SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT	PAGES	PAGE 1
STATIONARY SOURCE COMPLIANCE DIVISION	APPL No See below	DATE 9/23/08
PERMIT APPLICATION PROCESSING AND CALCULATIONS	PROCESSED BY TK	CHECKED BY

Applicant

LA County Sanitation Districts
P.O.Box 4998
Whittier, CA 90607

Equipment Location:

Palos Verdes Landfill
26301 Crenshaw Blvd.
Rolling Hills, CA

Equipment Description

A/N 483598

LANDFILL GAS MICROTURBINE SYSTEM CONSISTING OF:

1. MICROTURBINE LANDFILL GAS PRETREATMENT UNIT WITH:
   A. INLET CONTAMINANT REMOVAL
   B. CHILLED LIQUID KNOCKOUT
   C. GAS COMPRESSORS
   D. SILOXANE REMOVAL

2. EIGHT MICROTURBINES, INGERSOLL RAND, MODEL NO. MT250, 3.3 MM BTU/HR, EACH LANDFILL GAS FIRED, AUGMENTED WITH NATURAL GAS, EACH DRIVING A 250 KW ELECTRIC GENERATOR

A/N 483617

LANDFILL GAS FUEL CELL SYSTEM CONSISTING OF:

1. FUEL CELL LANDFILL GAS PRETREATMENT UNIT WITH A COMPRESSOR, COALESCING FILTER, GAS CHILLER AND A SORBENT BED.

2. FUEL CELL, FUEL CELL ENERGY, MODEL DFC300, 2.2 MM BTU/HR, 300 KW POWER OUTPUT, LANDFILL GAS FIRED, AUGMENTED WITH NATURAL GAS.

A/N 483623

LANDFILL GAS FLARING SYSTEM CONSISTING OF:

1. LIQUID KNOCKOUT/PARTICULATE REMOVAL VESSEL, JOHN ZINK, 2'-6" DIA. X 6'-0" H.

2. BLOWER, LANDFILL GAS, MAXIMUM FLOW RATE, 8100 SCFM

3. FLARE, JOHN ZINK, ZULE, 13'-0" DIA. X 35'-0" H., 75.6 MMBTU/HR, LANDFILL GAS FIRED, AUGMENTED WITH NATURAL GAS, WITH A MULTI JET BURNER, A PROPANE GAS PILOT, NATURAL GAS AUGMENTATION, ELECTRIC IGNITER, UV FLAME SENSOR, THERMOCOUPLE WITH TEMPERATURE INDICATOR AND RECORDER, AUTOMATIC SHUTDOWN AND ALARM SYSTEM, AUTOMATIC COMBUSTION AIR REGULATING SYSTEM, TEMPERATURE CONTROLLER AND FLAME ARRESTOR.

A/N 483625

MODIFICATION OF THE LANDFILL GAS COLLECTION SYSTEM CONSISTING OF:

1. FOUR HUNDRED EIGHTY TWO (482) VERTICAL LANDFILL GAS COLLECTION WELLS.

2. 3,500 LINEAR FEET OF HORIZONTAL LANDFILL GAS COLLECTION TRENCHES AND ASSOCIATED PIPING.

3. SIXTY (60) VERTICAL LANDFILL GAS COLLECTION WELLS AND 5,000 LINEAR FEET OF HORIZONTAL LANDFILL GAS COLLECTION TRENCHES AND ASSOCIATED PIPING TO BE INSTALLED ON “AS NEEDED BASIS” AT A LOCATION TO BE DETERMINED.

BY THE ADDITION OF:

1.. LATERAL CONNECTIONS TO THE FUEL CELL AND EIGHT MICROTURBINES.

History

The Palos Verdes Landfill is a closed landfill with an existing landfill gas collection and control system consisting of two boilers and a flare station. The applicant is proposing to repower by installing one landfill gas fuel cell and eight micro-turbines for electric generation,

a new flare to combust the excess landfill gas and to modify the gas collection system. The new flare will also be used as a backup for the fuel cell and micro-turbines. The existing flare station, consisting of six old flares, will be used as a backup for the new low emissions flare. Two boilers (A/N 422941 and 42942) will be removed from service after placing the micro-turbines and fuel cell into operation. The installation of the new equipment requires a significant change in monitoring terms and conditions in the Title V permit. Therefore, this is considered a significant permit revision to the Title V permit.

Process Description

Landfill gas from the core (center) of the landfill with high methane content will be collected and then re-directed to a pretreatment system to remove moisture, particulates, siloxanes, some nmoc's, and sulfur compounds in order to protect the fuel cell electrodes. A maximum of 60 scfm pretreated landfill gas will be used in the fuel cell to generate 300 kilowatts of electricity. A fuel cell will convert the methane in the landfill gas to hydrogen. The hydrogen then reacts with oxygen across an electrode to produce electricity. Also, a maximum of 1640 scfm of lower methane content landfill gas (from top deck header) will be pretreated and used to fuel eight microturbines. Each microturbine will produce 250 kilowatts of electricity. A flare will combust the remaining landfill gas, primarily from the perimeter wells, consisting of 6400 scfm, and have capacity for 1700 scfm on a standby basis for the fuel cell and microturbines, for a total of 8100 scfm. The fuel cell and microturbines may be augmented with natural gas. In addition, the flare may also be augmented with natural gas if the quality of the landfill gas falls below the combustible level, about 9% methane. The fuel cell requires a minimum of 50% methane and does not tolerate oxygen or contaminants to operate properly. The microturbines require a minimum of 30% methane and are a little more tolerant to contaminants.

Calculations

Emissions are based on worst case when the eight microturbines, fuel cell and partial flare (1640 scfm + 60 scfm + 6400 scfm) are in operation simultaneously and not when only flare is in full operation (8100 scfm).
ROG emissions are calculated (for Offset) based on flaring the same amount of gas

Emissions from each microturbine:

Each turbine is limited to 3.3 MM Btu/hr
Example:
At max flow, 205 scfm x 268 Btu/cft x 60 min/hr = 3.3 MM Btu/hr

ROG = 20 ppm x (21-18.5/21-3) x 4327 dscfm x 60 min/hr x 86 lb/379 cft
= 0.16 lbs/hr
= 3.8 lbs/day

ROG emissions per flare source test dated 6/22/07 were 15.2 lbs/hr inlet at 2014 dscfm inlet .

@98% destruction:
ROG = 15.2 lbs/hr x 205 scfm/2014 scfm x (1 -0.98)
= 0.031 lbs/hr
= 0.74 lbs/day

NOx = 9 ppm x (21-18.5/21-15) x 4327 dscfm x 60 min/hr x 46 lb/379 cft
= 0.12 lbs/hr
= 28.8 lbs/day

SOx = 40 ppm x 205 dscfm x 60 min/hr x 64 lb/379 cft
= 0.08 lbs/hr
= 2 lbs/day

CO = 9 ppm x (21-18.5/21-15) x 4327 dscfm x 60 min/hr x 28 lb/379 cft
= 0.072 lbs/hr
= 1.7 lbs/day

PM10 = 0.003 gr/dscf x 4,327 dscfm x 60 min/hr /7000 gr/lb
= 0.11 lbs/hr
= 2.7 lbs/day

Emissions from 8 microturbines:
ROG = 0.16 lbs/hr x 8
= 1.28 lbs/hr
= 31 lbs/day
@98% destruction:
ROG = 0.031 lbs/hr x 8
= 0.25 lbs/hr
= 6 lbs/day

NOx = 0.12 lbs/hr x 8
= 0.96 lbs/hr
= 23 lbs/day

SOx = 0.08 lbs/hr x 8
= 0.64 lbs/hr
= 15 lbs/day

CO = 0.072 lbs/hr x 8
= 0.57 lbs/hr
= 13.8 lbs/day

PM10 = 0.11 lbs/hr x 8
= 0.88 lbs/hr
= 21 lbs/day

Emissions from the fuel cell:
Fuel cell is limited to 2.2 MM Btu/hr
Example:
At max flow, 60 scfm x 611 Btu/cft x 60 min/hr = 2.2 MMBtu/hr

ROG = 20 ppmv x (21-12.1/21-3) x 86 lbs/379 cft x 899 scf/min x 60 min/hr
= 0.12 lbs/hr
= 2.9 lbs/day
ROG emissions per flare source test dated 6/22/07 were 15.2 lbs/hr inlet at 2014 dscfm inlet .
@98% destruction:
ROG = 15.2 lbs/hr x 60 scfm/2014 scfm x (1 -0.98)
= 0.009 lbs/hr
= 0.217 lbs/day

NOx = 5 ppmv x (21-12.1/21-15) x 46 lbs/379 cft x 899 scf/min x 60 min/hr
= 0.05 lbs/hr
= 1.2 lbs/day

SOx = 40 ppmv x 64 lbs/379 cft x 60 scf/min x 60 min/hr
= 0.024 lbs/hr
= 0.6 lbs/day

CO = 4.5 ppmv x (21-12.1/21-15) x 28 lbs/379 cft x 899 scf/min x 60 min/hr
= 0.027 lbs/hr
= 0.65 lbs/day

PM10 = 0.003 gr/dscf x lb/7000 g x 899 dscf/min x 60 min/hr
= 0.023 lbs/hr
= 0.55 lbs/day

Emissions from the flare:
Flare is limited to 75.6 MM Btu/hr.
Example: At max flow (8100 SCFM), 8100 scfm x 155 Btu/cft x 60 min/hr = 75.6 MMBtu/hr
At max BTU/cft (360 Btu/cft), 3500 scfm x 360 Btu/cft x 60 min/hr = 75.6 MMBtu/hr
Flare emissions based on 6400 scfm = 8,100 scfm (flare) - 1640 scfm (turbines) - 60 scfm (fuel cell).

ROG emissions per source test dated 6/22/07.
ROG = 0.31 lbs/hr x 6400/2014)
= 0.98 lbs/hr
= 23 lbs/day
ROG = 1.23 lbs/hr (at 8100 scfm)

NOx based on BACT.
NOx = 0.025 lbs/MMBtu x 75.6 MMBtu/hr x 6400/8100
= 1.49 lbs/hr
= 36 lbs/day
NOx = 1.89 lbs/hr (at 8100 scfm)

SOx based on 40 ppm H2S per applicant.
SOx = 40 ppmv x 64 lbs/379 scft x 6,400 scft/min x 60 min/hr
= 2.6 lbs/hr
= 62 lbs/day
SOx = 3.39 lbs/hr (at 8100 scfm)

CO based on BACT.
CO = 0.06 lbs/MMBtu x 75.6 MMBtu/hr x 6400/8100
= 3.6 lbs/hr
= 86 lbs/day
CO = 4.46 lbs/hr (at 8100 scfm)

PM10 per applicant.
PM10 = 0.0152 lbs/MMBtu x 75.6 MMBtu/hr x 6400/8100
= 0.91 lbs/hr
= 22 lbs/day
PM10 = 1.15 lbs/hr (at 8100 scfm)

Existing emissions from two existing boilers, to be removed (A/N 422941 and 422942). Since the boilers will not be removed contemporaneously, the boiler emissions will not be subtracted.

ROG = 2.6 lbs/hr
= 62 lbs/day

NOx = 10 lbs/hr
= 240 lbs/day

SOx = 5.8 lbs/hr
= 139 lbs/day

CO = 7.17 lbs/hr (Based on standby flares)
= 172 lbs/day

PM10 = 6.8 lbs/hr
= 163 lbs/day

Emissions increase/decrease.
Microturbines + fuel cell + flare

ROG = (1.28 + 0.12 + 0.97) lbs/hr
= 2.37 lbs/hr
= 57lbs/day

NOx = (0.96 + 0.05 + 1.49) lbs/hr
= 2.5 lbs/hr
= 60 lbs/day

SOx = (0.64 + 0.024 + 2.6) lbs/hr
= 3.26 lbs/hr
= 78 lbs/day

CO = (0.57 + 0.027 + 3.6) lbs/hr
= 4.2 lbs/hr
= 100 lbs/day

PM10 = (0.88 + 0.023 + 0.91) lbs/hr
= 1.81 lbs/hr
= 43.5 lbs/day

Evaluation

Rule 401 Visible Emissions:
No violations are expected.

Rule 402 Nuisance:
No violations are expected.

Reg II: CEQA
A Negative Declaration was prepared and approved by the Los Angeles County Sanitation Districts (LACSD) on March 27, 2008. The LACSD determined that the project will not have a significant effect on the environment.

Rule 212 Not located within 1000 feet of a school, toxic risk is less ten in a million but the emission increase exceeds 212g. Therefore, a public notice is required since this is a significant project.

Rule 404 Particulate Matter:

Microturbines

0.88 lbs/hr x 7000 gr/lb = 0.003 gr/dscf
34,616 dscfm x 60 min/hr
Allowable losses = 0.049 gr/dscf

Fuel cell

0.023 lbs/hr x 7000 gr/lb = 0.003 gr/dscf
899 dscfm x 60 min/hr
Allowable losses = 0.196 gr/dscf

Flare

0.91 lbs/hr x 7000 gr/lb = 0.003 gr/dscf
31,914 dscfm x 60 min/hr
Allowable losses = 0.052 gr/dscf

Rule 407 Liquid and Gaseous Air Contaminants:

Microturbines

(a)(1) Actual CO losses.

$$0.57 \frac{\text{lbs}}{\text{hr}} \times 379 \frac{\text{cft}}{\text{lb mole}} \times \frac{\text{lb mole}}{28 \text{ lb CO}} \times \frac{\text{min}}{34616 \text{ cft}} \times \frac{\text{hr}}{60 \text{ min}} = 4 \text{ ppm}$$

Allowable losses = 2000 ppm

(a)(2) Actual SOx losses.

$$0.64 \frac{\text{lbs}}{\text{hr}} \times 379 \frac{\text{cft}}{\text{lb mole}} \times \frac{\text{lb mole}}{64 \text{ lb SO2}} \times \frac{\text{min}}{34616 \text{ cft}} \times \frac{\text{hr}}{60 \text{ min}} = 2 \text{ ppm}$$

Allowable losses = 500 ppm

Fuel Cell

(a)(1) Actual CO losses.

$$0.027 \frac{\text{lbs}}{\text{hr}} \times 379 \frac{\text{cft}}{\text{lb mole}} \times \frac{\text{lb mole}}{28 \text{ lb CO}} \times \frac{\text{min}}{899 \text{ cft}} \times \frac{\text{hr}}{60 \text{ min}} = 6.8 \text{ ppm}$$

Allowable losses = 2000 ppm

(a)(2) Actual SOx losses.

$$0.024 \frac{\text{lbs}}{\text{hr}} \times 379 \frac{\text{cft}}{\text{lb mole}} \times \frac{\text{lb mole}}{64 \text{ lb SO2}} \times \frac{\text{min}}{899 \text{ cft}} \times \frac{\text{hr}}{60 \text{ min}} = 2.6 \text{ ppm}$$

Allowable losses = 500 ppm

Flare
(a)(1) Actual CO losses.
3.6 lbs x 379 cft x lb mole x min x hr = 21 ppm
hr lb mole 28 lb CO 31914 cft 60 min
Allowable losses = 2000 ppm

(a)(2) Actual SOx losses.
2.6 lbs x 379 cft x lb mole x min x hr = 8 ppm
hr lb mole 64 lb SO2 31914 cft 60 min
Allowable losses = 500 ppm

Rule 409 Combustion Contaminants:
Microturbines
Particulate emissions are 0.003 gr/dscf.

Fuel Cell
Particulate emissions are 0.003 gr/dscf.

Flare
Particulate emissions are 0.003 gr/dscf.

Equipment is in compliance (0.1 gr/scf allowable).

Rule 431.1 Sulfur Content of Gaseous Fuels:
Microturbines
0.64 lbs SOx/hr x 34 lbs H2S/ 64 lbs SOx = 0.34 lbs H2S/hr
0.34 lbs/hr x 379 cft/34 lbs H2S x 1/1640 cfm x hr/60 min = 38 ppm

Fuel Cell
0.024 lbs SOx/hr x 34 lbs H2S/ 64 lbs SOx = 0.013 lbs H2S/hr
0.013 lbs/hr x 379 cft/34 lbs H2S x 1/60 cfm x hr/60 min = 40 ppm

Flare
2.6 lbs SOx/hr x 34 lbs H2S/ 64 lbs SOx = 1.38 lbs H2S/hr
1.38 lbs/hr x 379 cft/34 lbs H2S x 1/6400 cfm x hr/60 min = 40 ppm

Equipment is in compliance. Sulfur compounds are not expected to exceed 150ppm.

Rule 1150.1 Control of Gaseous Emissions from MSW Landfills:
The microturbines, fuel cell and flare will meet ROG emissions of 20 ppm or 98% destruction.

Rule 1134 Emissions of NOx from Stationary Gas Turbines:
Not applicable since microturbines are less than 0.3 MW

Reg. XIII: New Source Review.

BACT:

Microturbines

VOC- 20 ppmv or 98% destruction
NOx - 25 ppmv dry at 15% O2
SOx – 150 ppm(Rule 431.1)
CO – 100 ppmv dry at 15% O2
PM10 – Fuel gas pretreatment

Fuel Cell

Although there are no BACT guidelines for fuel cells, the fuel cell is expected to meet the following:
VOC- 20 ppmv or 98% destruction
NOx - 5 ppmv dry at 15% O2
SOx – 40 ppm inlet H2S (Rule 431.1)
CO – 4.5 ppmv dry at 15% O2
PM10 – 0.003 gr/dscf (fuel pretreatment)

Flare

VOC - automatic combustion air dampers, automatic shutoff and restart, minimum 1500 ^{0}F and minimum 0.6 sec. retention time.
NOX - 0.025 lbs/MM Btu
CO – 0.06 lbs/MM Btu
PM10- Knockout vessel

Equipment is in compliance.

MODELLING:

Microturbines

Not required. Emissions are less than Table A-1

Fuel Cell

Not required. Emissions are less than Table A-1

Flare

Modeling is required since emissions exceed Table A-1
Max GLC = 0.754 ug/m3 @ 0.126 gr/sec
Compliance is expected. See attached Table A-2

OFFSETS:
Emissions will be offset from the Priority Reserve per 1309.1(a)(3).

Rule 1401: Toxic Air Contaminants:

Microturbines - toxic risk is 1.7 in a million (See applicants risk assessment)

Fuel cell - toxic risk is 0.16 in a million (See applicants risk assessment)
The HIC and HIA are less than 1 and a cancer burden less than 0.5.

Flare - exempt from a risk assessment per Rule (g)(1)(C) functionally identical replacement. (Replaces the existing flare station)

Equipment is in compliance.

Rule 3000: Title V Permits
Emission increase exceeds Table 1. Therefore, this is a significant permit revision. A 45 day EPA review and a 30 day public notice is required.

NSPS (WWW), NESHAP (AAAA):
This landfill is not subject to these regulations because final closure occurred in 1980.

Conclusions and Recommendations

Equipment is expected to comply with the Rules and Regulations of the SCAQMD. A proposed revised Title V permit shall be sent for a 45 day EPA review and a 30 day public notice.