State of Washington Department of Ecology
Technical Support Document (TSD)
Notice of Construction (NOC) Approval Order 17AQ-E021

Applicant:	Department of Corrections
Source Location:	1301 N Ephrata Ave, Connell, WA 99326
County:	Franklin
Reviewer:	MengChiu Lim

1. PROJECT DESCRIPTION

On 4/24/17, WA Department of Corrections submitted a Notice of Construction application for an 800 kW Caterpillar C27 emergency generator at the Coyote Ridge Correction Center.

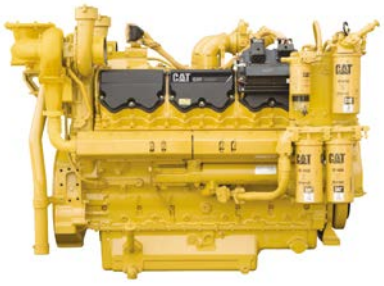
1.1. Project Emission Unit

Manufacturer: Caterpillar Model: C27
North American Industry Classification System (NAICS) code: 922140
Standard Industrial Classification (SIC) Code: 9223

The Department of Corrections (DOC) plans to replace their obsolete Detroit Diesel 750 kW emergency generator with a new 800 kW Caterpillar C27 emergency generator at the Coyote Ridge Corrections Center (CRCC). The brake horse power (bhp) of the unit is approximately 1214 bhp (from submitted vendor's performance data), larger than the exemption threshold of 500 bhp described in WAC 173-110 (4)(h)(xxxix).

Emergency engine is used to produce power when electric generation from the local utility is interrupted. The emergency power is important for firefighting, rescue operation and control of health hazard, smoke removal systems, communication systems, ventilation systems, industrial process that when stopped could create hazards.

The Caterpillar C27 Generator Set is a diesel generator set that can provide output with a varying load for the duration of the interruption of normal source power. The generator exhausts to atmosphere through the ceiling and the top of the stack is 3.6 feet above the roof. The exhaust stack is equipped with a hinged flapper type damper. This is a 12 cylinders engine and total displacement is 27.03L. At 100% load, the ultra-low sulfur diesel fuel consumption rate for the unit is 57.3 gallons per hour.



1.2. Source Permitting History

Ecology issued Order of Approval No.07AQ-E200 on 2/27/2007 for Coyote Ridge Corrections Center. The Order of Approval No.07AQ-E200 approves the followings units:

Description:	
Caterpillar 3516CD standby generator	2 units
	2.5 megawatt (MW) each
Natural gas heating boilers	35 units
	Total heat input rate of 16.99 mmBtu/hr
Natural gas hot water heaters	41 units
	Total heat input rate of 7.955 mmBtu/hr
Natural gas unit heaters	13 units
	Total heat input rate of 4.14 mmBtu/hr
Natural gas radiant heaters	2 units
	Total heat input rate of 2.705 mmBtu/hr
Natural gas HVAC units	9 units
	Total heat input rate of 1.341 mmBtu/hr
Additional Note:	
Each emergency generator is powered by a 3604 brake horsepower, distillate fired, and reciprocating internal combustion engine (RICE) and is certified by the manufacturer to meet EPA Tier 2 standards. The RICE engines are equipped with catalytic converters to reduce the CO and other incomplete combustion by products by 85 percent. The maximum fuel consumption by each emergency generator is 173.3 gallons per hour. The potential natural gas consumption by boiler and heaters is 33.131 million BTU per hour.	

The original Correctional Center was constructed without an Order. The emission sources are one 750 KV Detroit Diesel Generator, one 100 KV Detroit Diesel Generator, forty three small natural gas HVAC heating units (8.035 million BTU per hour), forty one small natural gas water heaters (6.275 million BTU per hour), ten natural gas space heaters (1.5 million BTU per hour), five natural gas clothes dryers (1.435 million BTU per hour), twenty six natural gas warmer hoods (0.78 million BTU per hour), two food service natural gas steam kettles (0.335 million BTU per hour), two food service natural gas ovens (0.20 million BTU per hour), three natural gas grills(est. 0.18 million BTU per hour), and two natural gas domestic style ranges (est. 0.192 million BTU per hour). The potential natural gas consumption is 18.932 million BTU per hour.

1.3. Project Permitting

The documents listed below are the basis of this permit. They are specifically related to this permitting action.

Date	Description

4/24/17	Received application.
5/15/17	Request for additional information.
5/23/17	Received additional information.
11/20/17	Received environmental checklist.
1/16/18	Received respond from City of Connell regarding SEPA.
1/16/18	Received additional information.

2. EMISSION ESTIMATION

2.1. Project Emission

The emissions from diesel engines consist of both gaseous and particulate fractions. The gaseous constituents include carbon dioxide, carbon monoxide, nitric oxide, nitrogen dioxide, oxides of sulfur, and hydrocarbons (e.g., ethylene, formaldehyde, methane, benzene, phenol, 1,3-butadiene, acrolein, and polynuclear aromatic hydrocarbons. Particulates (soot) in diesel exhaust are composed of solid carbon cores. Approximately more than 95% of these particulates are less than 1 micrometer in size [Travis and Munro 1983; Vostal 1980; McCawley and Cocalis 1986]. Therefore, for the purpose of this project, total PM, PM 10, PM2.5 emission rate are assumed to be the same.

Because of the operational design, the maximum operating hours of an emergency engine is inherently constrained by:

- Duration of maintenance checks and readiness testing; and
- Duration of power outage.

Consistent with EPA's guidance "Calculating Potential to Emit (PTE) for Emergency Generators" dated September 6, 1995, staff believes assuming that the engine operates 8,760 hours per year would be unrealistic and did not account for the emergency engine operational design for the purpose of potential to emit (PTE) definition in WAC 173-400-030.

The duration of the maintenance/testing is short and predictable, range from 10-30 hours per year. Local utility power outage also is not expected to exceed a day per year. See the discussions below for further details.

Maintenance Checks and Readiness Testing: For a new installation, the engine usually will be tested for approximately 2 hours after the initial startup, where the engine will be run at 30% nameplate KW for ½ hr, 50% for ½ hr and 100% for 1 hr. Afterward, National Fire Protection Association (NFPA) 110 requires emergency engine to conduct monthly testing for minimum 30 minutes to reach recommended exhaust temperature or 30 % nameplate KW. Underloading (< 30%) during maintenance and testing can impact engine life and creates "wet stacking" condition caused by unburned fuel or carbon in the exhaust system. In practice, it is common for a facility to conduct this testing on bi-weekly interval. For the purpose of this project, the proposed engine is estimated to conduct maintenance and testing 2 times per month, with each test run of at least 30 minutes.

In addition to the readiness testing as described above, the facility might also conduct annual load bank testing to ensure reliable operation during a utility power failure. The duration of the load bank test is approximately 2 hours.

Under the assumptions as described above, the owner or operator will operate the engine for maintenance checks and readiness testing purpose for approximately 14 hours per year.

In EPA's June 2006 NSPS, Subpart IIII response to comment document, EPA stated that survey conducted by the CA ARB indicated that emergency engines spend on average of about 30 hours per year for all operation.

Conservatively, staff expects that maintenance checks and readiness testing spend no more than 50 hours per year.

Power Outage: The proposed unit will be located within Franklin County. Staff is not aware of any power outage data readily accessible from Franklin County, therefore the power outage data from Avista Energy's service territories (adjacent to Franklin County) is assumed to be presentative and are being used to estimate the hours of power outage per year.

	*SAIDI total (minute)					
	2011	2012	2013	2014	2015	Average
Avista	146	118	138	139	163	140.8

**SAIDI = Measures total number of all outage minutes in a calendar year without exclusion.*

Based on the Annual Reliability Reports submitted to Utilities and Transportation Commission (UTC), on 5 years average (2011-2015), SAIDI for Avista Energy's service territories is 140.8 minutes or 2.35 hours. Staff believes that the 2011-2015 data is sufficient to provide a representative indication of how long power interruption could occur in a year, taking into account of the outages caused by significant events without exclusion.

Conservatively, staff applies safety factor of 2 to estimate the duration of power interruption per year, which is approximately 4.7 hours per year. Staff deemed that limiting emergency hours of operation is not necessary because:

- Power interruption is beyond operator's control.
- It would not make sense to expect the operator to choose between potentially exceeding the permitted hours of operation and making sure that the engine is providing emergency power for health and safety reason.

Emission Factors: The applicant proposes to use weighted average performance data from vendor for criteria emission estimation. The emission factors are as shown below.

	Emission in g/bhp-hr					
Pollutant	100%	75%	50%	25%	10%	weighted
PM	0.02	0.03	0.07	0.13	0.25	0.0935
NOx	5.18	4.02	3.63	4.34	4.96	4.151
CO	0.23	0.37	0.52	0.72	1.45	0.621

However, staff believes that using the emission limits as the emission factors for emission estimation is more appropriate because:

- The limits are enforceable.
- The limits are higher than the performance data, therefore more conservative.

The emission limits are as shown below.

	Emission Limit

Pollutant	g/Kw-hr	g/bhp-hr
PM	0.20	0.15
NMHC + NOx	6.4	4.8
CO	3.5	2.6

Criteria Pollutant Emission Rate

Pollutant	hours/year	bhp	g/bhp-hr	lb/yr	tpy
NOx	54.7	1214	4.56	667	0.33
VOC	54.7	1214	0.24	35	0.018
PM	54.7	1214	0.15	21.9	0.011
CO	54.7	1214	2.6	380.3	0.19
	hours/year	sulfur content	fuel usage	lb/yr	tpy
SO2	54.7	0.000015	57.3 gal/hr	0.66	0.0003

Note:
- PM = PM10 = PM 2.5
- Hours of operation = Maintenance/testing + power outage = 50 + 4.7 = 54.7 hours
- NOx = 0.95 x (NMHC + NOx) = 0.95 x 4.8 = 4.56 g/bhp-hr
- VOC = 0.05 x (NMHC + NOx) = 0.05 x 4.8 = 0.24 g/bhp-hr
- Fuel density = 7 lbs/gal
- lb = 454 grams
- lb SO2/lb S = 2

Toxic Air Pollutant Emission Rate

	Emission Factor	Emission Rate
Pollutant	lb/MMBtu	lb/hr
Acetaldehyde	1.86E-04	1.86E-04
Acrolein	5.83E-05	5.83E-05
Benz(a)anthracene	4.60E-06	4.60E-06
Benzene	5.74E-03	5.74E-03
Benzo(a)pyrene	1.90E-06	1.90E-06
Benzo(b)fluoranthene	8.21E-06	8.21E-06
Benzo(k)fluoranthene	1.61E-06	1.61E-06
Chrysene	1.13E-05	1.13E-05
Dibenz(a,h)anthracene	2.56E-06	2.56E-06
Diesel Engine Exhaust, Particulate	-	4.00E-01
Formaldehyde	7.89E-05	5.84E-04
Indeno(1,2,3-cd)pyrene	4.14E-07	3.06E-06
Naphthalene	1.30E-04	9.62E-04
NO2	-	1.22
Propylene	2.79E-03	2.06E-02
Toluene	2.81E-04	2.08E-03
Xylenes (m,p,o)	1.93E-04	1.43E-03

Note:
- Total PM is assumed to be diesel fuel exhaust.

- MMBTU/hr = 7 lb/gal x 18390 Btu/lb x 57.3 gal/hr ÷ 1000000 = 7.4 MMBtu/hr
- Assume 10% of NOx is NO_2.
- Except for diesel particulate and NO_2, all the emission factors are from Table 3.4-3 and Table 3.4-4 of AP-42.

2.2 Facility Wide Emission

See the Table below for the facility wide potential emission.

Equipment	Size	Number	PM_{10}	NO_x	CO	VOC
	MMBTU/hr	Units	Ton/yr	Ton/yr	Ton/yr	Ton/yr
Heating Boilers						
	0.750	2	0.05	0.27	0.28	0.04
	0.500	23	0.35	2.09	2.11	0.28
	0.399	10	0.12	0.72	0.73	0.10
Water Heating Units						
	0.250	20	0.15	0.91	0.92	0.12
	0.150	18	0.08	0.48	0.50	0.07
	0.120	1	0.00	0.02	0.02	0.00
	0.070	1	0.00	0.01	0.01	0.00
	0.065	1	0.00	0.01	0.01	0.00
Roof Top HVAC Units						
	0.325	2	0.02	0.25	0.10	0.02
	0.240	1	0.01	0.09	0.04	0.01
	0.135	1	0.00	0.05	0.02	0.00
	0.100	1	0.00	0.04	0.02	0.00
	0.060	2	0.00	0.05	0.02	0.00
	0.048	2	0.00	0.04	0.01	0.00
Heaters						
Make up air	1.300	2	0.08	0.99	0.40	0.06
Unit	0.175	8	0.04	0.53	0.22	0.03
Radiant	0.830	1	0.03	0.32	0.13	0.02
Kitchen Units						
	1.875	1	0.06	0.71	0.29	0.05
Furnaces						
	0.060	1	0.00	0.02	0.01	0.00
	0.040	2	0.00	0.03	0.01	0.00
Emergency Generators						
	hp	Number	PM_{10}	NO_x	CO	VOC
CAT 3516B	3604	1	0.07	10.03	0.12	0.10
Detroit Diesel	134	1	0.03	0.51	0.63	0.07
CAT C 27	1214	1	0.011	0.33	0.19	0.018
Total						
			1.10	18.4	6.79	0.99

3. BEST AVAILABLE CONTROL TECHNOLOGY (BACT) DETERMINATION

As required by WAC 173-400-113, the source shall employ Best Available Control Technology (BACT) to control criteria air contaminant emissions.

Please see the table below for the control requirements for comparable units.

Unit Description	Agency	Year	BACT
Emergency Diesel fired CI Engine – Vantage-Quincy Data Center Data Center	WA Ecology NOC # 16AQ-E026	2017	NOx, PM, CO and VOC - Use of EPA Tier 2 certified engines
Emergency Diesel fired CI Engine – Solana County Transit Operations	BAAQMDs – Application # 28434	2017	6.4 g/kW-hr NMHC + NOx; 3.5 g/kW-hr CO; and 0.20 g/kW-hr PM.

Basically, both permits require the emergency engine to comply with Tier 2 emission standards in NSPS, Subpart IIII. NSPS Subpart IIII requires stationary non-road engines to comply with Tier 2, Tier 3 or Tier 4 emission standards in accordance with the horse power rating, model year and type of the engine. NSPS, Subpart IIII exempts emergency CI engines from Tier 4 standards.

Tier 2 and 3 standards generally can be achieved through in-engine design improvements and Tier 4 standards can be achieved through the use of diesel particulate filter (DPF) and selective catalytic reduction (SCR) unit.

Control options for PM_{10}, CO and VOC include diesel particulate filter (DPF) and diesel oxidation catalyst (DOC). DPF is a device designed to physically capture particulate matter from the exhaust stream. DOC is a flow-through device where exhaust gases are brought in contact with materials that oxidize unburned hydrocarbons and reduce emissions. Catalyst-based DPFs use catalyst materials to reduce the temperature at which collected diesel PM oxidizes.

Control option to lower NOx emission include SCR technology. SCR uses a catalyst (commonly precious metals, vanadium, or zeolites) and injection of a reductant (liquid ammonia or urea) to convert the NOx in the diesel exhaust to water (H_2O) and nitrogen (N_2). SCR systems require an operating temperature between 260 °C to 540 °C. Reaching these temperatures may be difficult in routine maintenance and testing operations where the engine is typically operated at low load for short periods of testing. If this temperature is not met while the engine is running, there will not be any NOx emission reduction benefits. There is also challenge with urea crystallization for the standby emergency engines due to their periodic and low hours of usage.

These controls were evaluated during the rule making of NSPS, Subpart IIII and EPA concludes that the use of add-on controls could not be justified as best demonstrated technology (BDT) due to the cost of the technology relative to the emission reduction that would be obtained (see NSPS Subpart IIII preamble). Therefore, staff concludes that use of add-on control is not economically feasible for this project. BACT for PM_{10}, CO, VOC and NOx is to meet the Tier II emission standards which can be achieved with engine-based technologies including combustion optimization and different fuel injection strategies, consistent with NSPS requirements.

For PM_{10} & SO_2, BACT is also to reduce the emissions through the use of lower sulfur fuel with sulfur content of 15 ppm.

As required in WAC 173-460-040(4)(b), this project shall use Best Available Control Technology for Toxics (T-BACT) to control toxic emissions. Because the Tier 2 emission standards can be surrogate for the TAPs (i.e. PM standard can be surrogate for diesel particulate), staff concludes that T-BACT for this project is the same as BACT as described above.

4. AIR QUALITY ANALYSIS

4.1 NAAQS

Modeling of the ambient air quality impacts from this facility was not performed due to the minimal potential emissions. Based on engineering discretion, it is believed this project will not result in exceedance of the NAAQS.

4.2 TAP Impact Level Analysis – First Tier

Per WAC 173-460-070, this analysis is conducted to ensure that emission from the proposed unit are sufficiently low to protect human health and safety from potential carcinogenic and/or other toxic effects.

Each toxic air pollutant (TAP) emission rate from the proposed unit is compared to the corresponding small quantity emission rate (SQER) as shown below.

	Emission Rate		Averaging period	SQER
TAP	lb/hr	lb/avg.pd	avg.pd	lb/avg.pd
Acetaldehyde	1.86E-04	1.02E-02	year	71
Acrolein	5.83E-05	1.40E-03	24-hr	0.00789
Benz(a)anthracene	4.60E-06	2.52E-04	year	1.74
Benzene	5.74E-03	3.14E-01	year	6.62
Benzo(a)pyrene	1.90E-06	1.04E-04	year	0.174
Benzo(b)fluoranthene	8.21E-06	4.49E-04	year	1.74
Benzo(k)fluoranthene	1.61E-06	8.82E-05	year	1.74
Chrysene	1.13E-05	6.19E-04	year	17.4
Dibenz(a,h)anthracene	2.56E-06	1.40E-04	year	0.16
Diesel Engine Exhaust, Particulate	4.00E-01	2.19E+01	year	0.639
Formaldehyde	5.84E-04	3.19E-02	year	32
Indeno(1,2,3-cd)pyrene	3.06E-06	1.68E-04	year	1.74
Naphthalene	9.62E-04	5.26E-02	year	5.64
NO_2	1.22	1.22	1-hr	1.03
Propylene	2.06E-02	4.96E-01	24-hr	394
Toluene	2.08E-03	4.99E-02	24-hr	657
Xylenes (m,p,o)	1.43E-03	3.43E-02	24-hr	29

As shown by the table above, each of the TAP emission rates is less than the corresponding SQER threshold, except diesel particulate and NO_2.

The applicant has used AERMOD to predict the ambient concentration of diesel particulate for the project. The stack input data is as shown below.

STACK DATA

Point Source Parameter	Emergency Generator			
UTM Coordinates[1]	358271	m E	5170618	m N
DEEP Emission Rate	32	lb/yr	4.62E-04	g/s
Stack Height[1]	18.3	ft	5.58	m
Stack Diameter[2]	0.83	ft	0.25	m
Stack Temperature[2]	953	°F	784.54	°K
Exit Velocity	184	ft/sec	56.45	m/sec
Stack Flow Rate[2]	6,012	ACFM		

1. Location per map, stack, and building height provided by Dorothy Trainer per 3/27/2017 email.
2. Stack Diameter, temperature, and flow rate per Western States Equipment Co. Quote REN-17-0441.

Distance from Source [m]	Grid Spacing [m]
0 – 250	10
250-500	30
500-1000	75
1000-2000	200
2000-5000	500

Distance from stack to nearest property line = 300ft.

Building	Building Height (ft)[1]
Generator building	14.8
South Side building	20
East Side building	28

The model result shows that the maximum diesel particulate concentration is 0.0167 ug/m3. However due to the difference in the submitted emission estimation and staff's own estimation, the result is scaled as shown below.

Original input emission rate = 32 lbs/yr
Estimated diesel particulate emission rate = 21.9 lbs/yr
Estimated NO_2 emission rate = 66.7 lbs/yr
Diesel particulate ASIL = 0.00333 ug/m3
NO_2 ASIL = 470 ug/m3

Maximum predicted diesel particulate concentration = 21.9/32 x 0.0167 ug/m3 = 0.01143 ug/m3 > ASIL
Maximum predicted NO2 concentration = 66.7/32 x 0.0167 ug/m3 = 0.0348 ug/m3

4.3 TAP Impact Level Analysis – Second Tier

Second Tier review has been conducted to estimate the increase cancer and non-cancer risk because of DEEP. The Second Tier review concludes that:

- The highest increase in risks attributable to DOC's emissions is 3 per million and occurs at a 60 meters northeast of the engine exhaust stack.
- Chronic non-cancer hazards attributable to DOC's increased DEEP emissions are not likely to result in adverse non-cancer health effects.

A copy of the Second Tier analysis will be filed as part of this support document.

5. RULE APPLICABILITY

5.1 Source Classification

The facility is not a "Major Source" under WAC 173-401-200 (19) because:

- Does not have the potential to emit, in the aggregate, ten tons per year (tpy) or more of any hazardous air pollutant which has been listed pursuant to section 112(b) of the FCAA, or twenty-five tpy or more of any combination of such hazardous air pollutants.
- Does not have the potential to emit, one hundred tpy or more of any air pollutant subject to regulation.

5.2 Applicable Federal Standards

New Source Performance Standard (NSPS): The proposed not fire pump emergency engine is subject to NSPS, Subpart IIII according to 40 CFR 60.4200. For model year 2007 or later and between 37 and 2,237 kW, the engine shall meet the emission standards in 40 CFR 89.112 and 89.113. To meet the standards (see below), the applicant proposes to install an EPA certified Tier II engine.

According to 40 CFR 89.112, Tier II engine exhaust shall not exceed:

- 6.4 g/kW-hr NMHC + NOx;
- 3.5 g/kW-hr CO; and
- 0.20 g/kW-hr PM.

According to 40 CFR 89.113, the exhaust opacity from the engine must not exceed:

- 20 percent during the acceleration mode;
- 15 percent during the lugging mode; and
- 50 percent during the peaks in either the acceleration or lugging modes.

40 CFR 60.4207 (b) also requires the engine to use the ultra-low sulfur diesel fuel that meets the requirements in 40 CFR 80.510. 40 CFR 60.4209(a) requires a non-resettable hour meter.

National Emission Standard for Hazardous Air Pollutants (NESHAP): The proposed emergency engine is subject to NESHAP, Subpart ZZZZ (RICE) according to 40 CFR 63.6585. While this is an institutional emergency stationary RICE as defined in 40 CFR 63.6675, the unit cannot be exempted from RICE per 40 CFR 63.6585 (f) because it is a new stationary RICE per 40 CFR 63.6590 (2).

The engine shall meet all the applicable requirements in NESHAP Subpart ZZZZ for a new emergency engine located at an area source of HAP emission.

For NESHAP purpose, emergency engine can operate for a maximum of 100 hours per calendar year for limited circumstances such as maintenance check and readiness testing, for non-emergency operation. NESHAP does not impose time limit on the use of emergency stationary RICE in emergency situations.

6. STATE ENVIRONMENTAL POLICY ACT (SEPA)

A copy of the environmental checklist was forwarded to City of Connell to verify SEPA lead. Based on the respond received on January 16, 2018, the project will not trigger SEPA for the City of Connell. It is determined that Ecology will be the lead agency for the project.

After reviewing the submitted environmental checklist and the application, staff finds that the proposal will not have significant adverse environmental impacts and will issue a determination of nonsignificance (DNS) for the project.

7. PUBLIC COMMENT

The application triggers mandatory 30-days public comment period per WAC 173-400-171 (3) because the DEEP concentration exceeds Acceptable Source Impact Level (ASIL). A newspaper public notice announcing the public comment period was published in the on .

8. CONCLUSION

Staff has determined that the applicant, Department of Correction, has satisfied all of the requirements of New Source Review. The operation of this unit shall be subject to the conditions of the attached proposed Approval Order No. 17AQ-E021.