

**DRAFT ENGINEERING EVALUATION**  
**Residence Betsy Ellis Chung, Plant No. 23861**  
**Application No. 28585**  
Residence Betsy Ellis Chung Ave, Hillsborough, CA

**A. BACKGROUND**

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

S1, Micro Cogeneration Natural Gas Engine, Yanmar – 10 kW (13.4 hp), 2016

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.

**B. EMISSIONS**

The emissions of nitrogen oxides (NOx) and carbon monoxide (CO) 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
CO	3.217	0.0709	1.702	621.3	0.311
NOx	2.547	0.0562	1.348	491.9	0.246

The emissions of carbon dioxide (CO<sub>2</sub>), sulfur dioxide (SO<sub>2</sub>), 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

As can be seen in the discussion of toxic air contaminants in Section E below, the engine will be restricted to operating 3,288 hours per year or less. In this case, the annual emissions will be:

Pollutant	tpy
CO	0.117
NOx	0.092
SO2	0.000
VOC	0.021
PM	0.002
CO2	19.829

### **C. PLANT CUMULATIVE INCREASE**

Pollutant	tpy
CO	0.117
NOx	0.092
SO2	0.000
VOC	0.021
PM	0.002

### **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. The emission factors are the natural gas 4-stroke lean burn factors from ARB's CATEF database. The "mean" factors were used.

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.

	EF lb/MMcf	Annual	PAH Eq.	PAH Eq. lb/yr	Trigger lb/yr
		emissions lb/yr	factor		
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 is above the trigger in Regulation 2, Rule 5.

*The results from the HRA indicate that, at 8760 hours/year, the maximum project cancer risk for continuous operation is estimated at 22 in a million, and the maximum project chronic hazard index is estimated at 0.14 and the acute hazard index is estimated at 0.22. The estimated cancer risk was not considered to be acceptable.*

The applicant agreed to operate the engine for no more than 3,822 hours per year. At this rate, the cancer risk is less than 10 in a million and is acceptable.

Following are the estimated emissions for operation of 3.288 hours per year.

TAC	EF lb/MMcf	Hourly	Annual	Triggers	
		emissions lb/hr	emissions lb/yr	lb/hr	lb/yr
Acetaldehyde	3.99E+00	4.29E-04	1.64E+00	1.00E+00	2.90E+01
Benzene	1.21E+00	1.30E-04	4.97E-01	6.00E-02	2.90E+00
Formaldehyde	2.87E+01	3.09E-03	1.18E+01	1.20E-01	1.40E+01
Naphthalene	1.22E-01	1.31E-05	5.01E-02	none	2.40E+00
Propylene	1.87E+01	2.01E-03	7.68E+00	none	1.20E+05
Toluene	4.12E-01	4.43E-05	1.69E-01	8.20E+01	1.20E+04
Xylene (m,p)	8.63E-02	9.28E-06	3.55E-02	4.90E+01	2.70E+04
Xylene (o)	4.94E-02	5.31E-06	2.03E-02	4.90E+01	2.70E+04

Following are the estimated emissions for operation of 3,822 hours per year for PAH as benzo(a)pyrene-equivalents.

	EF lb/MMcf	Annual	PAH Eq.	PAH Eq. lb/yr	Trigger lb/yr
		emissions lb/yr	factor		
Acenaphthene	7.17E-04	2.95E-04	none		
Acenaphthylene	7.59E-03	3.12E-03	none		
Anthracene	2.56E-04	1.05E-04	none		
Benzo(a)anthracene	7.78E-05	3.20E-05	0.1	3.20E-06	
Benzo(a)pyrene	3.55E-05	1.46E-05	1	1.46E-05	
Benzo(b)fluoranthene	3.27E-04	1.34E-04	0.1	1.34E-05	
Benzo(g,h,i)perylene	1.03E-04	4.23E-05	none		
Benzo(k)fluoranthene	5.30E-04	2.18E-04	0.1	2.18E-05	
Chrysene	9.64E-05	3.96E-05	0.01	3.96E-07	
Dibenz(a,h)anthracene	1.09E-05	4.48E-06	1.05	4.70E-06	
Fluoranthene	2.50E-04	1.03E-04	none		

Fluorene	4.60E-04	1.89E-04	none		
				4.93E-	
Indeno(1,2,3-cd)pyrene	1.20E-04	4.93E-05	0.01	07	
Phenanthrene	8.93E-04	3.67E-04	none		
Pyrene	1.23E-04	5.05E-05	none		
				5.86E-	3.30E-
				05	03

Although the manufacturer’s specifications state that the engine has an oxidation catalyst, no information was provided about control efficiency for precursor organic compounds or organic TACs. Therefore, no control was assumed.

**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.

A permit condition 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 will be double the test values. Following is a calculation of the concentration limits:

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

Test value, CO	3.217	g/kw-hr
Test value, CO x 2	6.434	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	0.14184	lb/hr
	3.40	lb/day
n, CO	0.00308	lb-mol/hr
Conc @ double the test value	351	ppm @ 15% O2

The concentrations will be rounded to 300 ppm for NOx and 350 ppm for CO. Although the allowable concentrations will be double the test values, the emissions will still be below the BACT triggers of 10 lb/day for each pollutant.

### 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 will be required and comments will 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 SO<sub>2</sub> 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<sub>x</sub> 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:

$$\frac{\text{HC} + \text{NO}_x}{8} \qquad \frac{\text{CO}}{610}$$

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 subject to the regulation and fuel by a fossil fuel meet the following standards:

#### **2007 Fossil Fuel Emission Standards**

<b>Pollutant</b>	<b>Emission Standard (lb/MW-hr)</b>
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 MW-hr 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.

<b>Pollutant</b>	<b>Emission Standard (lb/MW-hr)</b>
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 NO<sub>x</sub>/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**

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 the engine operates no more than 3,822 hours per any consecutive 12-month period. [Basis: Cumulative Increase, Regulation 2, Rule 5]
4. The owner/operator shall ensure that the concentration of nitrogen oxides (NO<sub>x</sub>) does not exceed 300 ppm @ 15% oxygen on a dry basis. [Basis: Cumulative Increase]
5. The owner/operator shall ensure that the concentration of carbon monoxide (CO) does not exceed 350 ppm @ 15% oxygen on a dry basis. [Basis: Cumulative Increase]
6. 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]
7. The owner/operator shall measure the concentration of NO<sub>x</sub> 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. NO<sub>2</sub>: 300 ppm @ 15% O<sub>2</sub>, dry
  - b. CO: 350 ppm @ 15% O<sub>2</sub>, dryIf either concentration is above the limits above, the owner/operator shall shut down the equipment immediately and take corrective action.  
[Basis: Cumulative Increase]
8. 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.

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

9. 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. 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

By: \_\_\_\_\_  
**Brenda Cabral**  
**Supervising Air Quality Engineer**

Date: \_\_\_\_\_