

DRAFT Engineering Evaluation
1169 Market Street, L.P.
Application No. 30611 / Plant No. 24614
1169 Market Street, 12th Floor,
San Francisco, CA 94103

BACKGROUND

1169 Market Street, L.P. has applied for an Authority to Construct (AC) and/or a Permit to Operate (PO) for the following equipment:

- S-2 Micro Cogeneration Combined Heat and Power (CHP) System: Natural Gas (NG) engine**
Aegenco, Model: CGN-17-01, Model Year: 2019
100.3 BHP, 0.95MMBtu/hr
Permit Condition #: 27350
 Abated by
- A-2 Non-Selective Catalytic Converter (DCL, MINE-X, Model 2-DC7E)**

EMISSIONS CALCULATIONS

This new type of micro cogeneration system uses a natural gas spark ignition engine combined with a synchronous generator and integral pump. The heat from the system is recovered and pumped into a heat exchanger and regulated via a radiator to heat water and air, while the generator uses an inverter to produce AC power to residents of the building or the power is wheeled back onto the utility grid.

The emission factors used to estimate criteria pollutant emissions from the natural gas engine cogeneration operation described above are based on the manufacturer abated emissions data. Total Hydrocarbon emission rates were assumed to be equal to Precursor Organic Compound (POC) emission rates. The Abated Efficiency, PM₁₀ and SO₂ emission factors are based on AP 42, Fifth Edition, Volume I, Chapter 3: Stationary Internal Combustion Sources; Section 2.4.1 Control Techniques for 4-Cycle Rich-burn Engines.¹ The engine will operate during regular use and for a maximum of 8760 hours per year including for maintenance and testing. NSCR Default Abatement factors will be used: NO_x:85%, CO: 80%, POC:50%*. See Table 1.

Table 1-Estimated Emissions From S-2

Pollutant	Emission Factor (g/BHP-hr)	Emission (lb/hr)	Emission (lb/yr)	Emission (TPY)	Maximum Daily Emissions (lb/day)
NO _x *	0.15	0.03	290.56	0.145	0.80
POC *	0.35	0.08	677.96	0.339	1.86
CO *	0.40	0.09	774.82	0.387	2.12
PM ₁₀	0.04	0.01	78.93	0.039	0.22
SO ₂	0.00	0.00	4.89	0.002	0.01

Basis:

100.3hp Max Rated Output

930 cf/hr Max fuel use Rate = 0.95 MMBTU/hr

NO_x, HC and CO emission factors are from EPA certificate KAGNB07.4CHP-001

The PM and SO₂ emission factors are from EPA AP-42, Table 3.2-3 for 4 stroke Rich-burn Engines

Annual Emissions are based on the Annual Limit (8760 hr/yr) of operation for testing and maintenance

Max daily emissions are based on 24 hr/day since no daily limits are imposed on emergency operations

* Default abatement reductions used are from BAAQMD Engineering Division, Engine Training Manual, Page 7, August 2012

¹ SO₂ Emission Factor = 5.88 E-04 Lb./MMBtu; calculations assume 100% of fuel sulfur conversion with the content in natural gas = 2000 gr/10⁶scf. PM₁₀ Fuel input Emission Factor = 9.95E-03 Lb./MMBtu; aerodynamic particle diameter <= 1 μm, for the purposes of filterable emissions PM₁₀= PM_{2.5}. These emissions are expected to be negligible, but included for completeness.

TOXIC RISK SCREENING ANALYSIS

The emission factors used to estimate Hazardous Air Pollutants (HAPs) emissions from the engine described in this application are from: AP-42 for natural gas fired 4-cycle rich burn engine Table 3.2-3, or the California Air Toxics Emission Factor Database (maintained by the California Air Resources Board) for natural gas fired 4-cycle rich burn engines with less than 650 hp. Table 3.2-3 also provided a conservative ratio for NO_x and POC emission factors. The CATEF Emission Factors maintained by the ARB were used to estimate emissions for all compounds that have AP-42 emission factors and CATEF emission factors.

The HAP emission estimates are based on uncontrolled emission factors for natural gas engines and an assumed abatement efficiency of 50% removal of organic HAP compounds, except for the pollutants which have abated emission factors in CATEF. The abatement efficiency is based on the engine specs is equipped with a Catalytic Converter and an air fuel ratio controller. The actual abatement efficiency of the Aegis unit is expected to be much higher but using a more conservative estimate (typically used for other natural gas engines) was used as a worst-case scenario.

As shown in Table 2 and Table 3 below, no toxic air contaminants exceed the District Risk Screening Trigger levels listed in Table 2-5-1 and a Risk Screening Analysis is not required.

Table 2
HAP EMISSIONS ESTIMATES BASED ON AP-42 TABLE 3.2-3 (FOR COMPOUNDS WITH NO CATEF E.F.)

Compound		E.F.	Unit	Assumed Abatement Efficiency %	Abated Emissions (lb/hr)	Acute Trigger Level (lb/hr)	HRSA Triggered? (Y/N)	Abated Emissions (lb/yr)	Chronic Trigger Level (lb/yr)	HRSA Triggered? (Y/N)
1,1,2,2-Tetrachloroethane		2.53E-05	lb/MMBtu	50	1.20E-05	None	NO	1.05E-01	1.40E+00	NO
1,1,2-Trichloroethane	<	1.53E-05	lb/MMBtu	50	7.26E-06	None	NO	6.36E-02	5.00E+00	NO
1,1-Dichloroethane	<	1.13E-05	lb/MMBtu	50	5.36E-06	None	NO	4.69E-02	5.00E+01	NO
1,2-Dichloroethane	<	1.13E-05	lb/MMBtu	50	5.36E-06	None	NO	4.69E-02	None	NO
1,2-Dichloropropane	<	1.30E-05	lb/MMBtu	50	6.16E-06	None	NO	5.40E-02	None	NO
1,3-Butadiene		6.63E-04	lb/MMBtu	50	CATEF	None	NO	CATEF	4.80E-01	NO
1,3-Dichloropropene	<	1.27E-05	lb/MMBtu	50	6.02E-06	None	NO	5.28E-02	None	NO
Acetaldehyde		2.79E-03	lb/MMBtu	50	CATEF	1.00E+00	NO	CATEF	2.90E+01	NO
Acrolein		2.63E-03	lb/MMBtu	50	CATEF	5.5E-03	NO	CATEF	1.40E+01	NO
Benzene		1.58E-03	lb/MMBtu	50	CATEF	6.0E-02	NO	CATEF	2.90E+00	NO
Butyr/isobutyraldehyde		4.86E-05	lb/MMBtu	50	2.30E-05	None	NO	2.02E-01	None	NO
Carbon Tetrachloride	<	1.77E-05	lb/MMBtu	50	8.39E-06	4.2E+00	NO	7.35E-02	1.90E+00	NO
Chlorobenzene	<	1.29E-05	lb/MMBtu	50	6.12E-06	None	NO	5.36E-02	3.90E+04	NO
Chloroform	<	1.37E-05	lb/MMBtu	50	6.50E-06	3.3E-01	NO	5.69E-02	1.50E+01	NO
Ethylbenzene	<	2.48E-05	lb/MMBtu	50	CATEF	None	NO	CATEF	3.30E+01	NO
Ethylene Dibromide	<	2.13E-05	lb/MMBtu	50	1.01E-05	None	NO	8.85E-02	1.10E+00	NO
Formaldehyde		2.05E-02	lb/MMBtu	50	CATEF	1.2E-01	NO	CATEF	1.40E+01	NO
Methanol		3.06E-03	lb/MMBtu	50	1.45E-03	6.2E+01	NO	1.27E+01	1.50E+05	NO
Methylene Chloride		4.12E-05	lb/MMBtu	50	1.95E-05	3.1E+01	NO	1.71E-01	8.20E+01	NO
Naphthalene	<	9.71E-05	lb/MMBtu	50	CATEF	None	NO	CATEF	2.40E+00	NO
PAH		1.41E-04	lb/MMBtu	50	CATEF	None	NO	CATEF	None	NO
Styrene	<	1.19E-05	lb/MMBtu	50	5.64E-06	4.6E+01	NO	4.94E-02	3.50E+04	NO
Toluene		5.58E-04	lb/MMBtu	50	2.65E-04	8.2E+01	NO	2.51E-04	1.20E+04	NO
Vinyl Chloride	<	7.18E-06	lb/MMBtu	50	3.40E-06	4.0E+02	NO	2.98E-02	1.10E+00	NO
Xylene		1.95E-04	lb/MMBtu	50	9.25E-05	4.9E+01	NO	8.10E-01	2.70E+04	NO

**Table 3
HAP EMISSION ESTIMATES BASED ON CATEF EMISSION FACTORS**

SUBSTANCE	E.F. MEAN	UNIT	Assumed Abatement Efficiency %*	Abated Emissions (lb/hr)	Acute Trigger Level (lb/hr)	HRSA Triggered? (Y/N)	Abated Emissions (lb/yr)	Chronic Trigger Level (lb/yr)	HRSA Triggered? (Y/N)
1,3-Butadiene	1.04E-01	lbs/MMcf	50%	4.84E-05	1.50E+00	NO	4.24E-01	4.80E-01	NO
Acenaphthene	1.94E-03	lbs/MMcf	50%	9.02E-07	None	NO	7.90E-03	None	NO
Acenaphthylene	1.45E-02	lbs/MMcf	50%	6.74E-06	None	NO	5.91E-02	None	NO
Acetaldehyde	8.83E-01	lbs/MMcf	50%	4.11E-04	1.00E+00	NO	3.60E+00	2.90E+01	NO
Acrolein	5.47E-01	lbs/MMcf	50%	2.54E-04	5.50E-03	NO	2.23E+00	1.40E+01	NO
Anthracene	1.84E-03	lbs/MMcf	50%	8.55E-07	None	NO	7.49E-03	None	NO
Benzene	1.38E-01	lbs/MMcf	0%	6.87E-05	6.00E-02	NO	6.02E-01	2.90E+00	NO
Benzo(a)anthracene	3.39E-04	lbs/MMcf	50%	1.58E-07	None	NO	1.38E-03	None	NO
Benzo(a)pyrene	1.15E-04	lbs/MMcf	50%	5.35E-08	None	NO	4.68E-04	None	NO
Benzo(b)fluoranthene	2.37E-04	lbs/MMcf	50%	1.10E-07	None	NO	9.65E-04	None	NO
Benzo(g,h,i)perylene	1.95E-04	lbs/MMcf	50%	9.07E-08	None	NO	7.94E-04	None	NO
Benzo(k)fluoranthene	1.03E-04	lbs/MMcf	50%	4.79E-08	None	NO	4.19E-04	None	NO
Chrysene	3.10E-04	lbs/MMcf	50%	1.44E-07	None	NO	1.26E-03	None	NO
Dibenz(a,h)anthracene	1.25E-05	lbs/MMcf	50%	5.81E-09	None	NO	5.09E-05	None	NO
Ethylbenzene	1.16E-02	lbs/MMcf	50%	5.39E-06	None	NO	4.72E-02	4.30E+01	NO
Fluoranthene	9.95E-04	lbs/MMcf	50%	4.63E-07	None	NO	4.05E-03	None	NO
Fluorene	6.91E-03	lbs/MMcf	50%	3.21E-06	None	NO	2.81E-02	None	NO
Formaldehyde	4.99E-02	lbs/MMcf	0%	4.64E-05	2.10E-01	NO	4.06E-01	1.80E+01	NO
Indeno(1,2,3-cd)pyrene	1.69E-04	lbs/MMcf	50%	7.86E-08	None	NO	6.88E-04	None	NO
Naphthalene	7.65E-02	lbs/MMcf	50%	3.56E-05	None	NO	3.12E-01	2.40E+00	NO
Phenanthrene	7.07E-03	lbs/MMcf	50%	3.29E-06	None	NO	2.88E-02	None	NO
Propylene	1.60E+01	lbs/MMcf	50%	7.44E-03	None	NO	6.52E+01	1.20E+05	NO
Pyrene	1.79E-03	lbs/MMcf	50%	8.32E-07	None	NO	7.29E-03	None	NO
Toluene	1.07E+00	lbs/MMcf	50%	4.97E-04	8.20E+01	NO	4.36E+00	1.20E+04	NO
Xylene (m,p)	4.41E-01	lbs/MMcf	50%	2.05E-04	4.90E+01	NO	1.80E+00	2.70E+04	NO
Xylene (o)	2.17E-01	lbs/MMcf	50%	1.01E-04	4.90E+01	NO	8.84E-01	2.70E+04	NO
Xylene (Total)	6.02E-02	lbs/MMcf	50%	2.80E-05	4.90E+01	NO	2.45E-01	2.70E+04	NO
PAH Equivalents as Benzo(a)pyrene	1.70E-06	lbs/MMcf	50%	4.09E-07	5.00E+01	NO	3.58E-03	3.30E-03	YES

*Benzene and Formaldehyde emission factors are already abated.

There was one other related project within the last three years. Previous Application #:30302, for S-1 (Emergency Standby Diesel Generator set, 2220 BHP), required a risk screen because the diesel particulate emissions were greater than the toxic trigger level listed in Table 2-5-1. The results from the health risk screening analysis indicate that the maximum project cancer risk (resident) is estimated at 1.6 in a million, and the maximum project chronic hazard index is estimated at 0.00043. The results from this previous application will be added to the total project risk.

HRA Results for both S-1 and S-2 operating at 50 hours per year

Receptor	Cancer Risk	Chronic Non-Cancer Hazard Index
Resident	1.6 in a million	0.00043
Worker	0.56 in a million	0.00043

The HRA results from the entire project deem this application is in compliance with project risk requirements as recommended. The addition of this application does not trigger any additional risk requirements. In accordance with

the District's Regulation 2, Rule 5, the combined risk level is considered acceptable, as it has been determined that the sources in this project meet the current TBACT standards.

PLANT CUMULATIVE EMISSIONS

Table 4 summarizes the cumulative increase in criteria pollutant emissions that will result from the operation of S-2.

Table 4

Plant Cumulative Increase: (tons/year)			
Pollutant	Existing	New	Total
POC	0.017	0.339	0.356
NOx	0.543	0.145	0.688
CO	0.109	0.387	0.496
PM _{10/2.5}	0.001	0.039	0.040
SO ₂	0.001	0.002	0.003

BEST AVAILABLE CONTROL TECHNOLOGY (BACT)

In accordance with Regulation 2-2-301, BACT is triggered for any new or modified source with the potential to emit 10 pounds or more per highest day of POC, NPOC, NOx, CO, SO₂ or PM₁₀.

Based on the emission calculations above, BACT is not triggered for any pollutant since the maximum daily emission of each pollutant does not exceed 10 lb/day. Therefore, the BACT requirement of NSR (Regulation 2-2-302) does not apply.

OFFSETS

Per Regulation 2-2-302, offsets must be provided for any new or modified source at a facility that emits more than 10 tons/yr of POC or NOx. Based on the emission calculations above, offsets are not required for this application.

New Source Performance Standards (NSPS)

The New Source Performance Standard in 40 CFR 60, Subpart JJJJ applies because the engine was installed after January 1, 2011, which requires rich burn spark ignition engines greater than 25 BHP, but less than 130 BHP to emit less than the following emission levels for these criteria pollutants:

Pollutant	S-2 Emission Factor	NSPS Standard
NOx + HC	0.50 g/bhp-hr	10.0 g/bhp-hr
CO	0.40 g/bhp-hr	387.0 g/bhp-hr

As the information above shows, S-2 is in compliance with these NSPS emission requirements.

National Emission Standards for Hazardous Air Pollutants (NESHAP)

This engine will be classified as a HAP area source therefore will be subject to the Reciprocating Internal Combustion Engine (RICE) NESHAP (40 CFR Part 63, Subpart ZZZZ) because it is a new source and installed after 2007. A new RICE at an area source that is subject to Part 60 Subpart JJJJ NSPS requirements has no further requirements under Subpart ZZZZ pursuant to 40 CFR Part 63.6590(c). Therefore, S-2 complies with NESHAP by meeting the requirements under 40CFR60 (NSPS).

STATEMENT OF COMPLIANCE

The owner/operator of S-2 shall comply with Regulation 6, Rule 1 (*Particulate Matter and Visible Emissions Standards*) and Regulation 9-1-301 (*Inorganic Gaseous Pollutants: Sulfur Dioxide for Limitations on Ground Level Concentrations*). From Regulation 9-1-301, the ground level concentrations of SO₂ will 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-2 is a micro-cogeneration System that employs a natural gas engine to generate electric power, heat, and hot water; and subject to the requirements of Regulation 9, Rule 8 (*NO_x and CO from Stationary Internal Combustion Engines*), Section 301.1 Rich Burn Engines and comply with NO_x emissions less than 25 ppmv as corrected to 15% oxygen, dry basis. S-2 must also comply with the requirements of Regulations 9-8-301.3 and comply with the CO emission requirement of less than 2000 ppmv as corrected to 15% oxygen, dry basis.

The emissions factors, using the manufacturer's emissions data for NO_x and CO can be converted to emission factors to demonstrate compliance:

$$\begin{aligned} \text{Exhaust NO}_x &= [0.03 \# / \text{hr}] [1/0.41 \text{ hr} / \text{MMBTU}] [1/8710 \text{ MMBTU} / \text{dscf}] [1/46 \# \text{-mole} / \#] [385 \text{ dscf} / \# \text{-mole}] \\ &= 70.3108 \text{ ppm @ uncorrected} \\ &\quad [70.3108 \text{ ppm}] [(20.9-15)/20.9 \% \text{ O}_2] \\ &= 19.8485 \text{ ppm @ 15\% O}_2 < 25 \text{ ppm NO}_x \text{ limit} \end{aligned}$$

$$\begin{aligned} \text{Exhaust CO} &= [0.08 \# / \text{hr}] [1/0.41 \text{ hr} / \text{MMBTU}] [(1/8710 \text{ MMBTU} / \text{dscf}) [1/28 \# \text{-mole} / \#] [385 \text{ dscf} / \# \text{-mole}]] \\ &= 308.0283 \text{ ppm @ uncorrected} \\ &\quad [308.0283 \text{ ppm}] [(20.9-15)/20.9 \% \text{ O}_2] \\ &= 86.9554 \text{ ppm @ 15 \% O}_2 < 2000 \text{ ppm CO limit} \end{aligned}$$

S-2 is expected to comply with 9-8-302 (*Emission Limits on Waste Derived Fuel Gas*) if they should ever change to this type of fuel, 9-8-303 (*Emissions Limits – Delayed Compliance, Existing Spark-Ignited Engines, 51 to 250 bhp or Model Year 1996 or Later*), 9-8-304 (*Emission Limits – Compression-Ignited Engines*), 9-8-305 (*Emission Limits – Delayed Compliance, Existing Compression-Ignited Engines, Model Year 1996 or Later*), 9-8-501 (*Initial Demonstration of Compliance*) and 9-8-503 (*Quarterly Demonstration of Compliance*).

The engine is certified by EPA (KAGNB07.4CHP-001) to be in compliance with the requirements of the Clean Air Act and as a certified engine will not require a Start-up test to demonstrate initial compliance. The system is also continuously monitored and will automatically shut down should any emissions exceed normal operation. The applicant has agreed to annual testing of their EPA certified engine to demonstrate that the equipment has stayed in continued compliance with District emissions requirements of Regulation 8, Rule 8.

The project is considered to be ministerial under the District's CEQA 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 emissions factors and therefore is not discretionary as defined by CEQA. (Permit Handbook Chapter 2.3)

Because this equipment will be located within 1,000 feet of DeMarillac Academy, the project is subject to the public notification requirements of Regulation 2-1-412 due to the increase in emissions from the project.

A public notice will be sent to all parents of students of the above mentioned school(s) and all residents within 1,000 feet of the facility. There will be a 30-day public comment period.

PERMIT CONDITIONS**CONDITION#: 27350**

1. The owner/operator of S-2 shall abate S-2 at all times by A-2 Non-Selective Catalytic Converter (NSCR).
[Basis: Regulation 2-5-301, Cumulative Increase]
2. The owner/operator of S-2 shall operate this engine only when a non-resettable totalizing meter (with a minimum display capability of 9,999 hours) that measures the hours of operation for the engine is installed, operated and properly maintained.
[Basis: Title 17 CCR Section 93115, Regulation 9-8-530]
3. The owner/operator of S-2 shall only operate with a continuously monitored alarm system measuring fuel to oxygen ration, proper catalyst function, proper exhaust temperature and maintained in accordance with required maintenance for proper operation.
[Basis: Regulation 9-1-301.1, housekeeping.]
4. The owner/operator of S-2 shall ensure that Natural Gas NOx emissions do not exceed the applicable limits of Regulation 9, Rule 8.
[Basis: BACT, Regulation 9-8]
5. The owner/operator of S-2 shall ensure that Natural Gas CO emissions do not exceed the applicable limits of Regulation 8, Rule 8.
[Basis: BACT, Regulation 9-8]
6. The owner/operator of S-2 shall use a portable analyzer to measure NOx, CO, and O2 concentrations to verify compliance with all applicable emission limits, including but not limited to Parts 4 and 5, at least once per calendar year.
[Basis: Regulation 9-8-503]
7. If monitoring using the portable analyzer shows an exceedance of any applicable limits, the owner/operator of S-2 shall conduct a District approved source test to demonstrate compliance with the emissions limits of Parts 4 and 5 within 60 days of the exceedance. The owner/operator shall conduct all source test in accordance to Regulation 9-8-601, Regulation 9-8-602, and the District's Manual of Procedures. The owner/operator shall notify the Source Test Section of the scheduled test date at least 7 days prior to conducting the test and shall submit the source test results to the District within 30 days of completion of the source test.
[Basis: Regulation 9-8-503, Cumulative Increase]
8. The owner/operator of S-2 shall maintain the following records in a District approved log and shall make these records available to District staff upon request. All records shall be retained for at least 36 months from the date of entry. These record-keeping requirements shall not replace the record-keeping requirements contained in any applicable District or state regulations.
 - a. The owner/operator shall record the engine's hours of operation per day.
 - b. The owner/operator shall record the engine's total operating time for each consecutive rolling 12-month period.
 - c. Date of annual monitoring conducted per Part 7 and the measured NOx and CO concentration and the correction at 15% by O₂ concentration.
 - d. Fuel usage for the engine.[Basis: Cumulative Increase]

End of conditions

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/Permit to Operate for the equipment listed below. However, the proposed source will be located within 1,000 feet of at least one 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/Permit to Operate for the following source:

- S-2 Micro Cogeneration Combined Heat and Power (CHP) System: Natural Gas (NG) engine**
Aegis, Model: CGN-17-01, Model Year: 2019
100.3 BHP, 0.95MMBtu/hr
Permit Condition #: 27350
Abated by
- A-2 Non-Selective Catalytic Converter (DCL, MINE-X, Model 2-DC7E)**

By: MN

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Engineering Division