

Engineering Evaluation
Application No. 696413
Plant No. 203428
1080 Chestnut St., San Francisco, CA 94109

BACKGROUND

Plant No. 203428 located at 1080 Chestnut Street, San Francisco, has applied for an Authority to Construct (AC) for the following equipment:

- S-1 Prime Engine, Natural Gas fired, 4 Stroke Rich Burn, 85 BHP, 0.758 MMBtu/hr**
Engine: Origin, Model: HTCGB08.0TSC 8.0L, Model Year: 2022
 Abated by
- A-1 First Stage NSCR, Clariant Model Envicat 7319**
A-2 Second stage Aftertreatment, Ultera Oxidation Catalyst

S-1 is part of a 60-kW (85 BHP) natural gas-fired cogeneration system that will provide electricity for the building in parallel with the utility grid, while also using the engine's recovered waste heat to serve the building's domestic hot water needs and space heating loads. The proposed cogeneration system is a Tecogen Model "Tecopower 60" cogeneration module driven by S-1, whose emissions will be abated in series by A-1 and A-2 to ensure lowest pollutant emissions. The cogeneration unit will operate 24 hours a day, 7 days a week, 52 weeks a year (8,760 hours/year).

EMISSIONS CALCULATIONS

S-1's abated NO_x (oxides of nitrogen), CO (carbon monoxide) and POC (precursor organic compounds) emissions are calculated based on Tecogen's specification sheet (see Attachment A) and have been adjusted to allow for compliance margin. Hourly, daily and annual abated emissions are shown in Table 1.

Table 1: S-1's Abated NO_x, CO and POC Emissions

Pollutant	g/bhp-hr	lb/hr	lb/day	lb/year	tpy
NO _x	0.31	0.058	1.394	508.887	0.254
CO	2	0.375	8.995	3283.141	1.642
POC	0.6	0.112	2.698	984.942	0.492

The emission factors used to estimate PM₁₀, PM_{2.5} and SO₂ emissions are based on AP-42 Table 3.2-3: Uncontrolled Emission Factors for 4 stroke, rich burn engines.

$$*PM_{10} = 9.5E-03 \text{ lb/MMBtu} \times 0.758 \text{ MMBtu/hr} = 7.2E-03 \text{ lb/hr} = 0.17 \text{ lb/day} = 63.1 \text{ lb/yr}$$

$$*PM_{2.5} = 9.5E-03 \text{ lb/MMBtu} \times 0.758 \text{ MMBtu/hr} = 7.2E-03 \text{ lb/hr} = 0.17 \text{ lb/day} = 63.1 \text{ lb/yr}$$

Sulfur dioxide (SO₂) emission factor of 5.88 E-04 in AP-42 Table 3.2-3 is based on a sulfur content of 2,000 grains sulfur per 1 MMscf of natural gas; in California, PUC quality natural gas is guaranteed to have a sulfur content of 1 gr/100 scf (10,000 gr/MMscf), or 2.94E-03 lb/MMBtu.

$$SO_2 = 2.94E-03 \times 0.758 \text{ MMBtu/hr} = 2.23E-03 \text{ lb/hr} = 5.35E-02 \text{ lb/day} = 19.52 \text{ lb/yr}$$

S-1's criteria air pollutant (CAP) emissions are summarized in Table 2.

* PM₁₀ Emission Factor = 9.5E-03 Lb./MMBtu; aerodynamic particle diameter =< 1 μm, for the purposes of filterable emissions PM₁₀= PM_{2.5}.

Table 2: S-1's CAP Emissions

Pollutant	Emissions (lbs/hr)	Emissions (lb/day)	Emissions (lb/yr)	Emissions (tpy)
NO _x	0.058	1.394	508.887	0.254
CO	0.375	8.995	3283.141	1.642
POC	0.112	2.698	984.942	0.492
PM ₁₀	7.23E-03	1.74E-01	6.31E+01	3.16E-02
PM _{2.5}	7.23E-03	1.74E-01	6.31E+01	3.16E-02
SO ₂	2.23E-03	5.35E-02	1.95E+01	9.76E-03

HEALTH RISK ASSESSMENT

The emission factors used to estimate Toxic Air Compounds (TAC) and Hazardous Air Pollutants (HAPs) emissions from S-1 are from AP-42 Table 3.2-3 "Uncontrolled Emission Factors for 4 Stroke Rich-Burn (4SRB) Engines, or from the California Air Toxics Emission Factor (CATEF) database maintained by the California Air Resources Board for natural gas fired 4SRB engines rated less than 650 hp abated by NSCR (such as A-1). Abated TAC/HAP emissions summarized in Table 3 were conservatively estimated assuming an overall abatement efficiency of at least 50% by wt. for A-1 and A-2.

Table 3:S-1's TAC/HAP EMISSIONS

Compound	Basis	Chosen Emission Factor	Unit	Acute Emissions (lbs/hour)	Acute Trigger (lbs/hour)	Exceed Acute Trigger?	Chronic Emissions (lbs/year)	Chronic Trigger (lbs/year)	Exceed Chronic Trigger?
1,1,2,2-Tetrachloroethane	AP-42	2.53E-05	lb/MMBtu	9.6E-06	None	None	8.4E-02	1.4E+00	no
1,1,2-Trichloroethane	AP-42	1.53E-05	lb/MMBtu	5.8E-06	None	None	5.1E-02	5.0E+00	no
1,1-Dichloroethane	AP-42	1.13E-05	lb/MMBtu	4.3E-06	None	None	3.8E-02	5.0E+01	no
1,3-Butadiene	CATEF	1.02E-04	lb/MMBtu	3.9E-05	2.9E-01	no	3.4E-01	4.8E-01	no
Acetaldehyde	CATEF	8.66E-04	lb/MMBtu	3.3E-04	2.1E-01	no	2.9E+00	2.9E+01	no
Acrolein	CATEF	5.36E-04	lb/MMBtu	2.0E-04	1.1E-03	no	1.8E+00	1.4E+01	no
Benzene	CATEF	1.87E-03	lb/MMBtu	7.1E-04	1.2E-02	no	6.2E+00	2.9E+00	YES
Carbon Tetrachloride	AP-42	1.77E-05	lb/MMBtu	6.7E-06	8.4E-01	no	5.9E-02	1.9E+00	no
Chlorobenzene	AP-42	1.29E-05	lb/MMBtu	4.9E-06	None	None	4.3E-02	3.9E+04	no
Chloroform	AP-42	1.37E-05	lb/MMBtu	5.2E-06	6.6E-02	no	4.5E-02	1.5E+01	no
Ethylbenzene	CATEF	1.14E-05	lb/MMBtu	4.3E-06	None	None	3.8E-02	3.3E+01	no
Ethylene Dibromide	AP-42	2.13E-05	lb/MMBtu	8.1E-06	None	None	7.1E-02	1.1E+00	no
Formaldehyde	CATEF	2.30E-03	lb/MMBtu	8.7E-04	2.4E-02	no	7.6E+00	1.4E+01	no
Methanol	AP-42	3.06E-03	lb/MMBtu	1.2E-03	1.2E+01	no	1.0E+01	1.5E+05	no
Methylene Chloride	AP-42	4.12E-05	lb/MMBtu	1.6E-05	6.2E+00	no	1.4E-01	8.2E+01	no

Compound	Basis	Chosen Emission Factor	Unit	Acute Emissions (lbs/hour)	Acute Trigger (lbs/hour)	Exceed Acute Trigger?	Chronic Emissions (lbs/year)	Chronic Trigger (lbs/year)	Exceed Chronic Trigger?
Naphthalene	CATEF	7.50E-05	lb/MMBtu	2.8E-05	None	None	2.5E-01	2.4E+00	no
PAH Equivalent as Benzo(a)pyrene	CATEF	1.78E-07	lb/MMBtu	6.8E-08	None	None	5.9E-04	3.3E-03	no
Propylene	CATEF	1.57E-02	lb/MMBtu	5.9E-03	None	None	5.2E+01	1.2E+05	no
Styrene	AP-42	1.19E-05	lb/MMBtu	4.5E-06	9.3E+00	no	4.0E-02	3.5E+04	no
Toluene	CATEF	1.05E-03	lb/MMBtu	4.0E-04	2.2E+00	no	3.5E+00	1.6E+04	no
Vinyl Chloride	AP-42	7.18E-06	lb/MMBtu	2.7E-06	8.0E+01	no	2.4E-02	1.1E+00	no
Xylene (total)	CATEF	6.45E-04	lb/MMBtu	2.4E-04	9.7E+00	no	2.1E+00	2.7E+04	no

Per Table 3, a Health Risk Assessment (HRA) is required because the annual benzene emissions exceed the chronic TAC trigger level in Regulation 2-5 Table 2-5-1. 1080 Chestnut is not located within an OBC. Following is an excerpt from the HRA results memo dated March 19, 2024:

“The results of the HRA indicate that the project cancer risk is estimated at 0.84 in a million, and the project chronic hazard index (HI) is estimated at 0.0065, and the project acute HI is estimated at 0.11. In accordance with the District’s Regulation 2-5-301, this source does not require TBACT because the estimated source risk does not exceed a cancer risk of 1.0 in a million, and/or chronic hazard index of 0.20.

Since the estimated project cancer risk does not exceed 10 in a million and hazard indices do not exceed 1.0, this proposed project complies with the District’s Regulation 2-5-302 project risk requirements, for projects not located in an Overburdened Community, as defined in Regulation 2-1-243. This HRA represents an analysis of all sources of TACs at this facility. Therefore, these project HRA results also represent site wide HRA results for purposes of the Air Toxics “Hot Spots” Act (AB 2588).”

PLANT CUMULATIVE EMISSIONS

Plant 203428 is a new facility and the existing cumulative emissions increase is zero. Table 4 summarizes the cumulative increase in criteria pollutant emissions resulting from the operation of S-1:

Table 4: Plant Cumulative Increase (tons/year)

Pollutant	Existing	New	Total
NOx	0	0.254	0.254
CO	0	1.642	1.642
POC	0	0.492	0.492
PM10	0	3.16E-02	3.16E-02
PM2.5	0	3.16E-02	3.16E-02
SO ₂	0	9.76E-03	9.76E-03

BEST AVAILABLE CONTROL TECHNOLOGY (BACT)

Per Regulation 2-2-301.1, a new source such as S-1 shall require BACT to control emissions of a District BACT pollutant, as defined in Regulation 2-2-210, if the source will have the potential to emit that pollutant in an amount of 10.0 or more pounds on any day. It can be seen from Table 2 above that BACT is not triggered for any pollutant.

OFFSETS

Per Regulation 2-2-302 and 2-2-303, offsets must be provided for any new or modified source at a facility that will emit more than 10 tons/yr of POC or NO_x, or more than 100 tons/yr/pollutant of PM₁₀, PM_{2.5} and/or SO₂, respectively. As shown in Tables 2 and 4 above, offsets are not required for this application.

New Source Performance Standards (NSPS)

S-1, a four-stroke rich burn (4SRB) engine, will be installed after January 1, 2011 and is therefore, subject to the New Source Performance Standard (NSPS) in 40 CFR 60, Subpart JJJJ Table 1.

Table 1 in NSPS Subpart JJJJ

g/HP-hr		
NO _x	CO	VOC
1	2	0.7

As shown in Table 1 above, S-1 complies with Table 1 in NSPS Subpart JJJJ.

National Emission Standards for Hazardous Air Pollutants (NESHAP)

S-1 is subject to the emission or operating limitations in 40 CFR 63, Subpart ZZZZ (MACT ZZZZ), "National Emission Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines (RICE)". S-1 is a new engine that complies with MACT ZZZZ by meeting the requirements in 40 CFR Part 60 Subpart JJJJ per §63.6590(c)(1).

STATEMENT OF COMPLIANCE

Regulation 6, Rule 1 (*Particulate Matter and Visible Emissions Standards*)

S-1, with a displacement of 8 liters (480 in³), is subject to Regulation 6, Rule 1. Opacity and visible emissions from S-1 are limited by Regulations 6-1-303.1 (internal combustion engines of less than 25 liters (1,500 in³) displacement) to Ringelmann 2.

Regulation 6-1-305 prohibits emission of particles from any operation in sufficient number to cause annoyance to any other person where the particles are large enough to be visible as individual particles at the emission point, or of such size and nature as to be visible individually as incandescent particles. S-1 will burn natural gas and is not expected to produce visible emissions or fallout in violation of this regulation and will be assumed to be in compliance with this regulation.

S-1's compliance with Regulation 6-1-303.1 and 6-1-305 will be confirmed by the District's Compliance & Enforcement staff during their routine inspections.

Regulation 9-1-301 (*Inorganic Gaseous Pollutants: Sulfur Dioxide for Limitations on Ground Level Concentrations*)

Per Regulation 9-1-301, the ground level concentrations of SO₂ must not exceed 0.5 ppm continuously for 3 consecutive minutes or 0.25 ppm averaged over 60 consecutive minutes, or 0.05 ppm averaged over 24 hours. S-1 is subject to and is expected to comply with the applicable SO₂ limitations in Regulation 9, Rule 1. Because SO₂ emissions from S-1 are negligible (<20 lb/year), it is unlikely the APCO will require the owner/operator to conduct ground level monitoring.

Regulations 9-8-301: (*Emission Limits- Spark-ignited Engines Powered by Fossil Derived Fuels*)

S-1 is a spark-ignited rich burn engine, subject to Regulation 9-8-301.1, which limits NO_x emissions to 25 ppmv corrected to 15% oxygen, dry basis. Per Tecogen's spec sheet (see Attachment A), the post abated concentration of NO_x in the exhaust exiting A-2 at 15% oxygen, dry basis is 10.56 ppmvd. Therefore, S-1 complies with this limit

Regulation 9-8-301.3 limits CO emissions to 2,000 ppmvd at 15% oxygen. Per Tecogen's spec sheet (see Attachment A), the post abated concentration of CO in the exhaust exiting A-2 at 15% oxygen, dry basis is 69.40 ppmvd. Therefore, S-1 complies with this limit.

Since the S-1 guaranteed emissions are low compared to Regulation 9-8-301 limits and don't trigger BACT, permit conditions may allow some flexibility regarding NOx and CO emission limits while still being in compliance with the above rules. Hence, for NOx, the permit will impose 22 ppmvd corrected to 15% O₂, translating to 1.55 lb/day NOx. For CO, the permit will impose 210 ppmvd corrected at 15% O₂, translating to 8.99 lb/day. Lastly, the POC emission limit will be 110 ppmvd corrected to 15% O₂, corresponding to 0.6 g/bhp-hr, in compliance with NSPS Subpart JJJJ Table 1 of 0.7 g/bhp-hr. The proposed permit conditions will include recordkeeping requirements per Regulation 9-8-502 and NOx and CO quarterly emissions testing required by Regulation 9-8-503 will ensure continued compliance with Regulation 9-8-301.3.

California Environmental Quality Act (CEQA)

In the application forms submitted the applicant indicated that no CEQA review was required by the city of San Francisco. This permit application is not subject to CEQA because the evaluation is a ministerial action (Public Resources Code Section 21080(b)(1); CEQA Guidelines Section 15268(a)), conducted using the fixed standards and objective measurements outlined in standard air permitting/engineering reference materials including, but not limited to: permitting handbooks, permitting manuals, permitting guidance documents, source test/lab sampling results, and emissions factor clearinghouses. Therefore, the applicant was not required to submit any CEQA-related information.

Public Notification, Schools and Overburdened Communities (OBC)

1080 Chestnut St. is within 1,000 feet from the nearest school (Galileo Academy of Science and Technology, 1150 Francisco St., San Francisco, CA 94109), but it is not within an OBC. Per Regulation 2-1-412 and as shown in Table 3, the installation and subsequent operation of S-1 will result in an increase in TAC emissions. Therefore, a Waters Bill public notice will be prepared describing the proposed project and associated emissions, which will be distributed to the parents or guardians of children enrolled in any school within one-quarter mile of the source and to each address within a radius of 1000 feet of the source. Air District staff will review and consider all comments received during the 30 days after the notice is distributed and shall respond to all comments received and include written responses to the comments in the permit application file prior to taking final action on the application.

Prevention of Significant Deterioration (PSD)

This project is not subject to PSD per Regulation 2-2, since PSD only applies to major facilities.

PERMIT CONDITIONS

COND# 100291

1. The owner/operator shall fire S-1 exclusively on PUC quality natural gas and shall ensure no more than 6.51 MMscf in any rolling 12-month period is combusted at S-1.
(Basis: Cumulative Increase)
2. The owner/operator shall equip S-1 with a dedicated fuel flow meter to demonstrate compliance with Part 1 of this permit condition.
(Basis Regulation 2-1-403)

3. The owner/operator shall ensure S-1 is abated at all times of operation by the properly installed, operated and maintained A-1, First Stage NSCR Clariant Envicat 7319 and A-2, Second Stage Ultera Oxidation Catalyst configured in series.
(Basis: Cumulative Increase)
4. To demonstrate compliance with Part 1 of this permit condition, the owner/operator of S-1 shall maintain records of fuel usage recorded by the dedicated fuel flow meter required by Part 2 of this permit condition on site for at least 24-months from the last date of entry and shall make the records available for inspection by Air District staff upon request.
(Basis: Cumulative Increase)
5. The owner/operator of S-1 shall ensure abated emissions of Nitrogen Oxides (NO_x), carbon monoxide (CO) and precursor organic compound (POC) from S-1, exiting out of A-2, do not exceed 22 ppmvd corrected to 15% oxygen, 210 ppmvd corrected to 15% oxygen, and 110 ppmvd corrected to 15% oxygen, respectively.
(Basis: Cumulative Increase, Regulation 9-8-301)

6. To demonstrate compliance with both Part 5 of this permit condition and Regulation 9-8, the owner/operator of S-1 shall measure the NO_x and CO concentrations exiting A-2 using a portable analyzer per the following schedule:
 - a. within 30-days of startup;
 - b. at least once during each calendar quarter, following the initial demonstration of compliance.

All NO_x and CO concentrations shall be taken with S-1 operating either at conditions representative of normal operations or conditions specified in the permit-to-operate.

The portable analyzer shall be calibrated, maintained, and operated in accordance with the manufacturer's specifications and recommendations.

NO_x concentrations measured using the portable analyzer shall be averaged over a consecutive 15-minute period.

If any of the portable analyzer measurements show an exceedance of any of the limits contained either in part 5 or Regulation 9-8, the owner/operator of S-1 shall notify the Air District's assigned permit engineer within 24 hours from the time measurements were taken. The owner/operator shall conduct an Air District approved source test to demonstrate compliance with both part 5 (including POC) and Regulation 9-8 within 90 days of the exceedance. The source test shall be conducted using only Air District approved methods. The results of the source test shall be submitted to the Air District Source Test Manager within 60 days of the test date for review.

For the purposes of this condition, POC shall be considered the same as non-methane organic compounds (NMOC).

(Basis: Cumulative increase, Regulation 9-8-503)

7. The owner/operator of S-1 shall maintain the following records in a District-approved log for at least 24-months from the last date of entry. Log entries shall be retained on-site, either at a central location or at the engine's location and made available to the Air District staff upon request:
 - a. Monthly and annual fuel usage for S-1.
 - b. Quarterly NO_x and CO concentrations taken with the portable analyzer and the date the measurements were taken.
 - c. Any source testing results.

(Basis: Regulation 9-8-502.3)

End of Conditions**RECOMMENDATION**

The Air District has evaluated the permit application for the proposed project and has made a preliminary determination that the project is expected to comply with all applicable District, state, and federal air quality-related regulations, including the health risks resulting from toxic air contaminant emissions. The preliminary recommendation is to issue a permit for this project. After considering all comments received, the Air District will make a final determination.

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

- S-1 Prime Engine, Natural Gas Fired, 4 Stroke Rich Burn, 85 BHP, 0.758 MMBtu/hr
Engine: Origin, Model: HTCGB08.0TSC 8.0L, Model Year: 2022
Abated by**
- A-1 First Stage NSCR, Clariant Model Envicat 7319**
- A-2 Second stage Aftertreatment, Ultera Oxidation Catalyst**

Attachment A

Specification Sheet

Tecogen's catalyst manufactured by:



Tecogen, Inc.

45 First Avenue
Waltham, MA 02451
ph 781-466-6400 / fax 781-466-6466



EMISSION CONTROL EQUIPMENT SPECIFICATION

TECOGEN		Date: 4/4/2023		
Contact: Engineering 781-466-6400 sales@tecogen.com	Project: TECOGEN CM-60 (Tecopower 60) COGENERATION MODULE THREE-WAY CATALYST ONLY	Quote No.:	1080 Chestnut SF - BAAQMD Permitting	
ENGINE DATA <i>Rich-Burn</i>		For:		
Engine Mfr:		Phone:		
Engine Model:		Fax:		
Engine Power (bhp):	(60 kW from generator)	Origin: 8.0L (Industrial Natural Gas Engine)		
RPM:		85		
Load:		1800		
Fuel:		100%		
Temp into Catalyst, °F:		Natural Gas		
Operating Hours, hrs/yr:		1063 (before catalyst and exhaust heat recovery)		
		8760		
ENGINE PERFORMANCE				
Exhaust Flow, acfm:		340 (acfm at catalyst)		
Exhaust Flow, scfm:		116		
Exhaust Flow, scfh:		6965		
Exhaust Flow, lb/hr:		525		
Exhaust MW:		28.6		
TYPICAL (Rich-Burn) MW				
Ar, vol %:	39.9			
N2, vol %:	28.0	79.80		
O2, vol %:	32.0	0.20		
H2O, vol %:	18.0	10.00		
CO2, vol %:	44.0	10.00		
EMISSIONS DATA				
		PRE	POST	% Reduction
NOx as NO2, g/Bhp-hr:		13.40	0.1500	98.9%
NOx as NO2, lb/hr:		2.51	0.03	
NOx as NO2, tons/yr:		11.00	0.12	
NOx as NO2, ppmv:		2,975.68	33.31	
NOx as NO2, ppmvd @ 15% O2:		943.39	10.56	
CO, g/Bhp-hr:		16.90	0.6000	96.4%
CO, lb/hr:		3.17	0.11	
CO, tons/yr:		13.87	0.49	
CO, ppmv:		6,165.49	218.89	
CO, ppmvd @ 15% O2:		1,954.67	69.40	
THC as CH4, g/Bhp-hr:		3.00	0.1800	94.0%
THC as CH4, lb/hr:		0.56	0.03	
THC as CH4, tons/yr:		2.46	0.15	
THC as CH4, ppmv:		1,915.31	114.92	
THC as CH4, ppmvd @ 15% O2:		607.22	36.43	
NMHC as CH4, g/Bhp-hr:		2.30	0.1800	93.5%
NMHC as CH4, lb/hr:		0.43	0.03	
NMHC as CH4, tons/yr:		1.89	0.12	
NMHC as CH4, ppmv:		1,468.41	95.77	
NMHC as CH4, ppmvd @ 15% O2:		465.53	30.36	