

DRAFT ENGINEERING EVALUATION
Residence of Betsy Chung, Plant No. 23861
Application No. 29985
1952 Forest View Avenue, Hillsborough, CA

A. BACKGROUND

An application for a Permit to Operate for the following source has been submitted for Residence of Betsy Chung:

S1, Micro Cogeneration Natural Gas Engine, Yanmar – 10 kW (13.4 hp), 2016
abated by: A1, Mine-X Catalytic Converter

The engine is entitled to an exemption per BAAQMD Regulation 2-1-114.2.1. The owner has asked for a permit because the engine does not comply with ARB's Distributed Generation rule. The rule allows equipment that does not comply to be used if the facility can obtain a permit from an air quality management district or air pollution control district. The District, at its discretion, may issue a permit to a nominally exempt source if the source complies with all air pollution regulations.

The District will issue a permit with permit conditions that will ensure that the engine performs as described, so that it does not trigger Best Available Control Technology (BACT, Regulation 2, Rule 2, New Source Review), and so that estimated emissions of toxic air contaminants (TAC) do not result in a cancer risk over 10 in a million or an acute or chronic hazard index over 1.0.

The owner/operator submitted initial Application 28585 for this engine. The District evaluated the risk and determined that the engine would comply with the limits in BAAQMD Regulation 2, Rule 5, New Source Review for Toxic Air Contaminants, if the hours of operation were limited to 3,822 hours per year. The consultant for the owner/operator performed a source test for an identical source with an add-on catalyst. With the catalyst, the emissions of formaldehyde will no longer require evaluation for risk and the engine will be allowed to operate 8,760 hours per year.

B. EMISSIONS

The emissions of nitrogen oxides (NOx) have been calculated using manufacturer's data in units of g/kw-hr, a rating of 10 kw, and an assumption of operation for 8,760 hr/yr.

Pollutant	g/kw-hr	lb/hr	lb/day	lb/yr	tpy
NOx	2.547	0.0562	1.348	491.9	0.246

The emissions of carbon dioxide (CO2), sulfur dioxide (SO2), volatile organic compounds (VOC), and particulate matter (PM) have been calculated using AP-42 Table 3.2-2 for 4-stroke lean burn engines assuming an hourly heat input of 0.1097 MMBtu/hr based on a rate of 107.5 scf natural gas/hr, and an assumption of operation for 8,760 hr/yr.

Pollutant	lb/MMbtu	lb/day	lb/yr	tpy
CO2	110	289	105658.7	52.829
SO2	0.000588	0.0015	0.6	0.000
VOC	0.118	0.3105	113.3	0.032
PM	0.00999	0.0263	9.6	0.003

The emissions of carbon monoxide (CO) have been calculated using manufacturer's data in units of g/kw-hr, a rating of 10 kw, an assumption of 80% control by the catalytic converter, and operation for 8,760 hr/yr.

Pollutant	after control					
	g/kw-hr	g/kw-hr	lb/hr	lb/day	lb/yr	tpy
CO	3.217	0.643	0.014	0.333	121.5	0.061

C. PLANT CUMULATIVE INCREASE

Pollutant	Ap# 28585	Ap# 29985	Total
	tpy	tpy	tpy
CO	0.117	-0.056	0.061
NOx	0.092	0.153	0.246
SO2	0	0.000	0
VOC	0.021	0.011	0.032
PM	0.002	0.001	0.003

D. OFFSETS

The emissions of NOx and POC are not subject to offsets because Regulation 2-2-302 requires offsets only for facilities that emit or are permitted to emit more than 10 tpy of NOx or POC.

The emissions of SO2 and PM are not subject to offsets because Regulation 2-2-303 requires offsets only for facilities that emit or are permitted to emit more than 100 tpy of SO2 and PM.

Emissions of CO are not subject to offsets.

E. TOXIC RISK SCREENING ANALYSIS

Following are the emissions of TACs if the engine is allowed to run 8,760 hr/yr and the "mean" CATEF emission factors for natural gas 4-stroke lean burn engines are used. CATEF is ARB's emission factor database. These were the emissions used in Application 28585.

TAC	EF lb/MMcf	Hourly	Annual	Triggers	
		emissions lb/hr	emissions lb/yr	lb/hr	lb/yr
Acetaldehyde	3.99E+00	4.29E-04	3.76	1	29
Benzene	1.21E+00	1.30E-04	1.14	0.06	2.9
Formaldehyde	2.87E+01	3.09E-03	27.03	0.12	14
Naphthalene	1.22E-01	1.31E-05	0.11	none	2.4
Propylene	1.87E+01	2.01E-03	17.61	none	120000
Toluene	4.12E-01	4.43E-05	0.39	82	12000
Xylene (m,p)	8.63E-02	9.28E-06	0.08	49	27000
Xylene (o)	4.94E-02	5.31E-06	0.05	49	27000

Following is a calculation of the PAH as benzo(a)pyrene-equivalents using the factors in the CATEF database.

	EF lb/MMcf	Annual emissions lb/yr	PAH Eq. factor	PAH Eq. lb/yr	Trigger lb/yr
Acenaphthene	7.17E-04	6.75E-04	none		
Acenaphthylene	7.59E-03	7.15E-03	none		
Anthracene	2.56E-04	2.41E-04	none		
Benzo(a)anthracene	7.78E-05	7.33E-05	0.1	7.33E-06	
Benzo(a)pyrene	3.55E-05	3.34E-05	1	3.34E-05	
Benzo(b)fluoranthene	3.27E-04	3.08E-04	0.1	3.08E-05	
Benzo(g,h,i)perylene	1.03E-04	9.70E-05	none		
Benzo(k)fluoranthene	5.30E-04	4.99E-04	0.1	4.99E-05	
Chrysene	9.64E-05	9.08E-05	0.01	9.08E-07	
Dibenz(a,h)anthracene	1.09E-05	1.03E-05	1.05	1.08E-05	
Fluoranthene	2.50E-04	2.35E-04	none		
Fluorene	4.60E-04	4.33E-04	none		
Indeno(1,2,3-cd)pyrene	1.20E-04	1.13E-04	0.01	1.13E-06	
Phenanthrene	8.93E-04	8.41E-04	none		
Pyrene	1.23E-04	1.16E-04	none		
				1.34E-04	3.30E-03

This engine required a risk screen because the estimated formaldehyde was above the annual trigger of 14 lb/yr in Regulation 2, Rule 5.

The applicant performed a source test using a catalytic converter that lowered the amount of organic TACs in the effluent to allow the engine to operate up to 8760

hours/year. Following are calculations of the emissions using the new emission factors after control.

TAC	EF lb/MMcf	Hourly emissions	Annual emissions	Triggers	
		lb/hr	lb/yr	lb/hr	lb/yr
Acetaldehyde	4.55E-02	4.89E-06	4.28E-02	1.00E+00	2.90E+01
Benzene	1.10E-02	1.18E-06	1.04E-02	6.00E-02	2.90E+00
Formaldehyde	6.39E-01	6.87E-05	6.02E-01	1.20E-01	1.40E+01
Naphthalene	<8.48E-03	<9.12E-07	<7.99E-03	none	2.40E+00
Propylene	3.14E-02	3.38E-06	2.96E-02	none	1.20E+05
Toluene	<6.07E-03	<6.53E-07	<5.72E-03	8.20E+01	1.20E+04
Xylene (m,p)	<1.40E-02	<1.51E-06	<1.32E-02	4.90E+01	2.70E+04
Xylene (o)	<6.99E-03	<7.51E-07	<6.58E-03	4.90E+01	2.70E+04
Ethyl Benzene	<6.99E-03	<7.51E-07	<6.58E-03	none	3.30E+01

The levels above are below all triggers in Regulation 2, Rule 5.

The estimates of PAHs will not change because no tests were run for PAHs. However, PAHs were already below the toxic trigger using the CATEF factors.

F. BACT

This engine is not subject to BACT because emissions of POC, NOx, SO2, CO, PM10 or PM2.5 will all be below 10 lb/day.

G. STATEMENT OF COMPLIANCE

Regulation 2, Rule 1, Permits, General Requirements, and Rule 2, New Source Review S1 is entitled to an exemption from permits per Section 2-1-114.2.1. The owner/operator is seeking a permit because ARB does not subject permitted sources to the Distributed Generation rule. The District agrees to issue the source a permit if it complies with the District's rules. This source will be below the BACT triggers and will not result in a cancer risk over 10 in a million or an acute or chronic hazard index over 1.0, so it is approvable.

Permit conditions will be imposed to ensure that the engine is operated so that it performs within a range close to the representation made by the manufacturer. The owner/operator will monitor NOx and CO on a quarterly basis. The concentration limit for NOx will be double the test values. Following is a calculation of the concentration limit for NOx:

Test value, NOx	2.547	g/kw-hr
Test value, NOx x 2	5.094	g/kw-hr
Heat input	0.10965	MMbtu/hr
F-factor	8710	dscf/MMbtu
V, Flow	955	dscf/hr
Multiplier, 0% to 15% O2	3.542	
V, Flow @ 15% O2	3383	dscf/hr
P	1	atm
T	528	Rankine
R	0.7302	
n, flow @ 15% O2	8.775	lb-mol/hr
MW NO2	46	
lb NO2	0.1123	lb/hr
	2.70	lb/day
n, NO2	0.0024	lb-mol/hr
Conc @ double the test value	278	ppm @ 15% O2

An 80% control factor has been assumed for CO based on the use of the catalytic oxidizer. This is in the lower range of control for larger engines using catalytic oxidizers. The value during the source test was 0.0189 g/kw-hr, but some deterioration is expected over time. A higher CO concentration would indicate that organic TAC emissions have increased, so a lower concentration limit of 35 ppm @ 15% O2 for CO is being imposed. The concentration limit imposed in Application 28586 was 350 ppm, based on the BACT trigger of 10 lb CO/day.

CO limit	0.643	g/kw-hr
Heat input	0.10965	Mmbtu/hr
F-factor	8710	dscf/Mmbtu
V, Flow	955	dscf/hr
Multiplier, 0% to 15% O2	3.542	
V, Flow @ 15% O2	3383	dscf/hr
P	1	atm
T	528	Rankine
R	0.7302	
n, flow @ 15% O2	8.775	lb-mol
MW CO	28	
lb CO	0.01418	lb/hr
n, CO	0.00031	lb-mol/hr
CO concentration limit	35	ppm @ 15% O2

CEQA

The project is exempt from CEQA in accordance with BAAQMD Regulation 2-1-311 because it is ministerial per Permit Handbook Chapter 2.3.2.

Public School, Schools

The facility is within 1000 feet of a school. Therefore, the application is subject to public notification pursuant to BAAQMD Regulation 2-1-412, Public Notice, Schools. A public notice period of 30 days is required and comments must be considered before making a final decision on this application.

Regulation 6, Rule 1, Particulate Matter, General Requirements

The engine is expected to comply with the Ringelmann 2 standard in Section 6-1-303.1 for engines under 1500 cubic inches of displacement and the 0.15 gr/dscf in Section 6-1-310 because it is fueled with natural gas.

Regulation 9, Sulfur Dioxide

The engine will comply with 300 ppm SO₂ standard in Section 9-1-302 because it is fueled with natural gas.

Regulation 9, Nitrogen Oxides and Carbon Monoxide from Stationary Internal Combustion Engines

The engine is not subject to this rule per Section 9-8-110.2 because it is rated at less than 50 brake horsepower output. Nonetheless, the owner will use the stipulations of Section 9-8-503 to determine whether the engine meets the NO_x and CO limits imposed by this permit.

PSD

PSD is not triggered because this is not a major source.

NSPS

The engine is subject to 40 CFR 60, Subpart JJJJ, Standards of Performance for Stationary Spark Ignition Internal Combustion Engines, because it was built after July 1, 2008. The engine was built in 2016. Its displacement is 1,642 cc. Per Section 60.4231(a), engines under 25 hp above 255 cc that were built after January 1, 2011, are subject to the limits in 40 CFR 1054.

Section 1054.101(a)(2) states that nonhandheld engines must meet the exhaust emission standards in Section 1054.105. The engine is not subject to the evaporative emission standard per Section 1054.105(b) because it does not run on a volatile liquid fuel.

The emission limits in Section 1054.105 are for Class I and Class II engines. Per the definition in Section 1054.801, Class II engines are nonhandheld engines with a

displacement above 225 cc. The limits for non-marine engines in units of g/kw-hr are as follows:

<u>HC + NOx</u>	<u>CO</u>
8	610

The engine has been certified by EPA to meet these standards.

NESHAPS

The engine is subject to 40 CFR 63, Subpart ZZZZ, National Emission Standard National Emission Standards for Hazardous Air Pollutants for Reciprocating Internal Combustion Engines and complies with the standard by complying with 40 CFR 60, Subpart JJJJ, per Section 63.6590(c)(1).

Acid Rain

The engine is not subject to the Acid Rain Regulations, 40 CFR 72 through 78, because Section 72.6(b)(4)(ii) exempts the following cogeneration facilities:

“...units which commenced construction after November 15, 1990, supplies equal to or less than one-third its potential electrical output capacity or equal to or less than 219,000 MWe-hrs actual electric output on an annual basis to any utility power distribution system for sale (on a gross basis).”

Cogeneration unit is defined in Section 70.2 as:

“Cogeneration unit means a unit that has equipment used to produce electric energy and forms of useful thermal energy (such as heat or steam) for industrial, commercial, heating, or cooling purposes, through sequential use of energy.”

ATCM

CARB has not promulgated any Air Toxic Control Measures for spark ignited reciprocating engines.

Distributed Generation Regulation, CCR Title 17, 94200-94214

S1 is considered to be a distributed generation unit as defined by Section 94202(i) of ARB's regulation:

“Distributed Generation (DG). Electrical generation technologies that produce electricity near the place of use.”

Section 94203(b) requires that after January 1, 2007, DG units that are fueled by a fossil fuel and are subject to the regulation meet the following standards:

2007 Fossil Fuel Emission Standards

Pollutant	Emission Standard (lb/MW-hr)
NOx	0.07
CO	0.1
VOC	0.02

DG Units that produce combined heat and power may take a credit to meet the emission standard above. Credit shall be at the rate of one MWhr for each 3.4 million Btu's of heat recovered. To take the credit, the following must apply:

- (1) DG Units are sold with combined heat and power technology integrated into a standardized package by the applicant; and
- (2) DG Units achieve a minimum energy efficiency of 60 percent.

Pollutant	Actual Emissions (lb/MW-hr)
NOx	5.6
CO	7.1
VOC	1.3

The manufacturer's information states that 57,240 btu/hr are recovered. This is equivalent to 501.4 MMbtu/yr. A credit of 147.5 MW-hr can be taken. 87.6 MW-hr of electricity will also be generated. The following calculation compares the proposed emission factors to the limits for NOx:

$$491.9 \text{ lb NOx/yr} / (147.5 \text{ MW-hr} + 87.6 \text{ MW-hr}) = 2.1 \text{ lb NOx/MW-hr}$$

The engine does not meet the 0.07 lb NOx/MW-hr standard. Section 94201(d) of the regulation exempts units that have permits from an air pollution control district or air quality management district. Therefore, the owner/operator has sought a permit from BAAQMD.

H. PERMIT CONDITIONS

The conditions have been amended to ensure that use of A1, Mine-X Catalytic Converter, reduces emissions of toxic air contaminants under the triggers in Regulation 2, Rule 5. Therefore, the CO concentration limit has been lowered. The owner/operator will monitor back pressure to ensure that the catalytic converter is not plugged. The catalyst is expected to last 8,000 hours, so a condition has been imposed to require replacement of the catalyst at 8,000 hours.

Condition 26534:

1. The owner/operator shall use S1 as a cogeneration unit as defined by 40 CFR 72.2. [Basis: 40 CFR 72.2]
2. The owner/operator shall use pipeline quality natural gas to fuel the engine exclusively. [Cumulative Increase, Regulation 2, Rule 5]
3. The owner/operator shall ensure that S1 is controlled by the properly operated and maintained A1, Mine-X Catalytic Converter, at all times of operation. [Basis: Cumulative Increase, Regulation 2, Rule 5]
4. The owner/operator shall measure the back pressure after initial installation of A1,

Mine-X Catalytic Converter. The owner/operator shall ensure that the back pressure does not increase more than 2 inches of water over the initial back pressure. [Basis: Cumulative Increase, Regulation 2, Rule 5]

5. The owner/operator shall replace the catalyst in A1, Mine-X Catalytic Converter, after 8000 hours of operation. [Basis: Cumulative Increase, Regulation 2, Rule 5]
6. The owner/operator shall ensure that the concentration of nitrogen oxides (NOx) does not exceed 300 ppm @ 15% oxygen on a dry basis. [Basis: Cumulative Increase]
7. The owner/operator shall ensure that the concentration of carbon monoxide (CO) does not exceed 35 ppm @ 15% oxygen on a dry basis. [Basis: Regulation 2, Rule 5]
8. The owner/operator shall operate S1 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: Cumulative Increase, Regulation 2, Rule 5]
9. The owner/operator shall measure the concentration of NOx and CO at least once during each calendar quarter in which the engine operates with a portable analyzer to ensure compliance with the limits in parts 4 and 5 of this condition. The monitoring shall be performed in accordance with the requirements of Regulation 9-8-503. The following concentrations or lower shall be presumed to be in compliance:
 - a. NO₂: 300 ppm @ 15% O₂, dry
 - b. CO: 35 ppm @ 15% O₂, dryIf either concentration is above the limits above, the owner/operator shall shut down the equipment immediately and take corrective action. [Basis: Cumulative Increase]
10. The owner/operator shall measure the back pressure of A1, Mine-X Catalytic Converter, at least once during each calendar quarter in which the engine operates to ensure compliance with part 4 of this condition. If the back pressure exceeds the limit in part 4, the owner/operator shall shut down the equipment immediately and take corrective action. [Basis: Regulation 2, Rule 5]
11. Records: The owner/operator shall maintain the following monthly and quarterly records in a District-approved log for at least 24 months from the date of entry. Log entries shall be retained on-site, either at a central location or at the engine's location, and made immediately available to District staff upon request.
 - a. Hours of operation.
 - b. Fuel usage for the engine. The fuel usage may be derived by multiplying the hours of operation by the maximum hourly usage-1.097 therms (100,000 btu) per hour.
 - c. Results of the quarterly NOx and CO concentration monitoring required

by part 7 of this condition.

d. Results of the quarterly back pressure monitoring required by part 10 of this condition.

e. Records of catalyst replacement for A1, Mine-X Catalytic Converter.

[Basis: Cumulative Increase, Regulation 2, Rule 5]

12. Reports:

a. The owner/operator shall report annual fuel usage when the District requests such reports during the annual renewal.

[Basis: Cumulative increase, Regulation 2, Rule 5]

I. 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 2-1-412.6. 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:

S1, Micro Cogeneration Natural Gas Engine, Yanmar – 10 kW (13.4 hp), 2016
abated by: A1, Mine-X Catalytic Converter

By: _____

Brenda Cabral
Supervising Air Quality Engineer

Date: _____