

ENGINEERING EVALUATION
East Bay Municipal Utility District, Plant 13728
Application 6533

BACKGROUND

The East Bay Municipal Utility District (EBMUD) has applied for an Authority to Construct ten identical new, natural gas microturbines with exhaust heat recovery (S-2 through S-11). The microturbines will be installed at EBMUD's main administration building at 375 Eleventh Street, Oakland, CA. The microturbines will be installed within 1,000 feet of Oakland International School and Lincoln Elementary School, thus Waters Bill School Public Notice is triggered. As stated by the applicant, all ten microturbines will run at full load for 24 hours/day and 7 days/week. The generating capacity of the microturbines will provide less than 50% of the electricity used for the building. The heat recovered from the microturbines will be used to generate hot water and produce chilled water for the air conditioning system. This in turn would reduce the operational hours of two existing hot water boilers.

The sources within this application are:

- S-2 Capstone 60 Microturbine with Heat Recovery, 60 kW Maximum Output: Natural-Gas Fired, Maximum Firing Rate: 0.811 MM Btu/hr.**
- S-3 Capstone 60 Microturbine with Heat Recovery, 60 kW Maximum Output: Natural-Gas Fired, Maximum Firing Rate: 0.811 MM Btu/hr.**
- S-4 Capstone 60 Microturbine with Heat Recovery, 60 kW Maximum Output: Natural-Gas Fired, Maximum Firing Rate: 0.811 MM Btu/hr.**
- S-5 Capstone 60 Microturbine with Heat Recovery, 60 kW Maximum Output: Natural-Gas Fired, Maximum Firing Rate: 0.811 MM Btu/hr.**
- S-6 Capstone 60 Microturbine with Heat Recovery, 60 kW Maximum Output: Natural-Gas Fired, Maximum Firing Rate: 0.811 MM Btu/hr.**
- S-7 Capstone 60 Microturbine with Heat Recovery, 60 kW Maximum Output: Natural-Gas Fired, Maximum Firing Rate: 0.811 MM Btu/hr.**
- S-8 Capstone 60 Microturbine with Heat Recovery, 60 kW Maximum Output: Natural-Gas Fired, Maximum Firing Rate: 0.811 MM Btu/hr.**
- S-9 Capstone 60 Microturbine with Heat Recovery, 60 kW Maximum Output: Natural-Gas Fired, Maximum Firing Rate: 0.811 MM Btu/hr.**
- S-10 Capstone 60 Microturbine with Heat Recovery, 60 kW Maximum Output: Natural-Gas Fired, Maximum Firing Rate: 0.811 MM Btu/hr.**
- S-11 Capstone 60 Microturbine with Heat Recovery, 60 kW Maximum Output: Natural-Gas Fired, Maximum Firing Rate: 0.811 MM Btu/hr.**

S-2 through S-11 are new sources as defined in Regulation 2, Rule 1, Section 232. The microturbines have a power rating of less than 0.3 MW (300 kW). As such, sources 2 through 11 are exempt from Regulation 9, Rule 9 (Nitrogen Oxides And Carbon Monoxide from Stationary Gas Turbines) as stipulated in Section 9-9-110 (Exemption, Small Turbines).

EMISSIONS

Daily and annual emissions from S-2 through S-11, assuming a requested 8,760 hrs/yr of total annual operation, a maximum of 24 hrs/day, and 0.811 MMBtu/hr at full load, will be calculated using the emissions factors as furnished by the manufacturer for NO_x, CO, and VOC. Values for PM₁₀ and SO₂ were taken from AP-42, Chapter 3: Stationary Internal Combustion Sources, Section 3.1: Stationary Gas Turbines, Table 3.1-2a: Emission Factors For Criteria Pollutants and Greenhouse Gases From Stationary Gas Turbines.

Fuel Consumption: 811,000 Btu/hr @ Full Load

Formulas for Calculating Emissions of NO_x, CO, and VOC:

(24 hours/day) (60 kW) (X.XX lb/kW-hr) = X.XX lbs/day
 (24 hours/day) (365 days/yr) (60 kW) (X.XX lb/kW-hr) = X.XX lbs/yr
 (X.XX lbs/yr) (1 ton/ 2000 lbs) = X.XX tons/yr

Formulas for Calculating Emissions of PM₁₀ and SO₂:

(24 hours/day) (0.811 MMBtu/hr) (X.XX lbs/MMBtu) = X.XX lbs/day
 (24 hours/day) (365 days/yr) (0.811 MMBtu/hr) (X.XX lb/MMBtu) = X.XX lbs/yr
 (X.XX lbs/yr) (1 ton/ 2000 lbs) = X.XX tons/yr

TABLE 1: NO_x, CO, and POC Emissions

Pollutant	Emission Factor (lb/kW-hr)	Emissions (per Microturbine)			Emissions (for 10 Microturbines)		
		Maximum Daily usage (lbs/day)	Maximum Annual Usage (lbs/year)	Maximum Annual Usage (tons/year)	Maximum Daily usage (lbs/day)	Maximum Annual Usage (lbs/year)	Maximum Annual Usage (tons/year)
NO_x	4.91E-04	0.71	258.07	0.13	7.07	2580.70	1.29
CO	2.99E-04	0.43	157.15	0.08	4.31	1571.54	0.79
POC	1.71E-04	0.25	89.88	0.04	2.46	898.78	0.45

TABLE 2: PM₁₀ and SO₂ Emissions

Pollutant	Emission Factor (lb/MMBtu)	Emissions (per Microturbine)			Emissions (for 10 Microturbines)		
		Maximum Daily usage (lbs/day)	Maximum Annual Usage (lbs/year)	Maximum Annual Usage (tons/year)	Maximum Daily usage (lbs/day)	Maximum Annual Usage (lbs/year)	Maximum Annual Usage (tons/year)
PM₁₀	6.60E-03	0.13	46.89	0.02	1.28	468.89	0.23
SO₂	3.40E-03	0.07	24.15	0.01	0.66	241.55	0.12

TOXIC RISK SCREEN ANALYSIS (RSA)

TABLE 3: Toxic Air Contaminants (TACs)

CAS Number	Pollutant	Emission Factor (lbs/MMscf)	Calculated Annual Emissions (lbs/year):	BAAQMD Trigger Level (lbs/year):	Exceeds Trigger? (Yes/No)
106-99-0	1,3-Butadiene	1.33E-04	9.45E-03	1.10E+00	NO
75-07-0	Acetaldehyde	5.11E-01	3.63E+01	7.20E+01	NO
107-02-8	Acrolein	6.93E-02	4.92E+00	3.90E+00	YES
71-43-2	Benzene	9.90E-02	7.03E+00	6.70E+00	YES
50-00-0	Formaldehyde	6.52E-09	4.63E-07	3.30E+01	NO
110-54-3	Hexane	3.82E-01	2.71E+01	8.30E+04	NO
91-20-3	Naphthalene	7.88E-03	5.60E-01	2.70E+02	NO
*	PAHs	7.78E-04	5.53E-02	4.40E-02	YES
56-55-3	Benzo(a)anthracene	1.34E-04	9.52E-03	4.40E-02	NO
50-32-8	Benzo(a)pyrene	9.16E-05	6.51E-03	4.40E-02	NO
205-99-2	Benzo(b)fluoranthene	6.72E-05	4.77E-03	4.40E-02	NO
207-08-9	Benzo(k)fluoranthene	6.72E-05	4.77E-03	4.40E-02	NO
218-01-9	Chrysene	1.50E-04	1.07E-02	4.40E-02	NO
53-70-3	Dibenz(a,h)anthracene	1.34E-04	9.52E-03	4.40E-02	NO
193-39-5	Indenol(1,2,3-cd)pyrene	1.34E-04	9.52E-03	4.40E-02	NO
75-56-9	Propylene Oxide	5.87E-02	4.17E+00	5.20E+01	NO
108-88-3	Toluene	1.68E-01	1.19E+01	3.90E+04	NO
133-02-07	Xylene	6.26E-02	4.45E+00	5.80E+04	NO

Notes:

1. Emission Factors for all TACs, except for Formaldehyde, from CATEF II - Turbine firing Natural Gas.
2. Source specific emission factor for formaldehyde provided through in-house test on microturbine.
3. Speciated PAH emission factors from CATEF II. Speciated PAHs chosen to conform to list of 25 selected PAHs as listed by Brian Bateman, Manager of Toxics Division, through e-mail sent to Permit Bulletin Board on April 25, 2002.
4. Conversion factor of 1000 Btu/scf for natural gas was used in calculations.
5. Calculations include emissions from all ten microturbines and a firing rate of 0.811 MMBtu/hr running for 8760 hours per year (24 hours/day, 365 days/year).

A Toxic RSA was warranted for Sources 2 through 11 since emissions Acrolein, Benzene, and Polycyclic Aromatic Hydrocarbons (PAHs) exceeded the BAAQMD's trigger levels outlined in Regulation 2, Rule 1, Table 316. Please refer to Table 3 above.

On October 31, 2002 a memo requesting a RSA for S-2 through S-11 was sent to Brian Bateman, Air Quality Manager, Toxics Evaluation Section. On November 25, 2002 Jane Lundquist, Air Quality Engineer, Toxics Evaluation Section, conveyed through a memo that S-2 through S-11 passed the risk screen with a maximum increased cancer risk of 0.2 in a million and a maximum increased chronic hazard index of 0.02. The acceptable cancer risk and chronic hazard index are less than 1 in a million and 1, respectively, as described in the District's Risk Management Policy.

CUMULATIVE INCREASE

This is a new plant with no existing sources so there are no current cumulative increase emissions.

NO_x: 0.0 tons/yr (current) + 1.29 tons/yr (proposed) = 1.29 tons/yr (new total)
CO: 0.0 tons/yr (current) + 0.79 tons/yr (proposed) = 0.79 tons/yr (new total)
SO_x: 0.0 tons/yr (current) + 0.12 tons/yr (proposed) = 0.12 tons/yr (new total)
PM₁₀: 0.0 tons/yr (current) + 0.23 tons/yr (proposed) = 0.23 tons/yr (new total)
POC: 0.0 tons/yr (current) + 0.45 tons/yr (proposed) = 0.45 tons/yr (new total)

BACT

S-2 through S-11 do not trigger Best Available Control Technology since emissions from all regulated criteria pollutants are below the trigger level of 10 lbs/day as outlined in Section 2-2-301.

OFFSETS

Offsets are not required since plant 13728 currently has no reported emissions data and this application does not emit more than 15 tons of precursor organic compounds and/or nitrogen oxides or more than 1 ton of PM₁₀ and/or sulfur dioxide that trigger offsets per Rule 2-2.

STATEMENT OF COMPLIANCE

District regulations that govern the operation of I.C. engines¹ other than Reg. 2-1-301 and 2-1-302 include:

- Reg. 6 – Particulate matter and visible emissions standards;
- Reg. 9, Rule 1 – Inorganic Gaseous Pollutants – Sulfur Dioxide; and
- Reg. 9, Rule 9 – NO_x emissions from Stationary Gas Turbines

The Ringelmann No. 2 Opacity Limitation contained in Reg. 6-303 limits visible emissions to a period or periods aggregating no more than three minutes in any hour, a visible emission as dark or darker than No. 2 on the Ringelmann Chart, or of such opacity as to obscure an observer's view to an equivalent or greater degree, nor shall the said emission, as perceived by an opacity sensing device in good working order,

¹ CARB Compliance Assistance Manual on "Stationary Reciprocating Engines", June 1998, page 100-4

where such device is required by District regulations, be equal to a greater than 40% opacity. Sources S-2 through S-11 are expected to meet this requirement.

S-2 through S-11 are subject to the SO₂ limitations of Regulation 9-1-301 (ground level concentration) and 9-8-302 (General Emission Limitation). Sources S-2 through S-11 will comply with Regulation 9-1-301 and 9-1-302, since they will be fired exclusively with utility-grade natural gas with a maximum sulfur content of 1 gr/100 scf.

Reg. 9-9-110 exempts small gas turbines such as sources S-2 through S-11 from complying with Reg. 9, Rule 9 because the power rating on each individual microturbine does not exceed 0.3 MW i.e. 0.06 MW.

In a November 22, 2002 letter to the District, EBMUD stated they were the Lead Agency and the District was the Supplemental Reviewer Agency for the project in light of CEQA.

Regulation 2-1-312.8 states permit applications for cogeneration facilities that meet the criteria set forth in Section 15329 of CEQA guidelines are categorically exempt from CEQA review. Further, the applicant submitted a completed Appendix H of the State CEQA Guidelines in accordance with Reg. 2-1-426.1.

CEQA Article 19, Section 15329 sets forth qualification criteria that a cogeneration facility (facility) needs to meet before it is deemed to be categorically exempt from CEQA. The criteria that apply to EBMUD's project are presented below:

1. The capacity of the facility does not exceed 50 megawatts.
2. The emissions from the facility are lower than the amount that would require review under the new source review rules applicable in the county.
3. The facility complies with all applicable state, federal, and local air quality laws.
4. The facility does not result in noticeable increase in noise to nearby residential structures.
5. The facility is contiguous to other commercial or institutional structures.

The individual (each microturbine) and cumulative (ten microturbines) power generating capacity of the microturbines are 0.06 and 0.6 megawatts respectively². Results of the emission calculations summarized in Tables 1 and 2 indicate the maximum daily emissions from the microturbines are less than the District's BACT trigger levels, implying the sources are not subject to the District's new source review rules of 10 lbs/day. Sources S-2 through S-11 are required to comply with all State, Federal and District rules and regulations. The microturbines are expected to comply with District Reg. 6, Reg. 9-1 and 9-8.

The noise from the microturbines, comply with the current City of Oakland Noise Ordinance requirements. Specifically, EMBUD addressed the noise requirements set forth in the Design/Build Specification 1871. Under this specification, the contractor who installs the microturbines is required to:

² 1 kW = 1000 watts; 1 MW = 1000 kW

- Perform noise assessment studies to document existing and as-built ambient noise standards at Pacific Renaissance Plaza at 388 Ninth Street, Oakland, CA 94607.
- Design and install noise abatement measures necessary to comply with all City of Oakland noise ordinances. The objective of the noise study is to result in no net increase in the average ambient noise at the Pacific Renaissance Plaza residential units.
- Submit a Noise Verification Report to the City of Oakland's Planning Department that verifies and certifies that the as-built ambient noise within the Pacific Renaissance Plaza residential units comply with all City of Oakland noise ordinances and result in no net increase in average ambient noise within the Plaza.

EBMUD indicated the City of Oakland's Planning Department would review the pre-project and post-project noise levels associated with installing and operating the ten microturbines. If the Planning Department concludes there is "no net increase" in noise levels, it would suffice the noise criteria set forth in CEQA Article 19, Section 15329.

Lastly, EBMUD has stated in the filed Notice of Exemption (NOE) that the microturbines will be contiguously located with other commercial or institutional structures.

In light of the above facts, EBMUD filed a NOE with the Alameda County Clerk on 11/30/01. The County Clerk posted the NOE for the time period prescribed by law. No challenges and/or comments were received from the public during the comment period.

Therefore, the project to install and operate the ten microturbines is categorically exempt under Article 19, Section 15329.

This project is within 1,000 ft of the nearest public school and is therefore subject to the public notification requirements of Regulation 2-1-412.

A toxic risk screening analysis was required.

BACT, PSD, NSPS, and NESHAPS are not triggered.

Permit conditions warranting a source test were not proposed because the turbine models proposed (Capstone 60) were pre-certified in July 2001 to meet BACT for NO_x (9 ppmvd @ 15% O₂) under Application 2778. The emissions of CO and POC do not warrant source testing because the maximum daily emissions calculated are far below 10 lbs per highest day. Please refer to Table 1 above. The emissions of PM₁₀ and SO₂ are also far below the 10 lbs per highest day BACT limit. These emissions were calculated using US EPA AP-42 emissions factors, which are very conservative. Therefore, the annual fuel throughput limit will ensure cumulative annual emissions will not increase.

PERMIT CONDITIONS

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Sources S-2 through S-11

(PC 20234)

1. The owner/operator shall exclusively fire each source on utility-grade Natural Gas with a maximum sulfur content of 1 grain/100 standard cubic feet.
(Basis: Cumulative Increase)
2. The owner/operator shall ensure emissions of Nitrogen Oxides (NOx) from each source will not exceed 0.223 g/kW-hr (9 ppmvd @ 15% O₂).
(Basis: Cumulative Increase)
3. The owner/operator shall ensure emissions of Carbon Monoxide (CO) from each source will not exceed 0.136 g/kW-hr (9 ppmvd @ 15% O₂).
(Basis: Cumulative Increase)
4. The owner/operator shall ensure emissions of Precursor Organic Compounds (POC) from each source will not exceed 0.078 g/kW-hr (9 ppmvd @ 15% O₂).
(Basis: Cumulative Increase)
5. To determine compliance with Condition 1 in the event that natural gas is unavailable for use, the owner/operator shall obtain documentation from the natural gas supplier verifying that natural gas was unavailable due to a natural gas curtailment. The owner/operator shall maintain these records on site for at least 24 months, and shall make the records available for inspection by BAAQMD staff upon request.
(Basis: Cumulative Increase)

RECOMMENDATION

Issue EBMUD a conditional Authority to Construct for the following equipment:

- S-2 Capstone 60 Microturbine with Heat Recovery, 60 kW Maximum Output: Natural-Gas Fired, Maximum Firing Rate: 0.811 MM Btu/hr.
- S-3 Capstone 60 Microturbine with Heat Recovery, 60 kW Maximum Output: Natural-Gas Fired, Maximum Firing Rate: 0.811 MM Btu/hr.
- S-4 Capstone 60 Microturbine with Heat Recovery, 60 kW Maximum Output: Natural-Gas Fired, Maximum Firing Rate: 0.811 MM Btu/hr.
- S-5 Capstone 60 Microturbine with Heat Recovery, 60 kW Maximum Output: Natural-Gas Fired, Maximum Firing Rate: 0.811 MM Btu/hr.
- S-6 Capstone 60 Microturbine with Heat Recovery, 60 kW Maximum Output: Natural-Gas Fired, Maximum Firing Rate: 0.811 MM Btu/hr.
- S-7 Capstone 60 Microturbine with Heat Recovery, 60 kW Maximum Output: Natural-Gas Fired, Maximum Firing Rate: 0.811 MM Btu/hr.

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- S-8 Capstone 60 Microturbine with Heat Recovery, 60 kW Maximum Output:
Natural-Gas Fired, Maximum Firing Rate: 0.811 MM Btu/hr.
- S-9 Capstone 60 Microturbine with Heat Recovery, 60 kW Maximum Output:
Natural-Gas Fired, Maximum Firing Rate: 0.811 MM Btu/hr.
- S-10 Capstone 60 Microturbine with Heat Recovery, 60 kW Maximum Output:
Natural-Gas Fired, Maximum Firing Rate: 0.811 MM Btu/hr.
- S-11 Capstone 60 Microturbine with Heat Recovery, 60 kW Maximum Output:
Natural-Gas Fired, Maximum Firing Rate: 0.811 MM Btu/hr.

K. R. Bhagavan
AQE II

Date