H301	Toxic if swallowed
H302	Harmful if swallowed
H314	Causes severe skin burns and eye damage
H315	Causes skin irritation
H318	Cauese serious eye damage
H400	Very toxic to aquatic life

Above data apply only to the product mentioned in chapter 1 and under the circumstances as mentioned in this material safety data sheet.
These data do not apply with restriction if this product is used in combination with other materials and with restrictions if it is used in a process.
Although this material safety data sheet is composed with great care, Paques bv cannot accept any liability for harmful effects that may occur when using this product. The user should convince himself before he starts using this product if the data is complete and the product is suitable for the process where it will be used in.

SAFETY DATA SHEET
THE DOW CHEMICAL COMPANY

Product name: Monoethanolamine

Issue Date: 06/06/2022
Print Date: 07/21/2022

THE DOW CHEMICAL COMPANY encourages and expects you to read and understand the entire (M)SDS, as there is important information throughout the document. We expect you to follow the precautions identified in this document unless your use conditions would necessitate other appropriate methods or actions.

1. IDENTIFICATION

Product name: Monoethanolamine

Recommended use of the chemical and restrictions on use
Identified uses: Gas treatment agent. Chemical intermediate. We recommend that you use this product in a manner consistent with the listed use. If your intended use is not consistent with the stated use, please contact your sales or technical service representative.

COMPANY IDENTIFICATION
THE DOW CHEMICAL COMPANY
2211 H.H. DOW WAY
MIDLAND MI 48674
UNITED STATES

Customer Information Number: 800-258-2436
SDSQuestion@dow.com

EMERGENCY TELEPHONE NUMBER
24-Hour Emergency Contact: CHEMTREC +1 800-424-9300
Local Emergency Contact: 800-424-9300

2. HAZARDS IDENTIFICATION

Hazard classification
GHS classification in accordance with the OSHA Hazard Communication Standard (29 CFR 1910.1200)
Flammable liquids - Category 4
Acute toxicity - Category 4 - Oral
Skin corrosion - Category 1B
Serious eye damage - Category 1

Label elements
Hazard pictograms

Signal word: **DANGER!**

Hazards
Combustible liquid.
Harmful if swallowed.
Causes severe skin burns and eye damage.

Precautionary statements

Prevention
Keep away from heat/ sparks/ open flames/ hot surfaces. No smoking.
Wash skin thoroughly after handling.
Do not eat, drink or smoke when using this product.
Wear protective gloves, protective clothing, eye protection and/or face protection.

Response
IF SWALLOWED: Call a POISON CENTER/ doctor if you feel unwell. Rinse mouth.
IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/ shower.
IF INHALED: Remove person to fresh air and keep comfortable for breathing. Immediately call a POISON CENTER and/or doctor.
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a POISON CENTER and/or doctor.
Wash contaminated clothing before reuse.
In case of fire: Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide to extinguish.

Storage
Store in a well-ventilated place. Keep cool.
Store locked up.

Disposal
Dispose of contents and/or container to an approved waste disposal plant.

Other hazards
No data available

3. COMPOSITION/INFORMATION ON INGREDIENTS

Synonyms: Ethanolamine
This product is a substance.
Substance name: Monoethanolamine
CASRN: 141-43-5

Component	CASRN	Concentration
Monoethanolamine	141-43-5	>= 99.5 - <= 100.0 %
Diethanolamine	111-42-2	<= 0.2 %

4. FIRST AID MEASURES

Description of first aid measures
General advice:
First Aid responders should pay attention to self-protection and use the recommended protective clothing (chemical resistant gloves, splash protection). If potential for exposure exists refer to Section 8 for specific personal protective equipment.

Inhalation: Move person to fresh air and keep comfortable for breathing; consult a physician.

Skin contact: Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing. Seek medical attention if symptoms occur or irritation persists. Wash clothing before reuse. Suitable emergency safety shower facility should be immediately available.

Eye contact: Wash immediately and continuously with flowing water for at least 30 minutes. Remove contact lenses after the first 5 minutes and continue washing. Obtain prompt medical consultation, preferably from an ophthalmologist. Suitable emergency eye wash facility should be immediately available.

Ingestion: Do not induce vomiting. Give one cup (8 ounces or 240 ml) of water or milk if available and transport to a medical facility. Do not give anything by mouth unless the person is fully conscious.

Most important symptoms and effects, both acute and delayed:
Aside from the information found under Description of first aid measures (above) and Indication of immediate medical attention and special treatment needed (below), any additional important symptoms and effects are described in Section 11: Toxicology Information.

Indication of any immediate medical attention and special treatment needed
Notes to physician: Chemical eye burns may require extended irrigation. Obtain prompt consultation, preferably from an ophthalmologist. If burn is present, treat as any thermal burn, after decontamination. Due to irritant properties, swallowing may result in burns and/or ulceration of mouth, stomach and lower gastrointestinal tract with subsequent stricture. Aspiration of vomitus may cause lung injury. Suggest endotracheal or esophageal control if lavage is done. No specific antidote. Treatment of exposure should be directed at the control of symptoms and the clinical condition of the patient.

5. FIREFIGHTING MEASURES

Extinguishing media

Suitable extinguishing media: Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide..

Unsuitable extinguishing media: High volume water jet. Do not use direct water stream..

Special hazards arising from the substance or mixture

Hazardous combustion products: Carbon oxides. Nitrogen oxides (NOx).

Unusual Fire and Explosion Hazards: Flash back possible over considerable distance.. Exposure to combustion products may be a hazard to health.. Closed containers may rupture via pressure build-up when exposed to fire or extreme heat.. Vapours may form explosive mixtures with air..

Advice for firefighters

Fire Fighting Procedures: Use water spray to cool unopened containers.. Evacuate area.. Collect contaminated fire extinguishing water separately. This must not be discharged into drains.. Fire residues and contaminated fire extinguishing water must be disposed of in accordance with local regulations.. Contain fire water run-off if possible. Fire water run-off, if not contained, may cause environmental damage.. Use water spray to cool fire exposed containers and fire affected zone until fire is out and danger of reignition has passed.. Do not use a solid water stream as it may scatter and spread fire..
Use extinguishing measures that are appropriate to local circumstances and the surrounding environment. Remove undamaged containers from fire area if it is safe to do so.

Special protective equipment for firefighters: In the event of fire, wear self-contained breathing apparatus.. Use personal protective equipment..

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures: Remove all sources of ignition. Use personal protective equipment. Follow safe handling advice and personal protective equipment recommendations.

Environmental precautions: Do not release the product to the aquatic environment above defined regulatory levels Prevent further leakage or spillage if safe to do so. Prevent spreading over a wide area (e.g. by containment or oil barriers). Retain and dispose of contaminated wash water. Local authorities should be advised if significant spillages cannot be contained.

Methods and materials for containment and cleaning up: Do NOT use absorbent materials such as: Cellulose-based absorbents. Sawdust Ground corn cobs. Non-sparking tools should be used. Soak up with inert absorbent material. Suppress (knock down) gases/vapours/mists with a water spray jet. Absorb with inert materials such as: Clay-based absorbents. Dirt. Sand. Clean up remaining materials from spill with suitable absorbant. Local or national regulations may apply to releases and disposal of this material, as well as those materials and items employed in the cleanup of releases. You will need to determine which regulations are applicable. For large spills, provide dyking or other appropriate containment to keep material from spreading. If dyked material can be pumped, store recovered material in appropriate container.
See sections: 7, 8, 11, 12 and 13.

7. HANDLING AND STORAGE

Precautions for safe handling: Do not get on skin or clothing. Do not breathe vapours or spray mist. Do not swallow. Do not get in eyes. Keep container tightly closed. Keep away from heat and sources of ignition. Take precautionary measures against static discharges. Take care to prevent spills, waste and minimize release to the environment. Do not use sodium nitrite or other nitrosating agents in formulations containing this product. Suspected cancer-causing nitrosamines could be formed. Spills of these organic materials on hot fibrous insulations may lead to lowering of the autoignition temperatures possibly resulting in spontaneous combustion. Handle in accordance with good industrial hygiene and safety practice. CONTAINERS MAY BE HAZARDOUS WHEN EMPTY. Since emptied containers retain product residue follow all (M)SDS and label warnings even after container is emptied.
Use with local exhaust ventilation. See Engineering measures under EXPOSURE CONTROLS/PERSONAL PROTECTION section.

Conditions for safe storage: Keep in properly labelled containers. Store locked up. Keep tightly closed. Keep in a cool, well-ventilated place. Do not store with: Strong acids. Strong bases Combustible liquid. Store in accordance with the particular national regulations. Keep away from heat and sources of ignition. Monoethanolamine can react with iron to form an unstable material that can decompose at temperatures above 130 °C in air. Use caution when thawing drummed material. If steam heating is necessary, use only low pressure steam and stainless steel coils.

Storage stability
Storage temperature: 10 - 32 °C (50 - 90 °F)

Storage Period:
Plastic drums.
24 Month
Bulk
6 Month

Do not store with the following product types: Strong oxidizing agents. Organic peroxides. Explosives. Gases.
Unsuitable materials for containers**:** Aluminium Copper Copper alloys Galvanized containers. Zinc

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters
If exposure limits exist, they are listed below. If no exposure limits are displayed, then no values are applicable.

Component	Regulation	Type of listing	Value
Monoethanolamine	ACGIH	TWA	3 ppm
	ACGIH	STEL	6 ppm
	OSHA Z-1	TWA	6 mg/m3 3 ppm
Diethanolamine	Dow IHG	TWA	0.2 mg/m3
	Further information: SKIN: Absorbed via skin		
	ACGIH	TWA Inhalable fraction and vapor	1 mg/m3
	Further information: A3: Confirmed animal carcinogen with unknown relevance to humans; Skin: Danger of cutaneous absorption		

Exposure controls

Engineering controls: Use engineering controls to maintain airborne level below exposure limit requirements or guidelines. If there are no applicable exposure limit requirements or guidelines, use only with adequate ventilation. Local exhaust ventilation may be necessary for some operations.

Individual protection measures

Eye/face protection: Use chemical goggles. If exposure causes eye discomfort, use a full-face respirator.

Skin protection

Hand protection: Use gloves chemically resistant to this material. Examples of preferred glove barrier materials include: Polyethylene. Ethyl vinyl alcohol laminate ("EVAL"). Examples of acceptable glove barrier materials include: Butyl rubber. Avoid gloves made of: Chlorinated polyethylene. Polyvinyl alcohol ("PVA"). NOTICE: The selection of a specific glove for a particular application and duration of use in a workplace should also take into account all relevant workplace factors such as, but not limited to: Other chemicals which may be handled, physical requirements (cut/puncture protection, dexterity, thermal protection), potential body reactions to glove materials, as well as the instructions/specifications provided by the glove supplier.

Other protection: Use protective clothing chemically resistant to this material. Selection of specific items such as face shield, boots, apron, or full body suit will depend on the task.

Respiratory protection: Respiratory protection should be worn when there is a potential to exceed the exposure limit requirements or guidelines. If there are no applicable exposure limit requirements or guidelines, use an approved respirator. Selection of air-purifying or positive-pressure supplied-air will depend on the specific operation and the potential airborne concentration of the material. For emergency conditions, use an approved positive-pressure self-contained breathing apparatus.

The following should be effective types of air-purifying respirators: Organic vapor cartridge.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	
Physical state	Liquid.
Color	Colorless
Odor	Ammoniacal
Odor Threshold	No test data available
pH	12.1 *Literature* (50% aq. sol.)
Melting point/range	No test data available
Freezing point	10.5 °C (50.9 °F) *Literature*
Boiling point (760 mmHg)	170.3 °C (338.5 °F) at 1,013.25 hPa *Literature*
Flash point	**closed cup** 91 °C (196 °F) at 1.013 bar *ISO 2719* Pensky-Martens Closed Cup ASTM D 93
Evaporation Rate (Butyl Acetate = 1)	No data available
Flammability (solid, gas)	Not applicable to liquids
Flammability (liquids)	Not expected to be a static-accumulating flammable liquid.
Lower explosion limit	3.0 % vol *Literature*

Upper explosion limit	23.5 % vol *Literature*
Vapor Pressure	0.5 hPa at 20 °C (68 °F) *Literature*
Relative Vapor Density (air = 1)	2.1 at 20 °C (68 °F) *Literature*
Relative Density (water = 1)	1.02 *Literature*
Water solubility	1000 g/L at 20 °C (68 °F) *Literature*
Partition coefficient: n-octanol/water	log Pow: -2.3 *Measured*
Auto-ignition temperature	410 °C (770 °F) *Literature*
Decomposition temperature	No data available
Dynamic Viscosity	23.18 mPa.s at 20 °C (68 °F) *Literature*
Kinematic Viscosity	No test data available
Explosive properties	Not explosive
Oxidizing properties	No
Molecular weight	61.08 g/mol *Literature*

NOTE: The physical data presented above are typical values and should not be construed as a specification.

10. STABILITY AND REACTIVITY

Reactivity: Not classified as a reactivity hazard.

Chemical stability: Stable under normal conditions.

Possibility of hazardous reactions: Can react with strong oxidizing agents. Vapours may form explosive mixture with air.

Conditions to avoid: Heat, flames and sparks. Avoid moisture.

Incompatible materials: Heating above 60°C in the presence of aluminum can result in corrosion and generation of flammable hydrogen gas. Avoid contact with oxidizing materials. Avoid contact with: Acids Halogenated hydrocarbons Nitrites. Strong oxidizers. Combustible liquid. Avoid contact with metals such as: Aluminum. copper Galvanised metals Zinc.

Hazardous decomposition products: Decomposition products depend upon temperature, air supply and the presence of other materials..

11. TOXICOLOGICAL INFORMATION

Toxicological information appears in this section when such data is available.

Information on likely routes of exposure
Inhalation, Eye contact, Skin contact, Ingestion.

Acute toxicity (represents short term exposures with immediate effects - no chronic/delayed effects known unless otherwise noted)

Acute oral toxicity

Information for the Product:

Low toxicity if swallowed. Swallowing may result in gastrointestinal irritation or ulceration. Swallowing may result in burns of the mouth and throat.

Based on product testing:
LD50, Rat, 1,089 mg/kg

Information for components:

Monoethanolamine
LD50, Rat, 1,089 mg/kg

Diethanolamine
LD50, Rat, male and female, 1,600 mg/kg OECD 401 or equivalent

Acute dermal toxicity

Information for the Product:

Prolonged skin contact is unlikely to result in absorption of harmful amounts.

As product:
LD50, Rat, 2,504 mg/kg

Information for components:

Monoethanolamine
LD50, Rat, 2,504 mg/kg

Diethanolamine
LD50, Rabbit, male, > 8,200 mg/kg

Acute inhalation toxicity

Information for the Product:

Prolonged excessive exposure may cause adverse effects. Excessive exposure may cause irritation to upper respiratory tract (nose and throat).

As product:
LC50, Rat, 4 Hour, vapour, > 1.48 mg/l Estimated. No deaths occurred at this concentration.
Information for components:

Monoethanolamine
LC50, Rat, 4 Hour, vapour, > 1.48 mg/l Estimated. No deaths occurred at this concentration.

Diethanolamine
LC0, Rat, male, 4 Hour, dust/mist, 3.35 mg/l No deaths occurred at this concentration.

Skin corrosion/irritation

Information for the Product:

Based on product testing:
Brief contact may cause skin burns. Symptoms may include pain, severe local redness and tissue damage.
Classified as corrosive to the skin according to DOT guidelines.

Information for components:

Monoethanolamine
Brief contact may cause skin burns. Symptoms may include pain, severe local redness and tissue damage.
Classified as corrosive to the skin according to DOT guidelines.

Diethanolamine
Prolonged contact may cause skin irritation with local redness.
Repeated contact may cause skin burns. Symptoms may include pain, severe local redness, swelling, and tissue damage.
May cause more severe response if skin is abraded (scratched or cut).

Serious eye damage/eye irritation

Information for the Product:

Based on product testing:
May cause severe irritation with corneal injury which may result in permanent impairment of vision, even blindness. Chemical burns may occur.
Vapor may cause eye irritation experienced as mild discomfort and redness.

Information for components:

Monoethanolamine
May cause severe irritation with corneal injury which may result in permanent impairment of vision, even blindness. Chemical burns may occur.
Vapor may cause eye irritation experienced as mild discomfort and redness.

Diethanolamine
May cause severe eye irritation.
May cause severe corneal injury.
Effects may be slow to heal.

Sensitization

Information for the Product:

For skin sensitization:
Did not cause allergic skin reactions when tested in guinea pigs.

For respiratory sensitization:
No relevant data found.

Information for components:

Monoethanolamine

Did not cause allergic skin reactions when tested in guinea pigs.

For respiratory sensitization:
No relevant data found.

Diethanolamine
Did not cause allergic skin reactions when tested in guinea pigs.

For respiratory sensitization:
No relevant data found.

Specific Target Organ Systemic Toxicity (Single Exposure)

Information for the Product:

Material is corrosive. Material is not classified as a respiratory irritant; however, upper respiratory tract irritation or corrosivity may be expected.

Information for components:

Monoethanolamine
Material is corrosive. Upper respiratory tract irritation or corrosivity may be expected.

Diethanolamine
Evaluation of available data suggests that this material is not an STOT-SE toxicant.

Aspiration Hazard

Information for the Product:

Aspiration into the respiratory system may occur during ingestion or vomiting. Due to corrosivity, tissue damage or lung injury may occur.

Information for components:

Monoethanolamine
Aspiration into the respiratory system may occur during ingestion or vomiting. Due to corrosivity, tissue damage or lung injury may occur.

Diethanolamine
Based on physical properties, not likely to be an aspiration hazard.

Chronic toxicity (represents longer term exposures with repeated dose resulting in chronic/delayed effects - no immediate effects known unless otherwise noted)

Specific Target Organ Systemic Toxicity (Repeated Exposure)

Information for the Product:

In animals, effects have been reported on the following organs:
Kidney.
Liver.

Information for components:

Monoethanolamine
In animals, effects have been reported on the following organs:
Kidney.
Liver.

Diethanolamine
Results from repeated exposure tests on diethanolamine in laboratory animals include anemia (rats) and effects on kidney (rats and mice) and liver (mice). Heart and nervous system effects were also observed in animals given exaggerated doses of diethanolamine. Changes in other organs, causes of which are nonspecific, were judged secondary to the poor health of the animals due to the extremely high doses of diethanolamine given.

Carcinogenicity

Information for the Product:

Findings from a chronic diethanolamine skin painting study by NTP include liver and kidney tumors in mice; no tumors were observed in rats. Mechanistic studies indicate that tumor formation is of questionable relevance to humans. A number of factors may have influenced the results and are being considered in their interpretation.

Information for components:

Monoethanolamine
No relevant data found.

Diethanolamine
Findings from a chronic diethanolamine skin painting study by NTP include liver and kidney tumors in mice; no tumors were observed in rats. Mechanistic studies indicate that tumor formation is of questionable relevance to humans. A number of factors may have influenced the results and are being considered in their interpretation.

Carcinogenicity

Component	List	Classification
Diethanolamine	IARC	Group 2B: Possibly carcinogenic to humans
	ACGIH	A3: Confirmed animal carcinogen with unknown relevance to humans.

Teratogenicity

Information for the Product:

Has been toxic to the fetus in laboratory animals at doses toxic to the mother. However, the relevance of this to humans is unknown. Dose levels producing these effects were many times higher than any dose levels expected from exposure due to use.

Information for components:

Monoethanolamine
Has been toxic to the fetus in laboratory animals at doses toxic to the mother. However, the relevance of this to humans is unknown. Dose levels producing these effects were many times higher than any dose levels expected from exposure due to use.

Diethanolamine
Has been toxic to the fetus in laboratory animals at doses toxic to the mother. Did not cause birth defects in laboratory animals.

Reproductive toxicity

Information for the Product:

In animal studies, did not interfere with reproduction.

Information for components:

Monoethanolamine
In animal studies, did not interfere with reproduction.

Diethanolamine
In laboratory animal studies, effects on reproduction have been seen only at doses that produced significant toxicity to the parent animals. Repeated excessive exposures to high amounts may cause effects on testes and fertility in males.

Mutagenicity

Information for the Product:

In vitro genetic toxicity studies were negative. Animal genetic toxicity studies were negative.

Information for components:

Monoethanolamine
In vitro genetic toxicity studies were negative. Animal genetic toxicity studies were negative.

Diethanolamine
In vitro genetic toxicity studies were negative. Animal genetic toxicity studies were negative.

12. ECOLOGICAL INFORMATION

Ecotoxicological information appears in this section when such data is available.

Toxicity

Acute toxicity to fish
Material is moderately toxic to aquatic organisms on an acute basis (LC50/EC50 between 1 and 10 mg/L in the most sensitive species tested).

LC50, Cyprinus carpio (Carp), semi-static test, 96 Hour, 349 mg/l

Acute toxicity to aquatic invertebrates
EC50, Daphnia magna (Water flea), static test, 48 Hour, 65 mg/l

Acute toxicity to algae/aquatic plants
ErC50, Pseudokirchneriella subcapitata (green algae), 72 Hour, Growth rate inhibition, 2.5 mg/l, OECD Test Guideline 201 or Equivalent

NOEC, Pseudokirchneriella subcapitata (green algae), 72 Hour, Growth rate inhibition, 1 mg/l, OECD Test Guideline 201

Toxicity to bacteria
EC50, activated sludge, > 1,000 mg/l

Long-term (chronic) aquatic hazard
Chronic toxicity to fish
LOEC, Oryzias latipes (Orange-red killifish), 30 d, Other, 3.6 mg/l

Chronic toxicity to aquatic invertebrates
NOEC, Daphnia magna (Water flea), 21 d, number of offspring, 0.85 mg/l

Persistence and degradability
Biodegradability: Material is readily biodegradable. Passes OECD test(s) for ready biodegradability.
10-day Window: Pass
Biodegradation: > 90 %
Exposure time: 21 d
Method: OECD Test Guideline 301A or Equivalent

Theoretical Oxygen Demand: 2.36 mg/mg

Photodegradation
Sensitization: OH radicals
Atmospheric half-life: 0.45 d
Method: Estimated.

Bioaccumulative potential
Bioaccumulation: Bioconcentration potential is low (BCF < 100 or Log Pow < 3).
Partition coefficient: n-octanol/water(log Pow): -2.3 at 25 °C Measured

Mobility in soil
Partition coefficient (Koc): 1.17 Estimated.

13. DISPOSAL CONSIDERATIONS

Disposal methods: DO NOT DUMP INTO ANY SEWERS, ON THE GROUND, OR INTO ANY BODY OF WATER. All disposal practices must be in compliance with all Federal, State/Provincial and local laws and regulations. Waste characterizations and compliance with applicable laws are the responsibility solely of the waste generator. FOR UNUSED AND UNCONTAMINATED PRODUCT, always send to a licensed disposer per applicable regulations. Consult the local waste disposal expert for the appropriate waste disposal method. Recover or recycle, if possible. Otherwise, send it to a licensed disposer.

Contaminated packaging: Empty containers retain product residues. Follow label warnings even after container is emptied. Improper disposal or reuse of this container may be dangerous and illegal. Refer to applicable federal, state and local regulations.

14. TRANSPORT INFORMATION

DOT

Proper shipping name	Ethanolamine
UN number	UN 2491
Class	8
Packing group	III

Classification for SEA transport (IMO-IMDG):

Proper shipping name	ETHANOLAMINE
UN number	UN 2491
Class	8
Packing group	III
Marine pollutant	No
Transport in bulk according to Annex I or II of MARPOL 73/78 and the IBC or IGC Code	Consult IMO regulations before transporting ocean bulk

Classification for AIR transport (IATA/ICAO):

Proper shipping name	Ethanolamine
UN number	UN 2491
Class	8
Packing group	III

This information is not intended to convey all specific regulatory or operational requirements/information relating to this product. Transportation classifications may vary by container volume and may be influenced by regional or country variations in regulations. Additional transportation system information can be obtained through an authorized sales or customer service representative. It is the responsibility of the transporting organization to follow all applicable laws, regulations and rules relating to the transportation of the material.

15. REGULATORY INFORMATION

Superfund Amendments and Reauthorization Act of 1986 Title III (Emergency Planning and Community Right-to-Know Act of 1986) Sections 311 and 312
Flammable (gases, aerosols, liquids, or solids)
Acute toxicity (any route of exposure)
Skin corrosion or irritation
Serious eye damage or eye irritation

Superfund Amendments and Reauthorization Act of 1986 Title III (Emergency Planning and Community Right-to-Know Act of 1986) Section 313
This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

Pennsylvania Worker and Community Right-To-Know Act:
The following chemicals are listed because of the additional requirements of Pennsylvania law:

Components	**CASRN**
Monoethanolamine	141-43-5

California Prop. 65
WARNING: This product can expose you to chemicals including Diethanolamine, which is/are known to the State of California to cause cancer, and Ethylene glycol, which is/are known to the State of California to cause birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov.

United States TSCA Inventory (TSCA)
All components of this product are in compliance with the inventory listing requirements of the U.S. Toxic Substances Control Act (TSCA) Chemical Substance Inventory.

16. OTHER INFORMATION

Product Literature
Additional information on this product may be obtained by calling your sales or customer service contact.

Hazard Rating System
NFPA

Health	Flammability	Instability
3	2	0

Revision
Identification Number: 168147 / A001 / Issue Date: 06/06/2022 / Version: 10.0
Most recent revision(s) are noted by the bold, double bars in left-hand margin throughout this document.
Legend

ACGIH	USA. ACGIH Threshold Limit Values (TLV)
Dow IHG	Dow Industrial Hygiene Guideline
OSHA Z-1	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
STEL	Short-term exposure limit
TWA	8-hour, time-weighted average

Full text of other abbreviations
AIIC - Australian Inventory of Industrial Chemicals; ASTM - American Society for the Testing of Materials; bw - Body weight; CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act; CMR - Carcinogen, Mutagen or Reproductive Toxicant; DIN - Standard of the German Institute for Standardisation; DOT - Department of Transportation; DSL - Domestic Substances List (Canada); ECx - Concentration associated with x% response; EHS - Extremely Hazardous Substance; ELx - Loading rate associated with x% response; EmS - Emergency Schedule; ENCS - Existing and New Chemical Substances (Japan); ErCx - Concentration associated with x% growth rate response; ERG - Emergency Response Guide; GHS - Globally Harmonized System; GLP

- Good Laboratory Practice; HMIS - Hazardous Materials Identification System; IARC - International Agency for Research on Cancer; IATA - International Air Transport Association; IBC - International Code for the Construction and Equipment of Ships carrying Dangerous Chemicals in Bulk; IC50 - Half maximal inhibitory concentration; ICAO - International Civil Aviation Organization; IECSC - Inventory of Existing Chemical Substances in China; IMDG - International Maritime Dangerous Goods; IMO - International Maritime Organization; ISHL - Industrial Safety and Health Law (Japan); ISO - International Organisation for Standardization; KECI - Korea Existing Chemicals Inventory; LC50 - Lethal Concentration to 50 % of a test population; LD50 - Lethal Dose to 50% of a test population (Median Lethal Dose); MARPOL - International Convention for the Prevention of Pollution from Ships; MSHA - Mine Safety and Health Administration; n.o.s. - Not Otherwise Specified; NFPA - National Fire Protection Association; NO(A)EC - No Observed (Adverse) Effect Concentration; NO(A)EL - No Observed (Adverse) Effect Level; NOELR - No Observable Effect Loading Rate; NTP - National Toxicology Program; NZIoC - New Zealand Inventory of Chemicals; OECD - Organization for Economic Co-operation and Development; OPPTS - Office of Chemical Safety and Pollution Prevention; PBT - Persistent, Bioaccumulative and Toxic substance; PICCS - Philippines Inventory of Chemicals and Chemical Substances; (Q)SAR - (Quantitative) Structure Activity Relationship; RCRA - Resource Conservation and Recovery Act; REACH - Regulation (EC) No 1907/2006 of the European Parliament and of the Council concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals; RQ - Reportable Quantity; SADT - Self-Accelerating Decomposition Temperature; SARA - Superfund Amendments and Reauthorization Act; SDS - Safety Data Sheet; TCSI - Taiwan Chemical Substance Inventory; TECI - Thailand Existing Chemicals Inventory; TSCA - Toxic Substances Control Act (United States); UN - United Nations; UNRTDG - United Nations Recommendations on the Transport of Dangerous Goods; vPvB - Very Persistent and Very Bioaccumulative

Information Source and References
This SDS is prepared by Product Regulatory Services and Hazard Communications Groups from information supplied by internal references within our company.

THE DOW CHEMICAL COMPANY urges each customer or recipient of this (M)SDS to study it carefully and consult appropriate expertise, as necessary or appropriate, to become aware of and understand the data contained in this (M)SDS and any hazards associated with the product. The information herein is provided in good faith and believed to be accurate as of the effective date shown above. However, no warranty, express or implied, is given. Regulatory requirements are subject to change and may differ between various locations. It is the buyer's/user's responsibility to ensure that his activities comply with all federal, state, provincial or local laws. The information presented here pertains only to the product as shipped. Since conditions for use of the product are not under the control of the manufacturer, it is the buyer's/user's duty to determine the conditions necessary for the safe use of this product. Due to the proliferation of sources for information such as manufacturer-specific (M)SDSs, we are not and cannot be responsible for (M)SDSs obtained from any source other than ourselves. If you have obtained an (M)SDS from another source or if you are not sure that the (M)SDS you have is current, please contact us for the most current version.
US

Modeling parameters highlighted in blue.
Emissions information highlighted in orange.

Estimated Performance Summary

Customer Information					
Company:	GreenTec, LLC	Location:	Kinderhook, N.Y.	Email:	greene.tec.llc@gmail.com
Site Contact:	0	Phone:	(518) 951-5766	Project:	Pacific Ag- Sunnyside RNG- Scenario 2
Operating Conditions					
Gas Flow (scfm):	1345	Gas Pressure (psig):	1.00	Oxygen Conc (%):	0.60
Gas Temp (F):	100	Relative Humidity (%):	100%	H2S Contaminant Conc (ppm):	6000
Vessel Information					
Vessel ID (ft):	14	Vessel Configuration:	Single	Media Volume (lbs per vessel)	110,784
Vessle/Bed Height (ft):	30.0	Vessel Metallurgy:	n/a	Existing vessels(Y/N):	n/a
Performance Summary					
Operating time per vessel (days):	90	Flow Velocity (ft/min):	8.8	H2S Outlet (ppm):	<1
PD per vessel ("W.C.):	3.00	Carbon Consumed (lbs/yr)	447,596	H2S Removed (lbs/yr):	380,457
Financial Summary					
Product:	DARCO BG1	Media Cost ($/vessel):	[redacted]	H2S Removal Cost ($/SCFM):	[redacted]
Product cost ($/lb):	[redacted]	H2S Removal Cost ($/lb of H2S):	[redacted]	Annual Media Spend:	[redacted]
Norit Contact:	Howie Yerger		Email:	howard.yerger@norit.com	

Thank you for your business! www.norit.com

Estimated Performance Summary

Customer Information					
Company:	GreenTec, LLC	Location:	Kinderhook, N.Y.	Email:	greene.tec.llc@gmail.com
Site Contact:	0	Phone:	(518) 951-5766	Project:	Pacific Ag- Sunnyside RNG- Scenario 1
Operating Conditions					
Gas Flow (scfm):	1345	Gas Pressure (psig):	1.00	Oxygen Conc (%):	1.00
Gas Temp (F):	100	Relative Humidity (%):	100%	H2S Contaminant Conc (ppm):	60
Vessel Information					
Vessel ID (ft):	6	Vessel Configuration:	Single	Media Volume (lbs per vessel)	5,424
Vessle/Bed Height (ft):	8.0	Vessel Metallurgy:	n/a	Existing vessels(Y/N):	n/a
Performance Summary					
Operating time per vessel (days):	364	Flow Velocity (ft/min):	48.0	H2S Outlet (ppm):	<1
PD per vessel ("W.C.):	24.79	Carbon Consumed (lbs/yr)	5,435	H2S Removed (lbs/yr):	3,805
Financial Summary					
Product:	DARCO BG1	Media Cost ($/vessel):	[redacted]	H2S Removal Cost ($/SCFM):	[redacted]
Product cost ($/lb):	[redacted]	H2S Removal Cost ($/lb of H2S):	[redacted]	Annual Media Spend:	[redacted]
Norit Contact:	Howie Yerger		Email:	howard.yerger@norit.com	

Thank you for your business! www.norit.com

APPENDIX C

Boiler Specifications

Cleaver-Brooks Boiler Expected Emission Data

0 % Glycol - Water Solution

Nat Gas

BACKGROUND INFORMATION

Date	02/12/25	Boiler Model	CB(LE)
Author	Sam Denka	Altitude (feet)	700
Customer	Sunnyside RNG, LLC	Water Supply Temp Deg F	295.00
City & State	Sunnyside, WA	Furnace Volume (cuft)	198.26
		Furnace Heat Release (btu/hr/cu ft)	132,806
		Heating Surface (sqft)	3000
		Nox System	9

Nat Gas		Firing Rate			
		63%	**50%**	**75%**	**100%**
Horsepower		379	300	450	600
Input , Btu/hr		15,291,000	12,014,000	18,047,000	24,126,000
CO	ppm	50	50	50	50
	lb/MMBtu	0.0375	0.0375	0.0375	0.0375
	lb/hr	0.57	0.45	0.68	0.90
	tpy	2.510	1.972	2.963	3.961
NOx	ppm	9	9	9	9
	lb/MMBtu	0.0105	0.0105	0.0105	0.0105
	lb/hr	0.16	0.13	0.19	0.25
	tpy	0.703	0.553	0.830	1.110
NO	ppm	7.7	7.7	7.7	7.7
	lb/MMBtu	0.009	0.009	0.009	0.009
	lb/hr	0.14	0.11	0.16	0.22
	tpy	0.56	0.44	0.66	0.89
NO_2	ppm	1.4	1.4	1.4	1.4
	lb/MMBtu	0.002	0.002	0.002	0.002
	lb/hr	0.02	0.02	0.03	0.04
	tpy	0.14	0.11	0.17	0.22
SOx	ppm	0.34	0.34	0.34	0.34
	lb/MMBtu	0.0006	0.0006	0.0006	0.0006
	lb/hr	0.0090	0.0071	0.0106	0.0142
	tpy	0.039	0.031	0.047	0.062
VOCs	ppm	8	8	8	8
(Non-Methane Only)	lb/MMBtu	0.0036	0.0036	0.0036	0.0036
	lb/hr	0.054	0.043	0.064	0.086
	tpy	0.238	0.187	0.281	0.376
VOCs does not include any background VOC emissions.					
PM10 (Filterable)	ppm	N/A	N/A	N/A	N/A
	lb/MMBtu	0.0019	0.0019	0.0019	0.0019
	lb/hr	0.028	0.022	0.034	0.045
	tpy	0.125	0.098	0.147	0.197
PM10 (Condensable)	lb/MMBtu	0.0056	0.0056	0.0056	0.0056
	lb/hr	0.085	0.067	0.101	0.135
	tpy	0.374	0.294	0.442	0.591
PM2.5 (Filterable)	lb/MMBtu	0.0019	0.0019	0.0019	0.0019
	lb/hr	0.028	0.022	0.034	0.045
	tpy	0.125	0.098	0.147	0.197
PM2.5 (Condensable)	lb/MMBtu	0.0056	0.0056	0.0056	0.0056
	lb/hr	0.085	0.067	0.101	0.135
	tpy	0.374	0.294	0.442	0.591
Exhaust Data					
Temperature, F		308	320	333	346
Flow	ACFM	4,929	3,662	5,592	7,598
	SCFM (70 Degrees Fah.)	3,492	2,551	3,832	5,123
	DSCFM	3,155	2,286	3,433	4,590
	lb/hr	15,716	11,479	17,244	23,052
Velocity	ft/sec	26.15	19.43	29.67	40.31
	ft/min	1,569	1,166	1,780	2,419

Model Parameters

Notes:

1) All ppm levels are corrected to dry at 3% oxygen.
2) Emission data based on actual boiler efficiency.
3) % H2O , by volume in exhaust gas is **16.05** % O2, by volume **3.81**
4) Water vapor in exhaust gas is **99.39** lbs/MMBtu of fuel fired
5) CO2 produced is **116.31** lbs/MMBtu of fuel fired
6) Particulate is exclusive of any particulates in combustion air or other sources of residual particulates from material.
PM level indicated on this form is based on combustion air and fuel being clean and turndown up to 4:1.
7) Heat input is based on high heating value (HHV).
8.) Emission produced in tons per year (tpy) is based on 24 hours per day for 365 days = 8,760 hours per year
9.) Exhaust data is based on a clean and properly sealed boiler.
10.) Emission data is based on a burner turndown of 4 to 1, However the burner is capable of a higher turndown.
11.) Maximum flame temperature is 2800 degrees fahrenheit.

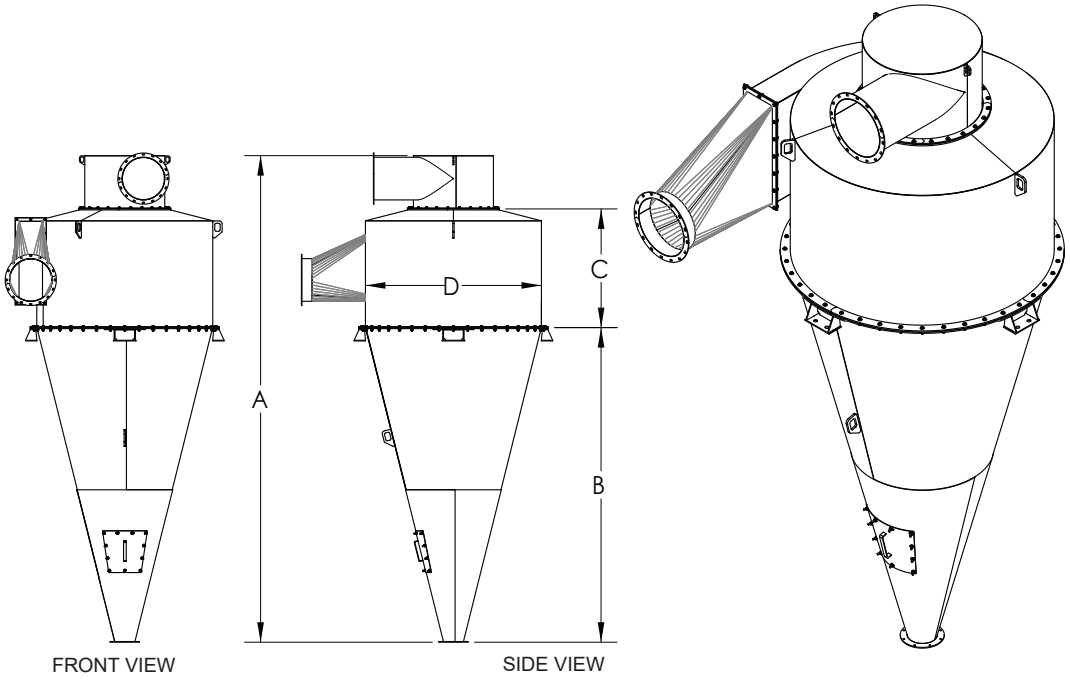
14) Fuel High Heating Value = **1000** Btu/FT^3

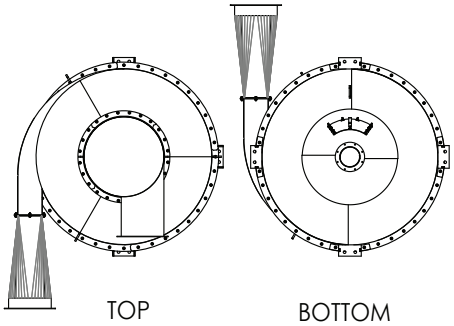
APPENDIX C

Dust Collector Specifications

CK CYCLONE COLLECTORS

KICE INDUSTRIES, INC. / 5500 Mill Heights Drive / Wichita, KS 67219 www.kice.com / sales@kice.com





Model #	CFM	A	B	C	D	Est. Weight
CK 18	500	44 13/16	21 1/16	16 3/4	18	176
CK 24	900	62 7/8	33 1/8	19 3/4	24	258
CK 30	1450	80 1/4	45 1/8	23 1/8	30	365
CK 36	2000	95 5/16	57 3/16	25 1/2	36	475
CK 42	2500	112 11/16	69 13/16	28 7/8	42	610
CK 48	3300	131 7/16	81 7/8	34 1/4	48	778
CK 54	4100	149 5/8	93 15/16	37 3/4	54	964
CK 60	5000	166	105 15/16	42 1/8	60	1133
CK 66	6000	182 1/2	121 3/4	44 1/2	66	1338
CK 72	7100	201 1/2	130 5/8	46 7/8	72	1588
CK 78	9300	219	142 3/4	49 1/4	78	1826
CK 84	11000	234 5/16	154 11/16	51 5/8	84	2112
CK 90	13500	250 3/4	166 3/4	54	90	2389
CK 96	15000	267 1/8	178 3/4	56 3/8	96	2703
CK 102	17200	283 7/16	191 7/16	59	102	3055
CK 108	19500	298 9/16	203 7/16	61 1/8	108	3339
CK 114	22000	316	216 1/2	63 1/2	114	3541
CK 120	25000	333 15/16	228 1/8	65 3/4	120	4179
CK 126	30000	353 3/8	240 1/4	70 1/8	126	4600
CK 132	35000	370 9/16	252 1/4	72 3/8	132	4955
CK 138	40000	388	264 1/4	74 3/4	138	5432

NOTES:

DIMENSIONS SHOWN MAY VARY DEPENDING ON JOB REQUIREMENTS

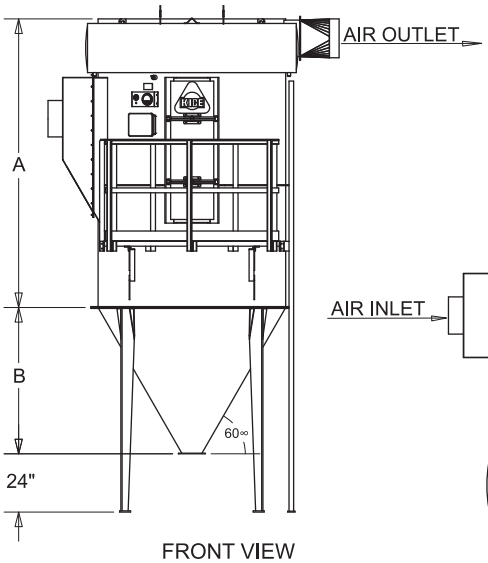
OPTIONAL SUPPORT FEET SHOWN

OPTIONAL INSPECTION DOOR

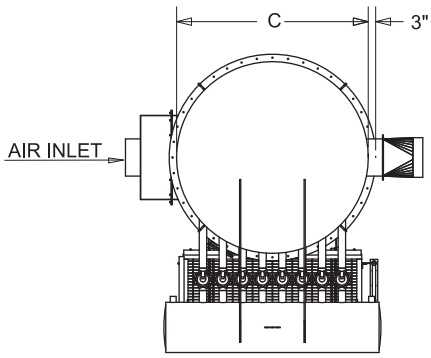
FOOTPRINT DIMENSIONS UPON REQUEST

R PNEUJET FILTERS (ROUND)

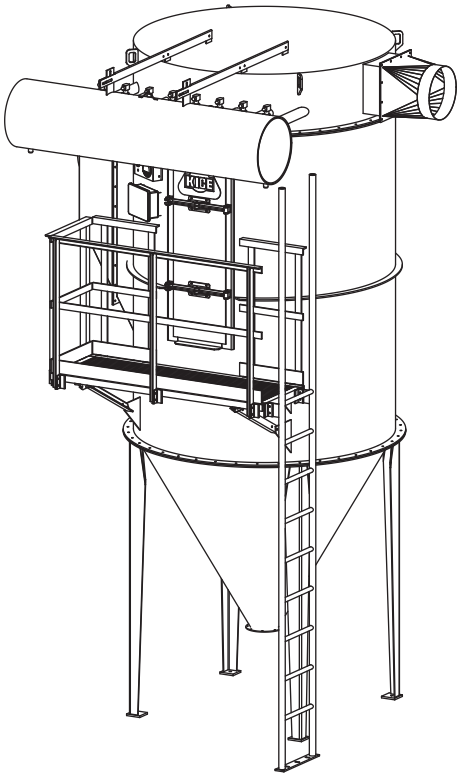
KICE INDUSTRIES, INC. / 5500 Mill Heights Drive / Wichita, KS 67219 www.kice.com / sales@kice.com



FRONT VIEW



TOP VIEW



MODEL #	FILTER AREA²	A	B	C	EST. WEIGHT
R 16-4	75	71	29 3/4	42	1600
R 21-4	99	71	31 1/2	44	1750
R 32-4	151	71	41	55	2250
R 45-4	212	71	50 1/2	66 1/4	2850
R 16-6	113	95	29 3/4	42	2300
R 21-6	148	95	31 1/2	44	2400
R 32-6	226	95	41	55	3150
R 45-6	318	95	50 1/2	66 1/4	3800
R 60-6	424	95	60 1/4	77 1/4	4550
R 77-6	544	95	69 3/4	88 1/4	5450
R 88-6	622	95	71 1/2	90 1/4	5550
R 96-6	679	95	79 1/4	99 1/4	6200
R 16-8	151	119	29 3/4	42	2450
R 21-8	198	119	31 1/2	44	2600
R 32-8	302	119	41	55	3350
R 45-8	424	119	50 1/2	66 1/4	4050
R 60-8	565	119	60 1/4	77 1/4	4950
R 77-8	726	119	69 3/4	88 1/4	5900
R 88-8	829	119	71 1/2	90 1/4	6100
R 96-8	905	143	79 1/4	99 1/4	6750
R 16-10	188	143	29 3/4	42	2650
R 21-10	247	143	31 1/2	44	2750
R 32-10	377	143	41	55	3600
R 45-10	530	143	50 1/2	66 1/4	4350
R 60-10	707	143	60 1/4	77 1/4	5350
R 77-10	907	143	69 3/4	88 1/4	6250
R 88-10	1037	143	71 1/2	90 1/4	6600
R 96-10	1131	143	79 1/4	99 1/4	7250

NOTES:

RECOMMENDED AIR VOLUMES DEPEND ON SEVERAL APPLICATION FACTORS. IN GENERAL, A RATIO OF 10 CFM PER SQUARE FEET OF FILTER AREA CAN BE USED. FOR FINE DUST, HIGH MOISTURE OR OTHER DIFFICULT APPLICATIONS, A LOWER RATIO WILL BE REQUIRED

MATERIALS OF CONSTRUCTION SPECIFIED ON PROPOSAL

OPTIONAL EXTERIOR WALKWAY AND LADDERS SHOWN

APPROVAL DRAWINGS TO BE SUBMITTED UPON RECEIPT OF ORDER

60 DEGREE HOPPER SHOWN
70 DEGREE HOPPER AVAILABLE

Kice Industries, Inc.
Standard Filter Efficiency Statement

Date: 3/19/2019

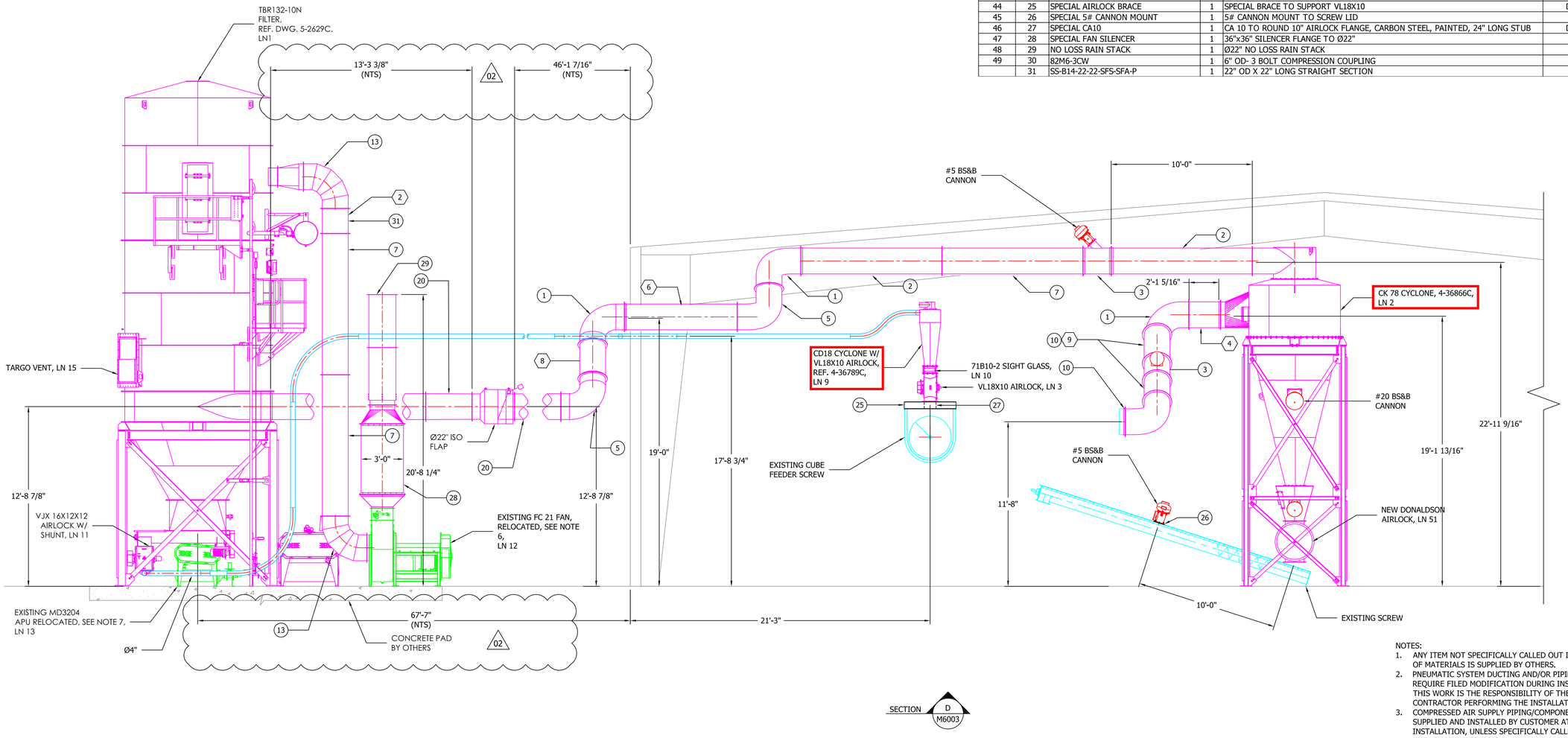
The standard filter bags supplied with Kice filters are rated to a mass efficiency of no less than 99.9% based on the inlet loading. For an inlet dust loading up to 2 grains per dry standard cubic foot of air, the particle emissions in the discharge gas stream from the filter should not exceed 0.002 grains per dry standard cubic foot over the life of the media. Efficiency results, reported by the media manufacturer have shown filtration to be 99.98% for Polyester Felt and 99.99% for 12oz Durates media at 2.5 micron particle size.

For gas streams handling primarily very small particles (less than 10 micron) some variation in efficiency can be expected. This is especially true during the break-in period of the filter bags, prior to a dust cake forming on the outer surface of the media which increases the filtering efficiency.

Filter bags provided by Kice are commonly used in large dust collectors and bin vent type filters associated with pneumatic conveying or dust control systems. Filter bags should be periodically inspected to insure no holes or leaks exist that will allow dust particles to enter the discharge gas stream. Pressure drop across the filter bags should also be monitored utilizing a differential pressure gauge.

ZEN-NOH- 351508- HAY GRINDING BILL OF MATERIAL

LINE NO.	POS	PART NO.	QTY.	DESCRIPTION	NOTE/DWG NO.
20	1	ER-B14-22-90-SFS-SFS-P	4	22"OD- 90 DEG. SHORT RADIUS ELBOW	
21	2	SS-B14-22-120-SFS-SFA-P	4	22" OD X 120" LONG STRAIGHT SECTION	
22	3	SPECIAL BS&B CANNON FITTING	2	22" DIA. W/ 45DEG BRANCH TO MATE #5 CANNON CUSTOM BRANCH PER DRAWING-PAINT	D125
23	4	SS-B14-22-27-SFS-SFA-P	1	22" OD X 27" LONG STRAIGHT SECTION	
24	5	ER-B14-22-90-SFS-SFA-P	2	22"OD- 90 DEG. SHORT RADIUS ELBOW	
25	6	SS-B14-22-108-SFS-SFA-P	1	22" OD X 108" LONG STRAIGHT SECTION	
26	7	SS-B14-22-120-SFS-SFS-P	3	22" OD X 120" LONG STRAIGHT SECTION	
27	8	SS-B14-22-35-SFS-SFA-P	1	22" OD X 35" LONG STRAIGHT SECTION	
28	9	SS-B14-22-90-SFS-SFS-P	1	22" OD X 90" LONG STRAIGHT SECTION	
29	10	SFA22-P	3	22 3/16" ID ANGLE FLANGE	
30	11	TUBERD16X4X20CSP	80'	4" OD, 16 GA., CARBON STEEL TUBING, PAINTED	
31	12	4B4-90-14	6	4" OD, 90 DEG., 14 GA., 4' RADIUS, CARBON STEEL ELBOW	
32	13	ERV-B14-22-90-SFS-NF	2	22"OD- 90 DEG. SHORT RADIUS ELBOW	
33	14	82M4-4CW	22	4" OD- 4 BOLT COMPRESSION COUPLING	
34	15	14B4-90-16	4	4" OD, 90 DEG., 16 GA., 10" RADIUS, CARBON STEEL ELBOW	
35	16	14B4-45-16	3	4" OD, 45 DEG., 16 GA., 10" RADIUS, CARBON STEEL ELBOW	
36	17	99B6	1	6" OD CS NULL POINT FITTING	
37	18	BS-B14-8NF-6NF-4NF-P	1	SINGLE BRANCH FITTING, CS STEEL CONSTRUCTION, 14GA	
38	19	82M8-3CW	1	8" OD- 3 BOLT COMPRESSION COUPLING	
39	20	SPECIAL TRANSITION	2	TRANSITION FROM 22" OD DUCT TO 22" IOS FLAP-PAINTED	3-31977
40	21	14B2-90-16	4	2" OD, 90 DEG., 16 GA., 9" RADIUS, CARBON STEEL ELBOW	
41	22	TUBERD14X2X20SS	2	2" OD, 14 GA., STAINLESS STEEL TUBING, 20' LENGTH	
42	23	82M2-4CW	8	2" OD- 4 BOLT COMPRESSION COUPLING	
43	24	26MB2-2	1	2" OD CS 2" NPT MALE ADAPTER	
44	25	SPECIAL AIRLOCK BRACE	1	SPECIAL BRACE TO SUPPORT VL18X10	D127
45	26	SPECIAL 5# CANNON MOUNT	1	5# CANNON MOUNT TO SCREW LID	
46	27	SPECIAL CA10	1	CA 10 TO ROUND 10" AIRLOCK FLANGE, CARBON STEEL, PAINTED, 24" LONG STUB	D128
47	28	SPECIAL FAN SILENCER	1	36"x36" SILENCER FLANGE TO Ø22"	
48	29	NO LOSS RAIN STACK	1	Ø22" NO LOSS RAIN STACK	
49	30	82M6-3CW	1	6" OD- 3 BOLT COMPRESSION COUPLING	
	31	SS-B14-22-22-SFS-SFA-P	1	22" OD X 22" LONG STRAIGHT SECTION	



NOTES:

1. ANY ITEM NOT SPECIFICALLY CALLED OUT IN THE BILL OF MATERIALS IS SUPPLIED BY OTHERS.
2. PNEUMATIC SYSTEM DUCTING AND/OR PIPING MAY REQUIRE FILED MODIFICATION DURING INSTALLATION. THIS WORK IS THE RESPONSIBILITY OF THE CONTRACTOR PERFORMING THE INSTALLATION.
3. COMPRESSED AIR SUPPLY PIPING/COMPONENTS TO BE SUPPLIED AND INSTALLED BY CUSTOMER AT INSTALLATION, UNLESS SPECIFICALLY CALLED OUT IN THE BILL OF MATERIALS.
4. UNLESS OTHERWISE NOTED, ALL SUPPORT STRUCTURE COMPONENTS AND MODIFICATIONS TO BE PROVIDED BY OTHERS.
5. EQUIPMENT TO BE PAINTED RAL 9002 PER PROJECT SPECIFICATIONS.
6. REUSE CUSTOMER HOUSING, ROTOR, AND HUB. INSTALL NEW BASE, SHAFT, BEARINGS, BELTS, BELT GUARD, SHEAVES.
7. REUSE CUSTOMER BLOWER, ADD MOTOR, ADAPTER PLATE, SHEAVES, AND BELT.

KICE

PROCESS GROUP

KICE INDUSTRIES, INC.
www.kice.com
tel. (316) 744-7151

COLOR KEY

- BUILDING
- EXISTING EQUIPMENT
- EXISTING EQUIPMENT - RELOCATED
- FUTURE EQUIPMENT
- MOTORS & DEVICES
- NEW EQUIPMENT BY KICE
- NEW EQUIPMENT BY OTHERS

NOTES:
TUBING CONNECTING BAG CLEANING BLOWER TO FILTER AIR TANK SUPPLIED BY KICE, INSTALLATION CONTRACTOR TO DETERMINE ROUTING

HAY GRINDING DUST COLLECTION SYSTEM MECHANICAL LAYOUT DRAWING SECTION "D" VIEW

REV.NO.	DESCRIPTION	DATE	BY
00	RELEASED FOR CONSTRUCTION	1/23/20	PF
01	ROTATED FILTER (EXPLOSION VENTS 90°	2/7/20	PF
02	MOVED FILTER PER INSTALLATION	3/24/20	PF

CUSTOMER NAME AND LOCATION
ZEN NOH
PASCO, WA

DRAWN	CHECKED	APPROVED	DATE
PJF	-	-	1/23/20

DWG. SCALE	PLOT
1/4"-1'=0"	1:48

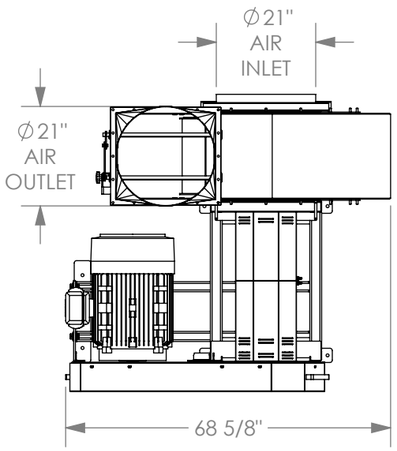
SHEET NO.	OF	SHEET SIZE
1	1	ANSI D

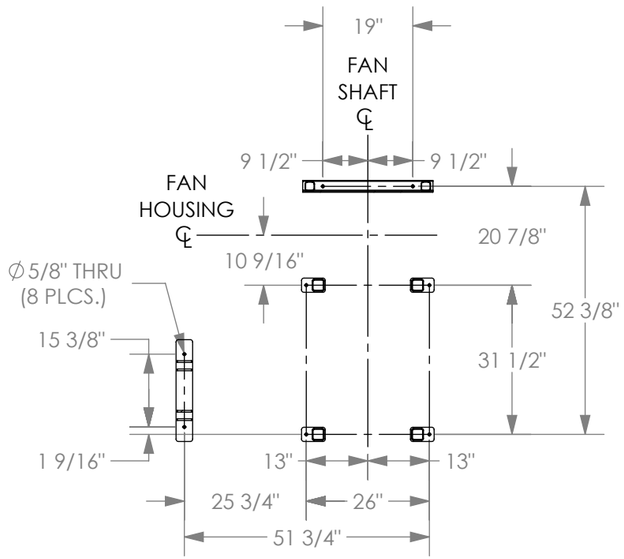
SKETCH NO.
-

QUOTE NO.
-

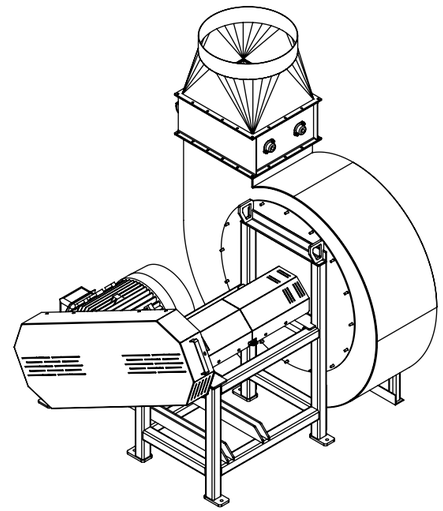
ORDER NO.
346125

DRAWING NO.	REVISION NO.
M6003	02

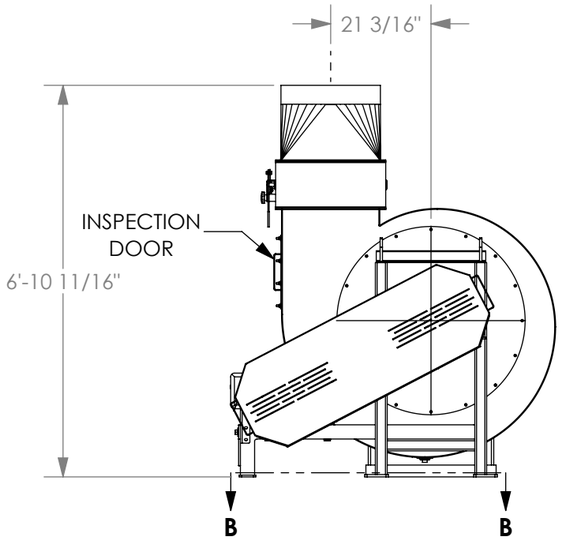


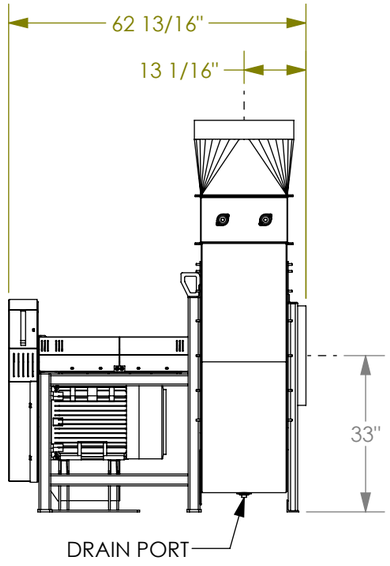


ANCHOR BOLT PATTERN
SECTION B-B



ISOMETRIC REFERENCE VIEW





EXAMPLE ONLY
NOT FOR CONSTUCTION

FC21 #9FB, ML, CW, UB, 40HP, 324T
DESCRIPTION:

KICE INDUSTRIES, INC.
5500 MILL HEIGHTS DR. WICHITA, KANSAS 67219
PH: (316) 744-7151 FAX: (316) 744- 7355

DKS
DWN:

11-16-18
DATE:

FAN-1064
DWG. NO.

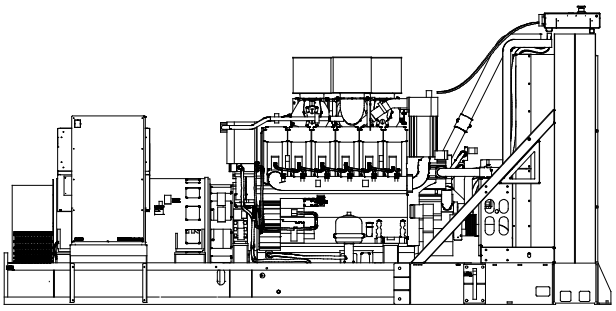
APPENDIX C

Generator Specifications

KOHLER®

Industrial Diesel Generator Set - KD2000

Tier 2 EPA-Certified for Stationary Emergency Applications



KDxxxx designates a generator set with a Tier 2 EPA-Certified engine.
KDxxxx-F designates a 60 Hz generator set with a fuel optimized engine.

Ratings Range

		60 Hz
Standby:	**kW**	1990- 2000
	kVA	2488- 2500
Prime:	**kW**	1810
	kVA	2262

Standard Features

- Kohler Co. provides one-source responsibility for the generating system and accessories.
- The generator set and its components are prototype-tested, factory-built, and production-tested.
- The 60 Hz generator set offers a UL 2200 listing.
- The generator set accepts rated load in one step.
- The 60 Hz generator set meets NFPA 110, Level 1, when equipped with the necessary accessories and installed per NFPA standards.
- A standard three-year or 1000-hour limited warranty for standby applications. Five-year basic, five-year comprehensive, and ten-year extended limited warranties are also available.
- A standard two-year or 8700-hour limited warranty for prime power applications.
- Other features:
  - Kohler designed controllers for one-source system integration and remote communication. See Controllers on page 4.
  - The low coolant level shutdown prevents overheating (standard on radiator models only).

General Specifications

Orderable Generator Model Number	GMKD2000
Manufacturer	Kohler
Engine: model	KD62V12
Alternator Choices	KH04970TO4D KH06220TO4D KH06930TO4D KH07000TO4D KH07080TO4D KH07630TO4D KH07770TO4D KH08430TO4D KH09270TO4D
Performance Class	Per ISO 8528-5
One Step Load Acceptance	100%
Voltage	Wye, 600 V., 4160 V, or 6600- 13800 V
Controller	APM603, APM802
Fuel Tank Capacity, L (gal.)	8577- 16383 (2266- 4328)
Fuel Consumption, L/hr (gal./hr) 100% at Standby	564 (149.1)
Fuel Consumption, L/hr (gal./hr) 100% at Prime Power	516 (136.3)
Emission Level Compliance (KDxxxx)	Tier 2
Open Unit Noise Level @ 7 m dB(A) at Rated Load	—
Data Center Continuous (DCC) Rating (Refer to TIB-101 for definitions)	Same as the Standby Rating below

Generator Set Ratings

				150°C Rise Standby Rating		130°C Rise Standby Rating		125°C Rise Prime Rating		105°C Rise Prime Rating	
Alternator	**Voltage**	**Ph**	**Hz**	**kW/kVA**	**Amps**	**kW/kVA**	**Amps**	**kW/kVA**	**Amps**	**kW/kVA**	**Amps**
KH04970TO4D	277/480	3	60	2000/2500	3008	2000/2500	3008	1810/2262	2721	1810/2262	2721
KH06930TO4D	220/380	3	60	2000/2500	3798	2000/2500	3798	1810/2262	3438	1810/2262	3438
	240/416	3	60	2000/2500	3470	2000/2500	3470	1810/2262	3140	1810/2262	3140
	277/480	3	60	2000/2500	3008	2000/2500	3008	1810/2262	2721	1810/2262	2721
	347/600	3	60	2000/2500	2406	2000/2500	2406	1810/2262	2177	1810/2262	2177
KH07770TO4D	220/380	3	60	1990/2488	3781	1990/2488	3781	1810/2262	3437	1810/2262	3437
	240/416	3	60	2000/2500	3470	2000/2500	3470	1810/2262	3140	1810/2262	3140
KH08430TO4D	220/380	3	60	2000/2500	3799	2000/2500	3799	1810/2262	3437	1810/2262	3437
	240/416	3	60	2000/2500	3470	2000/2500	3470	1810/2262	3140	1810/2262	3140
	277/480	3	60	2000/2500	3008	2000/2500	3008	1810/2262	2721	1810/2262	2721
	347/600	3	60	2000/2500	2406	2000/2500	2406	1810/2262	2177	1810/2262	2177
	2400/4160	3	60	2000/2500	347	2000/2500	347	1810/2262	314	1810/2262	314
KH06220TO4D	2400/4160	3	60	2000/2500	347	2000/2500	347	1810/2262	314	1810/2262	314
KH07000TO4D	347/600	3	60	2000/2500	2406	2000/2500	2406	1810/2262	2177	1810/2262	2177
	2400/4160	3	60	2000/2500	347	2000/2500	347	1810/2262	314	1810/2262	314

RATINGS: All three-phase units are rated at 0.8 power factor. *Standby Ratings:* The standby rating is applicable to varying loads for the duration of a power outage. There is no overload capability for this rating. *Prime Power Ratings:* At varying load, the number of generator set operating hours is unlimited. A 10% overload capacity is available for one hour in twelve. Ratings are in accordance with ISO-8528-1 and ISO-3046-1. For limited running time and continuous ratings, consult the factory. Obtain technical information bulletin (TIB-101) for ratings guidelines, complete ratings definitions, and site condition derates. The generator set manufacturer reserves the right to change the design or specifications without notice and without any obligation or liability whatsoever.

KOHLER®

Industrial Diesel Generator Set - KD2000

Tier 2 EPA-Certified for Stationary Emergency Applications

Alternator	Voltage	Ph	Hz	130°C Rise Standby Rating kW/kVA	130°C Rise Standby Rating Amps	105°C Rise Prime Rating kW/kVA	105°C Rise Prime Rating Amps
KH07080TO4D	3810/6600	3	60	2000/2500	219	1810/2262	198
	7200/12470	3	60	1990/2488	116	1810/2262	105
	7620/13200	3	60	1990/2488	109	1810/2262	99
	7970/13800	3	60	2000/2500	105	1810/2262	95
KH07630TO4D	3810/6600	3	60	2000/2500	219	1810/2262	198
	7200/12470	3	60	2000/2500	116	1810/2262	105
	7620/13200	3	60	2000/2500	110	1810/2262	99
	7970/13800	3	60	2000/2500	105	1810/2262	95
KH09270TO4D	3810/6600	3	60	2000/2500	219	1810/2262	198
	7200/12470	3	60	2000/2500	116	1810/2262	105
	7620/13200	3	60	2000/2500	110	1810/2262	99
	7970/13800	3	60	2000/2500	105	1810/2262	95

Engine Specifications	60 Hz
Manufacturer	Kohler
Engine: model	KD62V12
Engine: type	4-Cycle, Turbocharged, Intercooled
Cylinder arrangement	12-V
Displacement, L (cu. in.)	62 (3783)
Bore and stroke, mm (in.)	175 x 215 (6.89 x 8.46)
Compression ratio	16.0:1
Piston speed, m/min. (ft./min.)	774 (2539)
Main bearings: quantity, type	7, Precision Half Shells
Rated rpm	1800
Max. power at rated rpm, kWm (BHP)	2180 (2923)
Cylinder head material	Cast Iron
Crankshaft material	Steel
Valve (exhaust) material	Steel
Governor: type, make/model	KODEC Electronic Control
Frequency regulation, no-load to-full load	Isochronous
Frequency regulation, steady state	±0.25%
Frequency	Fixed
Air cleaner type, all models	Dry

Lubricating System	60 Hz
Type	Full Pressure
Oil pan capacity with filter (initial fill), L (qt.) §	335 (354)
Oil filter: quantity, type §	6, Cartridge
Oil cooler	Water-Cooled

§ Kohler recommends the use of Kohler Genuine oil and filters.

Fuel System	60 Hz
Fuel supply line, min. ID, mm (in.)	25 (1.0)
Fuel return line, min. ID, mm (in.)	19 (0.75)
Max. fuel flow, Lph (gph)	768 (202.9)
Min./max. fuel pressure at engine supply connection, kPa (in. Hg)	-30/30 (-8.8/8.8)
Maximum diesel fuel lift, m (ft.)	3.7 (12)
Max. return line restriction, kPa (in. Hg)	30 (8.9)
Fuel filter: quantity, type	2, Primary Engine Filter 2, Fuel/Water Separator
Recommended fuel	#2 Diesel ULSD

Fuel Consumption	60 Hz
Diesel, Lph (gph) at % load	**Standby Rating**
100%	564 (149.1)
75%	433 (114.3)
50%	308 (81.3)
25%	186 (49.1)
Diesel, Lph (gph) at % load	**Prime Rating**
100%	516 (136.3)
75%	401 (106.0)
50%	287 (75.8)
25%	172 (45.5)

Radiator System	60 Hz	
Ambient temperature, °C (°F)*	50 (122)	40 (104)
Engine jacket water capacity, L (gal.)	356 (94)	
Radiator system capacity, including engine, L (gal.)	643 (170)	539 (142)
Engine jacket water flow, Lpm (gpm)	2082 (550)	
Heat rejected to cooling water at rated kW, dry exhaust, kW (Btu/min.)	780 (44357)	
Charge cooler water flow, Lpm (gpm)	662 (174)	
Heat rejected to charge cooling water at rated kW, dry exhaust, kW (Btu/min.)	630 (35827)	
Water pump type	Centrifugal	
Fan diameter, including blades, mm (in.)	2235 (88)	1901 (75)
Fan, kWm (HP)	90 (120.7)	85 (114)
Max. restriction of cooling air, intake and discharge side of radiator, kPa (in. H_2O)	0.125 (0.5)	

* Enclosure with enclosed silencer reduces ambient temperature capability by 5°C (9°F).

Remote Radiator System†	60 Hz
Exhaust manifold type	Dry
Connection sizes:	Class 150 ANSI Flange
Water inlet/outlet, mm (in.)	216 (8.5) Bolt Circle
Intercooler inlet/outlet, mm (in.)	178 (7.0) Bolt Circle
Static head allowable above engine, kPa (ft. H_2O)	70 (23.5)

† Contact your local distributor for cooling system options and specifications based on your specific requirements.

Exhaust System	60 Hz
Exhaust flow at rated kW, m^3/min. (cfm)	498 (17586)
Exhaust temperature at rated kW at 25°C (77°F) ambient, dry exhaust, °C (°F)	500 (932)
Maximum allowable back pressure, kPa (in. Hg)	8.5 (2.5)
Exh. outlet size at eng. hookup, mm (in.)	See ADV drawing

Electrical System	60 Hz
Battery charging alternator:	
Ground (negative/positive)	Negative
Volts (DC)	24
Ampere rating	140
Starter motor qty. at starter motor power rating, rated voltage (DC)	Standard: 2 @ 9 kW, 24; Redundant (optional); 2 @ 15 kW, 24
Battery, recommended cold cranking amps (CCA):	
Quantity, CCA rating each, type (with standard starters)	4, 1110, AGM
Quantity, CCA rating each, type (with redundant starters)	8, 1110, AGM
Battery voltage (DC)	12

Air Requirements	60 Hz	
Radiator-cooled cooling air, m^3/min. (scfm)‡	50°C	40°C
	2549 (90000)	2321 (82000)
Cooling air required for generator set when equipped with city water cooling or remote radiator, based on 14°C (25°F) rise, m^3/min. (scfm)‡	930 (32858)	
Combustion air, m^3/min. (cfm)	179 (6321)	
Heat rejected to ambient air:		
Engine, kW (Btu/min.)	100 (5687)	
Alternator, kW (Btu/min.)	160 (9099)	

‡ Air density = 1.20 kg/m^3 (0.075 lbm/ft^3)

Alternator Specifications		60 Hz
Type		4-Pole, Rotating-Field
Exciter type		Brushless, Permanent-Magnet Pilot Exciter
Voltage regulator		Solid-State, Volts/Hz
Insulation:		NEMA MG1, UL 1446, Vacuum Pressure Impregnated (VPI)
Material		Class H, Synthetic, Nonhygroscopic
Temperature rise		130°C, 150°C Standby
Bearing: quantity, type		1 or 2, Sealed
Coupling type		Flexible Disc or Coupling
Amortisseur windings		Full
Alternator winding type (up to 600 V)		Random Wound
Alternator winding type (above 600 V)		Form Wound
Rotor balancing		125%
Voltage regulation, no-load to full-load		±0.25%
Unbalanced load capability		100% of Rated Standby Current
Peak motor starting kVA:		(35% dip for voltages below)
480 V	KH04970TO4D	3750
480 V	KH06930TO4D	5990
480 V	KH07770TO4D	7170
480 V	KH08430TO4D	9908

Alternator Standard Features

- The pilot-excited, permanent magnet (PM) alternator provides superior short-circuit capability.
- All models are brushless, rotating-field alternators.
- NEMA MG1, IEEE, and ANSI standards compliance for temperature rise and motor starting.
- Sustained short-circuit current of up to 300% of the rated current for up to 10 seconds.
- Sustained short-circuit current enabling downstream circuit breakers to trip without collapsing the alternator field.
- Self-ventilated and dripproof construction.
- Superior voltage waveform from two-thirds pitch windings and skewed stator.
- Brushless alternator with brushless pilot exciter for excellent load response.

NOTE: See TIB-102 Alternator Data Sheets for alternator application data and ratings, efficiency curves, voltage dip with motor starting curves, and short circuit decrement curves.

Controllers

APM802 Controller
Provides advanced control, system monitoring, and system diagnostics for optimum performance and compatibility.

- 12-inch graphic display with touch screen and menu control provide easy local data access
- Measurements are selectable in metric or English units
- User language is selectable
- Two USB ports allow connection of a flash drive, mouse, or keypad
- Electrical data, mechanical data, and system settings can be saved to a flash drive
- Ethernet port allows connection to a PC type computer or Ethernet switch
- The controller supports Modbus® RTU and TCP protocols
- NFPA 110 Level 1 capability

Refer to G6-152 for additional controller features and accessories.

Modbus® is a registered trademark of Schneider Electric.

APM603 Controller
Provides advanced control, system monitoring, and system diagnostics for optimum performance and compatibility.

- 7-inch graphic display with touch screen and menu control provides easy local data access
- Measurements are selectable in metric or English units
- Paralleling capability to control up to 8 generators on an isolated bus with first-on logic, synchronizer, kW and kVAR load sharing, and protective relays
  Note: Parallel with other APM603 controllers only
- Generator management to turn paralleled generators off and on as required by load demand
- Load management to connect and disconnect loads as required
- Controller supports Modbus® RTU, Modbus® TCP, SNMP and BACnet®
- Integrated voltage regulator with ±0.25% regulation
- Built-in alternator thermal overload protection
- UL-listed overcurrent protective device
- NFPA 110 Level 1 capability

Refer to G6-162 for additional controller features and accessories.

BACNet® is a registered trademark of ASHRAE.

Codes and Standards

- Engine- generator set is designed and manufactured in facilities certified to ISO 9001.
- Generator set meets NEMA MG1, BS5000, ISO, DIN EN, and IEC standards, NFPA 110.
- Engine generator set is tested to ISO 8528-5 for transient response.
- The generator set and its components are prototype-tested, factory-built, and production-tested.

Third-Party Compliance

- Tier 2 EPA-Certified for Stationary Emergency Applications

Available Approvals and Listings

- ❑ California HCAI Pre- Approval
- ❑ CSA Certified
- ❑ IBC Seismic Certification
- ❑ UL 2200 Listing
- ❑ cULus
- ❑ Florida Dept. of Environmental Protection (FDEP) Compliance (fuel tanks only)

Warranty Information

- A standard three-year or 1000-hour limited warranty for standby applications. Five-year basic, five-year comprehensive, and ten-year extended limited warranties are also available.
- A standard two-year or 8700-hour limited warranty for prime power applications.

Available Warranties for Standby Applications

- ❑ 5-Year Basic Limited Warranty
- ❑ 5-Year Comprehensive Limited Warranty
- ❑ 10-Year Major Components Limited Warranty

Standard Features

- Closed Crankcase Ventilation (CCV) Filters
- Customer Connection
- Local Emergency Stop Switch
- Oil Drain and Coolant Drain Extension
- Operation and Installation Literature
- Fan Bearing Grease Extension
- Fuel/Water Separator
- Generator Heater
- Spring Isolation Under the Skid

KOHLER®

Industrial Diesel Generator Set - KD2000

Tier 2 EPA-Certified for Stationary Emergency Applications

Available Options

Circuit Breakers

Type	Rating
❑ Magnetic Trip	❑ 80%
❑ Thermal Magnetic Trip	❑ 100%
❑ Electronic Trip (LI)	**Operation**
❑ Electronic Trip with Short Time (LSI)	❑ Manual
	❑ Electrically Operated (for paralleling)

Circuit Breaker Mounting

- ❑ Generator Mounted
- ❑ Remote Mounted
- ❑ Bus Bar (for remote mounted breakers)

Enclosed Remote Mounted Circuit Breakers

- ❑ NEMA 1 (15- 5000 A)
- ❑ NEMA 3R (15- 1200 A)

Engine Type

- ❑ KDxxxx Tier 2 EPA-Certified Engine
- ❑ KDxxxx-F Fuel Optimized Engine

Approvals and Listings

- ❑ California HCAI Pre- Approval
- ❑ CSA Certified
- ❑ IBC Seismic Certification
- ❑ UL 2200 Listing
- ❑ cULus
- ❑ Florida Dept. of Environmental Protection (FDEP) Compliance (fuel tanks only)

Enclosed Unit

- ❑ Sound Level 1 Enclosure/Fuel Tank Package
- ❑ Sound Level 2 Enclosure/Fuel Tank Package

Open Unit

- ❑ Exhaust Silencer, Critical
- ❑ Exhaust Silencer, Hospital
- ❑ Flexible Exhaust Connector, Stainless Steel

Controller

- ❑ Input/Output, Digital
- ❑ Input/Output, Thermocouple (standard on 4160 V and above)
- ❑ Load Shed (APM802 only)
- ❑ Manual Key Switch
- ❑ Remote Emergency Stop Switch
- ❑ Lockable Emergency Stop Switch
- ❑ Remote Serial Annunciator Panel

Cooling System

- ❑ Block Heater; 9000 W, 208 V, (Select 1 Ph or 3 Ph) *
- ❑ Block Heater; 9000 W, 240 V, (Select 1 Ph or 3 Ph) *
- ❑ Block Heater; 9000 W, 380 V, 3 Ph *
- ❑ Block Heater; 9000 W, 480 V, (Select 1 Ph or 3 Ph) *

* Required for Ambient Temperatures Below 10°C (50°F)

Electrical System

- ❑ Battery, AGM (kit with qty. 4)
- ❑ Battery Charger
- ❑ Battery Heater; 100 W, 120 V, 1Ph
- ❑ Battery Rack and Cables
- ❑ Redundant Starters

Fuel System

- ❑ Flexible Fuel Lines
- ❑ Restriction Gauge (for fuel/water separator)

Literature

- ❑ General Maintenance
- ❑ NFPA 110
- ❑ Overhaul
- ❑ Production

Miscellaneous

- ❑ Air Cleaner, Heavy Duty (loose)
- ❑ Air Cleaner Restriction Indicator
- ❑ Automatic Oil Replenishment System
- ❑ Engine Fluids (oil and coolant) Added
- ❑ Centrifugal Oil Filter Assembly
- ❑ Rated Power Factor Testing

Electrical Package (Requires Enclosure selection)

- ❑ Basic Electrical Package (select 1 Ph or 3 Ph)
- ❑ Wire Battery Charger (1 Ph)
- ❑ Wire Block Heater (select 1 Ph or 3 Ph)
- ❑ Wire Controller Heater (1 Ph)
- ❑ Wire Generator Heater (1 Ph)

Warranty (Standby Applications only)

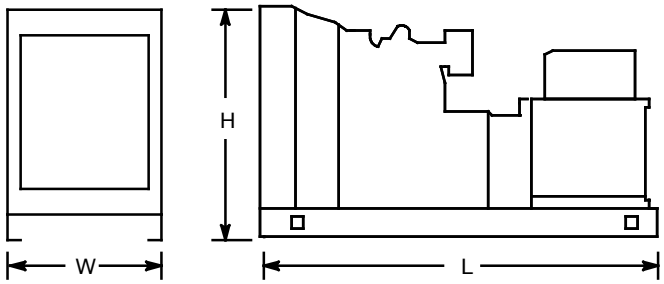
- ❑ 5-Year Basic Limited Warranty
- ❑ 5-Year Comprehensive Limited Warranty
- ❑ 10-Year Major Components Limited Warranty

Other

- ❑
- ❑

Dimensions and Weights

Overall Size, max., L x W x H, mm (in.):	6957 x 2852 x 3307 (273.9 x 112.3 x 130.2)
Weight, radiator model, max. wet, kg (lb.):	27033 (59598)



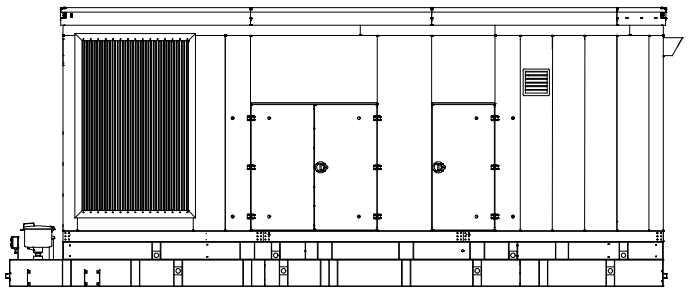
NOTE: This drawing is provided for reference only and should not be used for planning installation. Contact your local distributor for more detailed information.

KOHLER CO., Kohler, Wisconsin 53044 USA
Phone 920-457-4441, Fax 920-459-1646
For the nearest sales and service outlet in the US and Canada, phone 1-800-544-2444
KOHLERPower.com

Sound Enclosures and Subbase Fuel Tank

Sound Level 1 Enclosure Standard Features

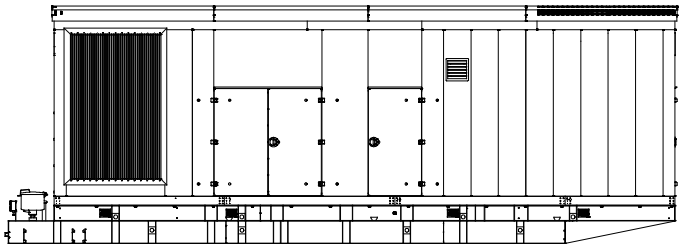
- Lift base or tank-mounted, aluminum construction enclosure with internal-mounted, exhaust silencers.
- Every enclosure has a sloped roof to reduce the buildup of moisture and debris.
- Sound attenuated enclosure that offers noise reduction using acoustic insulation, acoustic-lined air inlets and an acoustic-lined air discharge.
- Fade-, scratch-, and corrosion-resistant Kohler® Power Armor™ automotive-grade textured finish.
- Acoustic insulation that meets UL 94 HF1 flammability classification.
- Enclosure has large access doors that are hinged and removable which allow for easy maintenance.
- Lockable, flush-mounted door latches.
- Air inlet louvers reduce rain and snow entry.
- High wind bracing, 241 kph (150 mph).



Sound Level 1 Enclosure
(Shown with available spill containment)

Sound Level 2 Enclosure Standard Features

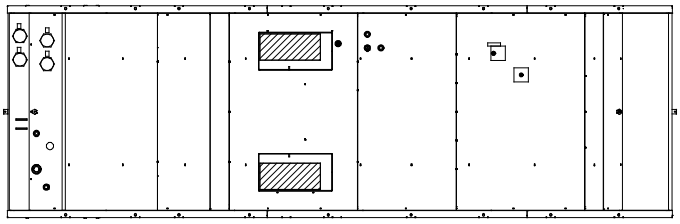
- Includes all of the sound level 1 enclosure features with the addition of up to 51 mm (2 in.) acoustic insulation material, intake sound baffles, vertical air discharge, and secondary silencers.
- Louvered air inlet and vertical outlet hood with 90 degree angles to redirect air and reduce noise.



Sound Level 2 Enclosure
(Shown with available spill containment)

Subbase Fuel Tank Features

- The fuel tank has a black powder-coat finish texture.
- The above-ground rectangular secondary containment tank mounts directly to the generator set, below the generator set skid (subbase).
- Both the inner and outer tanks have UL-listed emergency relief vents.
- Flexible fuel lines are provided with subbase fuel tank selection.
- The containment tank's construction protects against fuel leaks or ruptures. The inner (primary) tank is sealed inside the outer (secondary) tank. The outer tank contains the fuel if the inner tank leaks or ruptures.
- The above ground secondary containment subbase fuel tank meets UL 142 requirements.
- Features include:
  - Additional fittings for optional accessories (qty. 3)
  - Electrical stub-up area open to bottom
  - Emergency inner and outer tank relief vents
  - Fuel fill with lockable cap and 51 mm (2 in.) riser
  - Fuel leak detection switch
  - Fuel level mechanical gauge
  - Fuel level sender
  - Normal vent
  - Removable engine supply and return diptubes



Subbase Fuel Tank (Top View)

DISTRIBUTED BY:

KOHLER®

KD2000

60 Hz. Diesel Generator Set
Tier 2 EPA Certified for Stationary Emergency Applications
EMISSION OPTIMIZED DATA SHEET

ENGINE INFORMATION

Model:	KD62V12	Bore:	175 mm (6.89 in.)
Type:	4-Cycle, 12-V Cylinder	Stroke:	215 mm (8.46 in.)
Aspiration:	Turbocharged, Intercooled	Displacement:	62 L (3783 cu. in.)
Compression ratio:	16:0:1		
Emission Control Device:	Direct Diesel Injection, Engine Control Module, Turbocharger, Charge Air Cooler		

NOMINAL EMISSION DATA

Cycle point	100% ESP	75% ESP	50% ESP	25% ESP
Power [kW]	2180	1635	1090	545
Speed [rpm]	1800	1800	1800	1800
Exhaust Gas Flow [kg/h]	13620	12480	9227	5486
Exhaust Gas Temperature [C]	431	436	451	458
NO_X [g/kWh]	7.7	5.0	4.5	4.9
CO [g/kWh]	0.3	0.6	0.8	2.7
HC [g/kWh]	0.14	0.16	0.21	0.31
PM [g/kWh]	0.04	0.09	0.12	0.37

NOT TO EXCEED EMISSION DATA

Cycle point	100% ESP	75% ESP	50% ESP	25% ESP
NO_X [g/kWh]	9.1	5.9	5.3	5.8
CO [g/kWh]	1.1	1.8	2.6	8.3
HC [g/kWh]	0.16	0.19	0.24	0.36
PM [g/kWh]	0.06	0.13	0.17	0.53

TEST METHODS AND CONDITIONS

Test Methods:
Steady-State emissions recorded per EPA CFR 40 Part 1065, and ISO8178-1 during operation at rated engine speed (+/-2%) and stated constant load (+/-2%) with engine temperatures, pressures and emission rated stabilized.

Fuel Specification:
40-48 Cetane Number, 0.05 Wt. % max. Sulfur; Reference ISO8178-5, 40CFR86.1313-98 Type 2-D and ASTM D975 No. 2-D.

Reference Conditions:
25 °C (77 °F) Air Inlet Temperature, 40 °C (104 °F) Fuel Inlet Temperature, 100 kPa (29.53 in Hg) Barometric Pressure; 10.7 g/kg (75 grains H2O/lb.) of dry air Humidity (required for NOx correction); Intake Restriction set to maximum allowable limit for clean filter; Exhaust Back pressure set to maximum allowable limit.

Data was taken from a single engine test according to the test methods, fuel specification and reference conditions stated above and is subjected to instrumentation and engine-to-engine variability. Tests conducted with alternate test methods, instrumentation, fuel or reference conditions can yield different results.

Data and specifications subject to change without notice.

APPENDIX C

Flare Specifications

Declaration

Customer	**NORTH-TEC Maschinenbau GmbH** Oldenhörn 1 25821 Bredstedt
Reference:	**Gas flare US market**
Date:	17.07.2024
Typ:	MTU 3000
Project:	USA
Offer Number:	008/01/24Ma North-Tec

Conformity with TA-Luft

The previously mentioned gas flare is an insulated high-temperature flare with concealed combustion, suitable for the thermal disposal of combustible excess gases and meets the requirements of TA-Luft point 5.4.8.1.3a.

Especially:

- Combustion temperature > 1000°C
- Dwell time over 0.3 seconds
- Emission reduction > 99% based on total carbon content

With the expected gas concentration of 65% CH4, 0.2% N2, 0.1% O2, 0.0991% H2S, 0.004% VOC (all volume basis), with the remaining portion CO2 experience has shown that the following limit values are not exceeded in regular operation, but depend on the exact gas composition and therefore cannot be guaranteed.

Measuring component	Unit	Orientation value *
Oxygen - O2	%	6 - 16
Carbon dioxide - CO2	%	5 - 15
Carbon monoxide - CO	mg/Nm³	10 - 100
Nitrogen oxides - NOx	mg/Nm³	20 – 200
Sulphur dioxide- SOx	mg/Nm³	20 – 400

*measured values from reference projects with moist exhaust gas and current oxygen content

Korneuburg on 17/07/2024

Marco Gerhartl, CTO

Sample Exhaust Flow Calculation - See Flare Emissions in Appendix B for flowrate calculation.

GASTECHNIK HIMMEL www.gt-himmel.com | +43 (0) 2262 / 61369

Exhaust flow MTU 3000, Proj. USA

Design data:

V =	2500 m³	Biogas	
mit	65 %	CH_4	
T =	1000 °C	Verbrennungstemperatur	Model Temperature Parameter

Volume CH_4 =	1625 m³	
Volume CO_2 =	875 m³	
Total gas:	2500 m³	
Combustion air:	17875 m³	… 11m³ air per m³ CH_4
Total Volume:	20375 m³	… Combustion air + Total gas

Exhaust flow V_2:

V_2 =	95009 m³/h
=	26,39 m³/s

$$V_2 = \frac{V_{Ges} \times (T + 273°K)}{273°K}$$

Flow velocity v:

Tube diameter =	2 m
Section =	3,14 m²
v =	8,40 m/s

$$v = \frac{V_2}{A}$$

Tube height:

Residence time =	0,3 s
Residence zone =	2,52 m
Flame heigth =	3 m
min. h =	5,52 m

APPENDIX D

Permit Conditions

APPENDIX D: PERMIT CONDITIONS

Equipment List

The table below lists all equipment and processes that are considered air emission units at the facility for the purposes of this NOC application.

Table 1: Facility Air Emission Unit List

Emission Unit	Description
Boiler 1, Boiler 2	**Manufacturer & Model**: Cleaver-Brooks CB or similar **Rating per Equipment**: 24.13 MMBtu/hr **Fuel**: Natural gas **Control Device**: None
Emergency Generator Set 1	**Manufacturer & Genset Model**: Kohler KD2000 or similar **Engine Model**: KD62V12 or similar **Rating per Engine**: 2,190 kW (2,923 BHP) **Fuel**: Diesel **Control Device**: Tier 2 EPA-certified
Biogas Upgrading System with a Paques THIOPAQ® scrubbing system followed by granulated activated carbon beds	**Manufacturer**: Paques **Additional Control Device**: None
Emergency Flare 1, Emergency Flare 2, Emergency Flare 3, Emergency Flare 4	**Manufacturer & Model**: Gastechnik Himmel MTU 3000 or similar **Rating per Equipment**: 59 MMBtu/hr **Control Device**: None
Cellulose Grinding	**Control Device**: Enclosed building, KICE Industries cyclone and baghouse dust collection system or similar

Proposed Permit Conditions

Operating Limits

Facility-Wide

- The permittee must operate all equipment according to manufacturer specifications and materials submitted with the NSR application and the approval conditions of this order.
- An O&M plan for all emission units shall be developed and implemented as specified in this Order and manufacturer's recommended standards to control air emissions.

- The permittee shall use recognized good practice and procedures to reduce any odors from any source or activity which may unreasonably interfere with any other property owner's use and enjoyment of her or his property to a reasonable minimum.
- The permittee shall take reasonable precautions to prevent fugitive dust from becoming airborne and must maintain and operate the source to minimize emissions.

Boilers

- Boilers 1 and 2 shall be fueled by natural gas exclusively.
- Boilers 1 and 2 shall not have a rated input capacity greater than 24.2 MMBtu/hr, each.

Emergency Generator

- The emergency generator shall be fueled exclusively by diesel fuel that meets the requirements for ultra-low sulfur diesel standards of 40 CFR § 1090.305 [40 CFR § 60.4207(b)].
- The emergency generator is limited to 80 hours of operation per year for maintenance checks, readiness testing, and emergency operation.
- The emergency generator must be in compliance with applicable requirements of 40 CFR Part 60, Subpart IIII at all times.

Flares

- Biogas generated from the digestors shall either be transported to the natural gas pipeline or combusted in the flares.
- The total volume of biogas combusted in the flares shall not exceed 158.2 MMSCF per calendar year (total for all flares).
- A flame shall be present in the flare at all times the biogas is being combusted in the flare.
- The H_2S concentration of the gas being combusted in the flares shall not exceed 991 ppm.

Cellulose Grinding

- Straw processing shall not exceed 200 tons per day.

Emission Limits

- Facility-wide emissions shall not exceed any limits as noted in the table below:

Table 2: Facility-Wide Emission Limits

Pollutant	Annual Emissions (tpy)
CO	24.4
NO_X	7.5
PM_{10}	4.2
$PM_{2.5}$	2.8
SO_2	13.4
VOC	0.9

- The permittee shall also comply with all applicable standards for maximum air emissions as specified in WAC 173-400-040.
  - Visible emissions from each boiler stack, flare stack, and baghouse stack must not exceed 20 percent opacity averaged over six minutes.

Monitoring, Recordkeeping, and Reporting Requirements

Facility-Wide

- The permittee shall keep records of all maintenance and testing conducted on any of the emission units.
- The O&M plan shall be updated as necessary and reflect any changes in operating procedures and such changes shall be routinely implemented.
- The permittee must submit a report of any startup, shutdown, or malfunctions that are inconsistent with the O&M plan or this permit and include actions that were taken for the event pursuant to WAC 173-400-108 or WAC 173-400-109.
- Records and logs associated with monitoring and tracking within the O&M plan for the facility shall be kept on site or at a nearby office for a minimum of 3 years. These O&M Plan records shall be readily available, organized, and accessible upon request by the YRCAA or designated staff.

Boilers

- The permittee shall comply with applicable notification requirements of 40 CFR 60.48c(a) and 40 CFR 60.7, including: notification of the date of construction and heat input capacity of affected units, notification of actual date of initial startup, and notification of any physical or operational changes which may increase emissions unless exempted by 40 CFR 60, Subpart Dc or 50 CFR 60.14(e).
- The permittee shall record and maintain records of the amount of fuel combusted in the Boilers during each calendar month [40 CFR § 60.48c(g)(2)].

Emergency Generator

- The permittee shall record and maintain annual hours of operation of the Emergency Generator for emergency and non-emergency purposes recorded through a non-resettable hour meter. The owner must record the time of operation of the engine and the reason the engine was in operation during that time.

Flares

- The permittee shall record and maintain the annual quantity of biogas combusted in the flares.
- The permittee shall use an H_2S continuous emission monitoring system (CEMS) or a handheld H_2S monitor to determine H_2S concentration of the biogas combusted in the flares.
- Within 180 days of generating biogas in the anaerobic digester, the permittee shall use a handheld H_2S monitor or agency-approved alternative such as a laboratory analysis to determine the H_2S concentration in the biogas.
- The permittee shall install, calibrate, maintain, and operate a biogas flow meter at the inlet to the flares in order to determine the quantity of biogas combusted in the flares.

Cellulose Grinding

The permittee shall record and maintain records of the total amount of straw processed per day. The amount of straw processed per day shall be measured with a scale prior to processing.