

ENGINEERING EVALUATION
Orinda Senior Village; Plant 23449
Application 27775

BACKGROUND

The Orinda Senior Village has applied for an Authority to Construct and/or Permit to Operate the following equipment:

- S-1 Natural Gas Cogeneration System**
Tecogen CM60LE 60kW cogeneration system
Engine: General Motors/Tecogen, TecoDrive 7400, 85 BHP; 4 Stroke, rich burn,
abated by
 - A-1 Nonselective Catalytic Reduction (NSCR): Clariant, EnviCat 7319**

The cogeneration system will be used at 20 Irwin Way, Orinda, CA 94563 to provide 60 kW of electricity to the Orinda Senior Village. The system includes an exhaust heat recovery system that transfers heat in the exhaust to water that is then used for space heating and the hot water system. This allows the facility's boiler to operate less often which reduces emissions from that boiler.

The cogeneration system is also abated by a Nonselective Catalytic Reduction (NSCR) device that reduces emissions of NO_x, CO, and hydrocarbons by more than 90%.

EMISSIONS

Annual Emissions:

- Basis:
- 85 bhp output rating for full-load
365 x 24 = 8760 hr/yr of continuous use
 - Firing Rate: 0.798 MMBTU/hr (HHV)
 - Assume POC ~ NMHC
 - NO_x, CO, POC emission factors from manufacturer after abatement
 - PM10 emission factors per AP-42 (Table 3.2-3: 4-Stroke Rich-Burn engines)

Pollutant	Emission Factor (lb/MMBTU)	Abated Emission Factor (g/bhp-hr)	Abated Emission Concentration (ppmvd @ 15% O ₂)
NO _x :		0.4	25
CO:		1.4	142
POC:		0.175	31
PM10:	0.0095	-	
SO ₂	0.000588	-	

Annual Emissions Calculation

Pollutant	hours/yr		Bhp		emission factor (g/bhp-hr)	Lb/g		lb/year		TPY
NOx	8760	x	85	x	0.4	/ 453.4	=	656.9	=	0.328
CO	8760	x	85	x	1.4	/ 453.4	=	2299.2	=	1.150
POC	8760	x	85	x	0.175	/ 453.4	=	287.4	=	0.144
					MMBTU/hr	(lb/MMBTU)				
PM10	8760	x	0.798	x	0.0095		=	66.4	=	0.033
SO2	8760	x	0.798	x	0.000588		=	4.1	=	0.002

Daily Emissions:

Daily emissions are calculated to establish whether a source triggers the requirement for BACT (10 lb/highest day total source emissions for any class of pollutants). 24-hr/day operation will be assumed.

Pollutant	hours/day		Bhp		emission factor (g/bhp-hr)	Lb/g		lb/day
NOx	24	x	85	x	0.4	/ 453.4	=	1.8
CO	24	x	85	x	1.4	/ 453.4	=	6.3
POC	24	x	85	x	0.175	/ 453.4	=	0.8
					MMBTU/hr	(lb/MMBTU)		
PM10	24	x	0.798	x	0.0095		=	0.18
SO2	24	x	0.798	x	0.000588		=	0.01

Toxic Air Contaminants (TAC):

The emission factors used to estimate TAC emissions from the engine described above are from: California Air Toxics Emission Factor Database (maintained by the California Air Resources Board) for natural gas fired 4-stroke rich burn engines with less than 650 hp or AP-42 for natural gas fired 4-stroke rich burn engine Table 3.2-3. The engine being permitted has a maximum firing rate of 0.798 MMBtu/hr and a maximum rating of 85 hp. In accordance with the District's Permit Handbook Chapter 2.3.2 for Stationary Natural Gas Engines, the CATEF Emission Factors maintained by the ARB were used to estimate emissions for all compounds that have both AP-42 emission factors and CATEF emission factors. The heat content of natural gas was assumed to be 1020 Btu/scf. The NSCR abates organics by over 90%, however, to be very conservative for TAC emissions, a 50% reduction was used in the calculation. Even with this conservative calculation, no TAC would be emitted in levels in excess of the trigger levels in Regulation 2, Rule 5, Table 1.

Toxic Air Contaminant Emissions

Firing Rate (MMBTU/hr) =	0.798								
# of Hours/Yr Operation =	8760								
		Unabated		Abated	Hourly	Acute	Annual	Chronic	HRSA
		Emission factor	Abatement efficiency	Emission factor	Emissions	Trigger Level	Emissions	Trigger Level	Triggered ?
Toxic Air Contaminant	PEF	(lb/MMBTU)	%	(lb/MMBTU)	(lb/hr)	(lb/hr)	(lb/year)	(lb/year)	(Yes/No)
1,1,2,2-Tetrachloroethane*		2.53E-05	50%	1.27E-05	1.01E-05	-	8.84E-02	1.90E+00	no
1,1,2-Trichloroethane*		1.53E-05	50%	7.65E-06	6.10E-06	1.50E+02	5.35E-02	3.90E+04	no
1,1-Dichloroethane*		1.13E-05	50%	5.65E-06	4.51E-06	-	3.95E-02	6.60E+01	no
1,3-Butadiene		1.02E-04	50%	5.10E-05	4.07E-05	-	3.56E-01	6.30E-01	no
Acetaldehyde		8.66E-04	50%	4.33E-04	3.45E-04	1.00E+00	3.03E+00	3.80E+01	no
Acrolein		5.36E-04	50%	2.68E-04	2.14E-04	5.50E-03	1.87E+00	1.40E+01	no
Benzene			(note 1)	7.25E-05	5.78E-05	2.90E+00	5.06E-01	3.80E+00	no
Carbon Tetrachloride*		1.77E-05	50%	8.85E-06	7.06E-06	4.20E+00	6.19E-02	2.50E+00	no
Chlorobenzene*		1.29E-05	50%	6.45E-06	5.15E-06	-	4.51E-02	3.90E+04	no
Chloroform*		1.37E-05	50%	6.85E-06	5.47E-06	3.30E-01	4.79E-02	2.00E+01	no
Ethylbenzene		1.14E-05	50%	5.69E-06	4.54E-06	-	3.97E-02	4.30E+01	no
Ethylene Dibromide*		2.13E-05	50%	1.07E-05	8.50E-06	-	7.44E-02	1.50E+00	no
Formaldehyde			(note 1)	4.89E-05	3.90E-05	1.20E-01	3.42E-01	1.80E+01	no
Methanol*		3.06E-03	50%	1.53E-03	1.22E-03	6.20E+01	1.07E+01	1.50E+05	no
Methylene Chloride*		4.12E-05	50%	2.06E-05	1.64E-05	3.10E+01	1.44E-01	1.10E+02	no
Naphthalene		7.50E-05	50%	3.75E-05	2.99E-05	-	2.62E-01	3.20E+00	no

		Unabated		Abated	Hourly	Acute	Annual	Chronic	HRSA
		Emission factor	Abatement efficiency	Emission factor	Emissions	Trigger Level	Emissions	Trigger Level	Triggered ?
Toxic Air Contaminant	PEF	(lb/MMBTU)	%	(lb/MMBTU)	(lb/hr)	(lb/hr)	(lb/year)	(lb/year)	(Yes/No)
PAH or derivative									
Benzo(a)pyrene	1	1.13E-07							
Benzo(b)fluoranthene	0.1	2.32E-07							
Benzo(k)fluoranthene	0.1	1.01E-07							
Chrysene	0.01	3.04E-07							
Dibenz(a,h)anthracene	1.05	1.23E-08							
Indeno(1,2,3-cd)pyrene	0.1	1.66E-07							
PAH or derivative TOTAL		1.79E-07	50%	8.93E-08	7.12E-08	-	6.24E-04	6.90E-03	no
Propylene		1.57E-02	50%	7.84E-03	6.26E-03	-	5.48E+01	1.20E+05	no
Styrene*		1.19E-05	50%	5.95E-06	4.75E-06	4.60E+01	4.16E-02	3.50E+04	no
Toluene		1.05E-03	50%	5.25E-04	4.19E-04	8.20E+01	3.67E+00	1.20E+04	no
Vinyl Chloride*		7.18E-06	50%	3.59E-06	2.86E-06	4.00E+02	2.51E-02	1.40E+00	no
Xylene		5.90E-05	50%	2.95E-05	2.35E-05	4.90E+01	2.06E-01	2.70E+04	no
CATEF 4S/Rich/<650Hp, Mean emission factors were used where available									
* AP-42 Factors when CATEF was not available									
note 1: emission factor was from an abated engine									

PLANT CUMULATIVE INCREASE

The cumulative increase in criteria pollutant emissions that will result from the operation of S-1 is summarized below.

Pollutant	Current plant emissions (TPY)	Increase in plant emissions (TPY)	Cumulative emissions (TPY)
NO _x	0	0.328	0.328
CO	0	1.150	1.150
POC	0	0.144	0.144
PM10	0	0.033	0.033
SO ₂	0	0.002	0.002

HEALTH RISK SCREENING ANALYSIS

A health risk screening analysis is not required since toxic air contaminant emissions are less than the trigger levels in Regulation 2, Rule 5, Table 1.

BEST AVAILABLE CONTROL TECHNOLOGY

BACT is not triggered per Regulation 2-2-301 because maximum daily emissions do not exceed 10 lb/day for any of the pollutants.

OFFSETS

Offsets must be provided for any new or modified source at a facility that emits more than 10 tons/yr of POC or NO_x per Regulation 2-2-302. Offsets are not required because permitted POC and NO_x emissions are less than 10 ton/yr.

STATEMENT OF COMPLIANCE

S-1 will be operated as a prime engine. S-1 is subject to and expected to comply with Regulation 9, Rule 8 ("NO_x and CO from Stationary Internal Combustion Engines") section 301.1 for Rich Burn Engines (maximum NO_x emissions of 25 ppmvd at 15% O₂) and 301.3 (maximum CO emissions of 2000 ppmvd at 15% O₂) since the engine will be limited to 25 ppmvd NO_x at 15% O₂ and 142 ppmvd CO at 15% O₂ in permit conditions. S-1 is subject to the quarterly monitoring and record keeping requirements of Regulation 9-8-502.3 and 503 (quarterly demonstration of compliance with NO_x and CO standards using a portable analyzer).

S-1 is also subject to the SO₂ limitations of 9-1-301 (ground-level concentration) and 302 (SO₂ limit of 300 ppmvd). Compliance with Regulation 9-1 is very likely since pipeline natural gas has very low sulfur content.

Like all combustion sources, S-1 is subject to Regulation 6, Rule 1 ("Particulate and Visible Emissions") section 303.1 (Ringelmann 2 limitation). This engine is not expected to produce visible emissions or fallout in violation of this regulation since it burns natural gas and will be assumed to be in compliance with Regulation 6, Rule 1 pending a regular inspection.

S-1 is subject to 40 CFR Part 60 Subpart JJJJ - Standards of Performance for Stationary Spark Ignition Internal Combustion Engines per §60.4230(a)(4)(iii) since it commenced construction after June 12, 2006, and was manufactured on or after July 1, 2008, and has a maximum engine power less than 500 HP. Per §60.4233(d), the owner/operators must meet the emission standards in 40 CFR 1048.101(c), which are: HC + NO_x 3.8 g/kW-hr (2.8 g/bhp-hr) and CO 6.5 g/kW-hr (4.8 g/bhp-hr). Per 40 CFR 1048.101(c)(2), HC is assumed to be zero and does not need to be measured. The engine will comply with these emission standards since the concentration limits in the permit conditions are equivalent to 0.4

g/bhp-hr NO_x and 1.4 g/bhp-hr CO. Because this engine is not certified, per §60.4243(b)(2)(i), the owner/operator must comply by keeping a maintenance plan and records of conducted maintenance and must, to the extent practicable, maintain and operate the engine in a manner consistent with good air pollution control practice for minimizing emissions. In addition, the owner/operator must conduct an initial performance test to demonstrate compliance. Per §60.4243(f), the owner/operator is not required to conduct subsequent performance testing unless the stationary engine is rebuilt or undergoes major repair or maintenance (however, quarterly testing is required by BAAQMD Regulation 9-8-503). The initial testing must be in accordance with the test methods in §60.4244. §60.4243(g) also requires that an air-to-fuel ratio (AFR) controller will be used with the operation of three-way catalysts/non-selective catalytic reduction. The AFR controller must be maintained and operated appropriately in order to ensure proper operation of the engine and control device to minimize emissions at all times. Per §60.4245(a), the owner/operator must keep records of all notifications submitted, maintenance conducted, and documentation that the engine meets the emission standards. Per §60.4245(d) owners/operators must submit a copy of each performance test as conducted in §60.4244 within 60 days after the test has been completed.

S-1 is subject 40 CFR Part 63 Subpart ZZZZ National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines. Per §63.6590(c)(1), this engine complies with this subpart because it is located at an area source and meets the requirement of 40 CFR Part 60 Subpart JJJ.

This application is considered to be ministerial under the District's Regulation 2-1-311 and therefore is not subject to CEQA review. The engineering review for this project requires only the application of standard permit conditions and standard emission factors in accordance with Permit Handbook Chapter 2.3.2 (Stationary Natural Gas Engines).

This facility is less than 1,000 feet from the nearest schools (Holden High School and Fountainhead Montessori School) and therefore is subject to the public notification requirements of Regulation 2-1-412.

PSD is not triggered.

PERMIT CONDITIONS

Condition 26228

S-1 Natural gas-fired cogeneration system abated by A-1 Catalytic converter

1. The owner/operator shall abate emissions from Source S-1 at all times of operation with the properly maintained and properly operated Abatement device A-1 NSCR. (Basis: Cumulative Increase)
2. The owner/operator of S-1 shall operate this source on natural gas fuel exclusively. (basis: Cumulative Increase)
3. The owner/operator of S-1 shall operate and maintain the engine and A-1 catalytic converter in accordance with manufacturer recommendations. (basis: Cumulative Increase, 40 CFR Part 60.4243(b)(2)(i))
4. The owner/operator of S-1 shall not use more than 69,200 therms of natural gas in any consecutive twelve-month period. (basis: Cumulative Increase)
5. The owner/operator of S-1 shall ensure emissions from S-1 meet the following standards:

- a. NO_x = 25 ppmvd @ 15% O₂ (0.4 g/bhp-hr)
 - b. CO = 142 ppmvd @ 15% O₂ (1.4 g/bhp-hr)
- (basis: Cumulative Increase, BAAQMD Regulation 9-8-301.1, 40 CFR Part 60.4233(d))

6. Not later than 60 days from the startup of S-1, the owner/operator shall conduct District approved source tests to determine initial compliance with the limits in Part 5. The owner/operator shall submit the source test results to the District staff no later than 60 days after the source test. (basis: 40 CFR Part 60.4243(b)(2)(i), Cumulative Increase)
7. The owner/operator shall obtain approval for all source test procedures from the District's Source Test Section prior to conducting any tests. The owner/operator shall comply with all applicable testing requirements as specified in 40 CFR Part 60.4244 (and Volume V of the District's Manual of Procedures, as applicable). The owner/operator shall notify the District's Source Test Section, in writing, of the source test protocols and projected test dates at least 7 days prior to testing. (basis: Cumulative Increase)
8. To determine compliance with the above parts, the owner/operator shall maintain the following records for S-1 a District approved log:
 - a. Monthly natural gas usage in therms
 - b. Maintenance records
 - c. Emissions testing documentation, including date and time of testing, operating conditions during test, and test results
 - d. Notifications sent to the District

The log for the monthly natural gas usage shall be kept for at least 2 years and shall be made available to the District upon request. The maintenance records, emissions testing documentation, and notifications shall be kept for the lifetime of the engine. (basis: Recordkeeping, 40 CFR Part 60.4245(a))

RECOMMENDATION

The District has reviewed the material contained in the permit application for the proposed project and has made a preliminary determination that the project is expected to comply with all applicable requirements of District, state, and federal air quality-related regulations. The preliminary recommendation is to issue an Authority to Construct for the equipment listed below. However, the proposed source will be located within 1000 feet of a school, which triggers the public notification requirements of District Regulation 2-1-412. After the comments are received and reviewed, the District will make a final determination on the permit.

I recommend that the District initiate a public notice and consider any comments received prior to taking any final action on issuance of an Authority to Construct for the following source:

- S-1 Natural Gas Cogeneration System**
- Tecogen CM60LE 60kW cogeneration system**
- Engine: General Motors/Tecogen, TecoDrive 7400, 85 BHP; 4 Stroke, rich burn,**
- abated by**
- A-1 NSCR: Clariant, EnviCat 7319**

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