



1391 N Speer Boulevard | Suite 350 | Denver, CO 80204 | P (720) 638-7647

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HAND DELIVERED

February 20, 2019

New Source Review Program Manager
Air Pollution Control Division
Colorado Department of Public Health and Environment
APCD-SS-B1
4300 Cherry Creek Drive South
Denver, CO 80246-1530

**EXPEDITED
PROCESSING
REQUESTED**

RE: Haras Developments LLC - Application for New Source Review Construction Permit for a Back-up Power Facility Located at Buckley Air Force Base

Dear Madam or Sir:

On behalf of Haras Developments LLC, we are submitting this application for a New Source Review construction permit for a back-up power facility (the Facility) located at Buckley Air Force Base (the Base). The Facility is a greenfield site and will provide back-up power to a separate greenfield data center also located at the Base.

This submittal includes two paper copies of a complete permit application. **Haras Developments LLC is requesting expedited processing of this application.**

A full description of the Facility is found in Section 1 of the application. Section 4 of the application provides details for the emission calculations and the basis for a request to base emissions on fuel consumption. The application also includes one Air Pollutant Emission Notice (APEN) and a check for the applicable APEN processing fee. Invoices for the hourly charges for the technical review of the application should be sent to Haras Developments LLC at the mailing address shown in Section 1 of the APEN.

If there are questions regarding this application, please direct them to me at giwaszek@trinityconsultants.com or at (720) 638-7647 x105.

Sincerely,

Trinity Consultants

George Iwaszek
Principal Consultant

RECEIVED
APCD-SS-B1
February 20, 2019
Stationary
Sources

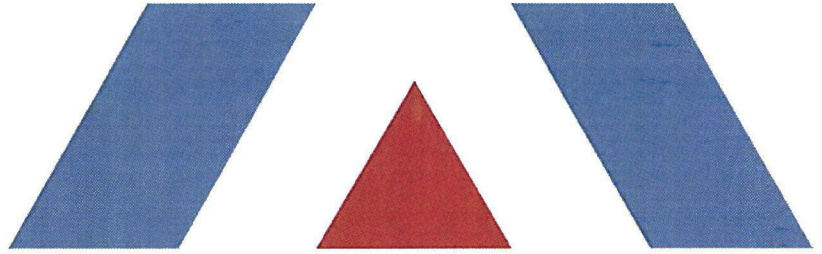
cc: Mr. Joseph McFadden, Haras Developments LLC

HEADQUARTERS >

12700 Park Central Drive | Suite 2100 | Dallas, TX 75251 | P (972) 661-8100 | F (972) 385-9203

North America | Europe | Middle East | Asia

ORIGINAL



AIR QUALITY CONSTRUCTION PERMIT APPLICATION

**Back-up Power Facility for a Data Center
Located at Buckley Air Force Base**

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APCD
Stationary
Sources

Haras Developments LLC

Cody Dill
2570 Beech Road NW
New Albany, OH 43031
(740) 350-8407

Prepared By:
George Iwaszek – Principal Consultant

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Project 170601.0128

February 2019

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Consultants

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1. SUMMARY

Haras Developments LLC (HD) is proposing to construct a back-up electrical power facility (Facility) at Buckley Air Force Base (Base) using up to 18 diesel-fueled reciprocating internal combustion engines (RICE) to drive electrical generators. The facility will provide electrical power to a separate modular data center at the Base in the event that utility power is not available. The data center is not a source of regulated air quality pollutants.

The Facility will be located in Arapahoe County, Township 4S, Range 66W, Section 10. This area is currently in nonattainment for the 2008 (moderate) and 2015 (marginal) 1-hour ozone standards and in attainment or unclassifiable for other pollutants regulated under New Source Review (NSR). A description of the Facility, an area map and plot plan, and a process flow diagram are provided in Section 9.

There are existing emission sources of regulated air pollutants at the Base that are subject to air quality permitting requirements. HD in a separate submittal requested a determination from the Colorado Department of Public Health and Environment (CDPHE) Air Pollution Control Division (APCD) regarding aggregation of the proposed Facility emission sources with other existing sources at the Base. The data center and the back-up power Facility will be located within the Base outer boundary, but will be solely under the control of HD and will be operated under the Standard Industrial Code (SIC) 73; other sources at the Base operate under SIC 97 and are under the control of other entities. In addition, there is no interdependency between the back-up power Facility and any other operations at the Base; any power produced will be used solely for the proposed data center. The aggregation determination request and the APCD response¹ are included in Section 5 of this permit application. In summary, the APCD response states that “...based on the information currently provided it seems [the data center and back-up power facility are a]...separate entity from Buckley [sources] and could be considered a separate source for air permitting purposes.” The APCD response also indicated that a final determination would be made after a full review of this permit application was completed.

The estimated potential-to-emit (PTE) for each regulated air quality pollutant from the Facility is shown in Table 1 below. The calculation method to determine the PTE for each pollutant is described in Section 4. As shown in the table, the Facility will be an area source for hazardous air pollutants (HAP) and a synthetic minor source for NSR regulated pollutants.

It is HD’s intent to operate the individual generator engines as emergency engines as defined in 40 CFR 60, Subpart IIII (NPS IIII) and 40 CFR 63, NESHAP ZZZZ. A complete regulatory applicability analysis is provided in this permit application.

As a new minor source of nitrogen oxides in an ozone nonattainment area the engines at the back-up facility are potentially subject to Reasonably Available Control Technology (RACT) requirements.² Based on the operational limits requested in this permit application, it is possible that a single engine could operate for a period of time such that annual emissions of nitrogen dioxides could exceed 5 tons per year; therefore, a RACT analysis is provided in this permit application.

Finally, HD requests expedited, “red tag” processing of this permit application.

¹ Email from M Burgett, Title V Operating Permits Unit Supervisor, dated 12 September 2018.

² Regulation 3, Part B, III.D.2.a.

Table 1. Potential to Emit for Regulated Air Pollutants

Pollutant / Speciated Organics	Emissions (tpy)
NO _x	39.1
CO	7.6
PM/PM ₁₀ /PM _{2.5}	2.8
SO ₂	5.9
Total HC	2.1
Benzene	0.02
Toluene	0.01
Xylene	0.005
1,3-Butadiene	0.001
Formaldehyde	0.02
Acetaldehyde	0.01
Acrolein	0.002
Total PAH	0.003
Total Hazardous Air Pollutants	0.07

2. AIR POLLUTION EMISSION NOTICE (APEN) FILING FEE

Pursuant to Regulation 3, Part A, II.B.4, grouping of multiple emission points on a single APEN is allowed if the following are met:

- The aggregated sources have identical source classification codes and emission factors for criteria pollutants;
- The aggregated sources share a similar location within the facility;
- All of the sources are regulated under the same NSPS;
- None of the sources are required to monitor emissions through the use of continuous emission monitors;
- Each of the individual emission points has fuel usage indistinguishable from the other emission points; and
- None of the individual sources grouped under a single APEN has been issued a separate permit;

The proposed engines in this application follow the above criteria; therefore, a single APEN is included in this application along with the applicable filing fee.

3. APCD FORM SERIES 200

The APEN for the back-up power facility is included in this section.

4. EMISSION CALCULATIONS

The methods used to calculate emissions from regulated sources and potentially regulated sources are explained here.

4.1. RICE

For flexibility, HD is proposing to implement an annual fuel-usage cap for all engines. The manufacturer's emission factors ("mass pollutant/hp-hr") at the sea-level power rating were used to calculate fuel-based emission factors ("mass pollutant/gallon fuel consumed"). Because power requirements vary during back-up usage, engine loads will also vary. To maintain power load flexibility, the highest emission factor at loads between 25% - 100% for each pollutant was used. This approach provides a conservative estimate of emissions.

Particulate emissions are the sum of the filterable and condensable particulate. To represent the latter, the hydrocarbon emissions (Total HC) were added to the particulate emissions reported in the manufacturer's specifications.

While engine hours of operation will be tracked for maintenance purposes, engine run time is not explicitly included in the emission calculations and is not requested as a permit limit.

The manufacturer specifications for the proposed generator engines are included in this section.

4.2. FUEL STORAGE TANKS

The fuel storage for the back-up power facility will include belly tanks (~5,000 gallon capacity each) integral to each engine and will also include up to six auxiliary fixed roof storage tanks, each with capacity of 40,000 gallons. Regardless, based on the liquid stored (diesel fuel) and total annual throughput (less than 400,000 gallons), the fuel storage tanks are APEN exempt per Regulation 3, Part A, II.D.1.fff. APEN exempt source emissions are not included in the emission calculations.

4.3. OTHER APEN EXEMPT SOURCES

Other APEN exempt-sources may include air conditioning and ventilation (II.D.1.c.), fuel burning equipment (II.D.1.k.), chemical storage tanks and areas (II.D.1.n. and mm.), welding operations (II.D.1.r.), aerosol can usage (II.D.1.u.), and lubricating oil storage (II.D.1.aaa.). APEN exempt source emissions are not included in the emission calculations. The Facility will not employ cooling towers.

DIESEL ENGINE - EMISSIONS

Number of Engines (Units)= 18
 Engine Make and Model = Caterpillar 3516C-HD ATAAC, V-16
 US EPA Tier Rating II
 Engine Maximum Brake Horsepower = 3,634 hp¹
 Fuel Type = Diesel
 Fuel Lower Heat Value = 18,390 Btu/lb²
 Fuel Lower Heat Value = 128,730 Btu/gal
 Total All Units, Annual Fuel Use= 265,500 gal/yr
 Avg Brake Specific Fuel Consumption = 0.334 lb/hp-hr³
 Avg Brake Specific Fuel Consumption = 0.046 gal/hp-hr (calculated)
 Per Unit Average Hourly Fuel Consumption at 100% Load = 173.50 gal/hr

Pollutant / Speciated Organics	Emission Factor	Units	Emission Factor (lb/gallon fuel) ⁴	Total Emissions (tpy) ⁵
NO _x	--	--	0.295	39.1
CO	--	--	0.058	7.6
PM/PM ₁₀ /PM _{2.5} ⁷	--	--	0.021	2.8
SO ₂	2.05E-03	lb/hp-hr ⁸	0.045	5.9
Total HC	--	--	0.016	2.1
Benzene	9.33E-04	lb/MMBtu input ⁸	1.20E-04	0.02
Toluene	4.09E-04	lb/MMBtu input ⁸	5.27E-05	0.01
Xylene	2.85E-04	lb/MMBtu input ⁸	3.67E-05	0.00
1,3-Butadiene	3.91E-05	lb/MMBtu input ⁸	5.03E-06	0.00
Formaldehyde	1.18E-03	lb/MMBtu input ⁸	1.52E-04	0.02
Acetaldehyde	7.67E-04	lb/MMBtu input ⁸	9.87E-05	0.01
Acrolein	9.25E-05	lb/MMBtu input ⁸	1.19E-05	0.00
Total PAH	1.68E-04	lb/MMBtu input ⁸	2.16E-05	0.00
Total HAPs				0.07

¹ CAT Standby 2500 kW 3125 kVA Diesel Generator Set. Not site derated for elevation above sea level.

² CAT Standby 2500 kW 3125 kVA Diesel Generator Set, Technical Data.

³ CAT Standby 2500 kW 3125 kVA Diesel Generator Set, General Performance Data, 100% load.

⁴ NO_x, CO, PM, and HC factors are the worst-case factors based on 100%, 75%, and 50% load scenarios. The factors were calculated by converting by multiplying the g/hp-hr factors by the respective hp at each load and dividing by the gal/hr fuel consumption at each load. Emission factors are per specification sheet for CAT Standby 2500 kW 3125 kVA Diesel Generator Set, Rated Speed Potential Site Variation. PM includes Total HC to represent condensible PM + filterable PM.

⁵ Annual Emissions (tpy) = Annual Fuel Throughput (gal/yr) * Emission Factor (lb/gal) / 2,000 (lb/ton)

$$\text{Annual Emissions NO}_x \text{ (tpy)} = \frac{0.29 \text{ lb}}{\text{gal}} \times \frac{265,500 \text{ gal}}{\text{yr}} \times \frac{\text{ton}}{2,000 \text{ lb}} = 39.10 \text{ ton/yr}$$

⁶ All particulate matter is assumed to be less than 10 µm, therefore the emission factor and the calculated emissions are the same for PM and PM₁₀. PM₁₀/PM_{2.5} is assumed to equal PM. Includes Total HC to account for condensible PM.

⁷ Emission factors are taken from AP-42, Chapter 3, Section 3, Table 3.3-1 (*Emission Factors for Gasoline and Diesel Industrial Engines October 1996*). Table 3.3-2 (*Speciated Organic Compound Emission Factors for Uncontrolled Stationary Diesel Engines*).

Diesel 1D fuel, density (lb/cf)

54.6 Source: https://www.engineeringtoolbox.com/fuels-densities-specific-volumes-d_166.html

Diesel 1D fuel, density (lb/gal)

7.3 Calculated by converting cubic feet to gallons

DIESEL ENGINE - EMISSIONS

PERFORMANCE DATA[DM8266]

Apr 25, 2016

Performance Number: DM8266

Change Level: 04

SERIES MODEL:	3516C	COMBUSTION:	DI
ENGINE POWER (BHP):	3 634	ENGINE SPEED (RPM):	1,800
GEN POWER WITH FAN (BKW):	2 500.0	HERTZ:	60
COMPRESSION RATIO:	14.7	FAN POWER (HP):	130.1
RATING LEVEL:	STANDARD	ASPIRATION:	TA
PUMP QUANTITY:	2	AFTERCOOLER TYPE:	ATAAC
FUEL TYPE:	DIESEL	AFTERCOOLER CIRCUIT TYPE:	JW-OC ATAAC
MANIFOLD TYPE:	DRY	INLET MANIFOLD AIR TEMP (F):	122
GOVERNOR TYPE:	ACRM3	JACKET WATER TEMP (F):	210.2
ELECTRONICS TYPE:	ACRM3	TURBO CONFIGURATION:	PARALLEL
CAMSHAFT TYPE:	STANDARD	TURBO QUANTITY:	4
IGNITION TYPE:	CI	TURBOCHARGER MODEL:	GTR0418N48T-1 10
INJECTOR TYPE:	EUI	CERTIFICATION YEAR:	2006
FUEL INJECTOR:	2501368	CRANKCASE BLOWBY RATE (FT3/HR):	3 619.4
RIP EXH STACK DIAMETER (IN):	12	FUEL RATE (RATED RPM) NO LOAD (GAL/HR):	16.2
MAX OPERATING ALTITUDE (FT):	2 553	PISTON SPD @ RATED ENG SPD (FT/MIN):	2 539.4

INDUSTRY	SUBINDUSTRY	APPLICATION
ELECTRIC POWER	STANDARD	PACKAGED GENSET
OIL AND GAS	LAND PRODUCTION	PACKAGED GENSET

General Performance Data

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	BRAKE MEAN EFF PRES (BMEP)	BRAKE SPEC FUEL CONSUMPTN (BHP/G)	VOL FUEL CONSUMPTN (VFC)	INLET MFLD PRES	INLET MFLD TEMP	EXH MFLD TEMP	EXH MFLD PRES	ENGINE OUTLET TEMP
BKW	%	B-HP	PSI	LB/HP-HR	GAL/HR	IN-HG	DEG F	DEG F	IN-HG	DEG F
2500.0	100	3633	336	0.334	173.5	78.1	121.9	1236.6	67.6	915.2
2250.0	90	3283	308	0.336	157.1	71.3	119.4	1190.0	61.3	881.2
2000.0	80	2935	271	0.339	142.3	64.3	116.9	1159.9	55.3	854.0
1875.0	75	2760	256	0.340	134.9	60.7	115.8	1145.6	52.3	855.6
1750.0	70	2586	239	0.348	127.6	57.0	114.7	1130.3	49.3	854.6
1500.0	60	2237	202	0.354	113.0	49.5	110.7	1103.4	43.2	851.2
1250.0	50	1889	164	0.368	98.4	41.3	111.0	1091.8	36.8	850.7
1000.0	40	1547	140	0.373	82.5	31.4	109.4	1081.5	29.3	856.6
750.0	30	1203	111	0.386	66.2	21.7	107.9	1070.3	22.1	848.2
500.0	20	1029	95	0.394	57.0	19.2	107.2	1063.3	18.7	831.1
250.0	10	497	46	0.441	31.3	4.8	106.1	1000.7	9.8	847.3

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	COMPRESSOR OUTLET PRES	COMPRESSOR OUTLET TEMP	WET INLET AIR VOL FLOW RATE	ENGINE OUTLET WET EXH GAS VOL FLOW RATE	WET INLET AIR MASS FLOW RATE	WET EXH GAS MASS FLOW RATE	WET EXH VOL FLOW RATE (32 DEG F AND 29.92 IN HG)	WET EXH VOL FLOW RATE (32 DEG F AND 29.92 IN HG)
BKW	%	B-HP	IN-HG	DEG F	CFM	CFM	LB/HR	LB/HR	FT3/MIN	FT3/MIN
2500.0	100	3633	85	459.7	7372.3	19 575.8	32045.3	33360.4	7001.7	6362.4
2250.0	90	3283	78	443.0	6831.8	17980.7	30219.3	31378.8	6593.0	6013.7
2000.0	80	2935	70	417.8	6404.5	16560.6	28284.6	29277.2	6151.5	5625.4
1875.0	75	2760	66	404.7	6179.3	15893.2	27261.3	28300.4	5928.1	5427.1
1750.0	70	2586	63	391.2	5829.5	15232.6	26196.0	27060.8	5696.4	5222.0
1500.0	60	2237	55	363.2	5411.8	13876.0	23947.5	24739.5	5205.5	4779.1
1250.0	50	1889	46	334.6	4843.3	12418.0	21444.3	22133.2	4697.5	4283.2
1000.0	40	1547	38	297.8	4121.4	10608.5	18262.0	18440.0	3963.0	3647.2
750.0	30	1203	25	249.8	3423.0	8763.8	15175.3	15640.3	3204.6	3037.8
500.0	20	1029	21	223.4	3104.6	7844.6	13765.1	14171.8	2988.1	2760.8
250.0	10	497	7	152.3	2257.9	4800.2	8217.6	10136.8	2132.0	1999.8

Page 1 of 1

Emission Factor Calculations

NOx					CO				
	100% Load	75% Load	50% Load	25% Load		100% Load	75% Load	50% Load	25% Load
g/hp-hr	6.38	5.15	3.74	3.50	g/hp-hr	0.76	0.48	0.58	1.47
lb fuel /bhp-hr	0.33	0.34	0.37	0.39	lb fuel /bhp-hr	0.33	0.34	0.37	0.39
bhp	3633.00	2760.00	1889.00	1029.00	bhp	3633.00	2760.00	1889.00	1029.00
lb fuel/hr	1213.42	943.92	691.37	405.43	lb fuel/hr	1213.42	943.92	691.37	405.43
lb pollutant/hr	51.10	31.34	15.58	7.94	lb pollutant/hr	6.09	2.92	2.42	3.33
gal fuel/hr	173.5	134.9	98.4	57.9	gal fuel/hr	173.5	134.9	98.4	57.9
EF: lb/gal emissions	0.29	0.23	0.16	0.14	EF: lb/gal emissions	0.04	0.02	0.02	0.06
Max EF	0.29				Max EF	0.06			

HC					PM				
	100% Load	75% Load	50% Load	25% Load		100% Load	75% Load	50% Load	25% Load
g/hp-hr	0.14	0.18	0.29	0.40	g/hp-hr	0.05	0.06	0.07	0.14
lb fuel /bhp-hr	0.33	0.34	0.37	0.39	lb fuel /bhp-hr	0.33	0.34	0.37	0.39
bhp	3633.00	2760.00	1889.00	1029.00	bhp	3633.00	2760.00	1889.00	1029.00
lb fuel/hr	1213.42	943.92	691.37	405.43	lb fuel/hr	1213.42	943.92	691.37	405.43
lb pollutant/hr	1.12	1.10	1.21	0.91	lb pollutant/hr	0.40	0.37	0.29	0.32
gal fuel/hr	173.5	134.9	98.4	57.9	gal fuel/hr	173.5	134.9	98.4	57.9
EF: lb/gal emissions	0.006	0.008	0.012	0.016	EF: lb/gal emissions	0.002	0.003	0.003	0.005
Max EF	0.016				Max EF	0.005			

Page 1 of 1

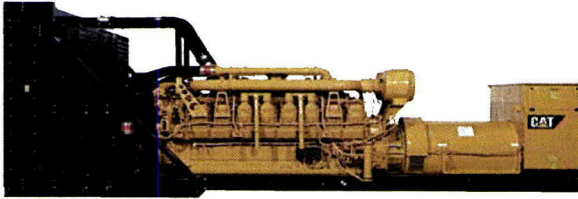


Image shown may not reflect actual package.

STANDBY

**2500 kW 3125 kVA
60 Hz 1800 rpm 480 Volts**

Caterpillar is leading the power generation marketplace with Power Solutions engineered to deliver unmatched flexibility, expandability, reliability, and cost-effectiveness.

FEATURES

FUEL/EMISSIONS STRATEGY

- EPA Certified for Stationary Emergency Application (EPA Tier 2 emissions levels)

DESIGN CRITERIA

- The generator set accepts 100% rated load in one step per NFPA 110 and meets ISO 8528-5 transient response.

UL 2200 / CSA - Optional

- UL 2200 listed packages
- CSA Certified
- Certain restrictions may apply. Consult with your Cat® Dealer.

FULL RANGE OF ATTACHMENTS

- Wide range of bolt-on system expansion attachments, factory designed and tested
- Flexible packaging options for easy and cost effective installation

SINGLE-SOURCE SUPPLIER

- Fully prototype tested with certified torsional vibration analysis available

WORLDWIDE PRODUCT SUPPORT

- Cat dealers provide extensive post sale support including maintenance and repair agreements
- Cat dealers have over 1,800 dealer branch stores operating in 200 countries
- The Cat® S•O•SSM program cost effectively detects internal engine component condition, even the presence of unwanted fluids and combustion by-products

CAT® 3516C-HD TA DIESEL ENGINE

- Reliable, rugged, durable design
- Field-proven in thousands of applications worldwide
- Four-stroke-cycle diesel engine combines consistent performance and excellent fuel economy with minimum weight

CAT GENERATOR

- Matched to the performance and output characteristics of Cat engines
- Industry leading mechanical and electrical design
- Industry leading motor starting capabilities
- High Efficiency

CAT EMCP 4 CONTROL PANELS

- Simple user friendly interface and navigation
- Scalable system to meet a wide range of customer needs
- Integrated Control System and Communications Gateway

SEISMIC CERTIFICATION

- Seismic Certification available
- Anchoring details are site specific, and are dependent on many factors such as generator set size, weight, and concrete strength. IBC Certification requires that the anchoring system used is reviewed and approved by a Professional Engineer
- Seismic Certification per Applicable Building Codes: IBC 2000, IBC 2003, IBC 2006, IBC 2009, CBC 2007
- Pre-approved by OSHPD and carries an OSP-0084-10 for use in healthcare projects in California

STANDBY 2500 ekW 3125 kVA

60 Hz 1800 rpm 480 Volts



FACTORY INSTALLED STANDARD & OPTIONAL EQUIPMENT

System	Standard	Optional
Air Inlet	• Single element canister type air cleaner • Service indicator	☐ Dual element & heavy duty air cleaners ☐ Air inlet adapters & shut-off
Cooling	• Radiator with guard • Coolant drain line with valve • Fan and belt guards • Cat® Extended Life Coolant	☐ Radiator duct flange
Exhaust	• Dry exhaust manifold • Flanged faced outlets	☒ Mufflers and Silencers ☒ Stainless steel exhaust flex fittings ☒ Elbows, flanges, expanders & Y adapters
Fuel	• Secondary fuel filters • Fuel priming pump • Flexible fuel lines • Fuel cooler*	☒ Water separator ☐ Duplex fuel filter
Generator	• Cat digital voltage regulator (CDVR) with kVAR/PF control, 3-phase sensing • Winding temperature detectors • Anti-condensation heaters	☒ Oversize & premium generators ☐ Bearing temperature detectors
Power Termination	• Bus bar (NEMA or IEC mechanical lug holes)- right side standard • Top and bottom cable entry	☒ Circuit breakers, UL listed, 3 pole with shunt trip, 100% rated, manual or electrically operated ☐ Circuit breakers, IEC compliant, 3 or 4 pole with shunt trip, manual or electrically operated ☐ Bottom cable entry ☒ Power terminations can be located on the right, left and/or rear as an option.
Governor	• ADEM™ 3	☐ Load share module
Control Panels	• EMCP 4.2 Genset controller	☐ Digital I/O Module ☐ Generator temperature monitoring & protection
Lube	• Lubricating oil and filter • Oil drain line with valves • Fumes disposal • Gear type lube oil pump	☐ Oil level regulator ☐ Deep sump oil pan ☐ Electric & air prelube pumps ☐ Manual prelube with sump pump ☐ Duplex oil filter
Mounting	• Rails - engine / generator / radiator mounting • Rubber anti-vibration mounts (shipped loose)	☒ Spring-type vibration isolator ☐ IBC Isolators
Starting/Charging	• 24 volt starting motor(s) • Batteries with rack and cables • Battery disconnect switch	☒ Battery chargers ☒ Charging alternator ☒ Oversize batteries ☐ Ether starting aid ☒ Heavy duty starting motors ☐ Barring device (manual) ☐ Air starting motor with control & silencer ☒ Jacket water heater
General	• Right-hand service • Paint - Caterpillar Yellow except rails and radiators are gloss black • SAE standard rotation • Flywheel and flywheel housing - SAE No. 00	☒ UL 2200 ☐ CSA certification ☐ CE Certificate of Conformance ☐ Seismic Certification per Applicable Building Codes: IBC 2000, IBC 2003, IBC 2006, IBC 2009, CBC 2007
Note	Standard and optional equipment may vary for UL 2200 Listed Packages. UL 2200 Listed packages may have oversized generators with a different temperature rise and motor starting characteristics.	

STANDBY 2500 ekW 3125 kVA

60 Hz 1800 rpm 480 Volts



SPECIFICATIONS

CAT GENERATOR

Cat Generator
Frame size..... 1842
Excitation..... Permanent Magnet
Pitch..... 0.6667
Number of poles..... 4
Number of bearings..... 2
Number of Leads..... 006
Insulation..... UL 1446 Recognized Class H with
tropicalization and antiabrasion
- Consult your Caterpillar dealer for available voltages
IP Rating..... IP23
Alignment..... Closed Coupled
Overspeed capability..... 125
Wave form Deviation (Line to Line)..... 003.00
Voltage regulator..... 3 Phase sensing with selectable
volts/Hz
Voltage regulation..... Less than +/- 1/2% (steady state)
Less than +/- 1/2% (w/3% speed change)

CAT DIESEL ENGINE

3516C-HD ATAAC, V-16, 4-Stroke Water-cooled Diesel
Bore..... 170.00 mm (6.69 in)
Stroke..... 215.00 mm (8.46 in)
Displacement..... 78.08 L (4764.73 in³)
Compression Ratio..... 14.7:1
Aspiration..... TA
Fuel System..... Electronic unit injection
Governor Type..... ADEM3

CAT EMCP 4 SERIES CONTROLS

EMCP 4 controls including:

- Run / Auto / Stop Control
- Speed and Voltage Adjust
- Engine Cycle Crank
- 24-volt DC operation
- Environmental sealed front face
- Text alarm/event descriptions

Digital indication for:

- RPM
- DC volts
- Operating hours
- Oil pressure (psi, kPa or bar)
- Coolant temperature
- Volts (L-L & L-N), frequency (Hz)
- Amps (per phase & average)
- ekW, kVA, kVAR, kW-hr, %kW, PF

Warning/shutdown with common LED indication of:

- Low oil pressure
- High coolant temperature
- Overspeed
- Emergency stop
- Failure to start (overcrank)
- Low coolant temperature
- Low coolant level

Programmable protective relaying functions:

- Generator phase sequence
- Over/Under voltage (27/59)
- Over/Under Frequency (81 o/u)
- Reverse Power (kW) (32)
- Reverse reactive power (kVAR) (32RV)
- Overcurrent (50/51)

Communications:

- Six digital inputs (4.2 only)
- Four relay outputs (Form A)
- Two relay outputs (Form C)
- Two digital outputs
- Customer data link (Modbus RTU)
- Accessory module data link
- Serial annunciator module data link
- Emergency stop pushbutton

Compatible with the following:

- Digital I/O module
- Local Annunciator
- Remote CAN annunciator
- Remote serial annunciator

STANDBY 2500 ekW 3125 kVA

60 Hz 1800 rpm 480 Volts



TECHNICAL DATA

Open Generator Set - - 1800 rpm/60 Hz/480 Volts	DM8266	
EPA Certified for Stationary Emergency Application (EPA Tier 2 emissions levels)		
Generator Set Package Performance Genset Power rating @ 0.8 pf Genset Power rating with fan	3125 kVA 2500 ekW	
Fuel Consumption 100% load with fan 75% load with fan 50% load with fan	656.8 L/hr 510.8 L/hr 372.4 L/hr	173.5 Gal/hr 134.9 Gal/hr 98.4 Gal/hr
Cooling System¹ Air flow restriction (system) Air flow (max @ rated speed for radiator arrangement) Engine Coolant capacity with radiator/exp. tank Engine coolant capacity Radiator coolant capacity	0.12 kPa 2800 m ³ /min 504.0 L 233.0 L 271.0 L	0.48 in. water 98881 cfm 133.1 gal 61.6 gal 71.6 gal
Inlet Air Combustion air inlet flow rate	204.2 m ³ /min	7211.3 cfm
Exhaust System Exhaust stack gas temperature Exhaust gas flow rate Exhaust flange size (internal diameter) Exhaust system backpressure (maximum allowable)	490.7 °C 554.5 m ³ /min 203.2 mm 6.7 kPa	915.3 °F 19582.0 cfm 8.0 in 26.9 in. water
Heat Rejection Heat rejection to coolant (total) Heat rejection to exhaust (total) Heat rejection to aftercooler Heat rejection to atmosphere from engine Heat rejection to atmosphere from generator	826 kW 2502 kW 786 kW 161 kW 101.5 kW	46975 Btu/min 142288 Btu/min 44700 Btu/min 9156 Btu/min 5772.3 Btu/min
Alternator² Motor starting capability @ 30% voltage dip Frame Temperature Rise	6559 skVA 1842 150 °C	270 °F
Lube System Sump refill with filter	466.0 L	123.1 gal
Emissions (Nominal)³ NOx g/hp-hr CO g/hp-hr HC g/hp-hr PM g/hp-hr	5.32 g/hp-hr .42 g/hp-hr .1 g/hp-hr .037 g/hp-hr	

¹ For ambient and altitude capabilities consult your Cat dealer. Air flow restriction (system) is added to existing restriction from factory.

² Generator temperature rise is based on a 40 degree C ambient per NEMA MG1-32. UL 2200 Listed packages may have oversized generators with a different temperature rise and motor starting characteristics.

³ Emissions data measurement procedures are consistent with those described in EPA CFR 40 Part 89, Subpart D & E and ISO8178-1 for measuring HC, CO, PM, NOx. Data shown is based on steady state operating conditions of 77°F, 28.42 in HG and number 2 diesel fuel with 35° API and LHV of 18,390 btu/lb. The nominal emissions data shown is subject to instrumentation, measurement, facility and engine to engine variations. Emissions data is based on 100% load and thus cannot be used to compare to EPA regulations which use values based on a weighted cycle.

STANDBY 2500 ekW 3125 kVA

60 Hz 1800 rpm 480 Volts



RATING DEFINITIONS AND CONDITIONS

Meets or Exceeds International Specifications: AS1359, CSA, IEC60034-1, ISO3046, ISO8528, NEMA MG 1-22, NEMA MG 1-33, UL508A, 72/23/EEC, 98/37/EC, 2004/108/EC

Standby - Output available with varying load for the duration of the interruption of the normal source power. Average power output is 70% of the standby power rating. Typical operation is 200 hours per year, with maximum expected usage of 500 hours per year. Standby power in accordance with ISO8528. Fuel stop power in accordance with ISO3046. Standby ambients shown indicate ambient temperature at 100% load which results in a coolant top tank temperature just below the shutdown temperature.

Ratings are based on SAE J1349 standard conditions.

These ratings also apply at ISO3046 standard conditions.

Fuel rates are based on fuel oil of 35° API [16° C (60° F)] gravity having an LHV of 42 780 kJ/kg (18,390 Btu/lb) when used at 29° C (85° F) and weighing 838.9 g/liter (7.001 lbs/U.S. gal.). Additional ratings may be available for specific customer requirements, contact your Cat representative for details. For information regarding Low Sulfur fuel and Biodiesel capability, please consult your Cat dealer.

STANDBY 2500 ekW 3125 kVA
60 Hz 1800 rpm 480 Volts



DIMENSIONS

Package Dimensions		
Length	6982.5 mm	274.9 in
Width	2569.2 mm	101.15 in
Height	3009.3 mm	118.48 in

NOTE: For reference only - do not use for installation design. Please contact your local dealer for exact weight and dimensions. (General Dimension Drawing #3292332).

Performance No.: DM8266

Feature Code: 516DE6N

Gen. Arr. Number: 2523944

Source: U.S. Sourced

November 06 2012

www.Cat-ElectricPower.com

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Materials and specifications are subject to change without notice.
The International System of Units (SI) is used in this publication.

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PERFORMANCE DATA[DM8266]

April 25, 2016

Performance Number: DM8266

Change Level: 04

SALES MODEL: 3516C
ENGINE POWER (BHP): 3,634
GEN POWER WITH FAN (EKW): 2,500.0
COMPRESSION RATIO: 14.7
RATING LEVEL: STANDBY
PUMP QUANTITY: 2
FUEL TYPE: DIESEL
MANIFOLD TYPE: DRY
GOVERNOR TYPE: ADEM3
ELECTRONICS TYPE: ADEM3
CAMSHAFT TYPE: STANDARD
IGNITION TYPE: CI
INJECTOR TYPE: EUI
FUEL INJECTOR: 2501368
REF EXH STACK DIAMETER (IN): 12
MAX OPERATING ALTITUDE (FT): 2,953

COMBUSTION: DI
ENGINE SPEED (RPM): 1,800
HERTZ: 60
FAN POWER (HP): 130.1
ASPIRATION: TA
AFTERCOOLER TYPE: ATAAC
AFTERCOOLER CIRCUIT TYPE: JW+OC, ATAAC
INLET MANIFOLD AIR TEMP (F): 122
JACKET WATER TEMP (F): 210.2
TURBO CONFIGURATION: PARALLEL
TURBO QUANTITY: 4
TURBOCHARGER MODEL: GT6041BN-48T-1.10
CERTIFICATION YEAR: 2006
CRANKCASE BLOWBY RATE (FT3/HR): 3,619.4
FUEL RATE (RATED RPM) NO LOAD (GAL/HR): 16.2
PISTON SPD @ RATED ENG SPD (FT/MIN): 2,539.4

INDUSTRY	SUBINDUSTRY	APPLICATION
ELECTRIC POWER	STANDARD	PACKAGED GENSET
OIL AND GAS	LAND PRODUCTION	PACKAGED GENSET

General Performance Data

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	BRAKE MEAN EFF PRES (BMEP)	BRAKE SPEC FUEL CONSUMPTN (BSFC)	VOL FUEL CONSUMPTN (VFC)	INLET MFLD PRES	INLET MFLD TEMP	EXH MFLD TEMP	EXH MFLD PRES	ENGINE OUTLET TEMP
EKW	%	BHP	PSI	LB/BHP-HR	GAL/HR	IN-HG	DEG F	DEG F	IN-HG	DEG F
2,500.0	100	3,633	336	0.334	173.5	78.1	121.9	1,235.6	67.6	915.2
2,250.0	90	3,283	303	0.335	157.1	71.3	119.4	1,190.0	61.3	881.2
2,000.0	80	2,935	271	0.339	142.3	64.3	116.9	1,158.9	55.3	864.0
1,875.0	75	2,760	255	0.342	134.9	60.7	115.8	1,145.6	52.3	858.5
1,750.0	70	2,586	239	0.346	127.6	57.0	114.7	1,133.3	49.3	854.6
1,500.0	60	2,237	207	0.354	113.0	49.5	112.7	1,112.4	43.2	851.2
1,250.0	50	1,889	174	0.365	98.4	41.3	111.0	1,091.8	36.8	850.7
1,000.0	40	1,547	143	0.373	82.5	31.4	109.4	1,061.5	29.3	856.6
750.0	30	1,203	111	0.385	66.2	21.7	107.9	1,010.3	22.1	848.2
625.0	25	1,029	95	0.394	57.9	17.2	107.2	968.3	18.7	831.1
500.0	20	854	79	0.403	49.2	12.7	106.4	902.0	15.5	796.1
250.0	10	497	46	0.441	31.3	4.8	104.1	700.7	9.8	647.3

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	COMPRESSOR OUTLET PRES	COMPRESSOR OUTLET TEMP	WET INLET AIR VOL FLOW RATE	ENGINE OUTLET WET EXH GAS VOL FLOW RATE	WET INLET AIR MASS FLOW RATE	WET EXH GAS MASS FLOW RATE	WET EXH VOL FLOW RATE (32 DEG F AND 29.98 IN HG)	DRY EXH VOL FLOW RATE (32 DEG F AND 29.98 IN HG)
EKW	%	BHP	IN-HG	DEG F	CFM	CFM	LB/HR	LB/HR	FT3/MIN	FT3/MIN
2,500.0	100	3,633	85	466.7	7,212.2	19,578.8	32,046.3	33,260.4	7,001.7	6,362.4
2,250.0	90	3,283	78	443.0	6,831.8	17,980.7	30,219.3	31,318.8	6,593.0	6,013.7
2,000.0	80	2,935	70	417.8	6,404.5	16,560.6	28,284.6	29,277.2	6,151.5	5,625.4
1,875.0	75	2,760	66	404.7	6,173.3	15,893.2	27,261.3	28,202.4	5,928.1	5,427.1
1,750.0	70	2,586	63	391.2	5,929.9	15,232.6	26,196.0	27,086.8	5,698.4	5,222.0
1,500.0	60	2,237	55	363.5	5,411.9	13,879.0	23,947.5	24,739.5	5,205.5	4,779.1
1,250.0	50	1,889	46	334.6	4,843.3	12,413.0	21,444.3	22,133.2	4,657.5	4,283.2
1,000.0	40	1,547	36	297.5	4,121.4	10,609.5	18,262.0	18,840.0	3,963.0	3,647.2
750.0	30	1,203	25	249.8	3,423.0	8,763.8	15,175.3	15,640.3	3,294.6	3,037.8
625.0	25	1,029	21	223.4	3,104.6	7,844.6	13,765.1	14,171.8	2,988.1	2,760.8
500.0	20	854	16	197.2	2,791.2	6,823.5	12,376.2	12,722.2	2,671.7	2,476.1
250.0	10	497	7	152.3	2,237.9	4,800.2	9,917.6	10,136.8	2,132.0	1,999.8

Heat Rejection Data

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	REJECTION TO JACKET WATER	REJECTION TO ATMOSPHERE	REJECTION TO EXH	EXHAUST RECOVERY TO 350F	FROM OIL COOLER	FROM AFTERCOOLER	WORK ENERGY	LOW HEAT VALUE ENERGY	HIGH HEAT VALUE ENERGY
EKW	%	BHP	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN
2,500.0	100	3,633	46,992	9,146	142,265	79,907	19,835	44,723	154,077	372,403	396,702
2,250.0	90	3,283	44,242	8,557	127,929	70,449	17,960	39,380	139,243	337,204	359,207
2,000.0	80	2,935	41,477	8,162	116,879	63,561	16,262	34,167	124,444	305,311	325,233
1,875.0	75	2,760	40,076	8,007	111,588	60,518	15,425	31,612	117,053	289,608	308,505
1,750.0	70	2,586	38,657	7,874	106,293	57,637	14,588	29,085	109,651	273,881	291,752
1,500.0	60	2,237	35,755	7,684	95,729	52,220	12,915	24,201	94,874	242,485	258,307
1,250.0	50	1,889	32,626	7,527	85,184	46,626	11,245	19,401	80,109	211,118	224,893
1,000.0	40	1,547	29,235	7,262	72,693	40,153	9,427	13,873	65,583	176,995	188,544
750.0	30	1,203	25,476	6,784	59,425	32,726	7,565	8,706	51,005	142,037	151,305
625.0	25	1,029	23,394	6,435	52,542	28,568	6,621	6,496	43,653	124,317	132,429
500.0	20	854	21,006	5,995	44,739	23,683	5,624	4,534	36,223	105,594	112,484
250.0	10	497	15,737	5,026	27,795	12,371	3,578	1,916	21,071	67,181	71,564

Emissions Data

RATED SPEED POTENTIAL SITE VARIATION: 1800 RPM

GENSET POWER WITH FAN	EKW	2,500.0	1,875.0	1,250.0	625.0	250.0
PERCENT LOAD	%	100	75	50	25	10
ENGINE POWER	BHP	3,633	2,760	1,889	1,029	497
TOTAL NOX (AS NO2)	G/HR	22,948	14,101	7,004	3,568	3,185
TOTAL CO	G/HR	2,726	1,304	1,092	1,496	2,098
TOTAL HC	G/HR	500	499	543	408	437
PART MATTER	G/HR	185.5	123.7	132.1	139.5	141.0
TOTAL NOX (AS NO2)	(CORR 5% O2) MG/NM3	2,818.9	2,229.5	1,544.3	1,352.7	2,230.2
TOTAL CO	(CORR 5% O2) MG/NM3	351.8	213.9	252.3	594.6	1,552.7
TOTAL HC	(CORR 5% O2) MG/NM3	55.9	72.8	108.8	140.7	282.4
PART MATTER	(CORR 5% O2) MG/NM3	19.7	16.5	25.8	48.5	88.2
TOTAL NOX (AS NO2)	(CORR 5% O2) PPM	1,373	1,086	752	659	1,086
TOTAL CO	(CORR 5% O2) PPM	281	171	202	476	1,242
TOTAL HC	(CORR 5% O2) PPM	104	136	203	263	527
TOTAL NOX (AS NO2)	G/HP-HR	6.38	5.15	3.74	3.50	6.47
TOTAL CO	G/HP-HR	0.76	0.48	0.58	1.47	4.26
TOTAL HC	G/HP-HR	0.14	0.18	0.29	0.40	0.89
PART MATTER	G/HP-HR	0.05	0.05	0.07	0.14	0.29
TOTAL NOX (AS NO2)	LB/HR	50.59	31.09	15.44	7.87	7.02
TOTAL CO	LB/HR	6.01	2.88	2.41	3.30	4.62
TOTAL HC	LB/HR	1.10	1.10	1.20	0.90	0.96
PART MATTER	LB/HR	0.41	0.27	0.29	0.31	0.31

RATED SPEED NOMINAL DATA: 1800 RPM

GENSET POWER WITH FAN	EKW	2,500.0	1,875.0	1,250.0	625.0	250.0
PERCENT LOAD	%	100	75	50	25	10
ENGINE POWER	BHP	3,633	2,760	1,889	1,029	497
TOTAL NOX (AS NO2)	G/HR	19,123	11,751	5,837	2,974	2,654
TOTAL CO	G/HR	1,515	725	607	831	1,165
TOTAL HC	G/HR	376	375	408	307	329
TOTAL CO2	KG/HR	1,740	1,340	966	559	296
PART MATTER	G/HR	132.5	88.4	94.3	99.6	100.7
TOTAL NOX (AS NO2)	(CORR 5% O2) MG/NM3	2,349.1	1,857.9	1,286.9	1,127.3	1,858.5
TOTAL CO	(CORR 5% O2) MG/NM3	195.4	118.8	140.1	330.3	862.6
TOTAL HC	(CORR 5% O2) MG/NM3	42.1	54.8	81.8	105.8	212.3
PART MATTER	(CORR 5% O2) MG/NM3	14.1	11.8	18.4	34.7	63.0
TOTAL NOX (AS NO2)	(CORR 5% O2) PPM	1,144	905	627	549	905
TOTAL CO	(CORR 5% O2) PPM	156	95	112	264	690
TOTAL HC	(CORR 5% O2) PPM	79	102	153	197	396
TOTAL NOX (AS NO2)	G/HP-HR	5.32	4.30	3.12	2.92	5.39
TOTAL CO	G/HP-HR	0.42	0.26	0.32	0.82	2.37
TOTAL HC	G/HP-HR	0.10	0.14	0.22	0.30	0.67

PERFORMANCE DATA[DM8266]

April 25, 2016

PART MATTER	G/HP-HR	0.04	0.03	0.05	0.10	0.20
TOTAL NOX (AS NO2)	LB/HR	42.16	25.91	12.87	6.56	5.85
TOTAL CO	LB/HR	3.34	1.60	1.34	1.83	2.57
TOTAL HC	LB/HR	0.83	0.83	0.90	0.68	0.72
TOTAL CO2	LB/HR	3,836	2,955	2,130	1,233	654
PART MATTER	LB/HR	0.29	0.19	0.21	0.22	0.22
OXYGEN IN EXH	%	9.4	10.4	11.3	12.2	14.4
DRY SMOKE OPACITY	%	1.7	1.4	1.9	2.5	3.8
BOSCH SMOKE NUMBER		0.58	0.49	0.62	0.92	1.27

Regulatory Information

EPA TIER 2				
2006 - 2010				
GASEOUS EMISSIONS DATA MEASUREMENTS PROVIDED TO THE EPA ARE CONSISTENT WITH THOSE DESCRIBED IN EPA 40 CFR PART 89 SUBPART D AND ISO 8178 FOR MEASURING HC, CO, PM, AND NOX. THE "MAX LIMITS" SHOWN BELOW ARE WEIGHTED CYCLE AVERAGES AND ARE IN COMPLIANCE WITH THE NON-ROAD REGULATIONS.				
Locality	Agency	Regulation	Tier/Stage	Max Limits - G/BKW - HR
U.S. (INCL CALIF)	EPA	NON-ROAD	TIER 2	CO: 3.5 NOx + HC: 6.4 PM: 0.20

EPA EMERGENCY STATIONARY				
2011 - ---				
GASEOUS EMISSIONS DATA MEASUREMENTS PROVIDED TO THE EPA ARE CONSISTENT WITH THOSE DESCRIBED IN EPA 40 CFR PART 60 SUBPART IIII AND ISO 8178 FOR MEASURING HC, CO, PM, AND NOX. THE "MAX LIMITS" SHOWN BELOW ARE WEIGHTED CYCLE AVERAGES AND ARE IN COMPLIANCE WITH THE EMERGENCY STATIONARY REGULATIONS.				
Locality	Agency	Regulation	Tier/Stage	Max Limits - G/BKW - HR
U.S. (INCL CALIF)	EPA	STATIONARY	EMERGENCY STATIONARY	CO: 3.5 NOx + HC: 6.4 PM: 0.20

Altitude Derate Data

ALTITUDE CORRECTED POWER CAPABILITY (BHP)

AMBIENT OPERATING TEMP (F)	50	60	70	80	90	100	110	120	130	NORMAL
ALTITUDE (FT)										
0	3,634	3,634	3,634	3,634	3,634	3,634	3,634	3,634	3,634	3,634
1,000	3,634	3,634	3,634	3,634	3,634	3,634	3,634	3,625	3,563	3,634
2,000	3,634	3,634	3,634	3,634	3,634	3,614	3,551	3,490	3,430	3,634
3,000	3,634	3,634	3,634	3,607	3,542	3,478	3,417	3,358	3,301	3,634
4,000	3,634	3,604	3,536	3,470	3,407	3,346	3,288	3,231	3,176	3,574
5,000	3,534	3,466	3,401	3,338	3,277	3,218	3,162	3,107	3,055	3,461
6,000	3,398	3,332	3,270	3,209	3,151	3,094	3,040	2,987	2,937	3,351
7,000	3,266	3,203	3,142	3,084	3,028	2,974	2,922	2,871	2,823	3,243
8,000	3,137	3,077	3,019	2,963	2,909	2,857	2,807	2,758	2,712	3,137
9,000	3,013	2,955	2,899	2,845	2,794	2,744	2,696	2,649	2,604	3,034
10,000	2,892	2,837	2,783	2,732	2,682	2,634	2,588	2,543	2,500	2,933
11,000	2,776	2,722	2,671	2,621	2,574	2,528	2,483	2,441	2,399	2,835
12,000	2,663	2,611	2,562	2,515	2,469	2,425	2,382	2,341	2,301	2,739
13,000	2,553	2,504	2,457	2,411	2,367	2,325	2,284	2,245	2,207	2,645
14,000	2,447	2,400	2,354	2,311	2,269	2,228	2,189	2,151	2,115	2,554
15,000	2,344	2,299	2,256	2,214	2,174	2,135	2,097	2,061	2,026	2,465

Cross Reference

Engine Arrangement			
Arrangement Number	Effective Serial Number	Engineering Model	Engineering Model Version
2666136	SBK00001	GS336	
3994249	DD500001	GS716	
5063096	SBK02000	GS336	

Test Specification Data					
Test Spec	Setting	Effective Serial Number	Engine Arrangement	Governor Type	Default Low Idle Speed
0K7009	LL5718	SBK00001	2666136		
3704978	GG0621	DD500001	3994249		
3704978	GG0621	SBK02000	5063096		

Supplementary Data

Type	Classification	Performance Number
SOUND	SOUND PRESSURE	DM8779

General Notes

General Notes DM8266 - 04

SOUND PRESSURE DATA FOR THIS RATING CAN BE FOUND IN PERFORMANCE NUMBER - DM8779

Performance Parameter Reference

Parameters Reference:DM9600-08

PERFORMANCE DEFINITIONS

PERFORMANCE DEFINITIONS DM9600

APPLICATION:

Engine performance tolerance values below are representative of a typical production engine tested in a calibrated dynamometer test cell at SAE J1995 standard reference conditions. Caterpillar maintains ISO9001:2000 certified quality management systems for engine test facilities to assure accurate calibration of test equipment. Engine test data is corrected in accordance with SAE J1995. Additional reference material SAE J1228, J1349, ISO 8665, 3046-1:2002E, 3046-3:1989, 1585, 2534, 2288, and 9249 may apply in part or are similar to SAE J1995. Special engine rating request (SERR) test data shall be noted.

PERFORMANCE PARAMETER TOLERANCE FACTORS:

Power	+/- 3%
Torque	+/- 3%
Exhaust stack temperature	+/- 8%
Inlet airflow	+/- 5%
Intake manifold pressure-gage	+/- 10%
Exhaust flow	+/- 6%
Specific fuel consumption	+/- 3%
Fuel rate	+/- 5%
Specific DEF consumption	+/- 3%
DEF rate	+/- 5%
Heat rejection	+/- 5%
Heat rejection exhaust only	+/- 10%
Heat rejection CEM only	+/- 10%

Heat Rejection values based on using treated water.

Torque is included for truck and industrial applications, do not use for Gen Set or steady state applications.

On C7 - C18 engines, at speeds of 1100 RPM and under these values are provided for reference only, and may not meet the tolerance listed.

These values do not apply to C280/3600. For these models, see the tolerances listed below.

C280/3600 HEAT REJECTION TOLERANCE FACTORS:

Heat rejection	+/- 10%
Heat rejection to Atmosphere	+/- 50%
Heat rejection to Lube Oil	+/- 20%
Heat rejection to Aftercooler	+/- 5%

TEST CELL TRANSDUCER TOLERANCE FACTORS:

Torque	+/- 0.5%
Speed	+/- 0.2%
Fuel flow	+/- 1.0%
Temperature	+/- 2.0 C degrees
Intake manifold pressure	+/- 0.1 kPa

OBSERVED ENGINE PERFORMANCE IS CORRECTED TO SAE J1995 REFERENCE AIR AND FUEL CONDITIONS.

REFERENCE ATMOSPHERIC INLET AIR

FOR 3500 ENGINES AND SMALLER

SAE J1228 AUG2002 for marine engines, and J1995 JAN2014 for other

PERFORMANCE DATA[DM8266]

April 25, 2016

engines, reference atmospheric pressure is 100 KPA (29.61 in hg), and standard temperature is 25deg C (77 deg F) at 30% relative humidity at the stated aftercooler water temp, or inlet manifold temp.

FOR 3600 ENGINES

Engine rating obtained and presented in accordance with ISO 3046/1 and SAE J1995 JANJAN2014 reference atmospheric pressure is 100 KPA (29.61 in hg), and standard temperature is 25deg C (77 deg F) at 30% relative humidity and 150M altitude at the stated aftercooler water temperature.

MEASUREMENT LOCATION FOR INLET AIR TEMPERATURE

Location for air temperature measurement air cleaner inlet at stabilized operating conditions.

REFERENCE EXHAUST STACK DIAMETER

The Reference Exhaust Stack Diameter published with this dataset is only used for the calculation of Smoke Opacity values displayed in this dataset. This value does not necessarily represent the actual stack diameter of the engine due to the variety of exhaust stack adapter options available. Consult the price list, engine order or general dimension drawings for the actual stack diameter size ordered or options available.

REFERENCE FUEL

DIESEL

Reference fuel is #2 distillate diesel with a 35API gravity; A lower heating value is 42,780 KJ/KG (18,390 BTU/LB) when used at 29 (84.2), where the density is 838.9 G/Liter (7.001 Lbs/Gal).

GAS

Reference natural gas fuel has a lower heating value of 33.74 KJ/L (905 BTU/CU Ft). Low BTU ratings are based on 18.64 KJ/L (500 BTU/CU FT) lower heating value gas. Propane ratings are based on 87.56 KJ/L (2350 BTU/CU Ft) lower heating value gas.

ENGINE POWER (NET) IS THE CORRECTED FLYWHEEL POWER (GROSS) LESS EXTERNAL AUXILIARY LOAD

Engine corrected gross output includes the power required to drive standard equipment; lube oil, scavenge lube oil, fuel transfer, common rail fuel, separate circuit aftercooler and jacket water pumps. Engine net power available for the external (flywheel) load is calculated by subtracting the sum of auxiliary load from the corrected gross flywheel out put power. Typical auxiliary loads are radiator cooling fans, hydraulic pumps, air compressors and battery charging alternators. For Tier 4 ratings additional Parasitic losses would also include Intake, and Exhaust Restrictions.

ALTITUDE CAPABILITY

Altitude capability is the maximum altitude above sea level at standard temperature and standard pressure at which the engine could develop full rated output power on the current performance data set

Standard temperature values versus altitude could be seen on TM2001.

When viewing the altitude capability chart the ambient temperature is the inlet air temp at the compressor inlet

Engines with ADEM MEUI and HEUI fuel systems operating at conditions above the defined altitude capability derate for atmospheric pressure and temperature conditions outside the values defined, see TM2001.

Mechanical governor controlled unit injector engines require a setting change for operation at conditions above the altitude defined on the engine performance sheet. See your Caterpillar technical representative for non standard ratings.

REGULATIONS AND PRODUCT COMPLIANCE

TMI Emissions information is presented at 'nominal' and 'Potential Site Variation' values for standard ratings. No tolerances are applied to the emissions data. These values are subject to change at any time. The controlling federal and local emission requirements need to be verified by your Caterpillar technical representative.

Customer's may have special emission site requirements that need to be verified by the Caterpillar Product Group engineer.

EMISSIONS DEFINITIONS:

Emissions : DM1176

HEAT REJECTION DEFINITIONS:

Diesel Circuit Type and HHV Balance : DM9500

HIGH DISPLACEMENT (HD) DEFINITIONS:

3500: EM1500

RATING DEFINITIONS:

Agriculture : TM6008

Fire Pump : TM6009

Generator Set : TM6035

Generator (Gas) : TM6041

Industrial Diesel : TM6010

Industrial (Gas) : TM6040

Irrigation : TM5749

Locomotive : TM6037

Marine Auxiliary : TM6036

Marine Prop (Except 3600) : TM5747

Marine Prop (3600 only) : TM5748

MSHA : TM6042

Oil Field (Petroleum) : TM6011

Off-Highway Truck : TM6039

On-Highway Truck : TM6038

SOUND DEFINITIONS:

Sound Power : DM8702

Sound Pressure : TM7080

Date Released : 7/7/15

SR5 GENERATORS



Image shown may not reflect actual product

1800 Frame

Standby Power

50 Hz 2500-3100 kVA	1500 rpm
60 Hz 2500-3100 kW	1800 rpm

Prime Power

50 Hz 2275-2825 kVA	1500 rpm
60 Hz 2250-2825 kW	1800 rpm

Continuous Power

50 Hz 2000-2600 kVA	1500 rpm
60 Hz 2050-2600 kW	1800 rpm

FEATURES

GENERAL

- Standards: meets the requirements of NEMA, IEC, ISO, IEEE, BS, AS
- Industry leading insulation technology
- Proven mechanical and electrical design
- Reliable and durable construction
- Improved excitation system for high power quality
- Improved motor starting capability
- Radio frequency noise suppression better than industry standards
- Superior construction and testing

STANDARD

- 3 phase brushless, salient pole
- NEMA Class H insulation
- Class H temperature rise 40 ° ambient
- 2/3 winding pitch
- Form Wound
- Standard voltages:
 - 60 Hz: 480V, 4160V
 - 50 Hz: 400V, 3300V
- Bus bar connections
 - 60 Hz models: NEMA standard hole pattern
 - 50 Hz models: IEC standard hole pattern

OPTIONAL

- Space heater kit
- Bearing temperature detectors
- Optional voltages:
 - 60 Hz: 380V, 440V, 600V
 - 50 Hz: 380V, and 415V
- Oversized generators for Class F temperature rise
- UL Listing

SPECIFICATIONS

Type.....	Brushless, revolving field solid-state automatic voltage regulator
Construction.....	Two bearings three phase, series star connected
Enclosure.....	Drip proof IP23, guarded
Over-speed capability	
60 Hz.....	125% of synchronous speed
50 Hz.....	150% of synchronous speed
Waveform deviation, line to line, no load.....	Less than 3%
Paralleling capability.....	Standard with adjustable voltage droop
Voltage level adjustment.....	+/- 5.0%
Voltage regulator	3-phase sensing with variable Volts-Per-Hertz response
Voltage regulation, steady state.....	+/- 0.5%
Voltage regulation with 3% speed change.....	+/- 0.5%
Voltage gain.....	adjustable to compensate for engine speed droop and line loss
TIF.....	Less than 50
Number of leads.....	6

PRODUCT SUPPORT

- Standard Caterpillar warranty
- Optional extended Caterpillar warranty
- Serviceable parts available through Cat Parts System
- Service intervals agree with recommended engine practices

SERVICEABILITY

- Stator leads exit top
- Replaceable bearing sleeve(s) for longer life and lower repair cost
- Easy access to serviceable parts
- Improved wire and terminal identification ensuring reliable connection

CABLE ENTRY

- Top cable entry on LV package
- Bottom cable entry on MV packages

MAIN STATOR CONSTRUCTION

The 1800 frame generators use Round lamination stator design.

Stator coil pitch, coil distribution designed to produce optimum waveform and minimum total harmonic distortion. Stator slots are insulated by slot liners and coil separators. Slot liners, coil separators, and top sticks provide an adequate distance from the coil to ground.

The thickness of liners, separators, and phase sheets provides superior protection between phases and ground.

Low voltage stator windings are given a 3000 volt "high pot" test (150% of the NEMA and IEC requirements for 460 volt generators) before the insulation is applied. The stators are then given a vacuum impregnation treatment of polyester material, followed by an application of epoxy resin. This sealed stator is then given a final 2000 volt "high pot" test.

ROTOR CONSTRUCTION

The main rotor is constructed using a precision "wet" layer winding process with epoxy painted on the bare rotor and on each layer. This ensures bonding of all the wire layers together, bonding of the coils to the rotor laminations, and a sealed insulation system. The rotor is put in the oven for curing the epoxy.

The exciter rotor is machine wound and receives a trickle coat of a fungus-resisting resin. Numerically controlled turning and grinding machines produce rotor shafts with close repeatable tolerances. Grade-8 bolts are used wherever joints are subject to induced stresses. A complete coating of red sealer is applied to protect the rotors and shaft from corrosion.

Every production rotor is dynamically balanced in two planes to within 0.0508 mm deflection peak-to-peak amplitude and run at rated speed before assembly into the stator.

Information contained in this publication may be considered confidential. Discretion is recommended when distributing.

Materials and specifications are subject to change without notice.

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www.Cat-ElectricPower.com

5. NONATTAINMENT NEW SOURCE REVIEW

The proposed Facility is located in the ozone nonattainment area. This area is currently in nonattainment for the 2008 (moderate) and 2015 (marginal) 1-hour ozone standards and in attainment or unclassifiable for other pollutants regulated under NSR. Based on the emission limits requested in this permit application, and that the Facility sources are not aggregated with existing emission sources at the Base, the Facility will be a synthetic minor source with respect Nonattainment New Source Review (NNSR).

HD has performed the three-part test for aggregation of sources and provided this analysis to the APCD³. That submittal, and the APCD response, is included in this section. In addition, the APCD is currently processing permit applications that will disaggregate existing emission sources at the Base currently permitted under a single Title V into separate permits.

Based on the three-part aggregation test and the current separation actions at the Base, this permit application has been prepared under the assumption that the Facility sources will not be aggregated with existing sources at the Base.

³ Email to Mr. Matt Burgett, APCD, Title V Program Manager, 11 September 2018. Response from Mr. Burgett received 12 September 2018.

August 30, 2018

Matt Burgett
Title V Program
Air Pollution Control Division
4300 South Cherry Creek Drive South
Denver, CO 80246

RE: Haras Developments LLC Data Center, Source Determination Request

Dear Mr. Burgett:

Haras Developments LLC (Haras) is preparing to construct a modular data center facility, with associated emergency generator installation, at the Buckley Air Force Base. We request that the Air Pollution Control Division (Division) provide a determination that the data center and the associated emergency generator installation are considered separate from other operations at the Base for purposes of air quality permitting.

The definition of "Stationary Source", at Colorado Regulation 3 Part A.1.B.43, sets out a three-part test to determine whether emission units must be grouped into a single source for air permitting purposes. Applying this test, we believe the data center and emergency generator facility project is separate from other emission sources at the Base.

Common control. The emergency generator facility that will provide backup power to the data center facility is under the control of Haras. The emergency generator equipment will be used solely as backup power for the data center when utility power is not available. Haras does not own or control any other emission generating operations at the Base.

Industrial grouping. The two-digit major SIC code for the data center facility is 73, for Business Services. The two-digit major code for the other operations at the Base is 97, for National Security and International Affairs.

Contiguous or Adjacent. The data center facility and associated emergency generator facility will be located within the fence line of the Buckley Air Force Base but will be located in an area that is separated (by at least 0.75 miles) from existing emission sources at the Base.

If any of the three prongs of the test fail, the facility should not be aggregated with other sources. We believe we do not meet the common control or industrial grouping criteria.

We note also that, in some cases, interdependency with other emission sources is considered when determining if sources should be aggregated. The data center facility's emergency generators will not provide any power to other operations at the Base. The data center will be independent of all other operations at the Base.

We are in the process of preparing appropriate documentation, including Air Pollution Emission Notices, to allow construction of the emergency generator facility associated with the data center. This will be delivered to the Division separately. We respectfully request that you confirm as soon

as possible that this project will not be grouped with other sources at the Base for air permitting purposes, so we can proceed with preparing the appropriate forms for submission to you.

Please contact Cody Dill at (740) 350-8407 if you have any questions or need any additional information from us. Thank you for your assistance.

Sincerely,

A handwritten signature in blue ink, appearing to be 'J. McFadden', with a stylized, cursive script.

Joseph McFadden
President, Haras Developments LLC

August 30, 2018

Chip Hancock
Construction Permits
Air Pollution Control Division
4300 South Cherry Creek Drive South
Denver, CO 80246

RE: Haras Developments LLC Data Center, Air Quality Permitting Determination Request

Dear Mr. Hancock:

Haras Developments LLC (Haras) is preparing to construct a modular data center facility, with associated emergency generator installation, at the Buckley Air Force Base. We request that the Air Pollution Control Division (Division) provide a determination regarding the air quality registration and permitting requirements for the data center and the associated emergency generator installation.

Recognizing that existing sources at the Base are subject to air quality permitting requirements, Haras, in a separate submittal, has requested a determination from the Division that the data center facility and the associated emergency generator facility are not subject to aggregation under any existing air quality permits. The determination request in this letter assumes that the data center and emergency generator facilities will not be aggregated with existing sources at the Base.

Data Center Facility Project

The data center project in the construction phase is expected to disturb over 25 contiguous acres of surface area, but less than 1,850 contiguous acres, for a period that may exceed six months in duration. In addition, Haras has determined that during the construction phase, no potentially contaminated soil will be disturbed since no land development will take place in an Installation Restoration Program (IRP) or in a Military Munitions Response Program (MMRP) area.

The data center, once in operation, will not be a significant source of regulated air quality pollutants.

- 1) Electricity will be provided by the local utility; data center operation is not dependent on any fuel burning equipment to generate power. Gaseous fuel burning equipment less than 10 MMBtu/hr (e.g., hot water heaters or building heat) is exempt from permitting requirements.
- 2) Day-to-day operations of the data center are not dependent on having backup power generation in place.
- 3) There are no other sources of regulated air emissions, other than those specifically exempted from air quality permitting by the CDPHE¹, associated with the data center.

¹ Potentially APEN-exempt activities at the data center include air conditioning or ventilating systems that do not include cooling towers, road and lot paving operations at commercial facilities, office emissions such as cleaning, copying, and restrooms, and comfort heaters that use gaseous fuel with a design rate of less than 10 MMBtu/hr.

Thus, Haras believes that a submittal of a Land Development Air Pollution Emission Notice (APEN) and registration under a General Permit for Land Development (GP03) will suffice to commence construction of the data center project.

Emergency Generator Installation

The data center will be powered by the local electrical utility, but Haras proposes to construct an emergency generators installation that will be physically separate from the data center to be used during periods of unavoidable power loss. That is, the data center and emergency generators will be separate installations connected only by an electrical busway and associated support structures.

For purposes of determining the air quality registration and permitting requirements, Haras specifies the following:

1. Each emergency generator set will include an approximately 3.125 kVA generator paired with an approximately 3,600 horsepower diesel-fueled engine.
2. Based on an estimated annual worst-case operating time of 120 hours, each generator package is expected to emit less than 3 tons per year (tpy) of NO_x or 0.4 tpy CO, 0.4 tpy of SO₂, and less than 0.1 tpy of other criteria pollutants. Total HAP emissions are expected to be less than 0.1 tpy and no individual HAP emission is expected to be above the reportable threshold. These estimates assume Tier 2 emission performance and the use of ultra-low sulfur fuel.
3. The total number of emergency generator sets will be such that total annual emissions from all units operating for 120 hours per year each will be less than the applicable major source Significant Emission Rates for criteria pollutants.
4. No individual generator engine would operate for more than 250 hours per year and operation would only occur during periods of maintenance or when utility power was not available.
5. The generator sets would be housed in a dedicated yard. Any cooling required would not entail the use of water-based cooling towers.
6. In addition to a 5,000 gallon integral belly tank on each engine skid, additional diesel fuel storage tanks might also be constructed. Total annual throughput of diesel fuel at the facility is estimated to be less than 400,000 gallons.
7. Storage tanks for lubricating oils or used lubricating oils would have a capacity of less than 40,000 gallons.
8. Any comfort heating units would use gaseous fuel and have an individual design rate of no more than 10 MMBtu/hr.
9. Any other fuel burning equipment would use gaseous fuel, and have an individual design rate of no more than 5 MMBtu/hr.

Haras believes the following are exempt from both APEN and construction permitting requirements:

- A. Diesel fuel storage tanks described in item 6 above, pursuant to Regulation 3, A.II.D.1.fff.
- B. Lubricating oil and used lubricating oil storage tanks described in item 7 above, pursuant to Regulation 3, A.II.D.1.aaa.
- C. Comfort heaters described in item 8 above, pursuant to Regulation 3, A.II.D.1.ggg.

- D. Other fuel burning equipment as described in item 9 above, pursuant to Regulation 3, A.II.D.1.k.

Haras believes that the generator engines would be subject to APEN submittal, revision, and renewal requirements but, pursuant to Regulation 3, B.II.D.1.c, are exempt from construction permitting requirements. As mentioned above, this exemption applies only if the emergency generator engines are not aggregated with any other permitted emission sources at the Base.

Request for Determination

Haras respectfully requests that the Division provide a written determination for the following:

1. The data center is subject to a land development APEN and GP03 submittal prior to commencing construction.
2. The emergency generator engines are subject to a RICE APEN submittal prior to commencing construction of any of the emergency generators, but are exempt from construction permitting requirements.

Haras understands that any determination provided by the Division is based on the accuracy of the statements provided above.

Please contact Cody Dill at (740) 350-8407 if you have any questions or need any additional information from us. Thank you for your assistance.

Sincerely,

A handwritten signature in blue ink, appearing to read 'J. McFadden', with a stylized, cursive script.

Joseph McFadden
President, Haras Developments LLC

George Iwaszek

From: Burgett - CDPHE, Matt <matt.burgett@state.co.us>
Sent: Wednesday, September 12, 2018 5:16 PM
To: George Iwaszek
Cc: Roland Hea; Conor Whetsel - CDPHE; Katherine Underriner - CDPHE; R K Hancock III
Subject: Re: Proposed Data Center at Buckley AFB

Hi George,

I reviewed your letter and spoke with Cody Dill regarding the data center. It sounds like the data center will have a government entity as a customer, but this is not an exclusive customer and others could utilize the data center in the future. Cody also stated that he does not believe the government customer has any other operations within the Buckley base. The Division will have the permit engineer fully review the information once an application is received, and the final decision will occur at that point. However, based on the information currently provided it seems to be a separate entity from Buckley and could be considered a separate source for air permitting purposes.

You may want to include a copy of this email with the application you submit.

Matt Burgett, P.E.
Title V Operating Permits Unit Supervisor
Stationary Sources Program

P 303.692.3183
4300 Cherry Creek Drive South, Denver, CO 80246-1530
matt.burgett@state.co.us | www.colorado.gov/cdphe/apcd

Are you curious about ground-level ozone in Colorado? Visit our [ozone webpage](#) to learn more.

On Wed, Sep 12, 2018 at 8:00 AM, R K Hancock III <r.hancock@state.co.us> wrote:
Morning George,

Wanted to clarify something from my last e-mail...

Based on the data submitted, the PTE of each engine at 500 hours would be 12+ tons per year of NOx. So, it would only take 9 of these engines to make the facility Non-Attainment New Source Review and T5 major if the company chooses to use the categorical permit exemption rather than apply for a synthetic minor permit.

Chip

R K "Chip" Hancock III, P.E.
Construction Permit Unit Supervisor
Stationary Sources Program
Air Pollution Control Division



COLORADO

Air Pollution Control Division

Department of Public Health & Environment

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r.hancock@state.co.us | www.colorado.gov/cdphe/apcd

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On Tue, Sep 11, 2018 at 1:26 PM, R K Hancock III <r.hancock@state.co.us> wrote:

Hi George,

Please let your client know that the Division does not make the kind of determinations requested in the letter to me unless APEN(s) and appropriate filing fee(s) are submitted first.

They should be aware of the following:

If they choose to claim the categorical permit exemption for the generators then the PTE of each generator is calculated at 500 hours per year. It is unclear how many generators are involved. Typically for a data center there are a lot of generators. The PTE of each unit would then be summed (along with the PTE of the APEN exempt equipment at 8760 hours) to determine major/minor source status (or major modification status depending upon Matt's unit's determination on the single source issue).

If the total requested level emissions of NO_x is 40 tons per year or more then impact modeling to the 1 hour NAAQS standard will be required to be submitted with the APEN(s). This would be required whether a permit is issued or not.

So, they may want to obtain a permit to get synthetic minor status and/or to stay below the modeling threshold.

It appears that at 250 hours (the level they wish to be limited to on a per generator basis), the emissions of NO_x for each generator is >5 tons per year. So a Reasonably Available Control Technology (RACT) analysis will also be required with the APEN(s). Basically they would need to look into the costs associated with purchasing the engines with Stage IV level emission controls instead of stage II.

As for the start of construction, a land development permit would allow them to begin clearing land and preparing the site. They can also purchase equipment and store on site. Should a permit be needed (or requested) then they could not build anything of a permanent nature (such as pads, buildings, electrical or fuel hook ups) until the permit is issued.

Chip

R K "Chip" Hancock III, P.E.
Construction Permit Unit Supervisor
Stationary Sources Program

Air Pollution Control Division



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r.hancock@state.co.us | www.colorado.gov/cdphe/apcd

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On Tue, Sep 11, 2018 at 12:03 PM, George Iwaszek <GIwaszek@trinityconsultants.com> wrote:

Matt and Chip,

I left phone messages for you regarding these letters that I am sending to you on behalf of my client, Haras Developments LLC, regarding proposed construction and operation of a data center at Buckley AFB. One of the letters, addressed to Chip, requests an air quality permitting determination; the other, addressed to Matt, requests a source aggregation determination.

I'll follow up in a few days to make sure that you received these letters and to offer a follow up meeting with Haras Developments and the APCD, but I am available to talk about our regulatory analysis anytime you are ready. If you have questions regarding the proposed project, a Haras Developments contact number is included in the letters. Cody Dill would be happy to speak with you as well about the project.

Thank you,

GEORGE IWASZEK | Manager of Consulting Services

[Trinity Consultants](#) | [On Demand Environmental](#) | [SafeBridge Consultants](#)
P: 720.638.7647 x105 | M: 303.349.4673 | E: giwaszek@trinityconsultants.com
1391 Speer Blvd, Suite 350 | Denver, CO 80204

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6. REASONABLY AVAILABLE CONTROL TECHNOLOGY ANALYSIS

An analysis of Reasonably Available Control Technology applicable to the Facility is presented in this section. Specifically, an analysis of the cost effectiveness to reduce NO_x emissions from the generator engines was performed. The low level of VOC emissions from the back-up facility engines precludes a RACT analysis for VOC.

The baseline case is the use of engines compliant with Tier 2 emission standards for large compression ignition engines. A search of the RACT/BACT/LAER Clearinghouse (RBLC) was performed for the period 1/1/2009 through 1/23/2019 and large diesel fueled emergency generator engines (> 1000 kW) were selected for comparison. The selected RBLC units are shown later in this section and the complete RBLC search results are included with the electronic files included with this permit application. The results of the RBLC search indicate that baseline case is the typical scenario for emergency / back-up power engines.

The result of the RBLC search restricted to emergency / back-up power engines indicates the highest tier rating for diesel engines found in this group is Tier 2. Frequently mentioned control methods included good combustion practices, limited hours of operation, and/or compliance with NSPS IIII/NESHAP ZZZZ requirements. For the RACT analysis comparison to the proposed baseline case, an interim Tier 4 engine is selected.

Control strategies to comply with Interim Tier 4 emission standards for NO_x include emission gas recirculation (EGR), advanced fuel/air ratio controls, and selective catalytic reduction (SCR) with injection of Diesel Emission Fluid (DEF). For the comparison case for this RACT analysis, a Caterpillar 3516C with engine power of 3,627 hp (sea level), equipped with SCR controls to achieve interim Tier 4 standards was selected. Other than the control technology, this engine is essentially identical to the baseline case. Recent, conservative, cost quotes for both units were used for the calculations shown here. The engine specifications for the baseline case are provided in Section 4; the engine specifications for the comparison case are provided in this section.

As shown in the results, the cost effectiveness of interim Tier 4 NO_x reduction is approximately \$27,000 per ton of NO_x removed. Based on these results and the results of the RBLC search, HD proposes that engines compliant with Tier2 emission standards and a limitation on annual fuel consumption is selected as RACT for NO_x.

NO_x Reduction Cost Analysis

Common Information

Annual Fuel Usage [AFU] (gallons/yr)

265,000

	Tier 2 (Base Case)	Tier 4i ³
Engine Rating @ 100% load, potential site variation (bhp)		3,626
Fuel Volume Consumption Rate [VCR] (gallons/hr)		179.2
Annual Hours of Operation at 100% Load		1,479
NO _x Emissions @ 100% load, site variable (lb/hr)		5.88
NO _x Emissions (tpy)	39.06	4.35
NO _x Reduced (tpy)	--	34.71
Interest Rate ¹ (%)	7%	
30-Year Equipment ²		
CI Engines (# units)	18	18
Capital Cost (\$) per unit ³	\$ 566,000	\$ 958,000
Installation cost (1.05 x Capital Cost) ⁴	\$ 594,300	\$ 1,005,900
General Facilities (0.05 x Capital Cost) ⁴	\$ 28,300	\$ 47,900
Engineering and Home Office Fees (0.1 x Capital Cost) ⁴	\$ 56,600	\$ 95,800
Process Contingency (0.05 x Capital Cost) ⁴	\$ 28,300	\$ 47,900
Start Up (0.01 x Capital Cost) ⁴	\$ 5,660	\$ 9,580
Performance Tests (0.01 x Capital Cost) ⁴	\$ 5,660	\$ 9,580
Total Capital Investment [TCI]	\$ 10,906,820	\$ 18,460,660
30-Year Equipment Capital Recovery Factor ⁵	0.08	
30-Year Equipment Indirect Annual Cost (\$/year)	\$ 982,480	\$ 1,662,926
5-Year Equipment ²		
Catalyst cost (\$/cubic foot) ⁴	--	\$500
Catalyst volume per unit (cubic feet) ⁴	--	40
Catalyst Capital Cost (\$) per unit	--	\$ 20,000
Total Capital Cost	\$ -	\$ 360,000
5-Year Equipment Capital Recovery Factor ⁶	0.24	
5-Year Equipment Indirect Annual Cost (\$/year)	--	\$ 87,801
Total Indirect Annual Cost ⁶ (\$/year)	\$ 982,480	\$ 1,750,727
Operating Costs		
Maintenance costs (0.015 TCI)	\$ 163,602	\$ 276,910
Aftertreatment Material Cost (\$/year) ⁷	--	\$ 47,700
Direct Annual Cost (\$/year):	\$ 163,602.30	\$ 324,609.90
Indirect + Direct Annual Cost (\$/year):	\$ 1,146,083	\$ 2,075,337
Controlled Annual Cost - Base Case Annual Cost (\$/year)	--	\$ 929,254
Cost Effectiveness (\$/ton)	--	\$ 26,771

¹ Interest rate conservatively set at 7.00%, based on EPA's seven percent social interest rate from the OAQPS CCM Sixth Edition.

² Per EPA's Nonroad Compression-Ignition Engines: Exhaust Emission Standards (March, 2016; EPA-420-B-16-022), the useful life of a large engine is 8,000 hrs/10 years. Assuming that a unit operates for up to 500 hours per year, the useful life is estimated at 16 years. For cost effectiveness calculations, the useful life is conservatively set at 30 years. The expected life of the SCR system, is assumed to be 10 years due to the corrosive nature of the materials used to reduce emissions. The catalyst is assumed to require replacement every 5 years.

³ Provided by Cody Dill, email 21 January 2019. Included in RACT section.

⁴ Indirect costs obtained from: Installation -US EPA 1994. NO_x Control Technologies Applicable to Municipal Waste Combustion, EPA-600/R-94-208. General, engineering, contingency, catalyst - U.S. EPA 2002. EPA Air Pollution Control Cost Manual, 6th Ed., Startup and test- U.S. EPA 1986. Control Technologies for Hazardous Air Pollutants. EPA/625/6-86/014.

⁵ Capital Recovery Fraction (CRF) = Interest Rate (%) x (1 + Interest Rate (%)) ^ Equipment Life / ((1 + Interest Rate (%)) ^ Equipment Life - 1)

⁶ Since annual costs such as administrative charges, property taxes, and insurance for the controlled systems are assumed to be similar to that of the base case, the indirect annual cost consists solely of capital recovery, calculated as Total Capital Investment * Capital Recovery Fraction.

⁷ Aftertreatment material is assumed to be Diesel Emission Fluid (DEF), a urea/water solution. The injection rate of DEF into the exhaust system is typically 2-6% of diesel consumption.

DEF Consumption Rate as Fraction of Fuel Consumption	4%
DEF Volume Consumption Rate (gallons/yr)	10,600
DEF Cost (\$/gallon)	\$4.50

George Iwaszek

From: Dill, Cody <codydill@amazon.com>
Sent: Thursday, January 17, 2019 12:15 PM
To: George Iwaszek
Subject: AWS - Blue Marlin Project - RACT Analysis Info
Attachments: CAT 3516C Tier4 Spec Sheet.pdf

George,

As discussed on the phone, here are some additional cost/emission details for your development of an analysis for the permit application. These cost estimates both come from quotes about a year old from the same vendor. Assuming that is sufficient? Also, I have attached the CAT cut sheet for a Tier 4 engine so you can complete a cost/ton assessment. I would note this is strictly purchase costs. The Tier4 gensets obviously have increased O&M costs as well. I would need a couple days to come up with this estimate if needed.

- Tier 2 genset/enclosure/tank Total cost per unit:
 - \$566,000
- Tier 4 genset (with emission controls)/enclosure/tank Total cost per unit:
 - \$958,000

Cody Dill, P.E.
Environmental Engineer
AWS | Infrastructure
codydill@amazon.com
Office: 614.758.1258
Mobile: 740.350.8407

Selected RBLC Results

Large Diesel-fueled Emergency Generator Engines

RBLC ID	ST	Permit Issued	Deter. Update	PROCESS_NAME	Fuel Type	Power	Units	POLLUTANT	CONTROL_METHOD_DESCRIPTION
*LA-0315	LA	May-14	Mar-17	Emergency Diesel Generator 1	Diesel	5364 hp		NOx	Compliance with 40 CFR 60 Subpart IIII and 40 CFR 63 Subpart ZZZZ
*LA-0315	LA	May-14	Mar-17	Emergency Diesel Generator 2	Diesel	5364 hp		NOx	Compliance with 40 CFR 60 Subpart IIII and 40 CFR 63 Subpart ZZZZ
LA-0305	LA	Jun-16	Apr-17	Diesel Engines (Emergency)	Diesel	4023 hp		NOx	Complying with 40 CFR 60 Subpart IIII
CA-1221	CA	Dec-11	Jul-17	ICE:Emergency-Compression Ignition	diesel	3634 hp		NOx	Tier 2 certified and 50 hr/yr for M&T limit
*MI-0434	MI	Mar-18	Aug-18	EUENGINE01 through EUENGINE08	Diesel	3633 hp		NOx	Good combustion practices.
NV-0050	NV	Nov-09	Mar-10	CC009 THRU CC015 AT CITY CENTER DIESEL EMERGENCY GENERATORS - UNITS	DIESEL OIL	3622 hp		NOx	TURBOCHARGER AAND AFTER-COOLER
IN-0173	IN	Jun-14	May-16	DIESEL FIRED EMERGENCY GENERATOR	NO. 2, DIESEL	3600 hp		NOx	GOOD COMBUSTION PRACTICES
IN-0180	IN	Jun-14	May-16	DIESEL FIRED EMERGENCY GENERATOR	NO. 2, DIESEL	3600 hp		NOx	GOOD COMBUSTION PRACTICES
MI-0418	MI	Jan-15	Jul-16	FG-BACKUPGENS (Nine (9) DRUPS Emergency Engines)	Diesel	3490 KW		NOx	No add-on controls, but injection timing retardation (ITR) is good design. Engines are tuned for low-NOx operation versus low CO operation.
LA-0316	LA	Feb-17	Apr-17	emergency generator engines (6 units)	diesel	3353 hp		NOx	Complying with 40 CFR 60 Subpart IIII
FL-0347	FL	Sep-14	Jul-16	Emergency Diesel Engine	Diesel	3300 hp		NOx	Use of good combustion practices based on the most recent manufacturer's specifications issued for engines and with turbocharger, aftercooler, and high injection pressure
LA-0309	LA	Jun-15	Apr-17	Emergency Generator Engines	Diesel	2922 hp		NOx	Complying with 40 CFR 60 Subpart IIII
MI-0418	MI	Jan-15	Jul-16	Four (4) emergency engines in FG- BACKUPGENS	Diesel	2710 KW		NOx	No add-on controls, but injection timing retardation (ITR) is good design. Engines are tuned for low-NOx operation versus low CO operation.
CA-1212	CA	Oct-11	Jan-14	EMERGENCY IC ENGINE	DIESEL	2683 hp		NOx	Compliance with 40 CFR 60 Subpart IIII; operating the engine in accordance with the engine manufacturer's instructions and/or written procedures (consistent with safe operation) designed to maximize combustion efficiency and minimize fuel usage.
LA-0296	LA	May-14	Apr-17	Emergency Diesel Generators	Diesel	2682 hp		NOx	No add-on control, but ignition timing retardation (ITR) is good design. Engines are tuned for low-NOx operation versus low CO operation.
MI-0395	MI	Jul-12	Aug-13	Four (4) Emergency Generators	Diesel	2500 KW		NOx	No add-on controls, but ignition timing retardation (ITR) is good design. Engines are tuned for low-NOx operation versus low CO operation.
MI-0394	MI	Feb-12	Aug-13	Four (4) Emergency Generators	Diesel	2280 KW		NOx	No add-on controls, but ignition timing retardation (ITR) is good design. Engines are tuned for low-NOx operation versus low CO operation.
OH-0352	OH	Jun-13	May-16	Emergency generator	diesel	2250 KW		NOx	Purchased certified to the standards in NSPS Subpart IIII
FL-0338	FL	May-12	May-16	Emergency Generator Diesel Engine - Development Driller 1	Diesel	2229 hp		NOx	Use of good combustion practices based on the current manufacturer's specifications for these engines, use of low sulfur diesel fuel, positive crankcase ventilation, turbocharger with aftercooler, high pressure fuel injection with aftercooler

Selected RBLC Results

Large Diesel-fueled Emergency Generator Engines

RBLC ID	ST	Permit Issued	Deter. Update	PROCESS_NAME	Fuel Type	Power	Units	POLLUTANT	CONTROL_METHOD_DESCRIPTION
EMERGENCY GENERATORS - UNITS LX024									
NV-0050	NV	Nov-09	Mar-10	AND LX025 AT LUXOR	DIESEL OIL	2206 hp		NOx	TURBOCHARGING, AFTER-COOLING, AND LEAN-BURN TECHNOLOGY
OK-0129	OK	Jan-09	Feb-10	EMERGENCY DIESEL GENERATOR (2200 HP)	LOW SULFUR	2200 hp		NOx	
FL-0338	FL	May-12	May-16	Emergency Generator Diesel Engine - C.R. Luigs	diesel	2064 hp		NOx	Use of good combustion practices based on the current manufacturer's specifications for these engines, use of low sulfur diesel fuel, positive crankcase ventilation, turbocharger with aftercooler, high pressure fuel injection with aftercooler
WV-0025	WV	Nov-14	May-18	Emergency Generator	Diesel	2015.7 hp		NOx	
IN-0158	IN	Dec-12	May-16	EMERGENCY DIESEL GENERATOR	DIESEL	2012 hp		NOx	COMBUSTION DESIGN CONTROLS AND USAGE LIMITS
CA-1191	CA	Mar-10	Dec-17	EMERGENCY ENGINE	DIESEL	2000 KW		NOx	OPERATIONAL RESTRICTION OF 50 HR/YR
ID-0017	ID	Feb-09	Feb-10	2 MW EMERGENCY GENERATOR, SRC25	ASTM #1, 2, D	2000 KW		NOx	GOOD COMBUSTION PRACTICES. EPA CERTIFIED PER NSPS IIII
CA-1220	CA	Oct-11	Jul-17	ICE:Emergency-Compression Ignition	diesel	1881 hp		NOx	Tier 2 certified and 50 hr/y M&T limit
TX-0728	TX	Apr-15	May-16	Emergency Diesel Generator	Diesel	1500 hp		NOx	Minimized hours of operations Tier II engine
*LA-0312	LA	Jun-17	Dec-17	DEG1-13 - Diesel Fired Emergency Generator Engine (EQT0012)	Diesel	1474 hp		NOx	Compliance with NSPS Subpart IIII
SC-0115	SC	Feb-09	Oct-12	DIESEL EMERGENCY GENERATOR	DIESEL	1400 hp		NOx	TUNE-UPS AND INSPECTIONS WILL BE PERFORMED AS OUTLINED IN THE GOOD MANAGEMENT PRACTICE PLAN.
IN-0166	IN	Jun-12	May-16	TWO (2) EMERGENCY GENERATORS	DIESEL	1341 hp		NOx	GOOD COMBUSTION PRACTICES AND LIMITED HOURS OF NON-EMERGENCY OPERATION
LA-0292	LA	Jan-16	Sep-16	Emergency Generators No. 1 & No. 2	Diesel	1341 hp		NOx	Good equipment design, proper combustion techniques, use of low sulfur fuel, and compliance with 40 CFR 60 Subpart IIII
*MI-0433	MI	Jun-18	Aug-18	EUEMENGINE (North Plant): Emergency Engine	Diesel	1341 hp		NOx	Good combustion practices and meeting NSPS Subpart IIII requirements.
*MI-0433	MI	Jun-18	Aug-18	EUEMENGINE (South Plant): Emergency Engine	Diesel	1341 hp		NOx	Good combustion practices and meeting NSPS IIII requirements.
OK-0154	OK	Jul-13	Jul-16	DIESEL-FIRED EMERGENCY GENERATOR ENGINE	DIESEL	1341 hp		NOx	COMBUSTION CONTROL
LA-0231	LA	Jun-09	May-10	EMERGENCY DIESEL POWER GENERATOR ENGINES (2)	DIESEL	1341 hp		NOx	COMPLY WITH 40 CFR 60 SUBPART IIII
NV-0049	NV	Aug-09	Dec-09	LARGE INTERNAL COMBUSTION ENGINES (>600 HP) - UNIT HA13	DIESEL OIL	1232 hp		NOx	THE UNIT IS EQUIPPED WITH A TURBOCHARGER.
LA-0272	LA	Mar-13	May-16	EMERGENCY DIESEL GENERATOR (2205-B)	DIESEL	1200 hp		NOx	Compliance with 40 CFR 60 Subpart IIII; good combustion practices.
FL-0348	FL	May-12	Jul-16	Emergency Electrical Generator	Diesel	1100 hp		NOx	Use of good combustion and maintenance practices based on the current manufacturer's specifications for this engine.

Selected RBLC Results
Large Diesel-fueled Emergency Generator Engines

RBLC ID	ST	Permit Issued	Deter. Update	PROCESS_NAME	Fuel Type	Power	Units	POLLUTANT	CONTROL_METHOD_DESCRIPTION
IN-0158	IN	Dec-12	May-16	TWO (2) EMERGENCY DIESEL GENERATORS FG-EMGEN7-8; Two (2) 1,000kW diesel- fueled emergency reciprocating internal	DIESEL		1006 hp	NOx	COMBUSTION DESIGN CONTROLS AND USAGE LIMITS
MI-0406	MI	Nov-13	Jul-16	combustion engines	Diesel		1000 kW	NOx	Good combustion practices

PERFORMANCE DATA[DM9370]

June 23, 2016

Performance Number: DM9370

Change Level: 01

SALES MODEL:	3516C	COMBUSTION:	DI
ENGINE POWER (BHP):	3,627	ENGINE SPEED (RPM):	1,800
GEN POWER WITH FAN (EKW):	2,500.0	HERTZ:	60
COMPRESSION RATIO:	14	FAN POWER (HP):	130.1
RATING LEVEL:	STANDBY	ASPIRATION:	TA
PUMP QUANTITY:	1	AFTERCOOLER TYPE:	ATAAC
FUEL TYPE:	DIESEL	AFTERCOOLER CIRCUIT TYPE:	JW+OC, ATAAC
MANIFOLD TYPE:	DRY	INLET MANIFOLD AIR TEMP (F):	122
GOVERNOR TYPE:	ADEM4	JACKET WATER TEMP (F):	210.2
ELECTRONICS TYPE:	ADEM4	TURBO CONFIGURATION:	PARALLEL
CAMSHAFT TYPE:	STANDARD	TURBO QUANTITY:	4
IGNITION TYPE:	CI	TURBOCHARGER MODEL:	GTB6041BN-48T-1.04
INJECTOR TYPE:	EUI	CERTIFICATION YEAR:	2011
REF EXH STACK DIAMETER (IN):	12	FUEL RATE (RATED RPM) NO LOAD (GAL/HR):	16.4
		PISTON SPD @ RATED ENG SPD (FT/MIN):	2,539.4

INDUSTRY	SUBINDUSTRY	APPLICATION
OIL AND GAS	LAND PRODUCTION	PACKAGED GENSET
ELECTRIC POWER	STANDARD	PACKAGED GENSET

General Performance Data

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	BRAKE MEAN EFF PRES (BMEP)	BRAKE SPEC FUEL CONSUMPTN (BSFC)	VOL FUEL CONSUMPTN (VFC)	INLET MFLD PRES	INLET MFLD TEMP	EXH MFLD TEMP	EXH MFLD PRES	ENGINE OUTLET TEMP
EKW	%	BHP	PSI	LB/BHP-HR	GAL/HR	IN-HG	DEG F	DEG F	IN-HG	DEG F
2,500.0	100	3,626	335	0.334	172.9	74.9	121.0	1,289.8	63.4	972.9
2,250.0	90	3,278	303	0.332	155.7	66.8	116.2	1,244.2	56.6	940.9
2,000.0	80	2,933	271	0.332	139.1	58.2	111.6	1,204.6	49.6	920.2
1,875.0	75	2,760	255	0.332	131.0	53.9	109.4	1,185.7	46.2	912.5
1,750.0	70	2,587	239	0.333	123.1	49.8	107.5	1,166.8	42.9	906.0
1,500.0	60	2,243	207	0.338	108.2	42.3	104.5	1,129.8	37.1	892.2
1,250.0	50	1,898	175	0.346	93.9	35.4	102.2	1,092.1	31.9	873.0
1,000.0	40	1,561	144	0.354	78.9	27.8	99.2	1,041.1	26.4	842.5
750.0	30	1,221	113	0.364	63.4	20.3	98.8	966.1	21.1	799.0
625.0	25	1,048	97	0.372	55.7	16.8	97.9	916.4	18.6	768.0
500.0	20	872	81	0.385	47.9	13.6	96.3	853.9	16.3	723.2
250.0	10	509	47	0.435	31.7	7.4	92.6	674.0	11.8	570.8

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	COMPRESSOR OUTLET PRES	COMPRESSOR OUTLET TEMP	WET INLET AIR VOL FLOW RATE	ENGINE OUTLET WET EXH GAS VOL FLOW RATE	WET INLET AIR MASS FLOW RATE	WET EXH GAS MASS FLOW RATE	WET EXH VOL FLOW RATE (32 DEG F AND 29.98 IN HG)	DRY EXH VOL FLOW RATE (32 DEG F AND 29.98 IN HG)
EKW	%	BHP	IN-HG	DEG F	CFM	CFM	LB/HR	LB/HR	FT3/MIN	FT3/MIN
2,500.0	100	3,626	80	424.7	6,985.4	19,660.0	30,845.2	32,056.1	6,747.5	6,125.9
2,250.0	90	3,278	72	398.2	6,581.8	17,973.4	28,890.1	29,979.9	6,309.5	5,745.0
2,000.0	80	2,933	63	369.4	6,084.5	16,257.6	26,537.4	27,511.3	5,792.8	5,285.2
1,875.0	75	2,760	58	354.7	5,819.2	15,409.4	25,310.0	26,228.0	5,521.4	5,042.3
1,750.0	70	2,587	54	339.8	5,546.1	14,578.4	24,057.3	24,919.5	5,248.6	4,797.8
1,500.0	60	2,243	46	311.8	5,055.6	13,079.5	21,836.3	22,594.4	4,757.0	4,357.8
1,250.0	50	1,898	39	283.5	4,606.4	11,692.7	19,829.4	20,487.4	4,314.0	3,963.9
1,000.0	40	1,561	31	249.8	4,093.9	10,095.4	17,554.5	18,106.7	3,811.9	3,515.2
750.0	30	1,221	23	213.4	3,553.2	8,426.2	15,232.7	15,677.1	3,291.6	3,050.2
625.0	25	1,048	19	195.4	3,309.3	7,625.6	14,124.4	14,514.5	3,053.9	2,839.2
500.0	20	872	16	177.6	3,086.7	6,841.8	13,169.0	13,504.7	2,843.8	2,655.5
250.0	10	509	9	141.9	2,659.4	5,127.6	11,327.9	11,549.9	2,446.6	2,312.5

Heat Rejection Data

HEAT REJECTION TO ATMOSPHERE SHOWN HERE IS ENGINE ONLY. CEM HEAT REJECTION TO ATMOSPHERE SHOWN IN THE SUPPLEMENTARY DATA IS THE ADDITIONAL HEAT REJECTED TO ATMOSPHERE FROM THE CEM. THIS ADDITIONAL HEAT IS INCLUDED IN THE HEAT REJECTION TO EXH AND EXH RECOVERY SHOWN HERE AND WOULD NEED TO BE DEDUCTED FROM THE EXH AND EXH RECOVERY VALUES WHEN SIZING EXHAUST RECOVERY HEAT EQUIPMENT.

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	REJECTION TO JACKET WATER	REJECTION TO ATMOSPHERE	REJECTION TO EXH	EXHAUST RECOVERY TO 350F	FROM OIL COOLER	FROM AFTERCOOLER	WORK ENERGY	LOW HEAT VALUE ENERGY	HIGH HEAT VALUE ENERGY
EKW	%	BHP	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN
2,500.0	100	3,626	47,859	9,535	146,173	85,330	19,765	37,831	153,767	371,077	395,290
2,250.0	90	3,278	43,583	8,971	131,308	75,424	17,796	32,958	139,025	334,116	355,918
2,000.0	80	2,933	40,017	8,574	117,399	66,624	15,897	27,576	124,365	298,465	317,940
1,875.0	75	2,760	38,324	8,379	110,760	62,598	14,975	24,951	117,053	281,145	299,490
1,750.0	70	2,587	36,648	8,180	104,305	58,731	14,070	22,508	109,718	264,158	281,394
1,500.0	60	2,243	33,631	7,808	92,674	51,825	12,373	18,251	95,101	232,306	247,464
1,250.0	50	1,898	30,825	7,422	81,562	45,194	10,739	14,520	80,502	201,622	214,778
1,000.0	40	1,561	27,544	6,942	68,856	37,468	9,014	10,617	66,193	169,244	180,287
750.0	30	1,221	23,983	6,423	55,783	29,417	7,249	7,094	51,768	136,101	144,982
625.0	25	1,048	22,040	6,104	49,221	25,265	6,366	5,564	44,447	119,526	127,325
500.0	20	872	19,991	5,707	42,527	20,874	5,478	4,265	36,994	102,846	109,557
250.0	10	509	15,922	4,938	27,696	10,374	3,621	2,155	21,599	67,983	72,419

Sound Data

SOUND DATA REPRESENTATIVE OF NOISE PRODUCED BY THE "ENGINE AND CEM" AS A UNIT WITHOUT A MUFFLER INSTALLED

EXHAUST: Sound Power (1/3 Octave Frequencies)

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	OVERALL SOUND	100 HZ	125 HZ	160 HZ	200 HZ	250 HZ	315 HZ	400 HZ	500 HZ	630 HZ	800 HZ
EKW	%	BHP	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
2,500.0	100	3,626	102.8	71.5	77.1	77.2	87.0	92.0	91.7	88.5	93.4	92.9	96.5
2,250.0	90	3,278	100.5	70.1	76.1	76.0	85.2	90.0	89.3	86.6	91.4	90.9	94.1
2,000.0	80	2,933	97.8	68.7	75.2	74.2	82.8	87.5	87.0	84.4	88.6	88.1	91.1
1,875.0	75	2,760	96.5	68.1	74.8	73.3	81.6	86.3	86.0	83.5	87.3	86.8	89.6
1,750.0	70	2,587	95.3	67.7	74.6	72.4	80.5	85.2	85.0	82.8	86.2	85.6	88.2
1,500.0	60	2,243	93.2	67.2	74.7	70.6	78.4	83.4	83.5	82.1	84.2	83.4	85.6
1,250.0	50	1,898	91.1	66.7	74.8	68.7	76.2	81.6	81.9	81.5	82.3	81.2	83.1
1,000.0	40	1,561	89.5	64.9	75.8	67.6	74.6	79.5	79.9	80.6	80.5	79.6	81.1
750.0	30	1,221	87.6	65.3	75.3	65.2	72.2	77.9	78.7	80.1	78.6	77.1	78.2
625.0	25	1,048	86.7	65.1	75.3	64.7	71.0	76.9	77.8	79.7	77.5	76.0	77.0
500.0	20	872	86.2	62.8	76.3	65.9	70.4	75.4	75.9	78.6	76.4	75.6	76.5
250.0	10	509	85.8	60.3	77.3	67.3	70.0	74.1	74.1	77.5	75.2	75.4	76.3

EXHAUST: Sound Power (1/3 Octave Frequencies)

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	1000 HZ	1250 HZ	1600 HZ	2000 HZ	2500 HZ	3150 HZ	4000 HZ	5000 HZ	6300 HZ	8000 HZ	10000 HZ
EKW	%	BHP	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
2,500.0	100	3,626	95.6	90.4	88.0	85.0	81.6	78.1	73.8	67.6	66.9	56.3	54.9
2,250.0	90	3,278	93.1	87.9	85.5	82.5	79.4	76.1	71.7	65.7	65.3	55.4	58.4
2,000.0	80	2,933	90.2	85.2	82.8	79.8	77.0	73.7	69.2	63.5	63.2	55.1	61.2
1,875.0	75	2,760	88.7	83.7	81.4	78.5	76.0	72.6	68.2	62.7	62.4	55.1	61.4
1,750.0	70	2,587	87.2	82.3	80.1	77.4	75.0	71.6	67.4	62.1	61.9	55.3	60.7
1,500.0	60	2,243	84.3	79.1	77.4	75.6	73.3	70.0	66.0	61.5	61.6	56.0	56.6
1,250.0	50	1,898	81.3	76.1	74.6	73.9	71.6	68.3	64.8	61.0	61.3	56.8	52.3
1,000.0	40	1,561	79.5	74.9	73.0	73.1	70.8	67.4	63.6	60.8	61.4	55.1	49.8
750.0	30	1,221	75.8	70.5	69.5	70.7	68.5	65.2	62.3	60.1	61.0	57.6	44.2
625.0	25	1,048	74.2	69.1	68.3	69.8	67.6	64.4	61.7	59.8	60.8	57.9	42.3
500.0	20	872	74.5	70.6	69.2	70.2	68.2	65.0	61.6	59.9	60.9	54.3	43.5
250.0	10	509	75.1	72.6	70.4	70.9	69.1	65.7	61.5	60.1	61.0	50.2	45.3

Sound Data (Continued)

MECHANICAL: Sound Power (1/3 Octave Frequencies)

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	OVERALL SOUND	100 HZ	125 HZ	160 HZ	200 HZ	250 HZ	315 HZ	400 HZ	500 HZ	630 HZ	800 HZ
EKW	%	BHP	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
2,500.0	100	3,626	123.1	90.9	108.2	97.3	100.5	101.6	104.1	102.6	106.0	108.1	109.8
2,250.0	90	3,278	122.7	90.1	107.7	96.8	100.2	100.9	103.2	101.7	105.3	107.4	109.4
2,000.0	80	2,933	123.0	89.3	107.1	96.1	99.4	100.2	102.8	100.9	105.5	106.7	108.7
1,875.0	75	2,760	122.5	88.9	106.8	95.7	98.8	99.7	102.6	100.9	105.5	106.6	108.6
1,750.0	70	2,587	122.0	88.5	106.5	95.2	98.2	99.1	102.4	100.9	105.4	106.4	108.6
1,500.0	60	2,243	121.1	88.0	105.7	94.1	97.0	98.1	101.8	100.8	104.2	106.0	108.6
1,250.0	50	1,898	120.4	87.7	104.9	92.4	95.0	96.5	100.7	99.8	103.5	106.0	107.9
1,000.0	40	1,561	119.9	87.8	104.3	91.1	93.7	95.8	99.7	101.4	103.4	106.2	107.3
750.0	30	1,221	119.5	87.9	103.7	90.9	93.2	95.5	98.2	101.4	104.1	105.9	107.8
625.0	25	1,048	119.3	87.7	103.5	90.9	93.5	95.4	97.8	100.7	104.9	106.0	108.2
500.0	20	872	119.1	87.1	103.3	90.5	94.3	95.2	98.2	100.3	105.9	106.6	108.6
250.0	10	509	119.0	86.0	102.6	90.0	94.9	95.3	99.2	101.0	106.6	107.6	109.5

MECHANICAL: Sound Power (1/3 Octave Frequencies)

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	1000 HZ	1250 HZ	1600 HZ	2000 HZ	2500 HZ	3150 HZ	4000 HZ	5000 HZ	6300 HZ	8000 HZ	10000 HZ
EKW	%	BHP	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
2,500.0	100	3,626	112.7	115.0	113.4	113.2	112.1	111.2	110.2	109.8	108.8	107.7	110.8
2,250.0	90	3,278	112.3	113.3	112.5	112.2	111.1	110.6	109.6	109.1	107.9	107.0	114.7
2,000.0	80	2,933	112.2	113.0	111.7	111.5	110.6	110.0	109.1	108.6	107.2	106.4	117.8
1,875.0	75	2,760	112.1	112.7	111.4	111.3	110.4	109.8	108.9	108.4	107.0	106.2	116.7
1,750.0	70	2,587	112.0	112.3	111.2	111.2	110.2	109.6	108.7	108.2	106.7	106.2	115.3
1,500.0	60	2,243	111.6	111.6	110.7	110.3	109.6	109.0	107.9	107.5	105.9	106.8	112.4
1,250.0	50	1,898	111.2	111.0	110.4	109.6	109.1	108.3	107.1	106.8	105.5	110.6	107.6
1,000.0	40	1,561	110.9	110.7	110.0	109.4	108.9	108.1	106.5	106.2	105.2	109.8	102.6
750.0	30	1,221	110.8	110.5	109.3	109.0	108.6	107.6	105.9	105.8	107.6	104.7	99.6
625.0	25	1,048	110.8	110.3	108.9	108.8	108.5	107.3	105.5	105.6	108.1	102.1	98.5
500.0	20	872	110.7	109.9	108.6	108.7	108.3	107.0	105.1	105.7	106.0	100.6	97.5
250.0	10	509	110.4	109.7	108.1	108.5	108.1	106.7	105.4	105.1	102.4	98.8	95.4

Emissions Data

EMISSIONS VALUES ARE TAILPIPE OUT WITH AFTERTREATMENT. VALUES SHOWN AS ZERO MAY BE GREATER THAN ZERO BUT WERE BELOW THE DETECTION LEVEL OF THE EQUIPMENT USED AT TIME OF MEASUREMENT.

CATERPILLAR EMISSIONS CERTIFIED ENGINES TESTED WITHIN EPA SPECIFIED TEST CONDITIONS, AND USING TITLE 40 CFR PART 1065 TEST PROTOCOL, MEET THE NEW SOURCE PERFORMANCE STANDARDS. POTENTIAL SITE VARIATION DATA ACCOUNT FOR PRODUCTION ENGINE AND SYSTEM VARIABILITY IN ADDITION TO MEASUREMENT VARIABILITY FOR TYPICAL FIELD TEST METHODS AS DESCRIBED IN DM1176. THIS DATA ASSUMES SITE CORRECTIONS FOR AMBIENT HUMIDITY TO 75 GRAINS, AND STANDARD CONDITIONS OF 25 C (77 F) AIR TO TURBO TEMPERATURE AND 152.4 M (500 FT) ALTITUDE. GUIDANCE ON HUMIDITY CORRECTION METHODS ARE AVAILABLE IN TITLE 40 CFR SECTION 1065.670. FOR APPLICATIONS WITH GEOGRAPHIC OR AMBIENT CONDITIONS BEYOND THESE PUBLISHED VALUES, CONSULT CATERPILLAR (APPLICATION SUPPORT CENTER) FOR ADDITIONAL VARIABILITY INFORMATION.

RATED SPEED POTENTIAL SITE VARIATION: 1800 RPM

GENSET POWER WITH FAN	EKW	2,500.0	1,875.0	1,250.0	625.0	250.0
PERCENT LOAD	%	100	75	50	25	10
ENGINE POWER	BHP	3,626	2,760	1,898	1,048	509
TOTAL NOX (AS NO2)	G/HR	2,668	1,309	755	379	621
TOTAL CO	G/HR	589	331	206	115	97
TOTAL HC	G/HR	78	97	110	84	96
PART MATTER	G/HR	266.9	75.8	67.1	58.0	34.7
TOTAL NOX (AS NO2)	(CORR 5% O2) MG/NM3	326.1	208.8	170.2	147.4	562.9
TOTAL CO	(CORR 5% O2) MG/NM3	75.8	55.8	48.6	46.1	77.3
TOTAL HC	(CORR 5% O2) MG/NM3	8.6	14.3	22.5	29.2	69.0
TOTAL NOX (AS NO2)	(CORR 5% O2) PPM	159	102	83	72	274
TOTAL CO	(CORR 5% O2) PPM	61	45	39	37	62
TOTAL HC	(CORR 5% O2) PPM	16	27	42	54	129
TOTAL NOX (AS NO2)	G/HP-HR	0.74	0.48	0.40	0.36	1.22
TOTAL CO	G/HP-HR	0.16	0.12	0.11	0.11	0.19
TOTAL HC	G/HP-HR	0.02	0.04	0.06	0.08	0.19
PART MATTER	G/HP-HR	0.07	0.03	0.04	0.06	0.07
TOTAL NOX (AS NO2)	LB/HR	5.88	2.89	1.66	0.84	1.37

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TOTAL CO	LB/HR	1.30	0.73	0.45	0.25	0.21
TOTAL HC	LB/HR	0.17	0.21	0.24	0.19	0.21
PART MATTER	LB/HR	0.59	0.17	0.15	0.13	0.08

RATED SPEED NOMINAL DATA: 1800 RPM

GENSET POWER WITH FAN	EKW	2,500.0	1,875.0	1,250.0	625.0	250.0
PERCENT LOAD	%	100	75	50	25	10
ENGINE POWER	BHP	3,626	2,760	1,898	1,048	509
TOTAL NOX (AS NO2)	G/HR	2,101	1,031	594	299	489
TOTAL CO	G/HR	115	65	40	23	19
TOTAL HC	G/HR	17	22	24	19	21
TOTAL CO2	KG/HR	1,773	1,354	964	570	325
PART MATTER	G/HR	102.7	29.1	25.8	22.3	13.3
TOTAL NOX (AS NO2)	(CORR 5% O2) MG/NM3	256.8	164.4	134.1	116.1	443.2
TOTAL CO	(CORR 5% O2) MG/NM3	14.9	10.9	9.5	9.0	15.2
TOTAL HC	(CORR 5% O2) MG/NM3	1.9	3.2	5.0	6.5	15.3
TOTAL NOX (AS NO2)	(CORR 5% O2) PPM	125	80	65	57	216
TOTAL CO	(CORR 5% O2) PPM	12	9	8	7	12
TOTAL HC	(CORR 5% O2) PPM	4	6	9	12	29
FORMALDEHYDE	(CORR 15% O2) PPM	0.03	0.02	0.02	0.03	0.20
ACROLEIN	(CORR 15% O2) PPM	0.00	0.00	0.00	0.00	0.00
ACETALDEHYDE	(CORR 15% O2) PPM	0.01	0.00	0.00	0.00	0.01
METHANOL	(CORR 15% O2) PPM	0.00	0.00	0.00	0.00	0.03
TOTAL NOX (AS NO2)	G/HP-HR	0.59	0.38	0.32	0.29	0.96
TOTAL CO	G/HP-HR	0.03	0.02	0.02	0.02	0.04
TOTAL HC	G/HP-HR	0.00	0.01	0.01	0.02	0.04
PART MATTER	G/HP-HR	0.03	0.01	0.01	0.02	0.03
TOTAL NOX (AS NO2)	LB/HR	4.63	2.27	1.31	0.66	1.08
TOTAL CO	LB/HR	0.25	0.14	0.09	0.05	0.04
TOTAL HC	LB/HR	0.04	0.05	0.05	0.04	0.05
TOTAL CO2	LB/HR	3,908	2,984	2,124	1,256	717
PART MATTER	LB/HR	0.23	0.06	0.06	0.05	0.03
OXYGEN IN EXH	%	8.9	9.7	10.8	12.6	15.1
DRY SMOKE OPACITY	%	1.0	0.3	0.6	1.2	1.1
BOSCH SMOKE NUMBER		0.38	0.16	0.25	0.41	0.40

Regulatory Information

EPA TIER 4 FINAL				
2015 - —				
GASEOUS EMISSIONS DATA MEASUREMENTS PROVIDED TO THE EPA ARE CONSISTENT WITH THOSE DESCRIBED IN EPA 40 CFR PART 1039 SUBPART F AND ISO 8178 FOR MEASURING HC, CO, PM, AND NOX. THE "MAX LIMITS" SHOWN BELOW ARE WEIGHTED CYCLE AVERAGES AND ARE IN COMPLIANCE WITH THE NON-ROAD REGULATIONS BY PARTICIPATING IN THE AVERAGE, BANKING, AND TRADING PROGRAM.				
Locality	Agency	Regulation	Tier/Stage	Max Limits - G/BKW - HR
U.S. (INCL CALIF)	EPA	NON-ROAD GENSET	TIER 4 FINAL	CO: 3.5 NOx: 0.67 HC: 0.19 PM: 0.03

EPA TIER 4 INTERIM				
2011 - 2014				
GASEOUS EMISSIONS DATA MEASUREMENTS PROVIDED TO THE EPA ARE CONSISTENT WITH THOSE DESCRIBED IN EPA 40 CFR PART 1039 SUBPART F AND ISO 8178 FOR MEASURING HC, CO, PM, AND NOX. THE "MAX LIMITS" SHOWN BELOW ARE WEIGHTED CYCLE AVERAGES AND ARE IN COMPLIANCE WITH THE NON-ROAD REGULATIONS.				
Locality	Agency	Regulation	Tier/Stage	Max Limits - G/BKW - HR
U.S. (INCL CALIF)	EPA	NON-ROAD GENSET	TIER 4 INTERIM	CO: 3.5 NOx: 0.67 HC: 0.4 PM: 0.10

EPA NON-EMERGENCY STATIONARY GENSET				
2015 - —				
GASEOUS EMISSIONS DATA MEASUREMENTS PROVIDED TO THE EPA ARE CONSISTENT WITH THOSE DESCRIBED IN EPA 40 CFR PART 60 SUBPART IIII AND ISO 8178 FOR MEASURING HC, CO, PM, AND NOX. THE "MAX LIMITS" SHOWN BELOW ARE WEIGHTED CYCLE AVERAGES AND ARE IN COMPLIANCE WITH THE NON-EMERGENCY STATIONARY REGULATIONS BY PARTICIPATING IN THE AVERAGE, BANKING, AND TRADING PROGRAM.				
Locality	Agency	Regulation	Tier/Stage	Max Limits - G/BKW - HR
U.S. (INCL CALIF)	EPA	STATIONARY	NON-EMERGENCY STATIONARY GENSET	CO: 3.5 NOx: 0.67 HC: 0.19 PM: 0.03

Altitude Derate Data

ALTITUDE CORRECTED POWER CAPABILITY (BHP)

AMBIENT OPERATING TEMP (F)	30	40	50	60	70	80	90	100	110	120	130	140	NORMAL
ALTITUDE (FT)													
0	3,627	3,627	3,627	3,627	3,627	3,627	3,627	3,627	3,627	3,627	3,627	3,627	3,627
1,000	3,627	3,627	3,627	3,627	3,627	3,627	3,627	3,627	3,627	3,627	3,598	3,538	3,627
2,000	3,627	3,627	3,627	3,627	3,627	3,627	3,627	3,627	3,591	3,529	3,469	3,411	3,627
3,000	3,627	3,627	3,627	3,627	3,627	3,627	3,587	3,523	3,461	3,401	3,344	3,288	3,627
4,000	3,627	3,627	3,627	3,627	3,587	3,520	3,456	3,395	3,335	3,277	3,222	3,168	3,570
5,000	3,627	3,627	3,590	3,521	3,455	3,391	3,329	3,269	3,212	3,157	3,103	3,051	3,461
6,000	3,598	3,526	3,457	3,390	3,326	3,265	3,205	3,148	3,093	3,039	2,988	2,938	3,355
7,000	3,463	3,394	3,327	3,263	3,201	3,142	3,085	3,030	2,976	2,925	2,875	2,828	3,251
8,000	3,332	3,265	3,201	3,140	3,080	3,023	2,968	2,915	2,864	2,814	2,767	2,721	3,150
9,000	3,205	3,141	3,079	3,020	2,963	2,908	2,855	2,804	2,755	2,707	2,661	2,617	3,051
10,000	3,082	3,020	2,961	2,904	2,849	2,796	2,745	2,696	2,649	2,603	2,559	2,516	2,954
11,000	2,963	2,903	2,846	2,792	2,739	2,688	2,639	2,592	2,546	2,502	2,460	2,419	2,860
12,000	2,847	2,790	2,736	2,683	2,632	2,584	2,536	2,491	2,447	2,405	2,364	2,325	2,768
13,000	2,736	2,681	2,629	2,578	2,529	2,483	2,437	2,394	2,352	2,311	2,272	2,234	2,679
14,000	2,629	2,576	2,526	2,477	2,430	2,385	2,342	2,300	2,260	2,221	2,183	2,147	2,593
15,000	2,526	2,475	2,427	2,380	2,335	2,292	2,250	2,210	2,171	2,133	2,097	2,062	2,509

Cross Reference

Engine Arrangement			
Arrangement Number	Effective Serial Number	Engineering Model	Engineering Model Version
3709876	SCK00001	GS539	-
3997544	DD700001	GS719	-
5075756	SCK01000	GS539	-

Test Specification Data						
Test Spec	Setting	Effective Serial Number	Engine Arrangement	Governor Type	Default Low Idle Speed	Default High Idle Speed
3704800	LL6340	SCK00001	3709876			
3704984	GG0627	DD700001	3997544			
3704984	GG0627	SCK01000	5075756			

Supplementary Data

Type	Classification	Performance Number
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AFTERTREATMENT	SCR	DM9373
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Performance Parameter Reference

Parameters Reference:DM9600-08
PERFORMANCE DEFINITIONS

PERFORMANCE DEFINITIONS DM9600

APPLICATION:
 Engine performance tolerance values below are representative of a typical production engine tested in a calibrated dynamometer test cell at SAE J1995 standard reference conditions. Caterpillar maintains ISO9001:2000 certified quality management systems for engine test Facilities to assure accurate calibration of test equipment. Engine test data is corrected in accordance with SAE J1995. Additional reference material SAE J1228, J1349, ISO 8665, 3046-1:2002E, 3046-3:1989, 1585, 2534, 2288, and 9249 may apply in part or are similar to SAE J1995. Special engine rating request (SERR) test data shall be noted.

PERFORMANCE PARAMETER TOLERANCE FACTORS:

Power	+/- 3%
Torque	+/- 3%
Exhaust stack temperature	+/- 8%
Inlet airflow	+/- 5%
Intake manifold pressure-gage	+/- 10%
Exhaust flow	+/- 6%
Specific fuel consumption	+/- 3%
Fuel rate	+/- 5%
Specific DEF consumption	+/- 3%
DEF rate	+/- 5%
Heat rejection	+/- 5%
Heat rejection exhaust only	+/- 10%
Heat rejection CEM only	+/- 10%

Heat Rejection values based on using treated water.

Torque is included for truck and industrial applications, do not use for Gen Set or steady state applications.

On C7 - C18 engines, at speeds of 1100 RPM and under these values are provided for reference only, and may not meet the tolerance listed.

These values do not apply to C280/3600. For these models, see the tolerances listed below.

C280/3600 HEAT REJECTION TOLERANCE FACTORS:

Heat rejection	+/- 10%
Heat rejection to Atmosphere	+/- 50%
Heat rejection to Lube Oil	+/- 20%
Heat rejection to Aftercooler	+/- 5%

TEST CELL TRANSDUCER TOLERANCE FACTORS:

Torque	+/- 0.5%
Speed	+/- 0.2%
Fuel flow	+/- 1.0%
Temperature	+/- 2.0 C degrees
Intake manifold pressure	+/- 0.1 kPa

OBSERVED ENGINE PERFORMANCE IS CORRECTED TO SAE J1995 REFERENCE AIR AND FUEL CONDITIONS.

REFERENCE ATMOSPHERIC INLET AIR
 FOR 3500 ENGINES AND SMALLER
 SAE J1228 AUG2002 for marine engines, and J1995 JAN2014 for other engines, reference atmospheric pressure is 100 KPA (29.61 in hg), and standard temperature is 25deg C (77 deg F) at 30% relative

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humidity at the stated aftercooler water temp, or inlet manifold temp.

FOR 3600 ENGINES

Engine rating obtained and presented in accordance with ISO 3046/1 and SAE J1995 JANJAN2014 reference atmospheric pressure is 100 KPA (29.61 in hg), and standard temperature is 25deg C (77 deg F) at 30% relative humidity and 150M altitude at the stated aftercooler water temperature.

MEASUREMENT LOCATION FOR INLET AIR TEMPERATURE

Location for air temperature measurement air cleaner inlet at stabilized operating conditions.

REFERENCE EXHAUST STACK DIAMETER

The Reference Exhaust Stack Diameter published with this dataset is only used for the calculation of Smoke Opacity values displayed in this dataset. This value does not necessarily represent the actual stack diameter of the engine due to the variety of exhaust stack adapter options available. Consult the price list, engine order or general dimension drawings for the actual stack diameter size ordered or options available.

REFERENCE FUEL

DIESEL

Reference fuel is #2 distillate diesel with a 35API gravity; A lower heating value is 42,780 KJ/KG (18,390 BTU/LB) when used at 29 (84.2), where the density is 838.9 G/Liter (7.001 Lbs/Gal).

GAS

Reference natural gas fuel has a lower heating value of 33.74 KJ/L (905 BTU/CU Ft). Low BTU ratings are based on 18.64 KJ/L (500 BTU/CU FT) lower heating value gas. Propane ratings are based on 87.56 KJ/L (2350 BTU/CU Ft) lower heating value gas.

ENGINE POWER (NET) IS THE CORRECTED FLYWHEEL POWER (GROSS) LESS EXTERNAL AUXILIARY LOAD

Engine corrected gross output includes the power required to drive standard equipment; lube oil, scavenge lube oil, fuel transfer, common rail fuel, separate circuit aftercooler and jacket water pumps. Engine net power available for the external (flywheel) load is calculated by subtracting the sum of auxiliary load from the corrected gross flywheel output power. Typical auxiliary loads are radiator cooling fans, hydraulic pumps, air compressors and battery charging alternators. For Tier 4 ratings additional Parasitic losses would also include Intake, and Exhaust Restrictions.

ALTITUDE CAPABILITY

Altitude capability is the maximum altitude above sea level at standard temperature and standard pressure at which the engine could develop full rated output power on the current performance data set.

Standard temperature values versus altitude could be seen on TM2001.

When viewing the altitude capability chart the ambient temperature is the inlet air temp at the compressor inlet.

Engines with ADEM MEUI and HEUI fuel systems operating at conditions above the defined altitude capability derate for atmospheric pressure and temperature conditions outside the values defined, see TM2001.

Mechanical governor controlled unit injector engines require a setting change for operation at conditions above the altitude defined on the engine performance sheet. See your Caterpillar technical representative for non standard ratings.

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REGULATIONS AND PRODUCT COMPLIANCE

TMI Emissions information is presented at 'nominal' and 'Potential Site Variation' values for standard ratings. No tolerances are applied to the emissions data. These values are subject to change at any time. The controlling federal and local emission requirements need to be verified by your Caterpillar technical representative.

Customer's may have special emission site requirements that need to be verified by the Caterpillar Product Group engineer.

EMISSIONS DEFINITIONS:

Emissions : DM1176

HEAT REJECTION DEFINITIONS:

Diesel Circuit Type and HHV Balance : DM9500

HIGH DISPLACEMENT (HD) DEFINITIONS:

3500: EM1500

RATING DEFINITIONS:

Agriculture : TM6008

Fire Pump : TM6009

Generator Set : TM6035

Generator (Gas) : TM6041

Industrial Diesel : TM6010

Industrial (Gas) : TM6040

Irrigation : TM5749

Locomotive : TM6037

Marine Auxiliary : TM6036

Marine Prop (Except 3600) : TM5747

Marine Prop (3600 only) : TM5748

MSHA : TM6042

Oil Field (Petroleum) : TM6011

Off-Highway Truck : TM6039

On-Highway Truck : TM6038

SOUND DEFINITIONS:

Sound Power : DM8702

Sound Pressure : TM7080

Date Released : 7/7/15

7. REGULATORY ANALYSIS

This section addresses the state and federal regulatory applicability specific to the proposed back-up power facility.

7.1. COLORADO STATE REGULATIONS

7.1.1. CDPHE APCD Regulation 3, Part A, Section II:

The Air Pollution Emission Notice (APEN) form for the equipment included in the proposed Facility are provided in this application.

7.1.2. Concerning Construction Permits (Regulation 3, Part B)

The back-up power facility is subject to this regulation and this application serves to apply for the required construction permit prior to the construction or modification.

7.1.3. Concerning Operating Permits (Regulation 3, Part C)

The back-up power facility will be a synthetic minor source with respect to the Title V Operating Permit Program, based on the requested emissions and separate facility determination with existing Buckley sources. A Title V Permit per Regulation 3, Part C, III.B.2 is not required.

7.1.4. Concerning Major Stationary Source New Source Review and Prevention of Significant Deterioration (PSD) (Regulation 3, Part D)

The proposed back-up power facility will be a minor source of NO_x and VOC with respect to Nonattainment New Source Review (NNSR) and will be a minor source of all other NSR pollutants with respect to PSD permitting. Therefore, the proposed facility is not subject to either NNSR or PSD review.

7.2. NEW SOURCE PERFORMANCE STANDARDS

7.2.1. Subpart A - General Provisions

Any source subject to a source-specific NSPS is also subject to the general provisions of NSPS Subpart A. Unless specifically excluded by the source-specific NSPS, Subpart A generally requires initial construction notification, initial startup notification, performance tests, performance test date initial notification, general monitoring requirements, general recordkeeping requirements, and semiannual monitoring and/or excess emission reports.

The engines at the back-up power facility are subject to the requirements of NSPS IIII and therefore may be subject to the requirements listed in Subpart A. As noted below, the engines may not be subject to initial notification if operated as emergency generator engines.

7.2.2. Subpart Dc - Industrial Steam Generating Units

This subpart applies to each steam generating for which construction, modification, or reconstruction commenced after June 9, 1989 and which has a minimum design heat input of 10 MMBtu/hr. A “steam generating unit” is defined in this subpart “...as a device that combusts any fuel and produces steam or heats water or heats any heat transfer medium.” Any fuel combustion equipment that heats any heat transfer medium at the Facility will have a maximum design heat input less than 10 MMBtu/hr; therefore this subpart does not apply.

7.2.3. Subpart Kb - Organic Liquid Storage Vessels (Including Petroleum Liquid)

This subpart applies to each storage vessel with a capacity greater than or equal to 75 m³ (19,812.9 gallons) used to store volatile organic liquids for which construction, modification, or reconstruction commenced after July 23, 1984. This subpart does not apply to tanks that have capacity greater than 151 m³ storing a liquid with a maximum true vapor pressure less than 3.5 kilopascals (kPa). Six auxiliary fixed roof storage tanks at the proposed Facility will each have capacity of 40,000 gallons (151.4 m³) to ensure sufficient on-site fuel storage. The stored fuel has a maximum vapor pressure of 0.25 kPa at 100 °F and therefore this subpart does not apply.

7.2.4. Subpart IIII - Stationary Compression Ignition Internal Combustion Engines

This subpart applies to owners and operators of compression ignition (CI) internal combustion engines (ICE) that commenced construction after July 11, 2005 and are manufactured after April 1, 2006. For purposes of this part, “commenced construction” means the date the unit was ordered from the manufacturer. HD will comply will all requirements under this subpart as these apply to the CI ICE at the Facility.

HD intends to operate these engines as emergency stationary ICE, defined in §60.4219 as:

Emergency stationary internal combustion engine means any stationary reciprocating internal combustion engine that meets all of the criteria in paragraphs (1) through (3) of this definition. All emergency stationary ICE must comply with the requirements specified in §60.4211(f) in order to be considered emergency stationary ICE. If the engine does not comply with the requirements specified in § 60.4211(f), then it is not considered to be an emergency stationary ICE under this subpart.

(1) The stationary ICE is operated to provide electrical power or mechanical work during an emergency situation. Examples include stationary ICE used to produce power for critical networks or equipment (including power supplied to portions of a facility) when electric power from the local utility (or the normal power source, if the facility runs on its own power production) is interrupted, or stationary ICE used to pump water in the case of fire or flood, etc.

(2) The stationary ICE is operated under limited circumstances for situations not included in paragraph (1) of this definition, as specified in § 60.4211(f).

(3) The stationary ICE operates as part of a financial arrangement with another entity in situations not included in paragraph (1) of this definition only as allowed in § 60.4211(f)(2)(ii) or (iii) and § 60.4211(f)(3)(

§60.4211(f) provides allowance for limited operation in non-emergency modes (e.g., maintenance and testing) or in cases where utility provided power deviates from voltage or frequency standards by 5% or more. There is no time limit on the use of emergency ICE in emergency situations.

§60.4205(b) specifies that the CI ICE with displacement less than 30 liters per cylinder must meet the emission standards specified in §60.4202(b)(2) which in turn points to the Tier 2 standards for all pollutants as shown in §89.112, Table 1 and §60.4212⁴.

Additional requirements that may apply to the Facility's engine include:

- §60.4207(a) requires the use of ultra-low sulfur fuel.
- §60.4209(a) states that installation of a non-resettable hour meters is not required as the ICE meet the non-emergency standards of Table 1 in this subpart. HD may elect to install hour meters on these engines for other purposes.
- §60.4211(a) lists compliance requirements for all ICE subject to emission standards under this subpart.
- §60.4211(f) list compliance requirements for emergency ICE.
- §60.4214(b) specifies that initial notification is not required for emergency ICE.

7.3. NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS

7.3.1. Subpart A - General Provisions

Any source subject to a source-specific NESHAP is also subject to the general provisions of NESHAP Subpart A. Unless specifically excluded by the source-specific NESHAP, Subpart A generally requires initial construction notification, initial startup notification, performance tests, performance test date initial notification, general monitoring requirements, general recordkeeping requirements, and semiannual monitoring and/or excess emission reports. The ICE at the back-up facility are subject to NESHAP ZZZZ but have no requirements under that subpart and therefore have no requirements under Subpart A.

7.3.2. Subpart ZZZZ - Stationary Reciprocating Internal Combustion Engines

NESHAP ZZZZ applies to reciprocating ICE at area sources of Hazardous Air Pollutants (HAP). The back-up power facility is an area source of HAP and the ICE are considered "new" for purposes of this subpart since construction of these engines commenced construction after June 12, 2006. For purposes of this subpart "commenced construction" means the date the affected source was installed on-site.

Pursuant to §63.6590(c)(1), new ICE located at an area source must meet the requirements of NESHAP ZZZZ by meeting the requirements of 40 CFR Part 60 Subpart IIII. No further requirements under NESHAP ZZZZ apply to these engines.

7.3.3. Subpart JJJJJJ - Industrial, Commercial, and Institutional Boilers Area Sources

NESHAP Subpart JJJJJJ establishes emission limits, operational standards, and energy assessment requirements for HAP emissions from industrial, commercial, and institutional boilers operating within area sources of HAP emissions. According to §63.11194(a)(1), an affected source is the collection of all existing industrial, commercial, and institutional boilers within a subcategory (coal, biomass, oil). There

⁴ Note per 60.4212, an owner or operator demonstrating compliance with the manufacturer Tier 2 emission limits in 89.112, must not exceed 1.25 the standard limit.

are no affected facilities is subject to Subpart JJJJJJ at the back-up power facility since any boilers will be exclusively natural gas-fired, and therefore do not fit into one of the subcategories covered by the rule.

8. AMBIENT AIR QUALITY IMPACTS

The draft *Colorado Department of Public Health and Environment Colorado Modeling Guideline for Air Quality Permits*, dated May 2018, states that the preliminary air impact analysis for construction permit applications can be done using quantitative (modeling) or qualitative (non-modeling) methods.⁵

Table 1 of the guidance, Modeling Thresholds, describes that modeling is usually warranted for sources that meet any of the following criteria:

- Carbon Monoxide (CO) emissions equal to or greater than 100 tons per year (tpy);
- Nitrogen Oxides (NO_x) emissions equal to or greater than 40 tpy;
- Sulfur Dioxide (SO₂) emissions equal to or greater than 40 tpy;
- Particulate Matter (PM₁₀) emissions equal to or greater 15 tpy;
- Particulate Matter (PM_{2.5}) emissions equal to or greater than 5 tpy;
- Lead (Pb) emissions equal to or greater than 25 pounds per 3-months;
- Sources of SO₂, PM₁₀, CO, or Pb where a substantial portion of the new or modified emissions have poor dispersion characteristics (e.g. rain caps, horizontal stacks, fugitive releases, or building downwash) in close proximity to ambient air at the site boundary;
- Sources of SO₂, PM₁₀, CO, or Pb located in complex terrain (e.g., terrain above stack height in close proximity to the source);
- Sources located in areas with poor existing air quality; and
- Modifications at existing majority stationary sources, including grandfathered sources that have been modeled before.

As shown in the Project Emissions Summary included with this application, all total annual emissions associated with this project will be below the modeling thresholds outlined in Table 1 of CDPHE's Modeling Guideline. Therefore, no further analysis is indicated.

⁵Draft Version - <https://www.colorado.gov/airquality/permits/guide.pdf>

9. FACILITY INFORMATION

Facility Description

HD proposes to construct a modular data center and the back-up power facility in a tract of land within the boundaries of the Buckley Air Force Base.

The data center will not be a significant source of regulated air quality pollutants.

- 1) Electricity will be provided by the local utility; data center operation is not dependent on any fuel burning equipment to generate power. Gaseous fuel burning equipment less than 10 MMBtu/hr (e.g., hot water heaters or building heat) is exempt from permitting requirements.
- 2) Day-to-day operations of the data center are not dependent on having back-up power generation.
- 3) There are no other sources of regulated air emissions, other than those specifically exempted from air quality permitting by the CDPHE⁶, associated with the data center.

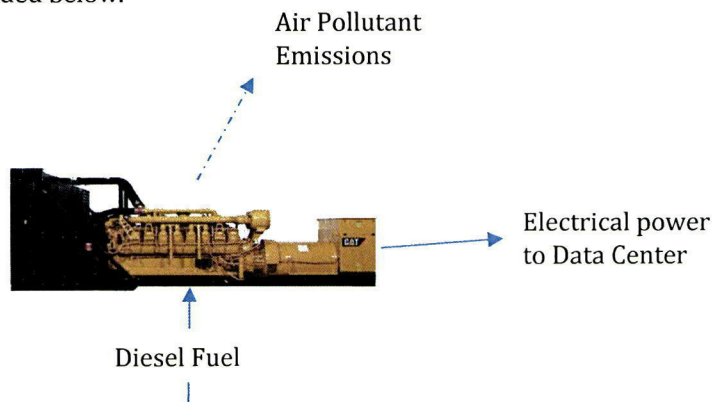
The back-up power Facility will include a building and/or dedicated yard separated from the data center. The only physical connection between the data center and the Facility will be power bus bars/lines. The Facility will include up to eighteen 3.125 kVA generators paired with 3,634 hp (sea level) diesel-fueled engines.

HD will use company-specific identifiers for the engines as shown in the Electrical Site Plan included in this section. The engine locations are identified by "GEN" in this figure. (E.g., GEN.CE1, 62.GEN3, etc.)

Liquid storage at the Facility will include belly tanks on each engine for fuel storage and will also include fixed roof storage tanks for diesel fuel and lubricating oils. Other materials may be stored in totes and other small containers.

Facility Process Flow

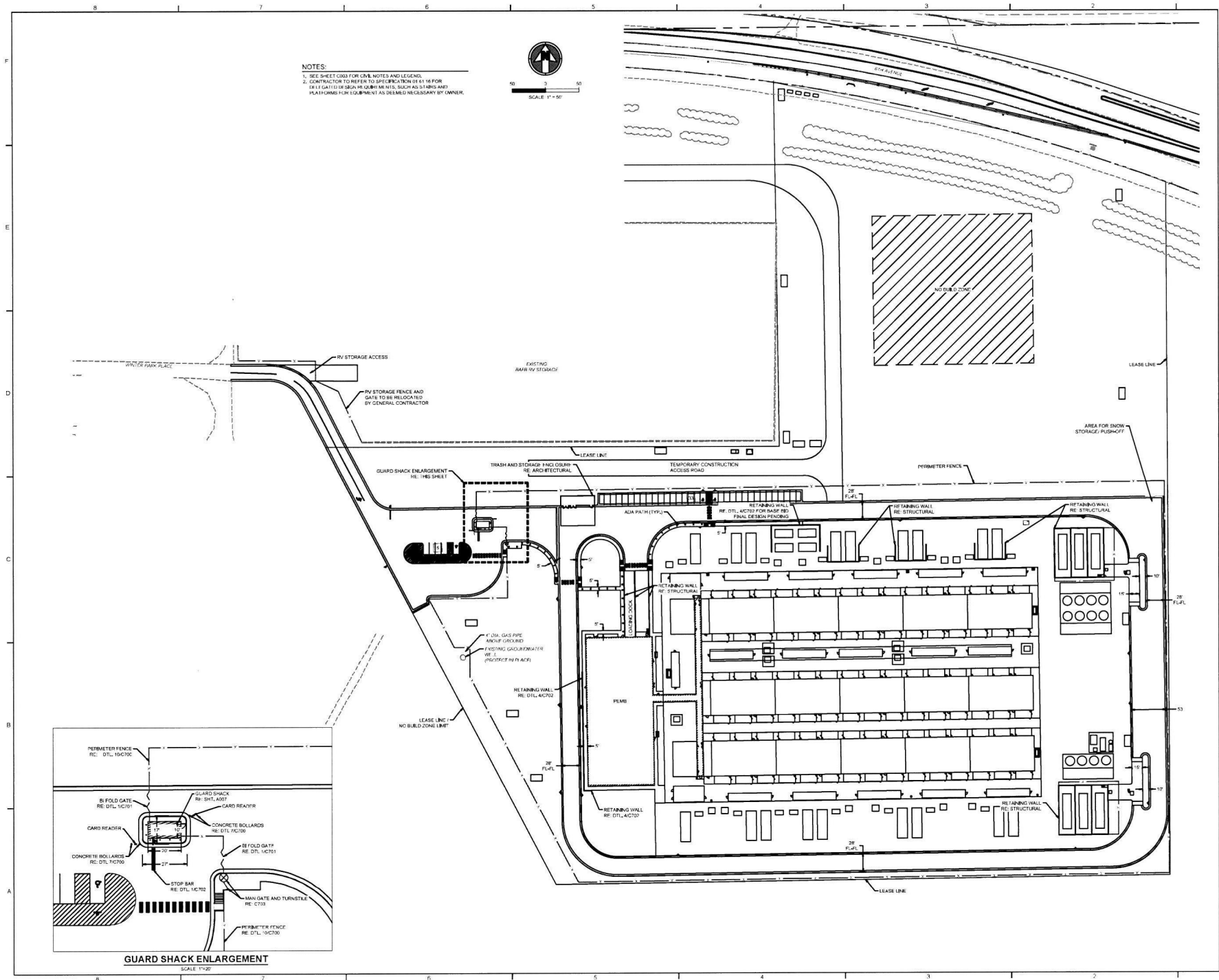
A simple process flow is provided below.



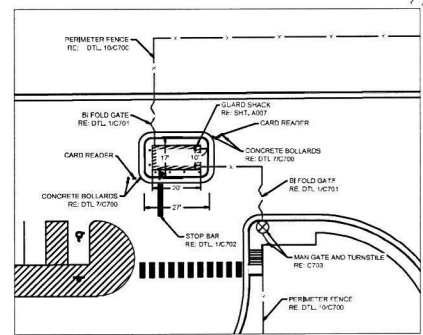
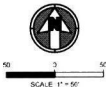
⁶ Potentially APEN-exempt activities at the data center include air conditioning or ventilating systems that do not include cooling towers, road and lot paving operations at commercial facilities, office emissions such as cleaning, copying, and restrooms, and comfort heaters that use gaseous fuel with a design rate of less than 10 MMBtu/hr.

Facility Plot Plan

The Civil Site Plan, Electrical Site Plan and Generators, and Vicinity Map provide information regarding the placement of the generator engines.



NOTES:
 1. SEE SHEET 003 FOR C&M NOTES AND LEGEND.
 2. CONTRACTOR TO REFER TO SPECIFICATION 01 61 16 FOR
 (A) LIFT GATE (B) SIGN RELOCATION (C) SIGN NO SHARED
 PLATFORM FOR EQUIPMENT AS DEEMED NECESSARY BY OWNER.



GUARD SHACK ENLARGEMENT
 SCALE: 1"=20'

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STRUCTURAL/CIVIL CONSULTANT
METRO
 4582 S. ULSTER ST
 SUITE 750
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 80237
 PHONE: (303) 741.3737

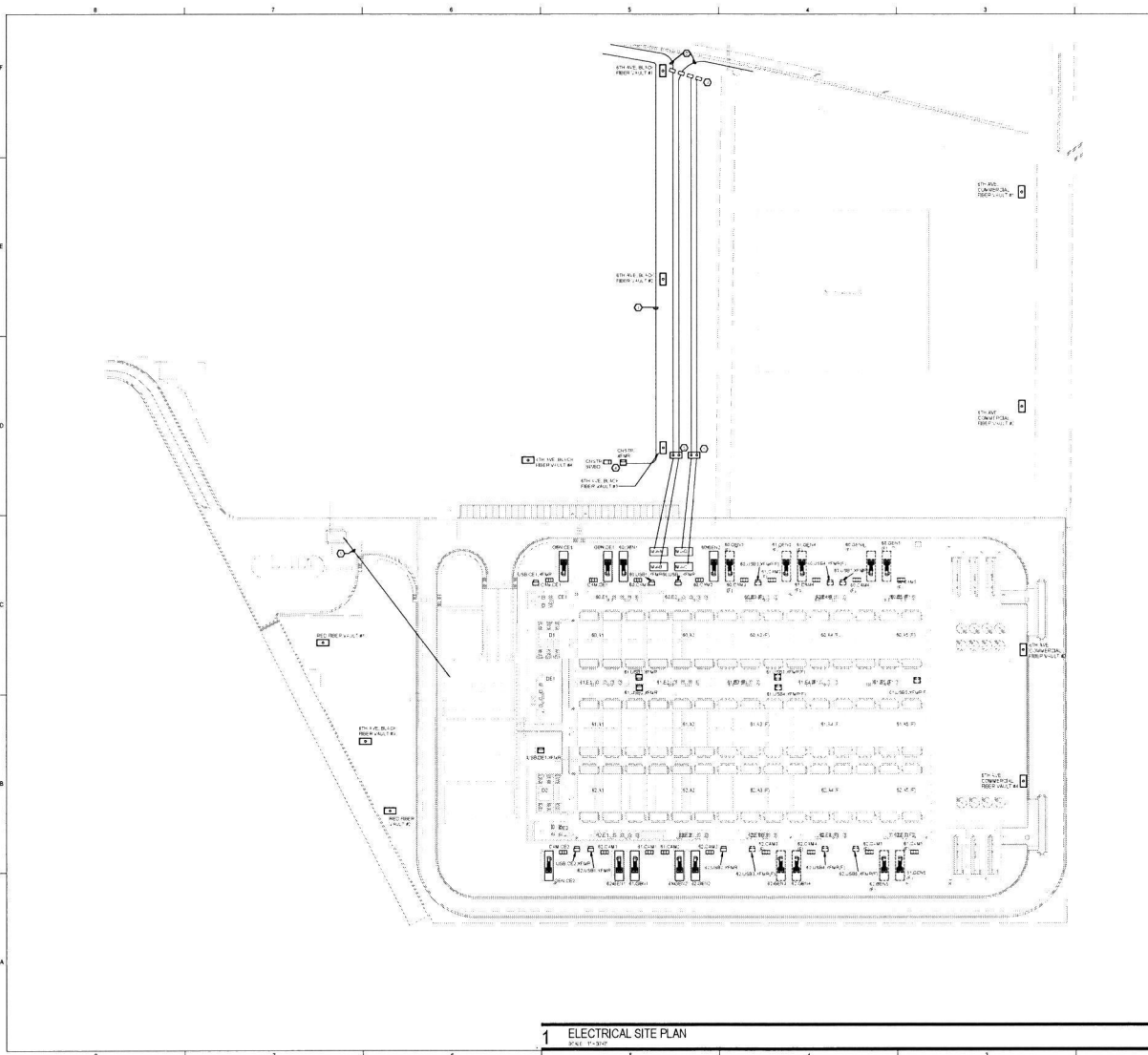
PROJECT BLUE MARLIN
CIVIL SITE PLAN

REV	DATE	DESCRIPTION
1	12/21/2018	ISSUE FOR CONSTRUCTION

Seal / Signature



DATE: 12/21/2018
 DRAWN BY: [Name] ENGINEERED BY: [Name]
C200
 12/21/2018



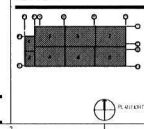
SHEET NOTES BY SYMBOL

1. ALL ELECTRICAL WORK SHALL BE IN ACCORDANCE WITH THE 2017 NATIONAL ELECTRICAL CODE (NEC) AND THE 2017 ILLINOIS ELECTRICAL CODE (IEC).
2. ALL ELECTRICAL WORK SHALL BE IN ACCORDANCE WITH THE 2017 NATIONAL ELECTRICAL CODE (NEC) AND THE 2017 ILLINOIS ELECTRICAL CODE (IEC).
3. ALL ELECTRICAL WORK SHALL BE IN ACCORDANCE WITH THE 2017 NATIONAL ELECTRICAL CODE (NEC) AND THE 2017 ILLINOIS ELECTRICAL CODE (IEC).
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6. ALL ELECTRICAL WORK SHALL BE IN ACCORDANCE WITH THE 2017 NATIONAL ELECTRICAL CODE (NEC) AND THE 2017 ILLINOIS ELECTRICAL CODE (IEC).

GENERAL NOTES

1. ALL ELECTRICAL WORK SHALL BE IN ACCORDANCE WITH THE 2017 NATIONAL ELECTRICAL CODE (NEC) AND THE 2017 ILLINOIS ELECTRICAL CODE (IEC).
2. ALL ELECTRICAL WORK SHALL BE IN ACCORDANCE WITH THE 2017 NATIONAL ELECTRICAL CODE (NEC) AND THE 2017 ILLINOIS ELECTRICAL CODE (IEC).

KEY PLAN



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PROJECT
Client: **PROJECT BLUE MARLIN**
Electrical: **ELECTRICAL SITE PLAN**

DATE: 01/11/2017
BY: [Signature]
CHECKED: [Signature]
APPROVED: [Signature]



E003

