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Filer:	Lindsey Xayachack
Organization:	Jacobs
Submitter Role:	Applicant Consultant
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Data Response Set 4 (Revised Responses to Data Requests 1 and 2)

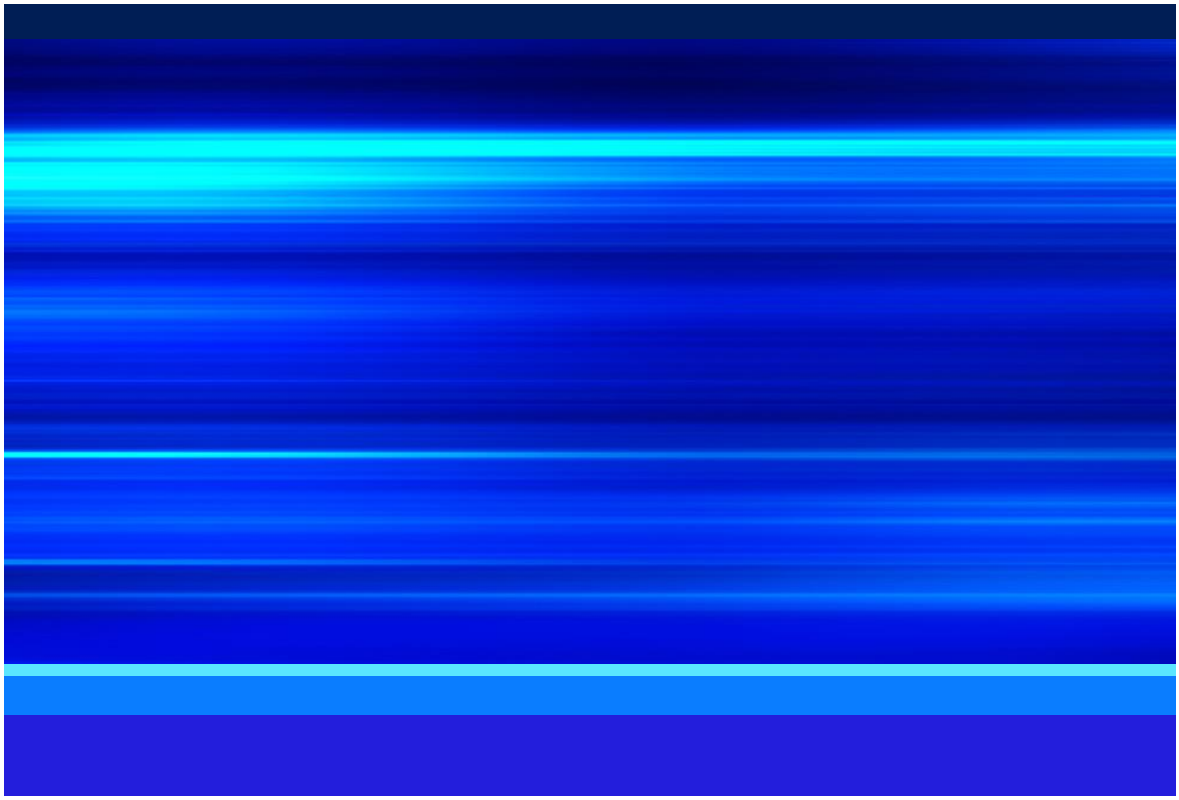
Submitted to
California Energy Commission

Prepared by
Black Rock Geothermal LLC

With assistance from
Jacobs

Black Rock Geothermal Project
(23-AFC-03)

March 6, 2024



Introduction

Attached are Black Rock Geothermal LLC's[1] (Applicant) revised responses to the California Energy Commission (CEC) Staff's *Data Requests Set 4* regarding the Application for Certification (AFC) for the Black Rock Geothermal Project (BRGP) (23-AFC-03). This submittal includes revised responses to Data Requests (DR) 1 and 2.

The responses are grouped by individual discipline or topic area. Within each discipline area, the responses are presented in the same order as presented in *Data Requests Set 4* and are keyed to the Data Request numbers.

New or revised graphics or tables are numbered in reference to the Data Request number. For example, the first table used in response to Data Request 28 would be numbered Table DR28-1. The first figure used in response to Data Request 28 would be Figure DR28-1, and so on. Figures or tables from the BRGP AFC that have been revised have a "R" following the original number, indicating a revision.

Additional tables, figures, or documents submitted in response to a data request (for example, supporting data, stand-alone documents such as plans, folding graphics, etc.) are found at the end of each discipline-specific section and are not sequentially page numbered consistently with the remainder of the document, though they may have their own internal page numbering system.

[1] An indirect, wholly owned subsidiary of BHE Renewables, LLC ("BHER").

Contents

Appendices

Tables

Acronyms and Abbreviations

µg/m^3	microgram(s) per cubic meter
AFC	Application for Certification
Applicant	Black Rock Geothermal LLC
BRGP	Black Rock Geothermal Project
CAAQS	California Ambient Air Quality Standards
CEC	California Energy Commission
DR	Data Request
EPA	U.S. Environmental Protection Agency
g/kW-hr	gram(s) per kilowatt-hour
lbs/hr	pound(s) per hour
MW	megawatt
NAAQS	National Ambient Air Quality Standards
NO_2	nitrogen dioxide
NOx	nitrogen oxides
Revised DRR Set 1	Black Rock Geothermal Project Data Request Response Set 1 (Revised Responses to Data Requests 3, 4, 7, 10 to 13, and 63 to 66)
SCR	Selective Catalytic Reduction
SIL	Significant Impact Level
TN	Transaction Number
tpy	ton(s) per year
VOC	volatile organic compounds

1. Air Quality (DR 1-2)

Background: Diesel Engine Emissions and Impacts (DR 1-2)

The Black Rock Geothermal Project Data Request Response Set 1 (Revised Responses to Data Requests 3, 4, 7, 10 to 13, and 63 to 66) (TN 253080) states that the project would use one Tier 3-certified fire pump and three Tier 4-certified emergency generators (collectively, the Units). In the emission estimation and impacts analysis, the applicant used vendor data for the Tier 3 fire pump and assumed Tier 4 emissions for the emergency generators. However, based on experience analyzing data center projects, staff understands that normally the selective catalytic reduction (SCR) for the Units needs time to warm up before it can reach full NOx control effectiveness. Therefore, worst-case hourly NOx emissions would include uncontrolled emissions during the warm-up period and controlled emissions for the rest of the hour. Staff needs engine manufacturer and emissions control device specifications sheets to verify the emission rates used by the applicant. Staff also needs clarification on whether the applicant would test the engines concurrently or only one engine at a time during a single hour.

Data Requests:

1. *For the Units, please provide up-to-date manufacturer specification sheets showing engine and emissions control system performance specifications. This information should identify uncontrolled and controlled emissions and the warm-up time for the SCR to reach full effectiveness.*

Response: The Applicant is currently proposing to use Kohler Model KD3250 diesel-fired emergency generators, driven by Kohler Model KD83V16 engines, for the BRGP. Attachment DR 1 presents a manufacturer specification sheet for the Tier 4 certified version of this engine. In the absence of manufacturer-provided data regarding the engine warm-up period, a manufacturer specification sheet for the Tier 2 certified version of this engine is also provided in Attachment DR 1. The Tier 2 emission rates were assumed to be representative of emissions during the Tier 4 engine's uncontrolled warm-up period. The warm-up period was assumed to last up to 15 minutes, based on data from similar facilities.

2. *For the Units, please update the NOx emissions estimation and NO_2 impacts modeling analysis to account for uncontrolled emissions during the SCR warm-up period and controlled emissions for the rest of the hour.*

Response: Nitrogen oxides (NOx) emission estimates from the three (3) 3.25-megawatt (MW) diesel-fired emergency generators have been updated to incorporate uncontrolled emissions during a 15-minute Selective Catalytic Reduction (SCR) control system warm-up period and controlled emissions for the remainder of the hour (e.g., 45 minutes). In the absence of manufacturer-provided emission rates for the engine's warm-up period, uncontrolled emissions were assumed to be represented by the engine's Tier 2 certification, as measured during a U.S. Environmental Protection Agency (EPA) D2 Cycle 5-mode Weighted test; this value is expected to be comparable to the Tier 2 standard of 6.4 grams per kilowatt-hour (g/kW-hr) for NOx and volatile organic compounds (VOC) combined. Controlled emissions were conservatively represented by the Tier 4 standard, as presented in Table 4 of Title 17 of the California Code of Regulations Section 93115.7, despite the expectation that the engine is capable of performing better than this standard.

The revised NOx emission estimates are presented in Table DR2-1. Supporting calculations, as well as a comparison to what was originally considered, are provided in Attachment DR 2. As shown, the hourly emissions per generator are approximately three times higher than what was presented in Table 5.1-12 of

Attachment DRR 7-1 of the *Black Rock Geothermal Project Data Request Response Set 1 (Revised Responses to Data Requests 3, 4, 7, 10 to 13, and 63 to 66)* (Revised DRR Set 1; Transaction Number [TN] #253080).

Table DR2-1. Maximum NOx Emissions from Emergency Generators

Pollutant	Per 3.25-MW Emergency Generator		Three 3.25-MW Emergency Generators
	(lbs/hr)	(tpy)	(tpy)
NO_x	12.66	0.32	0.95

Note:

lbs/hr = pound(s) per hour

tpy = ton(s) per year

To determine potential air quality impacts associated with this increase in hourly and annual NOx emissions, air dispersion modeling was performed per the methodology and source characterization outlined in Section 5.1.9 of Attachment DRR 7-1 of Revised DRR Set 1 (TN #253080) with the following exception:

- Only one (1) diesel-fired emergency generator or the diesel fire water pump could operate in a single hour, instead of assuming all four (4) emission sources could operate in a single hour.

Although NOx emissions from the BRGP's diesel fire water pump have not changed from what was presented in Table 5.1-12 of Attachment DRR 7-1 of Revised DRR Set 1 (TN #253080), they were also modeled to determine potential impacts from all NOx-emitting sources at the facility.

Results of the revised NOx air dispersion modeling are presented in Tables DR2-2 and DR2-3. As shown, facility impacts are less than the EPA's Significant Impact Levels (SILs) and the California and National Ambient Air Quality Standards (CAAQS and NAAQS, respectively) for all nitrogen dioxide (NO_2) averaging periods. In fact, these results are less than what was originally presented in Tables 5.1-30 and 5.1-31 of Attachment DRR 7-1 of Revised DRR Set 1 (TN #253080). Although the 1-hour modeled NOx emission rate for a single diesel-fired emergency generator tripled, modeling only one NOx-emitting source in a single hour (as will be done during actual facility operations) has resulted in less conservative, but still conservative modeled impacts.

Table DR2-2. Operation Air Quality Impact Results for NOx – Significant Impact Levels

Pollutant	Averaging Period	Maximum Concentration ($\mu g/m^3$) [a]	Class II SIL ($\mu g/m^3$)	Exceeds Class II SIL?
NO_2	5-year average of 1-hour yearly maxima	0.74	7.55	No
	Annual maximum	0.04	1.00	No

[a] Because only one diesel-fired emergency generator or the diesel fire water pump could operate in a single hour for maintenance and testing purposes, the maximum concentration presented is based on the maximum modeled impact from either the diesel fire water pump or one of the diesel-fired emergency generators.

Note:

$\mu g/m^3$ = microgram(s) per cubic meter

Table DR2-3. Operation Air Quality Impact Results for NOx – Ambient Air Quality Standards

Pollutant	Averaging Period	Modeled Conc. (µg/m³) [a]	Background Conc. (µg/m³)	Total Conc. (µg/m³)	CAAQS (µg/m³)	NAAQS (µg/m³)	Exceeds Standard?
NO_2	1-hour maximum (CAAQS)	89.7	105	195	339	--	No
	5-year average of 1-hour yearly 98th percentiles (NAAQS) [b]	0.70	65.2	65.9	--	188	No
	Annual maximum	0.04	17.4	17.4	57	100	No

[a] Because only one diesel-fired emergency generator or the diesel fire water pump could operate in a single hour for maintenance and testing purposes, the maximum concentration presented is based on the maximum modeled impact from either the diesel fire water pump or one of the diesel-fired emergency generators.

[b] 5-year average of 8th high.

Note:

-- = Not applicable and/or no standard

Based on the above results, the BRGP will not cause or contribute to a violation of the NAAQS or CAAQS, even with incorporation of a 15-minute warm-up period for each diesel-fired emergency generator's SCR control system. As such, a cumulative impacts assessment for NOx is still not warranted. Revised modeling files will be submitted under separate cover within one (1) week of submitting this response.

Attachment DR 1
Emergency Generator Specification Sheets

KOHLER®

KD3250

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

ENGINE INFORMATION

Model:	KD83V16	Bore:	175 mm (6.89 in.)
Nameplate kW @ 1800 RPM:	3490	Stroke:	215 mm (8.46 in.)
Type:	4-Cycle, 16-V Cylinder	Displacement:	83 L (5048 cu. in.)
Aspiration:	Turbocharged, Intercooled	EPA Family:	RLHAL103.ESP
Compression ratio:	16:0:1	EPA Certificate:	RLHAL103.ESP-018
Emission Control Device:	Direct Diesel Injection, Engine Control Module, Turbocharger, Charge Air Cooler		

EXHAUST EMISSION DATA:		**EPA D2 Cycle 5-mode weighted**
HC	(Hydrocarbons)	0.54 g/kWh
NO_x	(Oxides of Nitrogen as NO_2)	5.06 g/kWh
CO	(Carbon Monoxide)	1.02 g/kWh
PM	(Particulate Matter)	0.11 g/kWh

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 rates stabilized.

Fuel Specification:
ASTM D975 No. 2-D S15 or 40 CFR Part 1065 Petroleum Diesel Fuel.

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.

KOHLER®

KD3250-4

60 Hz. Diesel Generator Set

Tier 4 EPA Certified for Stationary and Mobile Applications

ENGINE INFORMATION

Model:	KD83V16	Bore:	175 mm (6.89 in.)
Nameplate kW @ 1800 RPM:	2644-3490	Stroke:	215 mm (8.46 in.)
Type:	4-Cycle, 16-V Cylinder	Displacement:	83 L (5048 cu. in.)
Aspiration:	Turbocharged, Intercooled	EPA Family:	RLHAL103.VQC
Compression ratio:	16:0:1	EPA Certificate:	RLHAL103.VQC-020
Emission Control Device:	Direct Diesel Injection, Engine Control Module, Turbocharger, Charge Air Cooler, Ammonia Slip Catalyst, Selective Catalytic Reduction		

EXHAUST EMISSION DATA:		**EPA D2 Cycle 5-mode weighted**
HC	(Hydrocarbons)	0.01 g/kWh
NO_x	(Oxides of Nitrogen as NO_2)	0.40 g/kWh
CO	(Carbon Monoxide)	0.15 g/kWh
PM	(Particulate Matter)	0.02 g/kWh

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 rates stabilized using Ramped Mode Cycle.

Fuel Specification:

ASTM D975 No. 2-D S15 or 40 CFR Part 1065 Petroleum Diesel Fuel.

Diesel Exhaust Fluid Specification:

32.5% urea in de-ionized water meeting ISO-22241

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.

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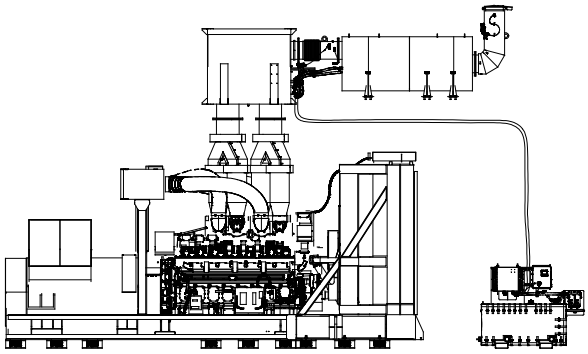
KOHLER®

Industrial Diesel Generator Set - KD3250-4

Tier 4 EPA-Certified for Stationary, Prime, Continuous Applications



KDxxxx-4 designates a 60 Hz generator set with a Tier 4 EPA-Certified engine.

Ratings Range

		60 Hz
Standby:	**kW**	3250
	kVA	4062
Prime:	**kW**	2950
	kVA	3688
Continuous:	**kW**	2450
	kVA	3062

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. Five-year basic and five-year comprehensive warranties are also available.
- A standard one-year warranty with unlimited hours for continuous power applications.
- Other features:
  - Kohler designed controllers for one-source system integration and remote communication. See Controller on page 4.
  - The low coolant level shutdown prevents overheating (standard on radiator models only).

General Specifications

Orderable Generator Model Number	GMKD3250-4
Manufacturer	Kohler
Engine: model	KD83V16
Alternator Choices	KH07631TO4D KH07632TO4D KH09370TO4D KH07640TO4D KH08590TO4D KH09390TO4D
Performance Class	Per ISO 8528-5
One Step Load Acceptance	100%
Voltage	480 V, 600 V, 4160 V, 6600 V, or 12470V, 13200V, 13800 V
Controller	APM603
Fuel Consumption, L/hr (gal./hr) 100% at Standby	829 (219.2)
Fuel Consumption, L/hr (gal./hr) 100% at Prime Power	739 (195.3)
Fuel Consumption, L/hr (gal./hr) 100% at Continuous Power	616 (162.8)
DEF Consumption, L/hr (gal./hr) 100% at Standby	66.4 (17.5)
DEF Consumption, L/hr (gal./hr) 100% at Prime Power	66.5 (17.6)
DEF Consumption, L/hr (gal./hr) 100% at Continuous Power	58.5 (15.5)
Emission Level Compliance (KDxxxx)	Tier 4
Open Unit Noise Level @ 7 m dB(A) at Rated Load	99
Data Center Continuous (DCC) Rating (Refer to TIB-101 for definitions)	Same as the Standby Rating below

Generator Set Ratings

				130°C Rise Standby Rating		105°C Rise Prime Rating		80°C Rise Continuous Rating	
Alternator	**Voltage**	**Ph**	**Hz**	**kW/kVA**	**Amps**	**kW/kVA**	**Amps**	**kW/kVA**	**Amps**
KH07631TO4D	277/480	3	60	3250/4062	4886	2950/3688	4436	2450/3062	3684
	2400/4160	3	60	3250/4062	564	2950/3688	512	2450/3062	425
	3810/6600	3	60	3250/4062	356	2950/3688	323	2450/3062	268
	7200/12470	3	60	3250/4062	189	2950/3688	171	2450/3062	142
	7620/13200	3	60	3250/4062	178	2950/3688	162	2450/3062	134
	7970/13800	3	60	3250/4062	170	2950/3688	155	2450/3062	129
KH07632TO4D	277/480	3	60	3250/4062	4886	2950/3688	4436	2450/3062	3684
	347/600	3	60	3250/4062	3909	2950/3688	3549	2450/3062	2947
	7200/12470	3	60	3250/4062	189	2950/3688	171	2450/3062	142

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 - KD3250-4

Tier 4 EPA-Certified for Stationary, Prime, Continuous Applications

				130°C Rise Standby Rating		105°C Rise Prime Rating		80°C Rise Continuous Rating	
Alternator	**Voltage**	**Ph**	**Hz**	**kW/kVA**	**Amps**	**kW/kVA**	**Amps**	**kW/kVA**	**Amps**
KH09370TO4D	277/480	3	60	3250/4062	4886	2950/3688	4436	2450/3062	3684
	2400/4160	3	60	3250/4062	564	2950/3688	512	2450/3062	425
	3810/6600	3	60	3250/4062	356	2950/3688	323	2450/3062	268
KH07640TO4D	277/480	3	60	3240/4050	4871	2950/3688	4436	2440/3050	3669
KH08590TO4D	277/480	3	60	3250/4062	4886	2950/3688	4436	2440/3050	3669
	347/600	3	60	3250/4062	3910	2960/3700	3560	2450/3062	2947
KH09390TO4D	277/480	3	60	3240/4050	4871	2940/3675	4420	2420/3025	3639

Engine Specifications	**60 Hz**
Manufacturer	Kohler
Engine: model	KD83V16
Engine: type	4-Cycle, Turbocharged, Intercooled
Cylinder arrangement	16-V
Displacement, L (cu. in.)	83 (5048)
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	9, Precision Half Shells
Rated rpm	1800
Max. power at rated rpm, kWm (BHP)	3490 (4680)
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.) §	420 (444)
Oil filter: quantity, type §	8, 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)	1050 (277.4)
Min./max. fuel pressure at engine supply connection, kPa (in. Hg)	-50/50 (-14.8/14.8)
Maximum diesel fuel lift, m (ft.)	3.7 (12)
Max. return line restriction, kPa (in. Hg)	30 (8.9)
Fuel filter: quantity, type	3, Primary Engine Filter 2, Fuel/Water Separator
Recommended fuel	#2 Diesel ULSD

Diesel Fuel Consumption		**DEF Consumption**	
	Standby Rating		**Standby Rating**
% load	**Lph (gph)**		**Lph (gph)**
100%	829 (219.2)		66.4 (17.5)
75%	616 (162.8)		58.5 (15.5)
50%	427 (112.8)		44.8 (11.8)
25%	244 (64.6)		24.4 (6.5)
10%	138 (36.3)		12.4 (3.3)
	Prime Rating		**Prime Rating**
% load	**Lph (gph)**		**Lph (gph)**
100%	739 (195.3)		66.5 (17.6)
75%	560 (148.0)		56.0 (14.8)
50%	396 (104.6)		39.6 (10.5)
25%	229 (60.4)		22.9 (6.0)
10%	107 (28.2)		9.6 (2.5)
	Continuous Rating		**Continuous Rating**
% load	**Lph (gph)**		**Lph (gph)**
100%	616 (162.8)		58.5 (15.5)
75%	474 (125.1)		47.4 (12.5)
50%	336 (88.8)		33.6 (8.9)
25%	202 (53.4)		20.2 (5.3)
10%	120 (31.6)		10.8 (2.8)

Radiator System	**60 Hz**
Ambient temperature, °C (°F)	50 (122)
Engine jacket water capacity, L (gal.)	375 (99)
Radiator system capacity, including engine, L (gal.)	1192 (315)
Engine jacket water flow, Lpm (gpm)	2707 (715)
Heat rejected to cooling water at rated kW, dry exhaust, kW (Btu/min.)	ESP 1150 (65400) PRP 1050 (59712) COP 950 (54026)
Heat rejected to charge cooling water at rated kW, dry exhaust, kW (Btu/min.)	ESP 1100 (62556) PRP 950 (54026) COP 700 (39809)
Water pump type	Centrifugal
Fan diameter, including blades, mm (in.)	2438 (96)
Fan, kWm (HP)	100 (134)
Max. restriction of cooling air, intake and discharge side of radiator, kPa (in. H_2O)	0.125 (0.5)

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)	250 (83.6)

† 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)	671 (23701)
Exhaust temperature at rated kW at 25°C (77°F) ambient, dry exhaust, °C (°F)	475 (887)
Maximum allowable back pressure, kPa (in. Hg)	See TIB- 119
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)‡	3823 (135000)
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)‡	1214 (42887)
Combustion air, m^3/min. (cfm)	ESP 258 (9100) PRP 241 (8504) COP 208 (7360)
Heat rejected to ambient air:	
Engine, kW (Btu/min.)	ESP 170 (9668) PRP 160 (9099) COP 140 (7962)
Alternator, kW (Btu/min.)	179 (10200)

‡ 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		2, Sealed
Coupling type		Coupling
Amortisseur windings		Full
Alternator winding type		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	KH07631TO4D	8996
480 V	KH09370TO4D	10941

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.

Controller

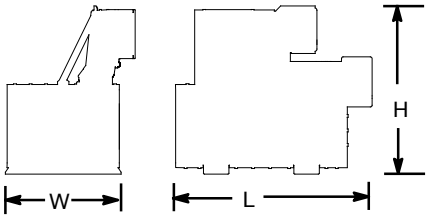
APM603 Controller
Provides advanced control, system monitoring, and system diagnostics for optimum performance and compatibility.

- 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.

Diesel Exhaust Fluid (DEF) Tank



Approximate size, L x W x H, mm(in.):	1868 x 1042 x 1479 (73.5 x 41.0 x 58.2)
Tank weight (dry), kg (lb.):	420.6 (927 lb)
Fillable volume:	224 gallons
Consumable volume:	164 gallons
Material:	Stainless steel

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 4 EPA-Certified for Stationary, Prime, and Continuous Applications

Available Approvals and Listings

- ❑ CSA Certified
- ❑ UL 2200 Listing

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. Five-year basic and five-year comprehensive warranties are also available.
- A standard one-year warranty with unlimited hours for continuous power applications.

Available Warranties for Standby Applications

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

Available Warranties for Prime Applications

- ❑ 5-Year Basic Limited Warranty
- ❑ 5-Year Comprehensive 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
- Fuel/Water Separator
- Generator Heater
- Spring Isolation Under the Skid
- Battery Rack and Cables

KOHLER®

Industrial Diesel Generator Set - KD3250-4

Tier 4 EPA-Certified for Stationary, Prime, Continuous Applications

Available Options

Circuit Breakers

Type

- ❑ Magnetic Trip
- ❑ Thermal Magnetic Trip
- ❑ Electronic Trip (LI)
- ❑ Electronic Trip with Short Time (LSI)
- ❑ Electronic Trip with Ground Fault (LSIG)

Rating

- ❑ 80%
- ❑ 100%

Operation

- ❑ 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 4 EPA- Certified Engine

Approvals and Listings

- ❑ CSA Certified
- ❑ IBC Certification Request—Contact Factory
- ❑ UL 2200 Listing
- ❑ cULus Listing (fuel tanks only)

Controller

- ❑ Input/Output, Digital
- ❑ Input/Output, Thermocouple
- ❑ Manual Key Switch
- ❑ Remote Emergency Stop Switch
- ❑ Lockable Emergency Stop Switch
- ❑ Remote Serial Annunciator Panel

Cooling System

- ❑ Block Heater; 10500 W, 208 V, (Select 1 Ph or 3 Ph) *
- ❑ Block Heater; 12000 W, 240 V, (Select 1 Ph or 3 Ph) *
- ❑ Block Heater; 12000 W, 380 V, 3 Ph *

* Required for Ambient Temperatures Below 5°C (41°F).

Electrical System

- ❑ Battery, 4/12 V, AGM (kit with qty. 4)
- ❑ Battery Charger
- ❑ Battery Rack and Cables
- ❑ Redundant Starters
- ❑ DEF Tank Heater
- ❑ Load Bank, 300 kW [Recommended for Ambient Temperature > -5°C (23°F)]
- ❑ Load Bank, 600 kW [Recommended for Ambient Temperature < -5°C (23°F)]

Fuel System

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

Literature

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

Miscellaneous

- ❑ Air Cleaner, Heavy Duty
- ❑ Air Cleaner Restriction Indicator
- ❑ Automatic Oil Replenishment System
- ❑ Engine Fluids (oil and coolant) Added
- ❑ Rated Power Factor Testing
- ❑ Weld- On Flange, DIN300
- ❑ Weld- On Flange, DEF Tank

Warranty (Standby Applications only)

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

Warranty (Prime Applications only)

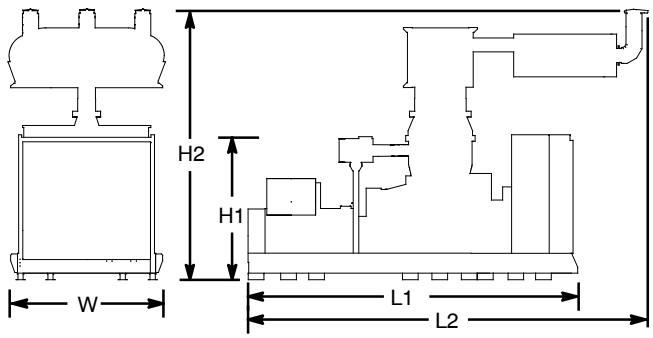
- ❑ 5-Year Basic Limited Warranty
- ❑ 5-Year Comprehensive Limited Warranty

Other

- ❑
- ❑

Dimensions and Weights

Generator set size, max., L1 x W x H1, mm (in.):	7650 x 3522 x 3451 (301.1 x 138.7 x 135.8)
With rear- facing SCR, max., L2 x W x H2, mm (in.):	7969 x 3522 x 6262 (313.7 x 138.7 x 246.5)
With forward- facing SCR, max., L2 x W x H2, mm (in.):	9257 x 3522 x 6262 (364.4 x 138.7 x 246.5)
Weight, radiator model, max. wet, kg (lb.):	32513 (71707)
Weight, with radiator and SCR, max. wet, kg (lb.):	36472 (80407)



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

Industrial Diesel Generator Set - KD3250-4

Tier 4 EPA-Certified for Stationary, Prime, Continuous Applications

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

DISTRIBUTED BY:

Attachment DR 2
Revised NOx Emission Estimates for the Emergency Generators

Black Rock Geothermal Project

BRGP Operational Emissions

Comparison of NO_X Emissions With and Without Startup Duration

March 2024

Emergency Generators	Comparison of NO_X Emissions for One Generator		Comparison of NO_X Emissions for Three Generators	
	Without Startup [b]	With Startup [c]	Without Startup [b]	With Startup [c, d]
Maximum Hourly Emissions (lbs/hr)	4.80	12.66	14.40	37.99
Daily Emissions (lbs/day) [a]	9.6	25.3	19.2	50.7
Annual Emissions (tpy)	0.12	0.32	0.36	0.95
Annual Average Hourly Emissions (lbs/hr)	0.03	0.07	0.08	0.22

lbs/day = pound(s) per day

lbs/hr = pound(s) per hour

tpy = ton(s) per year

[a] Daily emissions assume only 2 generators could operate in the same day for the following hours of operation at the maximum hourly emission rate: 2

[b] These emissions are based on the Tier 4 emissions standards specified in 17 CCR 93115.7, Table 4.

[c] These emissions account for 15-minutes of uncontrolled NO_X emissions, associated with the startup of the SCR, and are based both on vendor-provided emissions guarantees and the Tier 4 emissions standards specified in 17 CCR 93115.7, Table 4.

[d] Because only one diesel-fired emergency generator is expected to operate in a single hour, the maximum hourly emission rate presented here is not expected to occur during actual facility operation.

Black Rock Geothermal Project

BRGP Operational Emissions
Generator Emission Data - Without SCR Startup Period
March 2024

Engine Information	Value
Engine Rating (kW)	3,250
Engine Rating (HP)	4,680
Annual Hours of Operations (hrs/yr)	50
Fuel Use (gal/hr)	219
Heat Input (MMBtu/hr)	30.2
Generator Count	3

kW = kilowatt
HP = horsepower
hrs/yr = hour(s) per year
gal/hr = gallon(s) per hour
MMBtu/hr = million British thermal unit(s) per hour

Criteria Pollutant Emissions Per Generator

Pollutant	Controlled Emission Factor (g/kW-hr)	Basis	1-Hour Emission Rate (lbs/hr)	Annual Emissons (tpy)	Annual Average Hourly Emissions (lbs/hr)
NO_X Emissions	0.67	17 CCR 93115.7, Table 4	4.80	0.12	0.027
CO Emissions	3.5	17 CCR 93115.7, Table 4	25.1	0.63	0.14
PM_{10} Emissions	0.03	17 CCR 93115.7, Table 4	0.21	0.01	0.001
$PM_{2.5}$ Emissions	0.03	17 CCR 93115.7, Table 4	0.21	0.01	0.001
SO_x Emissions	0.000002	Calculated based upon 15 ppm ULSD	1.41E-05	3.53E-07	8.05E-08
VOC Emissions	0.19	17 CCR 93115.7, Table 4	1.36	0.03	0.008

g/kW-hr = gram(s) per kilowatt-hour
lbs/hr = pound(s) per hour
ppm = part(s) per million
tpy = ton(s) per year
USLD = Ultra low sulfur diesel

Toxic Emissions Per Generator

Pollutant	Emission Factor (lb/MMBTU) [a]	Annual Emissions (lbs/yr) [b]	Annual Emissions (tpy)
Benzene	7.76E-04	2.35E-01	1.17E-04
Toluene	2.81E-04	8.50E-02	4.25E-05
Xylenes	1.93E-04	5.84E-02	2.92E-05
Formaldehyde	7.89E-05	2.39E-02	1.19E-05
Acetaldehyde	2.52E-05	7.62E-03	3.81E-06
Acrolein	7.88E-06	2.38E-03	1.19E-06
Naphthalene	1.30E-04	3.93E-02	1.97E-05
Propylene	2.79E-03	8.44E-01	4.22E-04
Ammonia	5 ppm slip [c]	1.69E+01	8.44E-03
Acenaphthylene	9.23E-06	2.79E-03	1.40E-06
Acenaphthene	4.68E-06	1.42E-03	7.08E-07
Fluorene	1.28E-05	3.87E-03	1.94E-06
Phenanthrene	4.08E-05	1.23E-02	6.17E-06
Anthracene	1.23E-06	3.72E-04	1.86E-07
Fluoranthene	4.03E-06	1.22E-03	6.10E-07
Pyrene	3.71E-06	1.12E-03	5.61E-07
Benz(a)anthracene	6.22E-07	1.88E-04	9.41E-08
Chrysene	1.53E-06	4.63E-04	2.31E-07
Benzo(b)fluoranthene	1.11E-06	3.36E-04	1.68E-07
Benzo(k)fluoranthene	2.18E-07	6.59E-05	3.30E-08

Benzo(a)pyrene	2.57E-07	7.77E-05	3.89E-08
Indeno(1,2,3-cd)pyrene	4.14E-07	1.25E-04	6.26E-08
Dibenz(a,h)anthracene	3.46E-07	1.05E-04	5.23E-08
Benzo(g,h,l)perylene	5.56E-07	1.68E-04	8.41E-08

lb/MMBtu = pound(s) per million British thermal unit

lbs/yr = pound(s) per year

tpy = ton(s) per year

[a] Toxic Emission Factors from EPA's *AP-42* , Section 3.4, Tables 3.4-3 and 3.4-4 (EPA 1996).

[b] Control efficiencies use industry standard of 80% control of VOCs for Tier 4 engines.

[c] 5 ppm ammonia slip typical estimate for SCR systems.

Stack Parameters	Value	Units
Stack Diameter	1.04	feet
Stack Diameter	0.32	meters
Stack Height	23.52	feet
Stack Height	7.17	meters
Stack Flow	23,701	cubic feet per minute
Stack Flow	671.37	cubic meters per minute
Exit Velocity	141.33	meters per second
Stack Temperature	887	°F
Stack Temperature	748.15	K

GHG Emissions Per Generator

Source Name	Annual CO_2 Emissions (tpy)	Annual CH_4 Emissions (tpy)	Annual N_2O Emissions (tpy)	Annual CO_2e Emissions (tpy)
Generator 2-4	123.31	0.005	0.001	123.73

tpy = ton(s) per year

Diesel Fuel GHG Emission Factors and Conversions			Source
CO_2	73.96	kg/MMBtu	40 CFR 98.33, Table C-1
CH_4	3.00E-03	kg/MMBtu	40 CFR 98.33, Table C-2
N_2O	6.00E-04	kg/MMBtu	40 CFR 98.33, Table C-2
Default HHV	0.1380	MMBtu/gal	40 CFR 98.33, Table C-1
Density of Distillate #2	7.05	lbs/gallon	AP-42, Appendix A
Conversion	1.1023	ton/tonne	--
	0.0010	tonne/kg	--
	28.3168	L/ft^3	--
Molar Volume of Air at STP	22.4	L/mol	--

HHV = Higher Heating Value

kg/MMBtu = kilogram(s) per million British thermal unit

MMBtu/gal = million British thermal unit(s) per gallon

lbs = pound(s)

kg = kilogram(s)

L/ft^3 = liter(s) per cubic foot

L = liter(s)

Global Warming Potentials		Source
GWP CO_2 =	1	40 CFR 98 Subpart A, Table A-1
GWP CH_4 =	25	40 CFR 98 Subpart A, Table A-1
GWP N_2O =	298	40 CFR 98 Subpart A, Table A-1

Black Rock Geothermal Project

BRGP Operational Emissions
Generator Emission Data - With SCR Startup Period
March 2024

Engine Information	Value
Engine Rating (kW)	3,250
Engine Rating (HP)	4,680
Annual Hours of Operations (hrs/yr)	50
Fuel Use (gal/hr)	219
Heat Input (MMBtu/hr)	30.2
Generator Count	3
Assumed Startup Duration (min) [a]	15

kW = kilowatt
HP = horsepower
hrs/yr = hour(s) per year
gal/hr = gallon(s) per hour
MMBtu/hr = million British thermal unit(s) per hour
[a] During startup, the SCR is not expected to be functional, resulting in uncontrolled NO_X emissions. A startup duration of 15 minutes was assumed based on data from similar facilities.

Criteria Pollutant Emissions Per Generator

Pollutant	Uncontrolled Emission Factor (g/kW-hr)	Controlled Emission Factor (g/kW-hr)	Basis	1-Hour Emission Rate (lbs/hr)	Annual Emissons (tpy)	Annual Average Hourly Emissions (lbs/hr)
NO_X Emissions	5.06	0.67	Vendor Provided Data and 17 CCR 93115.7, Table 4 [a]	12.66	0.32	0.072
CO Emissions	--	3.5	17 CCR 93115.7, Table 4	25.1	0.63	0.14
PM_{10} Emissions	--	0.03	17 CCR 93115.7, Table 4	0.21	0.01	0.001
$PM_{2.5}$ Emissions	--	0.03	17 CCR 93115.7, Table 4	0.21	0.01	0.001
SO_x Emissions	--	0.000002	Calculated based upon 15 ppm ULSD	1.41E-05	3.53E-07	8.05E-08
VOC Emissions	--	0.19	17 CCR 93115.7, Table 4	1.36	0.03	0.008

g/kW-hr = gram(s) per kilowatt-hour
lbs/hr = pound(s) per hour
ppm = part(s) per million
tpy = ton(s) per year
USLD = Ultra low sulfur diesel
-- = Not required for demonstration

[a] In the absence of emission rates determined during the engine's warm-up time, uncontrolled emissions are represented by the engine's Tier 2 certification, as measured during an EPA D2 Cycle 5-mode Weighted test; this value is expected to be comparable to the Tier 2 standard of 6.4 g/kW-hr for NO_X and VOC combined. Controlled emissions are conservatively represented by the Tier 4 standard, despite the expectation that the engine is capable of performing better than this standard.

Toxic Emissions Per Generator

Pollutant	Emission Factor (lb/MMBTU) [a]	Annual Emissions (lbs/yr) [b]	Annual Emissions (tpy)
Benzene	7.76E-04	2.35E-01	1.17E-04
Toluene	2.81E-04	8.50E-02	4.25E-05
Xylenes	1.93E-04	5.84E-02	2.92E-05
Formaldehyde	7.89E-05	2.39E-02	1.19E-05
Acetaldehyde	2.52E-05	7.62E-03	3.81E-06
Acrolein	7.88E-06	2.38E-03	1.19E-06
Naphthalene	1.30E-04	3.93E-02	1.97E-05
Propylene	2.79E-03	8.44E-01	4.22E-04
Ammonia	5 ppm slip [c]	1.69E+01	8.44E-03
Acenaphthylene	9.23E-06	2.79E-03	1.40E-06
Acenaphthene	4.68E-06	1.42E-03	7.08E-07
Fluorene	1.28E-05	3.87E-03	1.94E-06
Phenanthrene	4.08E-05	1.23E-02	6.17E-06
Anthracene	1.23E-06	3.72E-04	1.86E-07
Fluoranthene	4.03E-06	1.22E-03	6.10E-07
Pyrene	3.71E-06	1.12E-03	5.61E-07
Benz(a)anthracene	6.22E-07	1.88E-04	9.41E-08
Chrysene	1.53E-06	4.63E-04	2.31E-07
Benzo(b)fluoranthene	1.11E-06	3.36E-04	1.68E-07
Benzo(k)fluoranthene	2.18E-07	6.59E-05	3.30E-08
Benzo(a)pyrene	2.57E-07	7.77E-05	3.89E-08
Indeno(1,2,3-cd)pyrene	4.14E-07	1.25E-04	6.26E-08
Dibenz(a,h)anthracene	3.46E-07	1.05E-04	5.23E-08

Benzo(g,h,l)perylene	5.56E-07	1.68E-04	8.41E-08

lb/MMBtu = pound(s) per million British thermal unit
lbs/yr = pound(s) per year
tpy = ton(s) per year

[a] Toxic Emission Factors from EPA's *AP-42* , Section 3.4, Tables 3.4-3 and 3.4-4 (EPA 1996).

[b] Control efficiencies use industry standard of 80% control of VOCs for Tier 4 engines.

[c] 5 ppm ammonia slip typical estimate for SCR systems.

Stack Parameters	Value	Units
Stack Diameter	1.04	feet
Stack Diameter	0.32	meters
Stack Height	23.52	feet
Stack Height	7.17	meters
Stack Flow	23,701	cubic feet per minute
Stack Flow	671.37	cubic meters per minute
Exit Velocity	141.33	meters per second
Stack Temperature	887	°F
Stack Temperature	748.15	K

GHG Emissions Per Generator

Source Name	Annual CO_2 Emissions (tpy)	Annual CH_4 Emissions (tpy)	Annual N_2O Emissions (tpy)	Annual CO_2e Emissions (tpy)
Generator 2-4	123.31	0.005	0.001	123.73

tpy = ton(s) per year

Diesel Fuel GHG Emission Factors and Conversions			Source
CO_2	73.96	kg/MMBtu	40 CFR 98.33, Table C-1
CH_4	3.00E-03	kg/MMBtu	40 CFR 98.33, Table C-2
N_2O	6.00E-04	kg/MMBtu	40 CFR 98.33, Table C-2
Default HHV	0.1380	MMBtu/gal	40 CFR 98.33, Table C-1
Density of Distillate #2	7.05	lbs/gallon	AP-42, Appendix A
Conversion	1.1023	ton/tonne	--
	0.0010	tonne/kg	--
	28.3168	L/ft^3	--
Molar Volume of Air at STP	22.4	L/mol	--

HHV = Higher Heating Value
kg/MMBtu = kilogram(s) per million British thermal unit
MMBtu/gal = million British thermal unit(s) per gallon
lbs = pound(s)
kg = kilogram(s)
L/ft^3 = liter(s) per cubic foot
L = liter(s)

Global Warming Potentials		Source
GWP CO_2 =	1	40 CFR 98 Subpart A, Table A-1
GWP CH_4 =	25	40 CFR 98 Subpart A, Table A-1
GWP N_2O =	298	40 CFR 98 Subpart A, Table A-1