San Joaquin Valley
AIR POLLUTION CONTROL DISTRICT

HEALTHY AIR LIVING™

NOV 21 2011

Tudor Williams
Cambrian Energy Woodville, LLC
One Wilshire Building Suite 2420
624 Grand Avenue
Los Angeles, CA 90017

RE: Notice of Final Action - Authority to Construct
Project Number: S-1103547

Dear Mr. Williams:

The Air Pollution Control Officer has issued Authority to Construct permits to Cambrian Energy Woodville, LLC for installing a 1,100 bhp landfill gas-fired internal combustion engine powering an electrical generator, at the Teapot Dome Landfill in Tulare County. Enclosed are copies of the Authority to Construct permits and a copy of the notice of final action to be published approximately three days from the date of this letter.

Notice of the District's preliminary decision to issue this Authority to Construct was published on September 7, 2011. The District's analysis of the proposal was also sent to CARB on September 7, 2011. All comments received following the District's preliminary decision on this project were considered.

Thank you for your cooperation in this matter. If you have any questions, please contact Mr. Leonard Scandura at (661) 392-5500.

Sincerely,

David Warner
Director of Permit Services

DW: DK/cm

Enclosures

Seyed Sadredin
Executive Director/Air Pollution Control Officer

Northern Region
4800 Enterprise Way
Modesto, CA 95356-8718
Tel: (209) 557-6400 FAX: (209) 557-6475

Central Region (Main Office)
1990 E. Gettysburg Avenue
Fresno, CA 93726-0244
Tel: (559) 230-6000 FAX: (559) 230-6061

Southern Region
34946 Flyover Court
Bakersfield, CA 93308-9725
Tel: 661-392-5500 FAX: 661-392-5585

www.valleyair.org www.healthyairliving.com

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AIR POLLUTION CONTROL DISTRICT

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NOV 21 2011

Mike Tollstrup, Chief
Project Assessment Branch
Stationary Source Division
California Air Resources Board
PO Box 2815
Sacramento, CA 95812-2815

RE: Notice of Final Action - Authority to Construct
Project Number: S-1103547

Dear Mr. Tollstrup:

Thank you for your comment on the above project. Following are the District's specific responses to your comment :

Comment: A top-down BACT analysis was not included for the project.

The District has included the top-down BACT analysis for NOx, VOC, and PM10 emissions in our revised application review. This analysis determined that the proposed control equipment satisfies BACT. Please see revised BACT evaluation (attached).

The Air Pollution Control Officer has issued Authority to Construct permits to Cambrian Energy Woodville, LLC for installing a 1,100 bhp landfill gas-fired internal combustion engine powering an electrical generator, at the Teapot Dome Landfill in Tulare County.

Enclosed are copies of the Authority to Construct permits and a copy of the notice of final action to be published approximately three days from the date of this letter.

We trust that the above response satisfies your concerns and appreciate your concurrence on this project. On the other hand, if you disagree with the District's position, we would appreciate your prompt response detailing your concerns.
If you have any questions, regarding the above response, or require additional clarification, please contact Mr. Leonard Scandura at (661) 392-5500.

Sincerely,

David Warner
Director of Permit Services

DW: DK/cm

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Visalia Times-Delta

NOTICE OF FINAL ACTION
FOR THE ISSUANCE OF AUTHORITY
TO CONSTRUCT PERMITS

NOTICE IS HEREBY GIVEN that the Air Pollution Control Officer has issued Authority to Construct permits to Cambrian Energy Woodville, LLC for installing a 1,100 bhp landfill gas-fired internal combustion engine powering an electrical generator, at the Teapot Dome Landfill in Tulare County.

All comments received following the District's preliminary decision on this project were considered.

The application review for Project #S-1103547 is available for public inspection at http://www.valleyair.org/notices/public_notices_idx.htm and the **SAN JOAQUIN VALLEY UNIFIED AIR POLLUTION CONTROL DISTRICT, 34946 FLYOVER COURT, BAKERSFIELD, CA 93308.**

San Joaquin Valley
AIR POLLUTION CONTROL DISTRICT

HEALTHY AIR LIVING™

AUTHORITY TO CONSTRUCT

PERMIT NO: S-7844-1-0 **ISSUANCE DATE:** 11/16/2011

LEGAL OWNER OR OPERATOR: CAMBRIAN ENERGY WOODVILLE, LLC
MAILING ADDRESS: 624 SOUTH GRAND AVENUE
SUITE 2420
LOS ANGELES, CA 90017

LOCATION: 21063 AVENUE 128
PORTERVILLE, CA 93257

EQUIPMENT DESCRIPTION:
1,100 BHP CATERPILLAR MODEL 3516 SITA LANDFILL GAS-FIRED LEAN BURN IC ENGINE POWERING A 850 KW ELECTRICAL GENERATOR AND SERVED BY A NOXTECH EMISSIONS CONTROL UNIT

CONDITIONS

1. No air contaminant shall be released into the atmosphere which causes a public nuisance. [District Rule 4102]
2. No air contaminant shall be discharged into the atmosphere for a period or periods aggregating more than three minutes in any one hour which is as dark as, or darker than, Ringelmann 1 or 20% opacity. [District Rule 4101]
3. Particulate matter emissions shall not exceed 0.1 grains/dscf in concentration. [District Rule 4201]
4. All equipment shall be maintained in good operating condition and shall be operated per the manufacturer's specifications to minimize emissions of air contaminants into the atmosphere. [District Rule 2201]
5. The engine shall be fired solely on landfill gas. [District Rules 2201 and 4801]
6. This engine shall be equipped with an operational non-resettable elapsed time meter. [District Rules 2201 and 4702]
7. The engine shall be equipped with a fuel flow meter that shall be used to accurately determine and record the fuel flow rate into the engine. [District Rule 2201]
8. The landfill gas flow rate into the engine shall not exceed 475,992 cubic feet per day (19,833 cubic feet per hour). [District Rule 2201]
9. During start-up periods the NOx emission rate shall not exceed 1.0 g/bhp-hr. [District Rules 2201 and 4702]
10. During start-up periods the VOC emission rate shall not exceed 1.1 g/bhp-hr. [District Rules 2201 and 4702]

CONDITIONS CONTINUE ON NEXT PAGE

YOU MUST NOTIFY THE DISTRICT COMPLIANCE DIVISION AT (661) 392-5500 WHEN CONSTRUCTION IS COMPLETED AND PRIOR TO OPERATING THE EQUIPMENT OR MODIFICATIONS AUTHORIZED BY THIS AUTHORITY TO CONSTRUCT. This is NOT a PERMIT TO OPERATE. Approval or denial of a PERMIT TO OPERATE will be made after an inspection to verify that the equipment has been constructed in accordance with the approved plans, specifications and conditions of this Authority to Construct, and to determine if the equipment can be operated in compliance with all Rules and Regulations of the San Joaquin Valley Unified Air Pollution Control District. Unless construction has commenced pursuant to Rule 2050, this Authority to Construct shall expire and application shall be cancelled two years from the date of issuance. The applicant is responsible for complying with all laws, ordinances and regulations of all other governmental agencies which may pertain to the above equipment.

Seyed Sadredin, Executive Director / APCO

DAVID WARNER, Director of Permit Services
S-7844-1-0 : Nov 16 2011 11:23AM – KLEVANND : Joint Inspection NOT Required

11. During start-up periods the CO emission rate shall not exceed 4.4 g/bhp-hr. [District Rules 2201 and 4702]
12. Except during start-up periods, the NOx emission rate shall not exceed 11 ppmv @ 15% O2. [District Rules 2201 and 4702]
13. Except during start-up periods, the VOC emission rate shall not exceed 26 ppmv @15% O2. [District Rules 2201 and 4702]
14. Except during start-up periods, the CO emission rate shall not exceed 168 ppmv @15% O2. [District Rules 2201 and 4702]
15. The PM10 emission rate shall not exceed 0.1 g/bhp-hr. [District Rule 2201]
16. The H2S content of the landfill gas shall not exceed 21 ppmvd. [District Rule 2201]
17. Ammonia (NH3) emissions shall not exceed 11 ppmvd @ 15% O2. [District Rule 2201]
18. Either the non-methane organic compound (NMOC) emissions from the landfill gas-fired engine shall not exceed 20 ppmvd (as Hexane) at 3 % O2 or the NMOC destruction efficiency shall be at least 98%. [District Rule 2201 and 40 CFR 60.752(b)(2)(iii)(B)]
19. The start-up periods shall not exceed a combined total of 0.5 hours in any one day. [District Rule 2201]
20. A start-up period is the amount of time necessary to operate the 1 MMBtu/hr burner serving the Noxtech, Inc. Aftertreatment system to bring the the Noxtech, Inc. Aftertreatment system up to the minimum temperature necessary for the Noxtech, Inc. Aftertreatment system to reduce emissions of NOx to the non-start-up NOx emissions rate required by this permit. [District Rule 2201]
21. The temperature of the Noxtech, Inc Aftertreatment reactor shall be maintained within the manufacturer's suggested range. [District Rules 2201 and 4702]
22. The Noxtech, Inc. Aftertreatment system shall be maintained in accordance with the recommendations of Noxtech, Inc. Records of the Noxtech, Inc. Aftertreatment system maintenance shall be maintained. [District Rules 2201 and 4702]
23. The exhaust stack shall be equipped with permanent provisions to allow collection of stack gas samples consistent with EPA test methods and shall be equipped with safe permanent provisions to sample stack gases with a portable NOx, CO, and O2 analyzer during District inspections. The sampling ports shall be located in accordance with the CARB regulation titled California Air Resources Board Air Monitoring Quality Assurance Volume VI, Standard Operating Procedures for Stationary Emission Monitoring and Testing. [District Rule 1081]
24. Source testing to measure landfill gas-combustion NOx, CO, NH3, and VOC emissions from this unit shall be conducted within 60 days of initial start-up. [District Rules 1081, 2201, and 4702]
25. Source testing to measure landfill gas-combustion NOx, CO, NH3, and VOC emissions from this unit shall be conducted at least once every 12 months. After demonstrating compliance on two consecutive annual source tests, the unit shall be tested not less than once every 24 months. If the result of the 24-month source test demonstrates that the unit does not meet the applicable emission limits, the source testing frequency shall revert to at least once every 12 months [District Rules 2201 and 4702]
26. Emissions source testing shall be conducted with the engine operating either at conditions representative of normal operations or conditions specified in the Permit to Operate. [District Rule 4702]
27. For emissions source testing, the arithmetic average of three 30-consecutive-minute test runs shall apply. If two of three runs are above an applicable limit, the test cannot be used to demonstrate compliance with an applicable limit. VOC emissions shall be reported as methane and as hexane. NOx, and CO concentrations shall be reported in ppmv, corrected to 15% oxygen. VOC concentrations shall be reported in ppmv, corrected to 15% oxygen as methane and corrected to 3% oxygen as hexane. [District Rules 2201, 4702 and 40 CFR 60.752(b)(2)(iii)(B)]

CONDITIONS CONTINUE ON NEXT PAGE

28. The following methods shall be used for testing: NOx (ppmv) - EPA Method 7E or ARB Method 100, CO (ppmv) - EPA Method 10 or ARB Method 100, stack gas oxygen - EPA Method 3 or 3A or ARB Method 100, VOC (ppmv) - EPA Method 18, 25A or 25B, or ARB Method 100, NMOC (ppmv) - EPA Method 18, 25, 25A, or 25C, PM10 - EPA Methods 201A and 202, stack gas oxygen - EPA Method 3 or 3A or ARB Method 100, and ammonia - BAAQMD ST-1B. EPA approved alternative test methods as approved by the District may also be used to address the source testing requirements of this permit. [District Rules 1081 and 4702 and 40 CFR 60.754(d)]

29. Compliance demonstration (source testing) shall be District witnessed, or authorized and samples shall be shipped under custody transfer and tested by a California Air Resources Board certified testing laboratory. Source testing shall be conducted using the methods and procedures approved by the District. Source testing may occur more frequently than once every 12 months at the discretion of the equipment owner or operator, if such frequency is necessary to schedule source testing during normal operating periods. Any source testing conducted more frequently than required, shall reset the 12-month testing clock. [District Rule 1081]

30. Source testing shall be conducted using the methods and procedures approved by the District. The District must be notified at least 30 days prior to any compliance source test, and a source test plan must be submitted for approval at least 15 days prior to testing. [District Rule 1081]

31. The results of each source test shall be submitted to the District within 60 days thereafter. [District Rule 1081]

32. The sulfur compound content of the landfill gas entering this stationary source shall be monitored and recorded monthly. After four consecutive monthly tests show compliance, the monitoring frequency may be reduced to once every calendar quarter. If quarterly monitoring shows an exceedance of the limit, then monthly monitoring shall resume and continue until four consecutive months of monitoring show compliance with the limit. Once compliance with the limit is shown for four consecutive months, then the monitoring frequency may return to quarterly. Monitoring shall not be required in any month during which neither the engines nor the flare operate. Records of monitoring results shall be maintained as required elsewhere in this permit. [District Rule 2201]

33. Monitoring of the landfill gas sulfur compound content shall be performed using Draeger tubes or an alternative method approved in writing by the District. [District Rule 2201]

34. The permittee shall monitor and record the stack concentration of NOx, CO, and O2 concurrently at least once every calendar month (in which a source test is not performed) using a portable emission monitor that meets District specifications. [In-stack O2 monitors may be allowed if approved by the APCO.] Monitoring shall not be required if the engine is not in operation, i.e. the engine need not be started solely to perform monitoring. Monitoring shall be performed within five days of restarting the engine unless monitoring has been performed within the last month. Records must be maintained of the dates of non-operation to validate extended monitoring frequencies. [District Rules 2201 and 4702]

35. The permittee shall monitor and record the stack concentration of NH3 at least once every calendar quarter (in which a source test is not performed). NH3 monitoring shall be conducted utilizing Draeger tubes or a District approved equivalent method. Monitoring shall not be required if the engine is not in operation, i.e. the engine need not be started solely to perform monitoring. Monitoring shall be performed within five days of restarting the engine unless monitoring has been performed within the last month. Records must be maintained of the dates of non-operation to validate extended monitoring frequencies. [District Rule 2201]

36. If either the NOx or CO concentrations corrected to 15% O2, as measured by the portable analyzer, or the NH3 concentrations corrected to 15% O2, as measured by District approved gas-detection tubes, exceed the allowable emissions levels, the permittee shall return the emissions to the acceptable level as soon as possible, but no longer than 8 hours of operation after detection. If the portable analyzer readings continue to exceed the allowable emissions levels after 8 hours of operation after detection, the permittee shall notify the District within the following 1 hour and conduct a certified source test within 60 days of the first exceedance. In lieu of conducting a source test, the permittee may stipulate a violation has occurred, subject to enforcement action. The permittee shall then correct the violation, show compliance has been re-established, and resume monitoring procedures. If the deviations are the result of a qualifying breakdown condition pursuant to Rule 1100, the permittee may fully comply with Rule 1100 in lieu of the performing the notification and testing required by this condition. [District Rules 2201 and 4702]

CONDITIONS CONTINUE ON NEXT PAGE

37. All alternate monitoring parameter emission readings shall be taken with the unit operating either at conditions representative of normal operations or conditions specified in the permit-to-operate. The analyzer shall be calibrated, maintained, and operated in accordance with the manufacturer's specifications and recommendations or a protocol approved by the APCO. Emission readings taken shall be averaged over a 15 consecutive-minute period by either taking a cumulative 15 consecutive-minute sample reading or by taking at least five readings, evenly spaced out over the 15 consecutive-minute period. [District Rules 2201 and 4702]

38. The permittee shall maintain records of: (1) the date and time of NOx, CO, O2 and NH3 measurements, (2) the O2 concentration in percent and the measured NOx, CO, and NH3 concentrations corrected to 15% O2, (3) make and model of exhaust gas analyzer, (4) exhaust gas analyzer calibration records, (5) the method of determining the NH3 emission concentration, and (6) a description of any corrective action taken to maintain the emissions within the acceptable range. [District Rules 2201 and 4702]

39. The permittee shall maintain an engine operating log to demonstrate compliance. The engine operating log shall include, on a monthly basis, the following information: total hours of operation, type of fuel used, maintenance or modifications performed, monitoring data, compliance source test results, and any other information necessary to demonstrate compliance. [District Rule 4702]

40. This engine shall be operated and maintained in proper operating condition per the manufacturer's requirements as specified on the Inspection and Monitoring (I&M) plan submitted to the District. [District Rule 4702]

41. The permittee shall update the I&M plan for this engine prior to any planned change in operation. The permittee must notify the District no later than seven days after changing the I&M plan and must submit an updated I&M plan to the APCO for approval no later than 14 days after the change. The date and time of the change to the I&M plan shall be recorded in the engine's operating log. For modifications, the revised I&M plan shall be submitted to and approved by the APCO prior to issuance of the Permit to Operate. The permittee may request a change to the I&M plan at any time. [District Rule 4702]

42. The permittee shall maintain a daily record that includes the date, the hours the engine operated, and the total daily fuel usage in standard cubic feet. [District Rule2201 and 4702]

43. The permittee shall maintain a record that includes the date, the time that each start-up began, the duration of each start-up, and the total time for all start-up periods for each day. [District Rule 2201]

44. The permittee shall maintain records of the cumulative total annual NOx, CO, and VOC emissions from the entire stationary source. These records shall be updated weekly. [District Rule 2201]

45. All records shall be maintained and retained on-site for a minimum of five years, and shall be made available for District inspection upon request. [District Rules 2201 and 4702]

Appendix E

Best Available Control Technology

3. Top-Down BACT Determination

EPA's RACT/BACT/LAER Clearinghouse database, CARB's BACT Clearinghouse database, the Bay Area Air Quality Management District (BAAQMD) BACT Clearinghouse, the South Coast Air Quality Management District (SCAQMD) BACT Clearinghouse, and the San Diego Air Pollution Control District (SDAPCD) BACT Clearinghouse were queried for BACT requirements for waste gas-fired IC engines. In addition, it is noted that SCAQMD Rule 1110.2 includes a future emission limit of 11 ppmvd NO_x, 250 ppmvd CO, and 30 ppmvd VOC (as carbon), all at @ 15% O_2, for landfill and digester gas-fired engines; these emission limits can become effective only if the SCAQMD Executive Officer reports to the governing board that a technological assessment (currently ongoing) confirms that the limits are achievable. The cost data that was used for the BACT determination was from project S-1103269. As this cost analysis was done within the past 12 months.

NO_x BACT:

Step 1 – Identify All Possible Control Technologies:

The following NO_x control technologies and emissions limits were identified as part of the BACT review of project S-1080811 for biogas-fired IC engines.

1) NO_X emissions ≤ 0.6 g/bhp-hr (lean burn, pre-stratified charge, or equivalent IC engine) – Achieved in Practice
2) NO_X emissions ≤ 0.15 g/bhp-hr (Selective Catalytic Reduction (SCR), Selective Non-Catalytic Reduction (SNCR) system, or equivalent.) – Achieved in Practice
3) Small Gas Turbine (< 25 ppmv NO_X @ 15% O_2) – Alternate Basic Equipment
4) Microturbine[3] (0.5 lb/MW-hr) – Alternate Basic Equipment
5) Fuel Cell (≤ 0.05 lb/MW-hr ≈ 1.5 ppmv NO_X @ 15% O_2) – Alternate Basic Equipment
6) Stirling Engine (≤ 30 ppmv NO_X @ 3% O_2 external combustion ≈ 10 ppmv NO_X @ 15% O_2) – Alternate Basic Equipment

While the District has previously considered NO_x emissions of 0.15 g/bhp-hr to only be technologically feasible, notice must be taken of recent developments in other jurisdictions. The District is aware of at least three other facilities at which LFG-fired engines equipped with add-on control devices are in compliance with this emission limit or an equivalent NO_x concentration. One of these facilities, Ameresco Half Moon Bay in BAAQMD, recently completed a 12,000-hour evaluation of the NO_x controls with compliance demonstrated through data gathered by a continuous emissions monitoring system. The emissions data and operational experience at this facility were sufficient to convince Ameresco to amend its Ameresco Foothill application to incorporate NO_x add-on controls. Furthermore, US EPA Region IX staff were consulted and concurred with the determination that an emission limit of 0.15 g/bhp-hr using add-on controls is achieved in practice.

Step 2 – Eliminate Technologically Infeasible Options:

1) Small Gas Turbine (< 25 ppmv NO_X @ 15% O_2) – Alternate Basic Equipment:

According to Solar Turbines, biogas-fired gas turbines rated less than 3 MW are not currently being produced or marketed since this size range is generally covered by other generation technologies such as reciprocating IC engines and microturbines. The proposed project calls for engines driving 0.850 MW generator; the comparable turbines would be below the range that is currently being marketed. Therefore, small biogas turbines are not considered feasible for this particular project and will be eliminated from consideration at this time.

[3] The NO_x emission limit specified for a microturbine is the current requirement for waste gas-fired microturbines certified under the Air Resources Board distributed generation program.

2) Stirling Engine (≤ 30 ppmv NO_X @ 3% O_2 external combustion ≈ 10 ppmv NO_X @ 15% O_2) – Alternate Basic Equipment

It is not known if Stirling engines are currently being commercially produced and the small size of the units would likely be inadequate for the proposed project. Therefore, Stirling engines are not considered feasible for this particular project and will be eliminated from consideration at this time.

Step 3 – Rank Remaining Control Technologies by Control Effectiveness

1) Fuel Cell (1.5 ppmv NO_x @ 15% O_2) – Alternate Basic Equipment
2) NO_x emissions of 0.15 g/bhp-hr (SCR, SNCR, equivalent) – Achieved in Practice
3) Microturbine[4] (0.5 lb/MW-hr) – Alternate Basic Equipment

As shown previously, to produce 0.850 MW of electrical output the engine with NOxTech control at 0.15 g/bhp-hr produces 9.7 lb-NO_x/day. The microturbine producing the same amount of electricity produces 10.2 lb-NO_x/day. Note that a limit of 0.6 g/bhp-hr is dropped as the less stringent of the two achieved in practice emission limits.

Step 4 – Cost Effectiveness Analysis

Option 1: Fuel Cells (≤ 0.05 lb/MW-hr ≈ 1.5 ppmv NO_X @ 15% O_2)

Since Fuel Cells have reduced NO_X and VOC emissions in comparison to a reciprocating IC engine, a Multi-Pollutant Cost Effectiveness Threshold (MCET) will be used to determine if this option is cost-effective.

Assumptions
- Landfill Gas Production: 19,833 scf per hour = 173.7 MMscf/yr (applicant)
- Biogas F-Factor: 9,604 dscf/MMBtu (60 °F)
- Higher Heating Value for Landfill Gas: 450 Btu/scf
- Molar Specific Volume = 379.5 scf/lb-mol (60°F)
- Price for electricity: $0.093/kW-hr (based on California Renewable Energy Tariff)
- Btu to kW-hr conversion: 3,413 Btu/kW-hr

Assumptions for Proposed Landfill Gas-Fired IC Engines
- Typical purchase and Installation Cost for lean burn engines: $1,475/kW (estimated based on extensive review conducted by District)
- Typical operation costs for engines: $0.0152/kW-hr [(5)]
- Rule 4702 NO_X emission limit for waste gas fueled lean burn IC engines: 0.252 lb/MMBtu (65 ppmv @ 15% O_2)
- 40 CFR Part 60, Subpart JJJJ limit: 1.0 g-VOC/bhp-hr

[4] (0.85 MW) x (24 hr) x (0.5 lb/MW-hr) = 10.2 lb/day
[5] Based on extensive research conducted for District project S-1080811.

Assumptions for Fuel Cell System

- Net electrical efficiency for fuel cell power plant: 39% (includes parasitic load for gas conditioning system)
- Typical Purchase and Installation Cost for fuel cells including cost for biogas conditioning system: $7,000/kW
- Typical operation costs for fuel cells: $0.0215/kW-hr [3]
- Fuel cell Stack Replacement Cost: $500/kW-yr (conservatively estimated based stack replacement being one quarter of initial installation cost and stack replacement being required every 3.5 years)
- Fuel Cell NO_X emissions: 0.07 lb/MW-hr (0.02 lb/MMBtu, *ARB Distributed Generation Certification)*
- Fuel Cell VOC emissions: 0.02 lb-VOC/MW-hr (0.003 lb/MMBtu, *ARB Distributed Generation Certification*)
- Size of fuel cell system needed for proposed project: 850 kW
- Fuel cells may offer the ability for greater heat recovery in comparison to an IC engine; however, the value of this heat will not be quantified since it is not known if the facility has an economical use for it.

1. Capital Cost:

The estimated increased incremental capital cost for replacement of the proposed engines with fuel cells is calculated based on the difference in cost of fuel cells and IC engines for a 850 kW system.

The incremental capital cost for replacement of the proposed IC engines with fuel cells is calculated as follows:

850 kW x ($7,000/kW – $1,475/kW) = **$4,696,250**

The biogas conditioning system that is already assumed in the above annual cost was developed for a dairy digester project. The biogas conditioning system is required to remove hydrogen sulfide from the biogas, but it is not designed to remove siloxanes from biogas because dairy digesters typically produce negligible siloxanes. LFG, on the other hand, can contain substantial concentrations of siloxanes which must be removed in order for the fuel cell to function.

Previous projects have provided capital costs for a siloxane removal system and additional construction costs, for a total of $1,829,651. The total capital cost of the siloxane removal system and incremental cost of the fuel cells is:

C = ($4,696,250) + ($1,829,651) = $6,525,901

Pursuant to District Policy APR-1305, Section X (11/09/99), the incremental capital cost for the purchase of the fuel cell system will be spread over the expected life of the system using the capital recovery equation. The expected life of the entire system will be estimated at 10 years. A 10% interest rate is assumed in the equation and the assumption will be made that the equipment has no salvage value at the end of the ten-year cycle.

$$A = [P \times i(I+1)^n] \div [(I+1)^n-1]$$

Where:
A = Annual Cost
P = Present Value
I = Interest Rate (10%)
N = Equipment Life (10 years)

$$A = [\$6,525,901 \times 0.1(1.1)^{10}] \div [(1.1)^{10}-1] = \mathbf{\$1,062,060/year}$$

2. Annual Costs:

Electricity Generated

The amount of electricity potentially generated by each option is calculated as follows:

Proposed IC Engines

(850 kW) x (8,760 hr/yr) = 7,446,000 kW-hr/year

Fuel Cells (Alternate Equipment)

= (19,833 scf/hr) x (450 Btu/scf) x (1 kW-hr/3,413 Btu) x (0.39) x (8,760 hr/yr)
= 8,933,741 kW-hr/year

Annual Costs of Increased Electric Generation

(7,446,000 kW-hr/yr – 8,933,741 kW-hr/yr) x \$0.093/kW-hr = **\$ -138,360/year**

Annual Operation and Maintenance Cost

The annual operation and maintenance costs for each option are calculated as follows:

Proposed IC Engine

(7,446,000 kW-hr/year) x (\$0.0152/kW-hr) = **\$113,179/year**

Fuel Cells (Alternate Equipment)

(8,933,741 kW-hr/yr) x ($0.0215/kW-hr) = **$192,075/year**

Annual Costs of Increased Maintenance

($328,794/yr) – ($213,043/yr) = **$348,999/year**

Fuel Cell Stack replacement Costs

($500/kW-yr) x (850 kW) = **$425,000/year**

Siloxane Removal System Maintenance

Estimate of additional operational and maintenance costs for siloxane removal system, which total $300,845/yr.

3 Total Increased Annual Costs for Fuel Cell System as an Alternative to Proposed Engines:

= ($1,062,060/yr) – ($138,360/yr) + ($348,999/yr) + ($425,000/yr) + ($300,845/yr)
= **$1,998,544/year**

4. NO_X and VOC Emission Reductions:

Pursuant to the District's Revised BACT Cost Effectiveness Thresholds Memo (5/14/08), District Standard Emissions that will be used to compare with the alternative equipment will be based on the emission limits for lean burn agricultural IC engines contained in District Rule 4702, Section 5.1.1, Table 2b. Note that District standard emissions cannot be greater (in the case of CO and VOC) than the emissions allowable under the applicable Federal NSPS, Subpart JJJJ. The following emissions factors will be used for the cost analysis:

District Standard Emissions for IC engines:

0.252 lb-NO_X/MMBtu (65 ppmv NO_X @ 15% O_2)
0.87 lb-VOC/MMBtu (1.0 g-VOC/bhp-hr)[6]

Emissions from Fuel Cells as Alternative Equipment:

0.021 lb-NO_X/MMBtu (0.07 lb/MW-hr)
0.0027 lb-VOC/MMBtu (0.02 lb/MW-hr)

6 EF = (1.0 g/bhp-hr) ÷ [(3,413 Btu/kW-hr) x (1 kW/1.341 bhp)] x (1 lb/453.6 g) x (106 Btu/MMBtu) = 0.87 lb/MMBtu

5. Proposed Engines Compared to Fuel Cells based on District Standard Emission Reductions:

NO_X Emission Reductions
(173.7 MMscf/yr) x (450 Btu/scf) x (0.252 lb-NO_X/MMBtu – 0.021 lb-NO_X/MMBtu)
= 18,056 lb-NO_X/yr (9.03 ton/yr)

VOC Emission Reductions
(173.7 MMscf/yr) x (450 Btu/scf) x (0.87 lb-VOC/MMBtu – 0.0027 lb-VOC/MMBtu)
= 67,793 lb-VOC/yr (33.90 ton/yr)

6. Multi-Pollutant Cost Effectiveness Thresholds (MCET) for NO_X and VOC Reductions based on District Standard Emission Reductions:

[(9.03 ton-NO_X/year) x ($24,500/ton-$NO_X$)] + [(33.9 ton-VOC/year) x ($17,500/ton-VOC)]
= $814,485/year

As shown above, the annualized cost of this alternative ($1,998,544/yr) exceeds the Multi-Pollutant Cost Effectiveness Threshold (MCET) calculated for the NO_X and VOC emission reductions. Therefore, pursuant to the District's BACT policy, this option is not cost effective and is being removed from consideration.

Option 2: NO_x emissions of 0.15 g/bhp-hr (11 ppmvd @ 15% O_2)

Cambrian has proposed to install NoxTech for the engine to ensure compliance with a NO_x emission limit of 11 ppmv. Since the applicant has proposed this level of control, and this level of control is achieved in practice, a cost effectiveness analysis is not required. No further discussion is required.

Step 5 – Select BACT

BATC is satisfied by Cambrian's proposal to use IC engines controlled by NoxTech to comply with an emission limit of 11 ppmv. No further discussion is required.

PM_{10} BACT:

Step 1 – Identify All Possible Control Technologies:

1. 80% control (water scrubbing of H_2S from fuel gas or equal) – Achieved in Practice (Rescinded BACT Guideline 3.3.13)
2. 0.08 g/bhp-hr (0.2 lb/hr from 1,408 bhp engine[7], or equivalent) – Achieved in Practice (ARB Clearinghouse for Chino Bay Desalter Authority, SCAQMD) no source test required
3. 0.1 g/bhp-hr – Achieved in Practice (New Hampshire DEP TP-B-0531) 3-hr source test required

In addition, the US EPA RACT/BACT/LAER Clearinghouse (RBLC) lists a number of other facilities with LFG-fired engines and PM_{10} emission limits in excess of 0.1 g/bhp-hr.

Step 2 – Eliminate Technologically Infeasible Options

As mentioned previously in the discussion of SO_x BACT, water scrubbing of LFG is not technologically feasible and will be removed from consideration at this time. All other emission limits listed in Step 1 are technologically feasible. However, the 0.08 g/bhp-hr limit from the Chino Bay Desalter Authority does not require a source test so this limit can not be confirmed as feasible.

Step 3 – Rank Remaining Control Technologies by Control Effectiveness

1. 0.1 g/bhp-hr

Step 4 – Cost Effectiveness Analysis

Cambrian has proposed the most effective control remaining from Step 3. No cost effectiveness analysis is required.

Step 5 – Select BACT

BACT is satisfied by Cambrian's proposed emission limit of 0.1 g-PM_{10}/bhp-hr. No further discussion is required.

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7 The limit stated in the ARB BACT Clearinghouse is 0.2 lb/hr. Since this limit is stated with one significant digit, emissions measured at 0.249 lb/hr would not violate this limit. To avoid a rounding error that may artificially depress the emission limit, the g/bhp-hr equivalent will be calculated using 0.249 lb/hr as follows:
(0.249 lb/hr) x (453.6 g/lb) ÷ (1,408 bhp) = 0.08 g/bhp-hr

VOC BACT:

Step 1 – Identify All Possible Control Technologies:

Applicable VOC emission control technologies and associated emission limits were obtained from project S-1080811, which evaluated biogas-fired IC engines at a dairy.

The application review for project S-1080811, for agricultural biogas-fired IC engines, states that VOC emission control due to the use of a microturbine is equivalent to the use of an IC engine. This is because VOC emissions from either an IC engine or a microturbine are primarily dependent on the type of fuel used. Since both would be fired on the same landfill gas, it is assumed that the use of a microturbine will comply with the same VOC emission limit as an IC engine.

1) VOC emissions ≤ 0.20 g/bhp-hr (equivalent to 41 ppmvd @ 15% O_2 as CH_4) (lean burn or equivalent and positive crankcase ventilation) - (Achieved in Practice)
2) Fuel Cell (≤ 0.02 lb/MW-hr ≈ 2.0 ppmv VOC @ 15% O_2 as CH_4) - (Alternate Basic Equipment)
3) Microturbine (equivalent to achieved-in-practice BACT for VOC from IC engines) - (Alternate Basic Equipment)

Step 2 - Eliminate technologically infeasible options

There are no technologically infeasible options to eliminate from step 1.

Step 3 - Rank remaining options by control effectiveness

1) Fuel Cell (≤ 0.02 lb/MW-hr ≈ 2.0 ppmv VOC @ 15% O_2 as CH_4)
2a) IC engine with VOC emissions ≤ 0.20 g/bhp-hr
2b) Microturbine (equivalent to 0.20 g/bhp-hr)

Step 4 - Cost Effectiveness Analysis

Option 1: Fuel Cell (≤ 0.02 lb/MW-hr ≈ 2.0 ppmv VOC @ 15% O_2 as CH_4):

The multi-pollutant cost analysis performed above for the NO_X and VOC emissions demonstrated that the annualized cost of this alternate option exceeds the Multi Pollutant Cost Effectiveness Threshold calculated for the NO_X and VOC emission reductions achieved by this technology. Therefore, this option is not cost effective and is being removed from consideration at this time.

Option 2a: IC engines with VOC emissions ≤ 0.20 g/bhp-hr:

This option is achieved-in-practice. Therefore, a cost analysis is not required.

Option 2b: Microturbines:

As shown above, VOC emissions from a microturbine are expected to be identical to those from an IC engine. Since the applicant has proposed an equivalent level of VOC control effectiveness, a cost analysis is not necessary.

Step 5 - Select BACT

The highest ranked control technology remaining is VOC emissions of 0.20 g/bhp-hr. The applicant has proposed lean burn IC engines with VOC emissions less than or equal to 0.20 g/bhp-hr. Therefore, the proposed IC engines meet BACT requirements for VOC.