Minor Revision to the Synthetic Minor Operating Permit
Application Evaluation Report
University of California, San Francisco
Application # 2776
Plant # 2478

BACKGROUND

The University of California, San Francisco (UCSF) is a health sciences teaching, research and patient care facility with graduate schools conducting research and training in medicine, dentistry, pharmacy, and nursing. Patient care is conducted by the UCSF Medical Center which operates the Long/Moffitt Hospitals and the Langley-Porter Psychiatric Institute at the Parnassus Campus.

UCSF operates the Central Utilities Plant (CUP), a cogeneration system consisting of two gas turbines, two heat recovery boilers, one steam turbine, two auxiliary boilers, and three emergency diesel generators to provide electricity and steam to the UCSF Parnassus campus.

Electricity is generated by two gas turbine generators (GTG) with a nominal rating of 5 MW gross output and one steam turbine generator (STG) with a nominal rating of 2.5 to 5 MW gross output. The turbine generators follow the electrical demand of the UCSF campus. In the event power demands exceed that of the turbine generators, supplemental power is purchased from PG&E. Two heat recovery steam generators (HRSG) are used to generate up to 108,000 pounds per hour of high pressure steam produced from the sensible heat from gas turbine exhaust and the combustion of natural gas fired in the duct burners. Most of the steam is used to drive the STG, producing electricity and low pressure steam. The low pressure steam is then circulated for campus space heating, cooling and water heating. A small amount of high pressure steam bypasses the STG for use in laboratory operations. Two auxiliary steam boilers capable of generating up to 90,000 pounds steam per hour each provide emergency or supplemental steam. The sources in the CUP include:

S-9 Gas Turbine, Solar Centaur Tauras or equivalent, 76 MMBtu/hr (5 MW) capacity; Abated by A-9, CO Catalyst and A-10, Selective Catalytic Reduction.
S-10 Heat Recovery Steam Generator, with Davis or equivalent Duct Burner, 46 MMBtu/hr capacity, Abated by A-9, CO Catalyst and A-10, Selective Catalytic Reduction.
S-11 Gas Turbine, Solar Centaur Tauras or equivalent, 76 MMBtu/hr (5 MW) capacity; Abated by A-11, CO Catalyst and A-12, Selective Catalytic Reduction.
S-12 Heat Recovery Steam Generator, with Davis or equivalent Duct Burner, 46 MMBtu/hr capacity, Abated by A-11, CO Catalyst and A-12, Selective Catalytic Reduction.
S-13 Auxiliary Boiler, Nebraska or equivalent, 120 MMBtu/hr, with Low NOx Burner and Flue Gas Recirculation.
S-14 Auxiliary Boiler, Nebraska or equivalent, 120 MMBtu/hr, with Low NOx Burner and Flue Gas Recirculation.
S-16 Emergency Generator, 4210 CID, 20 MMBtu/hr (Exempt).
S-17 Emergency Generator, 4210 CID, 20 MMBtu/hr (Exempt).
S-18 Emergency Generator, 4210 CID, 20 MMBtu/hr (Exempt).

UCSF also operates an ethylene oxidizer for sterilization of a variety of medical products at the Medical Center. The sterilization is carried out in a leak-proof chamber with an ethylene oxide and carbon dioxide mixture. The emissions from the ethylene oxidizers are abated by catalytic oxidation units. The applicant also operates an incinerator for pathological waste from medical research facilities. Permitted sources from these operations are:

S-5 Pathological Incinerator, Single Chamber, 1.92 MMBtu/hr Input.
S-7 Ethylene Oxide Gas Sterilizer, Castle Model MPS 7260, 70.9 ft^3; Abated by A-1 Castle Emission Control Device.

MODIFICATION

The S-9 and S-11 Gas Turbines are allowed to fire oil only during periods of natural gas curtailment by PG&E and during testing (testing periods limited to 100 hours per year).

The natural gas pressure as supplied to the facility by PG&E is inadequate for the proper operation of S-9 and S-11. Therefore, gas compressors are used in the CUP to boost the gas pressure. Each gas turbine has a dedicated compressor and share a back-up for a total of three compressors. Due to a plant design error, an accumulator was not installed. This resulted in the situation that when a compressor fails, there is insufficient pressure to maintain gas turbine operation until the back-up compressor can take over.

The applicant is planning to correct this problem in the near feature. In the interim, UCSF is proposing to fire oil to prevent nuisance shutdowns of the gas turbines in the event of a gas compressor failure. The oil will be fired just long enough until the back-up compressor can take over. Specifically, UCSF has requested that the oil firing at S-9 and S-11 be permitted for any upset condition that results in loss of natural gas supply, and also 200 hours annually be allowed for each turbine to fire on oil during testing and for loss of gas supply due to compressor failure.

EMISSIONS CALCULATIONS

The emissions increase calculated below is based on a worst case scenario in which each turbine S-9 and S-11 is fired on oil for an additional 100 hours per year:

A. NO_X

The NO_X emissions from the exhaust of the two gas turbines / HRSG systems is controlled to a maximum of 5 ppmvd (15% O_2) with selective catalytic reduction (SCR).

5 ppmvd NO_X (15% O_2) = 0.020 lb/MMBtu, oil

Annual Heat Input at each GTG/HRSG system:

(76 MMBtu/hr)(100 hr/yr) = 7.6E3 MMBtu/yr

NO_X Emissions:

NO_X = (7.6E3 MMBtu/yr)(0.020 lb/MMBtu) = 152 lb/yr
NO_X (total) = 152 X 2 = 304 lb/yr = **0.15 ton/yr**

B. CO

CO will not exceed 10 ppmvd (15% O_2) at the exhaust:

10 ppmvd CO (15% O_2) = 0.023 lb/MMBtu, Oil

CO = (7.6E3 MMBtu/yr)(0.023 lb/MMBtu) = 175 lb/yr (oil)
CO (total) = 175 X 2 = 350 lb/yr = **0.18 ton/yr**

C. POC

POC emissions will not exceed 0.01 lb/MMBtu by permit conditions.

POC = (7.6E3 MMBtu/yr)(0.010 lb/MMBtu) = 76 lb/yr
POC (total) = 76 X 2 = 152 lb/yr = **0.08 ton/yr**

D. SO_2

From AP-42, Table 3.1-2, The SO_2 emission factors given for utility turbines is:
EF (oil) = (1.01)(0.05) = 0.050 lb/MMBtu

SO_2 (oil) = (7.6E3 MMBtu/yr)(0.050 lb/MMBtu) = 380 lb/yr
SO_{2total} = 380 X 2 = 760 lb/yr = **0.38 ton/yr**

E. PM

From AP-42, Table 3.1-1, The TSP emission factors given for utility turbines are:

EF (oil) = 0.038 lb/MMBtu

PM(oil) = (7.6E3 MMBtu/yr)(0.038 lb/MMBtu) = 289 lb/yr
PM_{total} = 289 X 2 = 578 lb/yr = **0.29 ton/yr**

F. HAPs

1. Formaldehyde

Standard BAAQMD formaldehyde emission rates are used to estimate emissions:

Formaldehyde = (7.6E3 MMBtu/yr)(9.6E-3 lb/MMBtu)(1-0.95*) = 3.65 lb/yr
**catalyst removal efficiency*

Formaldehyde (total) = 3.65 X 2 = 7.3 lb/yr = **0.004 ton/yr**

2. Benzene

Per the BAAQMD 1990 Toxic Air Contaminant Emission Inventory Report, benzene emissions for all natural gas combustion sources are approximately 0.11% of the total organic emissions for the source.

Benzene = (76 lb POC/yr)(0.0011 lb Benz/lb POC)(1-0.85*) = 0.013 lb/yr (HRSG)
**catalyst removal efficiency*

Benzene (total) = 0.013 X 2 = 0.026 lb/yr = **1.25E-5 ton/yr**

3. Polycyclic Aromatic Hydrocarbon (PAH)

The two most prevalent PAHs detected in gas turbines, benzo(a)anthracene at 1.5E-6 lb/MMBtu and benzo(a)pyrene at 3.89E-6 lb/MMBtu:

benzo(a)anthracene = (7.6E3 MMBtu/yr)(1.5E-6 lb/MMBtu)(2) = 0.023 lb/yr = **1.14E-5 ton/yr**

benzo(a)pyrene = (7.6E3 MMBtu/yr)(3.89E-6 lb/MMBtu)(2) = 0.059 lb/yr = **2.96E-5 ton/yr**

CUMULATIVE EMISSIONS INCREASE

(ton/yr)	Current	New	Total
NOx	21.92 ton/yr	0.15 ton/yr	22.07
CO	21.93	0.18	22.11
SOx	3.10	0.38	3.48
PM	14.98	0.29	15.27
POC	8.61	0.08	8.69
HAPs	0.75	0.004	0.754

STATEMENT OF COMPLIANCE

The project complies with Regulation 6, Particulate Matter and Visible Emissions. The combustion sources comply with District Regulation 6-301 which prohibits visible emissions of Ringelmann 1 or greater and with Regulation 6-310 which imposes a particulate weight limitation of 0.15 grains/dscf.

This project also complies with Regulation 9, Rule 1, Sulfur Dioxide. Regulation 9-1-301 limits ground level SO2 concentrations to 0.5, 0.25, and 0.05 ppm at 3 minutes, 1 hour, and 24 hour intervals, respectively, and Section 9-1-302 limits stack SO2 concentrations to 300 ppm (dry). Since the project burns natural gas as primary fuel and low sulfur oil as emergency backup, this project will comply these requirements.

This project was determined to have a significant impact on the environment. Pursuant to the provisions of CEQA, an Environmental Impact Report (EIR) has been prepared. The Lead Agency, the Regents of the University, approved this project and certified the Final EIR on January 21, 1994.

This facility will remain in compliance with the necessary requirements in Regulation 2, Rule 6 to obtain a synthetic minor operating permit. University of California at San Francisco has voluntarily accepted federally enforceable permit conditions including emission limits that will keep UCSF's potential to emit under 95 tons per year of any regulated pollutant, 9 tons of any hazardous air pollutant, and 23 tons of any combination of hazardous air pollutants. These limits will not be exceeded with the modification to allow 100 additional hours of oil firing to Sources S-9 and S-11.

PSD, NSPS, NESHAPs do not apply.

RECOMMENDATIONS

It is recommended that the permit conditions be modified to allow 100 additional hours of oil firing for the following sources:

S-9 Gas Turbine, Solar Centaur Tauras or equal, 76 MMBtu/hr (5 MW) capacity; Abated by A-9, CO Catalyst and A-10, Selective Catalytic Reduction.

S-11 Gas Turbine, Solar Centaur Tauras or equal, 76 MMBtu/hr(5 MW) capacity; Abated by A-11, CO Catalyst and A-12, Selective Catalytic Reduction.

All references to the old UCSF power and steam generation facility that was replaced by the new Central Utilities Plant (CUP) and to the initial commissioning will be deleted from the permit conditions.

by: _____ Date: _____

Weyman Lee
Air Quality Engineer II