Preliminary Engineering Evaluation

for

BAAQMD PERMIT APPLICATION # 22636

Proposed Project:
New Landfill Gas to Energy Plant
Including Two Landfill Gas Fired Lean Burn IC Engines, a Landfill Gas Treatment System, and a Waste Gas Flare

BAAQMD PLANT # 20432

Applicant: Ameresco Vasco Road LLC
Location: Vasco Road Landfill, Livermore, CA

BAY AREA AIR QUALITY MANAGEMENT DISTRICT

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Ameresco Vasco Road LLC

PLANT # 20432

APPLICATION # 22636

A. BACKGROUND

This application is for the installation of a proposed landfill gas to energy facility that will be located on property owned Vasco Road Landfill (VRL; Plant # 5095) but that will be operated by an independent company: Ameresco Vasco Road LLC (Plant # 20432). The proposed equipment location is on a leased property in the southwest portion of the VRL landfill property, adjacent to the VRL flare station. The VRL is an active municipal solid waste landfill that is owned by Republic Services Vasco Road, Inc. It is located at 4001 North Vasco Road in Livermore in Alameda County.

Ameresco Vasco Road LLC (or "Ameresco") is applying for an Authority to Construct and Permit to Operate for three new emissions units. There are two 3012 bhp internal combustion engines (S-1 and S-2) that will be fired exclusively treated on landfill gas collected from Vasco Road Landfill. In addition, Ameresco is proposing to install a gas treatment system (S-3) that is a silica gel-based absorption system to remove siloxanes from the LFG prior to combustion in the engines and its associated waste gas flare. This gas treatment system includes two processes: (1) pretreatment of the raw LFG consisting of filtration, compression, and refrigeration, and (2) a silica gel-based absorption system to remove siloxanes from the LFG prior to combustion in the engines. The pretreatment system is a closed system without exhaust vents, and the siloxane removal system will include a 5.64 MM BTU/hr enclosed flare to control purge emissions.

In order to prevent triggering Offsets, Ameresco voluntarily accepted a facility-wide emission limit for NOx of 35 tons/year. Ameresco has submitted a Title V permit application (Application # 22637) for this facility, due to the facility-wide CO emissions being greater than 100 tons per year.

B. EMISSIONS

As discussed in the Background Section, this application involves installations of two landfill gas fired IC Engines (S-1 and S-2) and a gas treatment system (S-3) abated by A-1 Waste Gas Flare. The engines will emit combustion products including: nitrogen oxides (NOx), carbon monoxide (CO), sulfur dioxide (SO2), particulate matter (PM10), precursor organic compounds (POC), toxic air contaminants (TAC) such as formaldehyde, benzene, vinyl chloride, hydrogen chloride, and many others, and greenhouse gases (GHG) including carbon dioxide, methane, and nitrous oxide. The flare will have residual emissions of POC and TACs that remain after combustion of the waste gas and landfill gas fuel, and it will have secondary criteria pollutant emissions (NOx, CO, SO2, and PM10) and secondary TAC emissions (formaldehyde and acid gases). The emission limits for each source and for this total facility are discussed in detail below for each type of pollutant.

Criteria Pollutant Emissions

The criteria pollutant emission for the engines, the flare, and the total facility are each discussed below.

S-1 and S-2 IC Engines:
Each of the proposed 3012 bhp engines will operate for 24 hours per day and 365 days per year.
In order to preventing trigger offsets, Ameresco voluntarily accepted an annual NOx emission limit of 35 tons/year, which will be achieve by limiting the combined operating time for the two engines to 16775 hours/year. All maximum daily and maximum annual criteria pollutant emission limits for these engines were based on these operating rates.

CO emissions are calculated based on the proposed limit of 3.6 grams/bhp-hour. The equation used to calculate maximum annual CO emissions from these two engines is:

CO: (3.6 g/bhp-hr)*(3012 bhp)*(24 hrs/day)*(365 days/yr)/(453.59 g/lb)/ (2000 lbs/ton) = 104.71 tons/yr of CO per engine

NO_x emissions are calculated based on the proposed limit of 0.6 grams/bhp-hour. The equation used to calculate maximum annual NOx emissions from these two engines is:

NO_x: (0.6 g/bhp-hr)*(3012 bhp)*(24 hrs/day)*(365 days/yr)/(453.59 g/lb)/ (2000 lbs/ton) = 17.45 tons/yr of NO_x per engine

The maximum permitted criteria pollutant (CO, NO_x, POC, SO_2, PM_{10}, and NPOC) emissions from each engine and the two engines combined are summarized in Table B.1. The basis for each pollutant specific emission limit is identified in Table B.2. Equivalent emission factors and outlet concentrations for each pollutant are described in Table B.3. The derivation of the emission factors and emission calculation procedures for each pollutant are discussed in the paragraphs following these tables. Detailed spreadsheets are attached that show all assumptions, constants, and emission calculations.

Table B.1. Maximum Permitted Criteria Pollutant Emissions (S-1 and S-2)

	Each IC Engine		Total Permit Limit for Two Engines
	Pounds/Day	Tons/Year	Tons/Year
CO	573.72	104.71	200.51
NO_x	95.62	17.45	33.42
POC	29.67	5.42	10.37
SO_2	67.19	12.26	23.48
PM_{10}	15.94	2.91	5.57
NPOC	1.48	0.27	0.52

Table B.2. Emission Factor Basis for Each Criteria Pollutant (S-1 and S-2)

Basis for Emission Factor	Pollutant	Limit	Units
BACT, Mfg Guarantee, Permit Condition Limit	CO	3.6	g/bhp-hr
BACT, Mfg Guarantee, Permit Condition Limit	NO_x	0.6	g/bhp-hr
Regulation 8-34-301.4 NMOC Outlet Conc. Limit	POC	120	ppmv as CH_4 @ 3% O_2
BACT, Permit Condition Limit	SO_2	320	ppmv of TRS (as H_2S) in LFG
BACT, Mfg Guarantee, Permit Condition Limit	PM_{10}	0.1	g/bhp-hr
BAAQMD Calculation	NPOC	5%	of POC emission rate

Table B.3. Equivalent Emission Factors and Outlet Concentration Limits (S-1 and S-2)

Pollutant	grams / bhp-hour	pounds / hour	pounds / MM BTU	pounds / M scf LFG	ppmv @ 0% O_2	ppmv @ 3% O_2	ppmv @ 15% O_2	grains/sdcf @ 0% O_2
CO	3.600	23.905	1.13767	0.45229	1551	1329	438	
NO_x	0.600	3.984	0.18961	0.07538	157	135	44	
POC	0.186	1.236	0.05884	0.02339	140	120	40	
SO_2	0.301	1.775	0.08993	0.04469	57	48	16	
PM_{10}	0.100	0.664	0.03160	0.01256				0.0218
NPOC	0.009	0.062	0.00294	0.00117	7	6	2	

S-3 Gas Treatment System and A-1 Waste Gas Flare:

Landfill gas collected from the Vasco Road Landfill contains an average of 3000 ppmv of NMOC (expressed as C_1 at 50% methane) with a typical range of 1000-5000 ppmv of NMOC. Currently, this collected gas is abated by Vasco Road Landfill's enclosed flare, which achieves either 98% by weight control of these NMOC's or emits no more than 30 ppmv of NMOC (expressed as C_1 at 3% excess oxygen) from the outlet of the flare.

Ameresco is proposing to process this collected Vasco Road Landfill gas using the S-3 Gas Treatment System which includes filters, condensers, chillers, and adsorbers. The pretreatment system is a closed system without exhaust vents. The siloxane adsorption system will include a desorption cycle that will vent to a small (5.6 MMBTU/hr) enclosed flare (A-1) to control purge emissions. The flare will be fueled on treated landfill gas

The criteria pollutant emission rate limits for the A-1 Waste Gas Flare are summarized in Table B.4. The basis for each pollutant limit is described in Table B.5. Emissions factors for A-1 are summarized in Table B.6. Spreadsheets containing all calculations and assumptions are attached.

Table B.4. Maximum Permitted Criteria Pollutant Emissions (S-3 and A-1)

	Abated and Secondary From A-1	
	Pounds/Day	Tons/Year
CO	27.07	4.941
NO_x	8.12	1.482
POC	4.06	0.741
SO_2	146.70	26.773
PM_{10}	2.32	0.423
NPOC	0.20	0.037

Table B.5. Emission Factor Basis for Each Criteria Pollutant (From A-1)

Basis for Emission Factor	Pollutant	Limit	Units
Mfg Guarantee, Permit Condition Limit	CO	0.20	pounds/MM BTU
Mfg Guarantee, Permit Condition Limit	NO_x	0.06	pounds/MM BTU
Regulation 8-34-301.4: NMOC Destruction Efficiency Limit	POC	98%	by weight destruction of NMOC
Permit Condition Limit on gas to treatment system	SO_2	320	ppmv of TRS (as H_2S) in S-3 inlet gas
AP-42 Table 2.4-5	PM_{10}	17	pounds/MM scf CH4 burned
BAAQMD Calculation	NPOC	5%	by weight of POC emission rate

Table B.6. Emission Factors (From A-1)

Pollutant	pounds / MM BTU	pounds / M scf LFG	lbs/hour	lbs/day	tons/yr
CO	0.20000	0.07951	1.128	27.07	4.941
NOx	0.06000	0.02385	0.338	8.12	1.482
PM10	0.01710	0.00680	0.096	2.32	0.423
SO2	1.08377	0.43086	6.112	146.70	26.773
POC	0.02999	0.01192	0.169	4.06	0.741
NPOC	0.00150	0.00060	0.008	0.20	0.037

Residual Organic Emissions from A-1:

The desorption cycle purge gas will be abated by the A-1 Waste Gas Flare, which can burn up to 5.64 MM BTU/hour. If necessary, this waste gas will be blended with a fuel gas (filtered Vasco Road landfill gas) to ensure the flare has a sufficient inlet heat rate for the flare to run properly. However, worst case emissions will occur when the flare is burning purge gas alone. The A-1 Flare will meet the requirements of Regulation 8-34-301.3 by achieving either a minimum of 98% by weight destruction of the NMOC in the waste flush gas or by emitting no more than 30 ppmv of NMOC expressed as C_1 at 3% excess O_2 from the outlet of the flare. Maximum permitted emissions for S-3 abated A-1 will be based on the higher of the two allowable flare NMOC limits.

If the A-1 Flare is operating at maximum capacity on purge gas with the maximum expected NMOC content, the 98% by weight NMOC destruction efficiency limit is equal to an emission rate of 0.0941pounds/hour of NMOC, as calculated below.
(5.64 E6 BTU/hour)/(496.943 BTU/scf flush gas)*(10,000 scf NMOC/1E6 scf flush gas)/
(387.006 scf NMOC/lbmol NMOC)*(16.04 lbs NMOC/lbmol NMOC)*
(1.00-0.98 lbs NMOC emitted/lb NMOC) = 0.0941 pounds/hour of NMOC emitted

If the A-1 Flare is operating at maximum capacity on purge gas, the 30 ppmv NMOC outlet concentration limit is equal to an emission rate of 0.0786 pounds/hour of NMOC, as calculated below.
(5.64 MM BTU/hour)*(9605 sdcf flue gas at 0% O_2/MM BTU)*
[(29.95-0)/(20.95-3) scf flue gas at 3% O_2/scf flue gas at 0% O_2]*
(30 scf NMOC/1E6 scf flue gas at 3% O2)/(387.006 scf NMOC/lbmol NMOC)*
(16.04 lbs NMOC/lbmol NMOC) = 0.0786 pounds/hour of NMOC emitted

The maximum permitted emission rate for precursor organic compounds (POC) is the higher of the two possible NMOC emission rate limits that were determined above. Due to the high inlet NMOC concentration in the purge gas, the 8-34-301.3 requirement to achieve 98% NMOC destruction efficiency results in the higher residual NMOC emission rate than the NMOC outlet concentration limit. Therefore, the maximum permitted POC emission rate from the A-1 Flare is 0.0941 pounds/hour. For continuous operation (24 hours/day and 365 days/year), the maximum permitted POC emission rates are: 4.06 pounds/day and 0.741 tons/year.

Based on analytical data for Vasco Road Landfill gas, the concentration of non-precursor organic compounds (NPOC) in the collected landfill gas is no more than 5% of the total NMOC concentration. This relationship is expected to be valid for the purge gas as well. Therefore, maximum permitted NPOC emission rates are: 0.20 pounds/day, and 0.037 tons/year.

Secondary Criteria Pollutant Emissions from A-1:

Secondary emission rates for CO, NO_x, and PM_{10} are based on vendor specifications. The manufacturer guaranteed that the A-1 Waste Gas Flare would emit no more than: (a) 0.20 pounds of CO per MM BTU, (b) 0.06 pounds of NO_x per MM BTU, and (c) 0.017 pounds of PM_{10} per MM BTU. The maximum hourly emission rate for each of these pollutants is calculated below:

CO:	(0.20 lbs CO/MM BTU)*(5.64MM BTU/hour)	=	1.128 pounds/hour of CO
NO_x:	(0.06 lbs NO_x/MM BTU)*(5.64 MM BTU/hour)	=	0.338 pounds/hour of NO_x
PM_{10}:	(0.017 lbs PM_{10}/ MM BTU) * (5.64 MMBTU/hour)	=	0.096 pounds/hour of PM_{10}

Maximum daily and maximum annual emissions of CO, NO_x, and PM_{10} are based on continuous operation of the flare (24 hours/day and 365 days/year) at the maximum hourly emission rates determined above.

Sulfur dioxide emissions from A-1 were determined based on the amount of gas that will need to be treated by the treatment system (treated landfill gas throughput to engines plus treated landfill gas throughput to fuel the flare) and the expected sulfur content of this inlet gas to S-3. The S-3 treatment system will process 1010.9 million scf/year of landfill gas and is expected to generate 998.64 million scf/year of purge gas. All of the sulfur (at 320 ppmv of TRS) in the landfill gas processed by S-3 is assumed to be transferred to the purge gas from S-3. This purge gas from S-3 will be controlled by A-1. All of the sulfur in this purge gas is assumed to be converted to SO_2 by the A-1 flare.

Sulfur in Purge Gas: (1010.9 E6 ft^3 LFG/year)*(320 E-6 ft^3 S/ft^3 LFG)/(998.64 E6 ft^3 purge/yr)
= 323.9 ppmv of S in purge gas to flare

SO_2 from flare: (323.9 E-6 ft^3 S/ft^3 purge)/(387.006 ft^3 S/lbmol S)*(64.06 lbs SO_2/lbmol)
= 5.362 E-5 lbs SO_2/ft^3 of purge gas

(5.362 E-5 lbs SO_2/ft^3 of purge gas)*(1900 ft^3/min)*(60 min/hr) = 6.112 lbs SO_2/hour

Maximum Annual: (6.112 lbs/hour SO_2)*(24 hours/day)*(365 days/year)/(2000 lbs/ton)
= 26.773 tons/year of SO_2

Facility Wide Emissions

Maximum permitted emissions for each source and for the entire proposed project are summarized in Table B.7. Since this site has no other permitted equipment these total project emissions are also the total facility emissions.

Table B.7. Maximum Permitted Criteria Pollutant Emissions For Plant #20432

	S-1 LFG Engine Tons/Year	S-2 LFG Engine Tons/Year	S-3 and A-1 Gas Treatment & Flare Tons/Year	Total Project and Total Facility Emissions Tons/Year
CO	100.252	100.252	4.941	205.445
NO_x	16.709	16.709	1.482	34.900
POC	5.185	5.185	0.741	11.111
SO_2	11.741	11.741	26.773	50.254
PM_{10}	2.785	2.785	0.423	5.992
NPOC	0.259	0.259	0.037	0.556

Toxic Air Contaminant Emissions

This project is subject to Regulation 2, Rule 5. This project included two landfill gas fired engines (S-1 and S-2), the gas treatment system (S-3), and the A-1 Waste Gas Flare. All emissions from S-3 will be vented to A-1. The emission points are P-1 and P-2 (from each engine) and P-3 from the A-1 Flare.

The engines and the flare will burn gases that contain numerous toxic organic compounds and several toxic inorganic compounds. The engines and flare will destroy much of these toxic air contaminants (TACs) during combustion, but some residual organic and inorganic toxic compounds will remain in the emission points. In addition, the combustion process will produce secondary toxic compound emissions including: formaldehyde due to burning organic compounds, hydrogen chloride due to burning chlorinated compounds, and hydrogen fluoride due to burning fluorinated compounds. Toxic emissions from the engines and from the flare are discussed in more detail below. Detailed calculations are available in the attached spreadsheets.

From Engines:
Based on the consultant's gas concentration projections for the purge gas, the District estimates that gas treatment system will remove at least 50% of each TAC from the filtered landfill gas. Formaldehyde emissions were permitted at the highest hourly rate that would keep acute HI ≤ 1.0. The hydrogen sulfide concentrations are based on the sulfur content limits for these engines. The engines are expected to achieve at least 85% by weight destruction efficiency for each individual TAC present in the inlet gas (95% minimum destruction efficiency for hydrogen sulfide.) The maximum expected TAC concentrations in the clean landfill gas and the revised residual and secondary emissions estimates for each engine are summarized in Table B.9.

From Flare:
The carbon desorption process uses steam to remove the adsorbed compounds from the silica gel. The resulting purge gas will contain higher concentrations of VOCs and TACs. The District estimates that the TAC concentrations in the purge gas will be approximately twice as high as the Vasco Road landfill gas. Secondary organic TAC emissions are expected to follow a similar trend. The purge gas will be burned in the A-1 Flare, which will achieve higher destruction efficiencies for each individual TACs than the destruction rates expected for an IC engine. Since the purge gas / fuel gas blend that may be burned in this flare will contain lower TAC concentrations than the purge gas, combustion of the purge gas at the maximum flare capacity represents the worst-case scenario. The flare is expected to achieve at least 98% by weight destruction efficiency for each individual TAC present in the inlet gas (99% minimum destruction efficiency for hydrogen sulfide.) The maximum expected TAC concentrations in the purge gas and the residual and secondary TAC emission rate estimates for the A-1 Flare and the total project are summarized in Table B.10.

Table B.9. TAC Emission Estimates for S-1 and S-2 Engines Burning Vasco Road Landfill Gas

Significant TACs in LFG	Molecular Weight lbs/lb-mol	Estimated Max Cncn. in Raw LFG ppbv	Minimum Destruction Efficiency by Engines	Engine Emission Factor lbs/M scf	Emissions Per Engine lbs/hour	Emissions Per Engine lbs/year	Total at Max Limit lbs/yr
Acrylonitrile	53.06	200	85%	4.113E-06	2.174E-04	1.90	3.65
Benzene	78.11	2500	85%	7.569E-05	4.001E-03	35.04	67.11
Carbon Disulfide	76.13	500	85%	1.475E-05	7.798E-04	6.83	13.08
Carbon Tetrachloride	153.82	100	85%	5.962E-06	3.151E-04	2.76	5.29
Chlorobenzene	112.56	100	85%	4.363E-06	2.306E-04	2.02	3.87
Chloroethane (ethyl chloride)	64.51	200	85%	5.001E-06	2.643E-04	2.32	4.43
Chloroform	119.38	100	85%	4.627E-06	2.446E-04	2.14	4.10
Ethyl Benzene	106.17	5000	85%	2.057E-04	1.087E-02	95.26	182.42
Ethylene Dibromide	187.86	100	85%	7.281E-06	3.848E-04	3.37	6.46
Hexane	86.18	2000	85%	6.680E-05	3.531E-03	30.93	59.23
Hydrogen Sulfide	34.08	320000	95%	1.409E-03	7.446E-02	652.27	1249.07
Isopropyl Alcohol	60.10	15000	85%	3.494E-04	1.847E-02	161.77	309.78
Methyl Ethyl Ketone	72.11	15000	85%	4.192E-04	2.216E-02	194.10	371.69
Methylene Chloride	84.93	200	85%	6.584E-06	3.480E-04	3.05	5.84
Perchloroethylene	165.83	500	85%	3.214E-05	1.699E-03	14.88	28.49
Trichloroethylene	131.39	300	85%	1.528E-05	8.075E-04	7.07	13.55
Toulene	92.14	15000	85%	5.357E-04	2.831E-02	248.02	474.96
Vinyl Chloride	62.50	20000	85%	4.845E-04	2.561E-02	224.31	429.55
Xylenes (o, m, and p)	106.17	10000	85%	4.115E-04	2.175E-02	190.52	364.84
Secondary TACs	MW	ppbv		lbs/M scf	lbs/hour	lbs/year	lbs/year
Formaldehyde *	30.03			1.988E-02	1.051E+00	9203.39	17624.08
HCl	36.46	30000	0%	2.826E-03	1.494E-01	1308.62	2505.94
HF	20.01	6000	0%	3.102E-04	1.639E-02	143.61	275.00

Table B.10. TAC Emission Estimates for A-1 Flare Burning Waste Flush Gas and for the Total Project

Significant TACs in LFG	Molecular Weight lbs/lb-mol	Estimated Max Conc. in Raw LFG ppbv	Flare Control Efficiency	Worst Case Flare Emissions lbs/hour	Worst Case Flare Emissions lbs/year
Acrylonitrile	53.06	200	98%	6.576E-05	0.554
Benzene	78.11	2500	98%	1.210E-03	10.202
Benzyl Chloride	126.59	100	98%	7.843E-05	0.661
Carbon Disulfide	76.13	500	98%	2.359E-04	1.989
Carbon Tetrachloride	153.82	100	98%	9.531E-05	0.804
Chlorobenzene	112.56	100	98%	6.974E-05	0.588
Chloroethane (ethyl chloride)	64.51	200	98%	7.995E-05	0.674
Chloroform	119.38	100	98%	7.397E-05	0.624
Ethyl Benzene	106.17	5000	98%	3.289E-03	27.732
Ethylene Dibromide	187.86	100	98%	1.164E-04	0.981
Hexane	86.18	2000	98%	1.068E-03	9.004
Hydrogen Sulfide	34.08	320000	**99%**	3.378E-02	284.830
Isopropyl Alcohol	60.10	15000	98%	5.585E-03	47.093
Methyl Ethyl Ketone	72.11	15000	98%	6.702E-03	56.505
Methylene Chloride	84.93	200	98%	1.052E-04	0.887
Perchloroethylene	165.83	500	98%	5.138E-04	4.332
Trichloroethylene	131.39	300	98%	2.442E-04	2.059
Toulene	92.14	15000	98%	8.564E-03	72.204
Vinyl Chloride	62.50	20000	98%	7.745E-03	65.301
Xylenes (o, m, and p)	106.17	10000	98%	6.578E-03	55.464
Secondary TACs	MW	ppbv			
Formaldehyde *	30.03			2.554E-03	22.370
HCl	36.46	30000	0%	3.389E-01	2857.189
HF	20.01	6000	0%	3.719E-02	313.551

In Table B.11, the current project emissions are compared to the risk screen trigger levels. For this application, the maximum hourly project emissions of hydrogen sulfide and formaldehyde will exceed the acute trigger levels from Table 2-5-1. For annual emissions, the emission rates for acrylonitrile, benzene, benzyl chloride, carbon tetrachloride, ethyl benzene, ethylene dibromide, hydrogen sulfide, perchloroethylene, vinyl chloride, formaldehyde, and hydrogen fluoride will each exceed their chronic risk screen trigger level. Therefore, a Health Risk Screening Analysis is required for this project.

Table B.11. TAC Emissions for the Total Project Compared to Risk Screen Trigger Levels

Compound	App# 22636 Project lbs/hr	Acute HRSA Trigger lbs/hr	App# 22636 Project lbs/yr	Chronic HRSA Trigger lbs/yr
Acrylonitrile	5.01E-04	N/A	4.2	3.80E-01
Benzene	9.21E-03	2.9	77.31	3.80E+00
Benzyl Chloride	5.97E-04	0.53	5.01	2.20E+00
Carbon Disulfide	1.80E-03	14	15.07	3.10E+04
Carbon Tetrachloride	7.26E-04	4.2	6.09	2.50E+00
Chlorobenzene	5.31E-04	N/A	4.46	3.90E+04
Chloroethane (ethyl chloride)	6.09E-04	N/A	5.1	1.20E+06
Chloroform	5.63E-04	0.33	4.72	2.00E+01
Ethyl Benzene	2.50E-02	N/A	210.15	4.30E+01
Ethylene Dibromide	8.86E-04	N/A	7.44	1.50E+00
Hexane	8.13E-03	N/A	68.23	2.70E+05
Hydrogen Sulfide	1.83E-01	0.093	1533.9	3.90E+02
Isopropyl Alcohol	4.25E-02	7.1	356.87	2.70E+05
Methyl Ethyl Ketone	5.10E-02	29	428.19	N/A
Methylene Chloride	8.01E-04	31	6.73	1.10E+02
Perchloroethylene	3.91E-03	44	32.82	1.80E+01
Trichloroethylene	1.86E-03	N/A	15.61	5.40E+01
Toulene	6.52E-02	82	547.16	1.20E+04
Vinyl Chloride	5.90E-02	400	494.85	1.40E+00
Xylenes (o, m, and p)	5.01E-02	49	420.3	2.70E+04
Formaldehyde	2.10E+00	0.12	17646.45	1.80E+01
HCl	6.38E-01	4.6	5363.13	3.50E+02
HF	7.00E-02	0.53	588.55	5.40E+02

C. STATEMENT OF COMPLIANCE

Regulation 2, Rule 1 (CEQA and Public Notice Requirements)

Alameda County Planning Department was the Lead Agency for CEQA Review of the proposed Landfill Gas to Energy Facility at the Vasco Road Landfill. Alameda County conducted an initial study and concluded that the proposed project would not have any significant impact on the environment. On March 7, 2011, the Alameda County planning commission considered and adopted the Initial Study and Negative Declaration for Vasco Road landfill gas energy project and approved Conditional Use Permit, PLN2010-00209, for the Vasco Road Landfill Facility, for the construction and operation of a landfill gas power plant at the Vasco Road Landfill.

The District concluded that Ameresco had satisfied the requirements of Regulation 2-1-408.1 and that no further CEQA review was required.

The project is over 1000 feet from the nearest school and is therefore not subject to the public notification requirements of Regulation 2-1-412.

Regulation 2, Rule 2 (NSR – BACT for S-1 and S-2 Engines)

As shown in Table B.1, each of the proposed IC engines will emit more than 10 pounds per day of CO, NO_x, POC, SO_2, and PM_{10}. Therefore, BACT review is triggered for each of these pollutants that will be emitted from the proposed engines. BACT is intended to reduce emissions to the maximum extent possible considering technological and economic feasibility.

The District identifies BACT in two ways: BACT(1), which includes the most stringent emission controls or lowest emission limits possible for a source category that have been found to be both technologically feasible and cost effective for a particular project; and BACT(2), which is the level of emission controls or the maximum emission limit that has been deemed to be achieved in practice by sources in this source category. The District's BACT Guideline describes the procedures to be used for determining the cost of emission controls and the cost effectiveness thresholds that apply when one is considering BACT(1) controls. BACT(2) controls cannot be any less stringent the emission controls required by District, state, or federal rules or regulations.

BACT(1)

The District has recently been evaluating the performance of experimental NO_x and CO controls that were installed on lean-burn landfill gas fired IC engines at the Ameresco Half Moon Bay (HMB) facility (Plant # 17040). This site is equipped with a landfill gas treatment system (the first of this type of treatment system that was installed in the Bay Area) that removes siloxanes and other landfill gas compounds that can cause build-up inside the engine and impair engine performance. In particular, this contaminant build-up is known to cause CO and NMOC emissions to drift upward as engine operating hours increase. In addition, high formaldehyde emissions from landfill gas fired engines have been correlated to high NMOC emission rates from these engines. The siloxane build-up results in frequent and extensive engine maintenance to remove the build-up and restore emissions and performance to acceptable levels. Ameresco HMB's landfill gas treatment system includes filtration, condensation, and adsorption processes to remove the contaminants that can impair performance. The adsorption media is periodically regenerated, and waste gases from this regeneration step are controlled by a small enclosed flare. The treated landfill gas is burned in six 2677 bhp engines that produce a combined total of 11.4 MW of energy. Each of the six IC engines is equipped with an oxidation catalyst to determine if such add-on CO emissions controls would be feasible for lean-burn engines burning treated landfill gas. Likewise, one of the six engines is equipped with a selective catalytic reduction (SCR) system to evaluate the feasibility of using SCR to reduce NOx emissions from the exhaust from lean burn engines burning treated landfill gas. The catalysts have now been in operation on the engines for more than 12,000 hours and have demonstrated some success at reducing NO_x and CO emissions.

Based on the District's review of the performance of these experimental emission control systems for landfill gas fired engines, the District has determined that it is technologically feasible to use add-on catalytic controls on the exhaust from IC engines burning treated landfill gas to control NO_x and CO emissions. The specific emission limits that are possible for these add-on controls are still under review. In addition, the gas treatment system appears to be achieving some control of sulfur compounds, which would result in lower SO_2 emissions from the engines. The District expects that the oxidation catalysts are achieving some level of POC and formaldehyde emission control, but the control efficiencies for these pollutants have not been confirmed by source testing. In consideration of these findings, the District has concluded that a BACT(1) review for this project should at least consider the possibility of using landfill gas treatment and add-on catalysts as a potential emission control method for NO_x and CO emissions from the proposed engines.

BACT(1) for NO_x Control:
For the Ameresco HMB project, the target NO_x control efficiency was 75% for the SCR system installed on a lean-burn 2677 bhp engine that had a manufacturer guaranteed emission rate of 0.6 g/bhp-hr for uncontrolled NO_x emissions. The target outlet emission rate of 0.15 g/bhp-hr was achieved during more than 90% of the operating days evaluated. Thus, a NO_x control efficiency of 75% appears to be feasible for large engines burning treated landfill gas.

The Ameresco Vasco Road project involves two 3012 bhp engines burning landfill gas that will be treated in a manner similar to the gas treatment process for Ameresco HMB. An SCR system is technologically feasible for this project. The uncontrolled NO_x emission rate from each engine is 0.6 g/bhp-hr. The combined engine operating time is limited to 16,775 hours/year. At 75% NO_x removal, the potential emission reductions for the Ameresco Vasco Road project would be: 25.063 tons/year of NO_x.

Ameresco provided costs for both the Ameresco HMB project and the costs for a gas treatment system and waste gas flare that installed at the Ameresco Keller Canyon facility. The Vasco Road project (two 3012 bhp engines) is more similar in size to the Keller Canyon facility (two 2677 bhp engines) than to the HMB facility (six 2677 bhp engines). The District used the costs from these two Ameresco projects to estimate the costs of installing and operating a landfill gas treatment system, a waste gas flare, SCR systems for both engines, and a CEM system to monitor NO_x emissions for the proposed Vasco Road project.

The capital and installation cost for all of the equipment listed above was estimated to be $ 2.37 million. The District reviewed the 6-month average interest rate for 10-year Treasury Notes (3.2%) and determined that the District's standard interest rate assumption of 6% is still appropriate. Using this interest rate and the standard 10 year term, the capital recovery factor is 0.136. The annualized cost for this NOx abatement project is: (2.37 E6 * 0.136) $322,100/year. Annual operating costs were estimated to be: $234,500/year. Total annualized costs were estimated to be: $556,500/year. Comparing this annualized cost to the projected NO_x removal rate yields a cost effectiveness value of: $22,200/ton of NO_x removed. Although the District typically requires CEMs for projects controlled by SCR systems, the District also evaluated the costs for controlling this project without CEMs. The cost effectiveness value for the proposed project without CEMs is: \$19,700/ton of NO_x removed.

In accordance with the District's BACT Guidelines, the maximum cost effectiveness value for a BACT(1) project is \$17,500/ton of NO_x removed. Projects resulting in more than \$17,500/ton to control NO_x emissions are not deemed to be cost effective. Since the cost of controlling NOx emissions from the proposed NOx abatement project (using gas treatment and SCR) for the Amersco Vasco Road energy project will be more than \$17,500/ton of NO_x removed, this emission control scenario is not cost effective and will not be required under BACT(1). Since BACT(1) NO_x controls are not cost effective for this project, the engines will be required to meet BACT(2) instead. BACT(2) is discussed below.

BACT(1) for CO Control:
For the Ameresco HMB project, the target CO control efficiency was 75% for the oxidation catalysts installed on six lean-burn 2677 bhp engines. The manufacturer guaranteed emission rate for uncontrolled CO emissions was 2.1 g/bhp-hr for a clean engine. However, the District now expects that uncontrolled CO emissions could drift up to as high as 3.6 g/bhp-hr between engine cleanings. The target outlet emission rate was 0.52 g/bhp-hr based on 75% control of the 2.1 g/bhp-hr uncontrolled emission rate. This level of CO control was not met on a routine basis, but the project did demonstrate some success at reducing CO emissions. Outlet CO emission rates were less than 1.2 g/bhp-hr, and the catalysts achieved an average CO control efficiency of 66%. For an engine tuned to achieve 0.6 g/bhp-hr of NO_x and a not to exceed CO limit of 3.6 g/bhp-hr, it appears to be feasible to meet a CO limit of 1.2 g/bhp-hr (66.7% control efficiency compared to the 3.6 g/bhp-hr maximum expected emission rate).

For the Ameresco Vasco Road project (two 3012 bhp engines with a combined operating time limit of 16,775 hours/year), oxidation catalysts could potentially remove up to 133.67 tons/year of CO, if the abatement project could achieve a CO limit of 1.2 g/bhp-hr.

As discussed above for SCR Controls, the District used cost data provided by Ameresco for the energy projects at the Half Moon Bay and Keller Canyon facilities to estimate the CO emission control costs for the Vasco Road sized energy project equipped with a gas treatment system and waste gas flare and abated by oxidation catalysts on each engine. The capital and installation cost for this abatement scenario was estimated to be \$ 2.13 million. Using the the capital recovery factor of 0.136, the annualized cost for this CO abatement project is: \$290,000/year. Annual operating costs were estimated to be: \$112,400/year. Total annualized costs were estimated to be: \$402,400/year. Comparing this annualized cost to the projected CO removal rate yields a cost effectiveness value of: \$3010/ton of CO removed.

The District's BACT Guidelines do not contain a cost effectiveness threshold for BACT(1) CO emission control projects. Since the District has no CO cost effectiveness thresholds, the cost criteria from other air districts will be used to determine if the proposed CO abatement measures are cost effective. From South Coast Air Quality Management District's (SCAQMD) BACT Guidelines, the cost effectiveness criteria for non-major facilities are maximum incremental costs of \$1150/ton and maximum average costs of \$400/ton. San Joaquin Valley APCD listed a cost effectiveness threshold of \$300/ton for CO. For the Vasco Road project, the annualized average costs of using gas treatment and oxidation catalysts to control CO emissions exceed both the SCAQMD and SJVAPCD maximum cost criteria. Therefore, this CO abatement option is not considered cost effective. The Vasco Road engines will be required to meet BACT(2) instead. BACT(2) is discussed below.

BACT(2)

The District reviewed several BACT Clearinghouses for similar projects. No emission limits were identified that were more stringent than the emission limits identified in the District's own BACT Guidelines except for CO. In some cases, a CO emission limit of 2.5 g/bhp-hr was cited for landfill gas fired engines. However, as explained in the District's White Paper "Revisting BACT for Lean Burn Landfill Gas Fired Internal Combustion Engines", this CO emission limit can generally only be achieved for about 400 hrs/year of operation after each major engine cleaning event. On-going evaluations of several types of new landfill gas engines have found that CO emissions commonly exceed this initial operation limit shortly after the annual source test is conducted. The District prefers to use a "not to exceed" limit for CO emissions that more accurately portrays the CO potential to emit from these engines.

From the District's BACT Guideline (Document #96.2.2, 03/05/2009) for Landfill Gas Fired IC Engines ≥250 HP, the District has not specified any particular NO_x, CO, POC, SO_2, or PM_{10} emission limits for BACT(1). Lean burn engine technology is listed as a typical method for limiting NO_x emissions from landfill gas fired engines, while landfill gas pre-treatment is indicated as a typical method for reducing CO, POC, SO_2, and PM_{10} emissions from landfill gas fired engines. The potential BACT limits or controls are summarized below.

POC: 120 ppm @ 3% O_2 (BACT #2)
NOx: 0.6 g/bhp-hr (BACT #2)
CO: Not to exceed standard: 3.6 g/bhp-hr (BACT #2)
SO_2: LFG Treatment with >80% H_2S Removal (BACT #1)
PM10: LFG Filtration (BACT#2)

For NO_x and CO, the District has established two possible sets of BACT(2) – Achieved in Practice level of controls for landfill gas fired engines (NO_x at 0.6 b/bhp-hr and CO at 3.6 g/bhp-hr) or (NO_x at 0.5 g/bhp-hr and CO at 3.9 g/bhp-hr). This site has indicated the engines would be tuned to ensure lower CO emissions, thus the 0.6 g/bhp-hr limit for NO_x and 3.6 g/bhp-hr limit for CO would be applicable as BACT(2). For the proposed engines, the 0.6 g/bhp-hr NO_x emission rate is equivalent to 44 ppmv of NO_x in the engine exhaust at 15% oxygen, dry basis. The proposed BACT(2) NO_x limits above are more stringent than the applicable NSPS limit (2.0 g/bhp-hr) and more stringent than the District's new BARCT requirement (Regulation 9-8-302.1 limit of 70 ppmv of NO_x at 15% O_2 that becomes effective on 1/1/12). For the proposed engines, the 3.6 g/bhp-hr CO emission rate is equivalent to 438 ppmv of CO in the engine exhaust at 15% oxygen, dry basis. The proposed BACT(2) CO limits above are more stringent than the applicable NSPS limit (5.0 g/bhp-hr) and more stringent than the District's BARCT requirement (Regulation 9-8-302.3 limit of 2000 ppmv of CO at 15% O_2). The engine manufacturer's certified NO_x and CO emission rates indicate the S-1 and S-2 Engines will comply with the proposed BACT(2) emission rates discussed above. Permit conditions will require quarterly monitoring and annual source testing to demonstrate on-going compliance with these emission limits.

For POC emissions, the proposed BACT(2) limit (a maximum concentration in the engine exhaust of 120 ppmv of POC (expressed as methane) at 3% oxygen sry basis) is equivalent to the District's BARCT limit for landfill gas combustion devices other than enclosed flares (Regulation 8-34-301.4). For the proposed engines, this limit is equivalent to an emission rate of 0.186 g/bhp-hr and is more stringent the applicable NSPS limit (1.0 g/bhp-hr). The combustion of treated landfill gas in these engines is expected to result in lower POC emissions at the outlet from the engines, but insufficient data is available to date to establish a lower achieved in practice POC emission limit for the combustion of treated landfill gas. Therefore, the proposed limit of 120 ppmv at 3% O_2 is deemed to be BACT(2) for this project.

Landfill gas filtration is identified as a typical BACT(2) control technology but no PM_{10} emission limits are specified. The proposed gas treatment system includes a filtration step and is sufficient to meet BACT(2) for these engines. The manufacturer has guaranteed that the engines will meet an emission limit of 0.1 g/bhp-hr for PM_{10}, which equates to 0.022 grains/sdcf in the exhaust (at 0% O_2). The applicable NSPS has no PM_{10} emission limit. The proposed emission rate is far below the District BARCT limit of 0.15 grains/sdcf. The proposed emission rate is also less than the AP-42 emission factor for landfill gas fired engines (48 lbs/MM scf CH_4), which is equivalent to 0.153 g/bhp-hr and is the same as the AP-42 emission factor for natural gas fired engines. Since the proposed PM_{10} emission limit is achieved using filtration and is less than the PM_{10} emission rates expected for natural gas combustion, the proposed PM_{10} limit is acceptable as BACT(2).

No emission control measures or limits are specified in Document #96.2.2 as BACT(2) for SO_2 control from landfill gas fired engines. The proposed SO_2 emission limit (0.422 g/bhp-hr) is based on the maximum expected sulfur concentration in landfill gas from the Vasco Road Landfill. The landfill gas treatment system proposed for this project may achieve some removal of the sulfur compounds from the landfill gas, which would result in lower SO_2 emissions from the engines. However, insufficient data is available to establish an achieved in practice emission limit or sulfur control efficiency for this type of gas treatment system. Therefore, no sulfur dioxide emission reductions will be required as BACT(2) for the proposed engines.

Regulation 2, Rule 2 (NSR – BACT for S-3 Gas Treatment System)

Ameresco has proposed to control these POC emissions by venting all of the gases from S-3 to an enclosed flare (A-1) that will achieve at least 98% by weight reduction of these POC emissions and that will emit less than 10.0 pounds/day of residual POC emissions.

The District does not have any specific BACT determinations for landfill gas treatment systems; however, the BACT determinations for Landfill Gas Gathering Systems (Document #101.1) and Digester Gas or Landfill Gas Enclosed Flares (Document #80.1) involve similar gas flow rates and compositions and similar emission control methods. From Document #101.1, a BACT(2) achieved-in-practice level of control is to vent collected landfill gas to an enclosed flare or an IC engine. From Document # 80.1, the enclosed flare should be designed to have a minimum retention time of 0.6 seconds with the temperature maintained at a minimum of 1400 °F. The flare should also be equipped with automatic combustion air controls, automatic gas shutoff valves, and automatic restart systems.

This proposed flare is designed to operate at a maximum heat input rate of 5.64 MM BTU/hour. At the maximum flow rate, the flare is designed to achieve a minimum retention time of 0.7 seconds with operating temperatures ranging from 1400-1800 °F. At a set temperature of 1600 °F, the A-1 Flare will achieve 98% by weight destruction of non-methane organic compounds. The A-1 Flare will be equipped with automatic shutoff valves, automatic air damper louver controls, and automatic restart features. The A-1 is expected to achieve Therefore, the proposed A-1 Flare satisfies all of the BACT(2) design criteria described in Document #80.1. Since the residual POC emissions from the flare will be less than 10 pounds/day, it is not necessary for this proposed control system to achieve a higher POC control efficiency than 98% by weight. Thus, venting emissions from S-3 to the properly operating A-1 Flare constitutes BACT for the control of POC emissions from S-3.

Proposed Condition # 25010, Parts 1, 3, 4, 5, and 8 will ensure compliance with the BACT requirements identified above. These monitoring requirements include annual source testing to verify the NMOC destruction efficiency achieved by the flare and to establish the appropriate minimum combustion zone temperature, continuous combustion zone temperature records, and continuous gas flow rate records.

Regulation 2, Rule 2 (NSR – RACT for Secondary Emissions from A-1 Flare)

The A-1 Waste Gas Flare will have secondary combustion emissions due to burning purge gas from S-3 and/or landfill gas delivered from Vasco Road Landfill. Pursuant to Regulation 2-2-110, secondary emissions from abatement devices that are required to meet BACT or BARCT requirements for another pollutant are exempt from the Regulation 2-2-301 BACT requirements but must achieve a RACT level of control for these secondary pollutants instead. As shown in Table B.4, the secondary CO, NO_x, and SO_2 emissions from A-1 will each exceed 10 pounds/day. Therefore, A-1 is required to achieve a RACT level of control for the CO, NO_x, and SO_2 emissions.

CO:
From Document # 80.1, the BACT(2) requirement for secondary CO emissions from an enclosed landfill gas flare is the use of good combustion practices. Compliance with this BACT(2) requirement constitutes a RACT level of control for secondary CO emissions. For many other landfill gas flares, the District has determined that meeting a maximum CO emission limit of 0.2 pounds of CO per MM BTU is indicative of good combustion practice and is a reasonable and achievable CO emission limit for an enclosed landfill gas flare. The proposed flare is expected to comply with a maximum emission limit of 0.20 lbs CO/MM BTU. Proposed Condition #25010, Parts 6 will demonstrate compliance with this RACT limit based on annual source testing of the flare.

NO_x:
From Document # 80.1, the BACT(2) requirement for secondary NO_x emissions from an enclosed landfill gas flare is having a NO_x emission limit of 0.06 pounds of NO_x per MM BTU. The proposed flare is expected to comply with a maximum emission limit of 0.06 pounds of NO_x lbs/MM BTU. Proposed Condition #25010, Parts 5 and 9 will demonstrate compliance with this RACT limit based on annual source testing of the flare.

SO_2:
Document #80.1 has no BACT(2) controls for reducing SO_2 emissions. The BACT(1) level of control for SO_2 emissions includes the use of a scrubber or other approved gas pretreatment systems to remove sulfur compounds from the gas. The S-3 gas treatment system is expected to remove much of the sulfur from the landfill gas that is burned on the engines, but the sulfur may get transferred back into the purge gas and be burned in the flare creating SO2. The additional treatment technologies that would be needed to prevent combustion of sulfur at the flare are expected to be prohibitively expensive. The limit on sulfur content in the gas that is processed by S-3 will also limit the amount of SO_2 emissions occurring at A-1. These limits constitute a RACT level of control for secondary SO_2 emissions from A-1.

Proposed Condition #25010, Parts 7 and Part 9 will demonstrate compliance with these RACT limits for secondary sulfur dioxide emission limits. The annual test for either SO_2 emissions from the flare or for TRS content in the flare inlet gas will verify that that the TRS concentrations in the flare inlet gas are no higher than the TRS levels found in the gas burned in the engines. The fuel sulfur content monitoring in Condition #25009, Part 7 will verify compliance with the annual sulfur dioxide emission limit assumptions.

Regulation 2, Rule 2 (NSR – Offsets)

Regulation 2-2-302 requires offsets for NO_x and POC emission increases, if the facility-wide NO_x or POC emissions will exceed 10 tons per year. As shown in Table B.7, the total permitted emissions for this facility will be 34.9 tons/year of NO_x and 11.1 tons/year of POC. Since facility-wide NO_x and POC emissions will be greater than 10 tons/year, offsets are required for both NO_x and POC emissions. Since facility-wide NO_x and POC emissions are each less 35 tons/year, this facility qualifies for the District's small facility banking account. The District will provide the required NO_x and POC offsets for this project (at a ratio of 1.0:1.0) from the District's small facility banking account.

Regulation 2-2-303 requires PM_{10} and SO_2 offsets for major facilities that have more than 100 tons/year of PM_{10} or SO_2 emissions. Since neither PM_{10} nor SO_2 emissions from this facility will exceed 100 tons/year, offsets are not required for either of these pollutants.

Regulation 2, Rule 2 (NSR – PSD)

PSD review is required for facilities that emit more than 250 tons/year of a regulated air pollutant, or than emit more than 100 tons/year if the facility is one of 28 source categories that are subject to the lower PSD threshold of 100 tons/year. Landfill gas fired IC engines, gas treatment systems, and flares are not in one of the 28 special PSD source categories. Therefore, the PSD threshold for this site is 250 tons/year. Since this facility will emit less than 250 tons/year of each pollutant, PSD does not apply.

EPA's tailoring rule for greenhouse gases established an alternative PSD threshold of 100,000 tons/year for GHG emissions. For this facility, GHG emissions were determined to be 58,993 tons/year expressed as CO_2 equivalent emissions. Therefore, this site is not expected to be subject to PSD due to GHG emissions. Furthermore, EPA's recent amendments to this tailoring rule deferred the applicability of this PSD threshold for facilities that primarily produce or burn biogas such as landfill gas. Therefore, the applicability of the GHG PSD threshold has been delayed at this site until July 2014.

Regulation 2, Rule 2 (Publication and Public Comment)

This application is for an initial Title V permit that will result in total facility-wide emissions of more than 100 tons/year of CO. Therefore, this facility is a new major facility for CO emissions. Regulation 2-2-405 requires the District to notify EPA, ARB, adjacent Districts, and the general public of BAAQMD's preliminary decision on this project and to invite written public comment on this project for a 30-day period following publication of BAAQMD's preliminary decision.

Regulation 2, Rule 5 (NSR – Toxic Air Contaminants)

Since toxic air contaminant (TAC) emissions for this project will exceed risk screen trigger levels (see Table B.11), a Health Risk Screening Analysis (HRSA) is required for this project pursuant to Regulation 2-5-401. The District conducted an HRSA for this project in accordance with the BAAQMD HRSA Guidelines. The results of this HRSA are summarized below in Tables C.3 and C.4. A detailed HRSA report is attached.

Table C.3. HRSA Results: Total Project Risk			
	Acute Hazard Index	Chronic Hazard Index	Cancer Risk (per million)
Residential Receptor	1.0	0.04	0.41
Worker Receptor		0.30	0.03

Table C.4. HRSA Results: Source Risks			
	Acute Hazard Index	Chronic Hazard Index	Cancer Risk (per million)
S-1 IC Engine			
Residential Receptor	No Applicable Standard	0.02	0.2
Worker Receptor		0.13	0.015
S-2 IC Engine			
Residential Receptor	No Applicable Standard	0.02	0.2
Worker Receptor		0.13	0.015
A-1 Flare			
Residential Receptor	No Applicable Standard	0.005	0.01
Worker Receptor		0.04	0.001

TBACT:
Regulation 2-5-301 requires best available control technology for toxic air contaminants (TBACT) for each source that has a source risk of more than 1.0 in a million cancer risk or more than 0.2 chronic hazard index. As shown in Table C.4, the source risks due to each engine and the flare are each less than these TBACT thresholds. Therefore, S-1, S-2, and A-1 are not subject to TBACT.

Project Risks:
Regulation 2-5-302 limits project risks to 10.0 in a million cancer risk, 1.0 chronic hazard index, and 1.0 acute hazard index. The total project risks are identified in Table C.3,and these project risks are all less than the Regulation 2-5-302 project risk limits. Therefore, this project – as proposed – will comply with Regulation 2-5-302.

The limits on formaldehyde emission rates from the engines (Condition #25009, Part 8), and the testing requirements in Condition #25009, will verify that the project has not exceeded the emission rates that this HRSA was based on. Any exceedance of these TAC limits will require a new HRSA to verify that the increases will still comply with the project risk limits.

<u>Regulation 2, Rule 6 (Major Facility Review)</u>

Ameresco Vasco Road LLC submitted an application for an initial Title V permit for this facility on September 30, 2010 (Application # 22637). This Title V application satisfies the Regulation 2-6-404 requirements for submittal of a timely application for major facility review. All Title V permitting requirements will be discussed in detail in the Statement of Basis for Application # 22637.

BAAQMD Regulation 6 (Particulate Matter and Visible Emissions)

Properly operating landfill gas fired IC engines and landfill gas flares will have no visible particulate emissions. Therefore, the proposed engines (S-1 and S-2) and the A-1 Flare are expected to comply with the Regulation 6-301 Ringelmann 1.0 limitation and the Regulation 6-302 20% opacity limitation. Each stack is also subject to the Regulation 6-310 particulate weight limitation of 0.15 grains/dscf. At the engine manufacturer's guaranteed emission rate of 0.1 grams/bhp-hour, the grain loading in the exhaust will be 0.022 grains/dscf for at an outlet oxygen concentration of 0% by volume. At a typical oxygen concentration of 13% by volume, the grain loading will be less than 0.01 grains/dscf (less than 10% of the limit). At the flare manufacturer's guaranteed emission rate of 0.001 lbs/hr per scfm of gas, the grain loading in the exhaust will be 0.024 grains/dscf for at an outlet oxygen concentration of 0% by volume. At a typical oxygen concentration of 13% by volume, the grain loading will be less than 0.01 grains/dscf (less than 10% of the limit). Since the proposed PM_{10} emission rates are far below the Regulation 6-310 limit and non-compliance is highly unlikely, additional monitoring to verify compliance with this limit is not justifiable. Therefore, the District is not proposing to include a PM_{10} emission limit in the permit conditions for the engines or the flare and is not proposing any source testing for PM_{10} emissions.

BAAQMD Regulation 8, Rule 34 (Solid Waste Disposal Sites)

Landfill gas combustion operations are subject to Regulation 8, Rule 34. The proposed IC engines (S-1 and S-2) are energy recovery devices that are subject to Regulations 8-34-301.2, 8-34-301.4, 8-34-412, 8-34-413, 8-34-501.2, 8-34-501.4, 8-34-501.6, 8-34-501.10, 8-34-501.11, 8-34-501.12, 8-34-503, 8-34-504, 8-34-508, and 8-34-509. The A-1 Waste Gas Flare is subject to Regulations 8-34-301.2, 8-34-301.3, 8-34-412, 8-34-413, 8-34-501.2, 8-34-501.3, 8-34-501.4, 8-34-501.6, 8-34-501.10, 8-34-501.12, 8-34-503, 8-34-504, 8-34-507, and 8-34-508.

Regulation 8-34-301.2 limits the leaks from any component of a landfill gas emission control system to 1000 ppmv expressed as methane. Properly operated landfill gas fired engines and flares are not expected to result in any component leaks in excess of this limit. Regulations 8-34-503 and 504 require quarterly testing of all control system components that contain landfill gas using a portable gas analyzer. Regulations 8-34-501.4, 501.6, and 501.12 require the site to maintain records of these test results for at least five years. These monitoring and record keeping requirements are sufficient to demonstrate compliance with Regulation 8-34-301.2. The facility plans to use a consulting firm to comply with the necessary testing and record keeping provisions.

Regulation 8-34-301.3 requires each enclosed flare to achieve 98% by weight destruction efficiency for NMOC or to emit less than 30 ppmv of NMOC, expressed as methane at 3% oxygen, dry basis. This requirement is echoed in Condition #25010, Part 3 of the proposed permit conditions for the gas treatment system and flare, because this NMOC emission limit is also a BACT requirement for S-3. Regulations 8-34-412 and 413 and Condition #25010, Part 9 will require this site to conduct annual source tests on the flare to demonstrate compliance with the NMOC emission limit. In addition, Regulation 8-34-507 requires a continuous temperature monitor and recorder for this flare. In Condition #25010, Part 4, the temperature limit will initially be set to no less than 1400 degree F to ensure compliance with BACT and TBACT requirements. Regulation 8-34-501.3 and Condition #25010, Part 4 require this site to maintain continuous records of flare combustion zone temperature. These monitoring and record keeping requirements are sufficient to demonstrate compliance with Regulation 8-34-301.3. The facility plans to use independent source testing and consulting firms to comply with these requirements.

Regulation 8-34-301.4 requires each energy recovery device to achieve 98% by weight destruction efficiency for NMOC or to emit less than 120 ppmv of NMOC, expressed as methane at 3% oxygen, dry basis. This requirement is echoed in Condition #25010, Part 3 of the proposed permit conditions. Regulations 8-34-412 and 413 and Condition # 25010, Part 9 of the proposed permit conditions will require this site to conduct annual source tests to demonstrate compliance with the NMOC emission limit. In addition, Regulation 8-34-509 requires this site to establish a key emission control system operating parameter and monitoring schedule for each engine that will demonstrate compliance with Regulation 8-34-301.4 on an on-going basis. Condition #25009, Parts 6 and 9 describe how the key parameter, operating limits, and monitoring schedule will be determined. Regulation 8-34-501.4 and 8-34-501.11 require this site to maintain records of the key parameter monitoring data and all other test data necessary to demonstrate compliance with this rule. These monitoring and record keeping requirements are sufficient to demonstrate compliance with Regulation 8-34-301.4. The facility plans to use independent source testing and consulting firms to comply with these requirements.

In order to determine actual landfill gas consumption rates for energy recovery devices and the operating times for all landfill gas control system devices, Regulation 8-34-508 requires continuous monitoring of the landfill gas flow rates to the engines, and Regulation 8-34-501.2 requires records of all emission control system downtime. These monitoring and record keeping requirements will also demonstrate compliance with the heat input limits in Conditions #25009 and #25010. The gas treatment system flare and the engines will be equipped with the necessary flow rate monitoring and recording devices.

BAAQMD Regulation 9, Rule 1 (Sulfur Dioxide)

Regulation 9-1-302 limits sulfur dioxide concentrations in any exhaust point to 300 ppmv (dry basis). The SO_2 emission limit in Condition #25009, Part 7 is equivalent to an outlet concentration of 80 ppmvd of SO_2 (at 0% excess oxygen) in the exhaust from each engine. The SO_2 emission limit in Condition #25010, Part 7 is equivalent to an outlet concentration of 271 ppmvd of SO_2 in the exhaust from the flare. Therefore, compliance with these SO_2 emission limits should ensure compliance with the Regulation 9-1-302 sulfur dioxide limit of 300 ppmv (dry basis). The landfill gas sulfur content monitoring requirements proposed in Condition #25009, Part 7 and Condition #25010, Part 10 are adequate for demonstrating compliance with the proposed sulfur content limits and SO_2 emission limits in the permit conditions and also with the Regulation 9-1-302 SO_2 outlet concentration limit.

BAAQMD Regulation 9, Rule 8 (NO_x and CO from Stationary IC Engines)

Regulation 9, Rule 8 applies to stationary internal combustion engines rated at 50 bhp or more. Sections 301 and 302 limit nitrogen oxides (NO_x) and carbon monoxide (CO) emissions from gas fired IC engines. Sections 330 and 331 apply to emergency standby engines only. The proposed engines are subject to Regulation 9-8-302 only, which applies to waste gas fired engines. Regulation 9-8-302.1 currently limits the outlet NO_x concentration to 140 ppmv, corrected to 15% oxygen, dry basis, for lean burn waste gas fired engines. Effective January 1, 2012, this limit will be reduced to 70 ppmv NO_x, corrected to 15% O_2, dry basis. Regulation 9-8-302.3 limits the outlet CO concentration to 2000 ppmv, corrected to 15% oxygen, dry basis, for any waste gas fired engines. At the proposed BACT limits for NO_x and CO, the outlet concentrations for the proposed engines will be: 44 ppmv of NO_x at 15% O_2 and 438 ppmv of CO at 15% O_2. Therefore, the proposed engines will comply with both the current and future requirements Regulation 9, Rule 8. The initial source test required pursuant to Condition #25009, Part 9 will satisfy the initial compliance demonstration requirements of Regulation 9-8-501.

Federal Requirements (NSPS and NESHAPs)

Vasco Road Landfill is subject to the NSPS for MSW Landfills (40 CFR Part 60, Subpart WWW), which requires VRL to collect and control landfill gas from Vasco Road Landfill. In accordance with 40 CFR Part 60.752(b)(2)(iii), VRL may satisfy the requirements of this NSPS by: (A) routing the collected gas to an open flare, (B) routing the collected gas to a control system that meets the specified NMOC limits, or (C) routing the collected gas to a treatment system that processes this gas for subsequent sale or use. Treating the landfill gas to remove excess water and particulates and delivering the gas to Ameresco Vasco Road LLC satisfies the requirements of 40 CFR Part 60.752(b)(2)(iii)(C) for VRL. No additional Subpart WWW NSPS or Subpart AAAANESHAP requirements apply to the downstream off-site user of landfill gas from a facility that is subject to 40 CFR Part 60.752(b)(2)(iii)(C). Therefore, Ameresco's engines and flare are not subject to 40 Part 60, Subpart WWW or to 40 CFR Part 63, Subpart AAAA.

However, reciprocating engines are potentially subject to other NSPS and NESHAP requirements: 40 CFR, Part 60, Subpart JJJJ – Standards of Performance for Stationary Spark Ignition Internal Combustion Engines and 40 CFR, Part 63, Subpart ZZZZ – National Emission Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines. The applicability of each of these federal regulations is discussed in more detail below.

These following applicability determinations depend, in part, on whether the site is a major source of HAPs or an area source of HAPs. The largest three HAP emissions from this site (emissions from the two engines combined plus the flare) are as follows: 5.40 tons/year of formaldehyde (at 0.64 pounds/hour per engine plus 22 pounds/year from flare), 2.68 tons/year of hydrogen chloride, and 0.27 tons/year of toluene. Total emissions of all HAPs combined are: 9.13 tons/year for this site, based on the total NMOC emission limits for the engines and flare plus the projected acid gas emissions from these units. Since HAP emissions are less than 10 tons/year for any single HAP and less than 25 tons/year for all HAPs combined, this site is not a major source of HAPs and is instead an area source of HAPs.

The 40 CFR, Part 60, Subpart JJJJ NSPS for spark-ignition (SI) internal combustion engines (ICE) applies to both engine manufacturers and engine owners. This discussion covers the requirements for owners and operators. Section 60.4230(a)(4)(i) indicates that Subpart JJJJ applies to owners/operators of engines that commence construction after June 12,2006, where the engine power rating is greater than 500 hp and the engine is manufactured after July 1, 2007. The proposed engines meet these criteria. In accordance with 40 CFR Part 60.4233(e), SI ICE meeting the above criteria must comply with the emission limits in Table 1. For landfill/digester gas fired engines $\geq$ 500 bhp, the Table 1 standards below are effective as of 7/1/2010:

	g/bhp-hr	ppmv at 15% O2
NOx	2.0	150
CO	5.0	610
VOC	1.0	80

The proposed emission limits for the S-1 and S-2 engines (0.6 g/bhp-hr for NO_x, 3.6 g/bhp-hr for CO, and <0.2 g/bhp/hr for VOC) in Condition # 25009, Parts 3-5 are well below the Table 1 standards listed above.

For S-1 and S-2, the owner/operator is subject to Section 60.4243(b) and must demonstrate compliance with the Table 1 limits by complying with 60.4243(b)(2) and using the test procedures in 60.4244. Pursuant to 60.4243(b)(2)(ii), the operator must keep a maintenance plan and records of maintenance conducted. This requirement was added as Condition # 25009, Part 10. The operator must also conduct initial and subsequent performance tests (every 8760 hours of operation or every 3 years, whichever comes first). The testing requirements in Condition # 25009, Part 9 will satisfy this requirement.

In accordance with 40 CFR 60.4245(a), the operator must maintain records of: all notifications, all maintenance conducted on the engines, and all performances tests. Initial notification is required pursuant to 40 CFR 60.4245(c) and 60.7(a)(1).

The 40 CFR, Part 63, Subpart ZZZZ NESHAP for reciprocating internal combustion engines (RICE) now applies to both major and area sources of HAPs. These engines are located at an area source of HAPs and are new engines pursuant to 40 CFR Part 63.6590(a)(2)(iii), because the engines will commence construction after 6/12/06. In accordance with Section 63.6590(c)(1), new RICE located at area sources must comply with the requirements of either 40 CFR Part 60 Subpart IIII or JJJJ instead of 40 CFR Part 63, Subpart ZZZZ. Such is the case for the new RICE proposed at this site. Therefore, these engines (S-1 and S-2) must comply with 40 CFR Part 60, Subpart JJJJ and have no further requirements under 40 CFR Part 63, Subpart ZZZZ.

D. PERMIT CONDITIONS

The District is proposing to make the revisions identified below in Condition # 25009 for the engines and Condition # 25010 for the S-3 Gas Treatment Systems and the A-1 Waste Gas Flare in order to ensure that this equipment will comply with all applicable requirements identified in Section C of this report.

FOR S-1 AND S-2 LFG-FIRED LEAN-BURN INTERNAL COMBUSTION ENGINES:
[CONDITION # 25009]

1. The S-1 and S-2 Internal Combustion (IC) Engines shall be fired exclusively on landfill gas collected from the Vasco Road Landfill. [Basis: Cumulative Increase]

2. The combined heat input to both IC Engines (S-1 and S-2) shall not exceed 352,482 MM BTU (HHV) during any consecutive 12-month period. The Permit Holder shall demonstrate compliance with this limit by maintaining records of the heat input to each engine for each day, for each calendar month, and for each rolling 12-month period. Heat input shall be calculated using District approved procedures based on measured landfill gas flow rate data and measured landfill gas methane concentration data. The calculated heat input rates shall be recorded in a data acquisition system or electronic spreadsheet. The landfill gas flow rate to each engine shall be monitored and recorded continuously in accordance with Regulation 8-34-508. The landfill gas methane content supplied to either engine shall be monitored and recorded continuously using a gas chromatograph or other District approved device. The flow meters and methane sensor shall be installed and properly calibrated prior to any engine operation and shall be maintained in good working condition. [Basis: Offsets and Cumulative Increase]

3. Carbon Monoxide (CO) emissions from each IC Engine (S-1 and S-2) shall not exceed 3.6 grams of CO per brake-horsepower-hour. The Permit Holder may demonstrate compliance with this emission rate limit by having a carbon monoxide concentration in the engine exhaust of no more than 438 ppmv of CO, corrected to 15% oxygen, dry basis. An exhaust concentration measurement of more than 438 ppmv of CO shall not be deemed a violation of this part, if the Permit Holder can demonstrate that CO emissions did not exceed 3.6 g/bhp-hour during the test period. [Basis: BACT, Cumulative Increase, and 40 CFR 60.4233(e)]

4. Nitrogen Oxide (NO_x) emissions from each IC Engine (S-1 and S-2) shall not exceed 0.6 grams of NO_x (calculated as NO_2) per brake-horsepower-hour. The Permit Holder may demonstrate compliance with this emission rate limit by having a nitrogen oxide concentration in the engine exhaust of no more than 44 ppmv of NO_x, corrected to 15% oxygen, dry basis. An exhaust concentration measurement of more than 44 ppmv of NO_x shall not be deemed a violation of this part, if the Permit Holder can demonstrate that NO_x emissions did not exceed 0.6 g/bhp-hour during the test period. [Basis: BACT. Offsets, and 40 CFR 60.4233(e)]

5. Each IC Engine (S-1 and S-2) shall comply with either the destruction efficiency requirements or the non-methane organic compound (NMOC) outlet concentration limit specified in Regulation 8-34-301.4. [Basis: Regulations 2-5-302 and 8-34-301.4, BACT, Offsets, and 40 CFR 60.4233(e)]

6. In order to demonstrate on-going compliance with Part 5 and Regulation 8-34-509, the Permit Holder shall use outlet carbon monoxide concentration corrected to 15% oxygen (dry basis) as the key emission control system operating parameter for these engines, and the Permit Holder shall comply with the following limits and procedures. [Basis: Regulations 8-34-501.11 and 8-34-509]
    a. For the purposes of this part, the corrected and adjusted CO concentration in the exhaust from each engine shall not exceed the 438 ppmv of CO, corrected to 15% O_2, dry basis, as determined in accordance with Parts 6b-c below. This concentration limit shall not exceed the concentration limit specified in Part 3. However, the APCO will establish a lower concentration limit for Part 6a if source testing demonstrates that the NMOC concentration limit in Regulation 8-34-301.4 has been exceeded at a lower outlet corrected CO concentration level than the current limit. The Permit Holder may request to increase the Part 3 and Part 6a corrected CO concentration limits, if source testing has demonstrated that an engine has complied with both the Part 3 g/bhp-hour CO limit and the Regulation 8-34-301.4 NMOC outlet concentration limit at a higher outlet corrected CO concentration than the current limit.
    b. The Permit Holder shall measure and record the CO and O_2 concentrations in the exhaust gas from each engine on a weekly basis using District-approved portable flue gas analyzers. For each monitoring event, the Permit Holder shall calculate and record the corrected CO concentration (ppmv of CO, corrected to 15% O_2, dry basis) measured by this portable analyzer method.
    c. The Permit Holder shall multiply the corrected CO concentration recorded pursuant to Part 6b by the appropriate correlation factor (as established for a set of portable analyzers and an engine pursuant to Part 9m) to determine the corrected and adjusted CO concentration for each monitoring event. This corrected and adjusted CO concentration shall be compared to the Part 6a limit.
    d. If the corrected and adjusted CO concentration for any monitoring event exceeds the Part 6a limit, the excess shall be deemed a reportable exceedance of the Part 6a CO limit and the Regulation 8-34-301.4 NMOC concentration limit. The Permit Holder shall take all steps necessary to correct the excess including making adjustments to the engine and shutting the engine down for maintenance or overhaul.
    e. If the corrected and adjusted CO concentration is determined to be less than 80% of the Part 6a limit, the Permit Holder may reduce the monitoring frequency to a monthly basis. If any subsequent monitoring event finds that the corrected and

adjusted CO concentration is greater than 80% of the Part 6a limit, the monitoring frequency shall revert to a weekly basis.

f. The portable flue gas analyzers shall be calibrated and operated in accordance with the manufacturer's recommendations and shall be maintained in the conditions used during the annual source to establish the correlation factors between source test measured data and portable analyzer measured data.

g. All monitoring, calibration, and engine maintenance records shall be maintained onsite in a District approved log and shall be made readily available to District staff upon request for at least 5 years from the date of entry.

7. Sulfur Dioxide (SO_2) emissions from each IC Engine (S-1 and S-2) shall not exceed 2.80 pounds per hour. The Permit Holder shall demonstrate compliance with this SO_2 emission limit by complying with the landfill gas concentration limit, monitoring, and record keeping requirements identified below. [Basis: Cumulative Increase and Regulation 2-6-503]

a. The concentration of total reduced sulfur (TRS) compounds in the landfill gas sent to the engines shall not exceed 320 ppmv of TRS, expressed as hydrogen sulfide (H_2S) and corrected to a landfill gas methane concentration of 50% by volume, based on any individual source test or measurement.

b. On a monthly basis, the Permit Holder shall use either a District approved portable hydrogen sulfide monitor or a District laboratory analysis method to determine the concentration of TRS (measured as H_2S and corrected to 50% methane) in the clean landfill gas that is delivered to S-1 or S-2. Methane concentrations measured pursuant to Part 2 shall be used to correct the calculated TRS concentrations to a landfill gas methane concentration of 50% by volume (corrected TRS = measured TRS / measured % CH_4 * 50). The sampling dates and results shall be recorded in a District approved log.

i. If the portable H_2S analysis method is used, the TRS concentration shall be calculated by multiplying the measured H_2S concentration by 1.2 (TRS = 1.2 * H_2S).

ii. If a laboratory analysis method is used, the TRS concentration shall be calculated as the sum of the measured concentrations for the individual sulfur compounds, expressed as H_2S.

8. Formaldehyde emissions from each IC Engine (S-1 and S-2) shall not exceed 0.64 pounds per hour. [Basis: Regulation 2-5-302]

9. In order to demonstrate compliance with Parts 3, 4, 5, 7, and 8 above and Regulations 8-34-301.4, 9-1-302, 9-8-302.1, 9-8-302.3, and 40 CFR 60.4233(e), the Permit Holder shall ensure that a District approved source test is conducted within 60 days of initial start-up of each engine and annually thereafter. This source test shall be conducted while the engine is operating at or near the maximum operating rate and shall determine all items identified in Parts 9a-m below. The Source Test Section of the District shall be contacted to obtain approval of the source test procedures at least 14 days in advance of each source test. The Source Test Section shall be notified of the scheduled test date at least 7 days in advance of each source test. The source test report for the initial compliance demonstration test shall be submitted to the Source Test Section and the Engineering Division within 60 days of the test date. Subsequent annual source test reports shall be submitted to the Compliance and Enforcement Division and the Source Test Section within 60 days of the test date. [Basis: BACT, Offsets, Cumulative Increase, and Regulations 2-5-302, 8-34-301.4, 8-34-412, 9-1-302, 9-8-302.1, 9-8-302.3 and 40 CFR 60.4243(b)(2)(ii)]

a. Operating rate for each engine during the test period (bhp);
b. Total flow rate of all gaseous fuel to each engine (dry basis, sdcfm);
c. Concentrations (dry basis) of carbon dioxide (CO_2), nitrogen (N_2), oxygen (O_2), methane (CH_4), total non-methane organic compounds (NMOC), and total reduced sulfur compounds (TRS) in the gaseous fuel burned in the engines (percent by volume or ppmv);
d. High heating value for the landfill gas (BTU/scf);
e. Heat input rate to each engine averaged over the test period (BTU/hour);
f. Exhaust gas flow rate from each engine based on EPA Method 19 (dry basis, sdcfm);
g. Concentrations (dry basis) of NO_x, CO, CH_4, NMOC, SO_2, and O_2 in the exhaust gas from each engine (ppmv or percent by volume);
h. NO_x and CO concentrations corrected to 15% O_2 in the exhaust gas from each engine (ppmv);
i. NO_x and CO emission rates from each engine (grams/bhp-hour);
j. NMOC concentrations corrected to 3% O_2 in the exhaust gas from each engine (ppmv);
k. NMOC destruction efficiency achieved by each engine (weight percent);
l. SO_2 and Formaldehyde emission rates from each engine (pounds/hour);
m. CO and O_2 concentrations from each engine shall also be measured using portable flue gas analyzers. The Permit Holder shall take three CO/O_2 readings per engine and shall determine the average corrected CO concentration (ppmv CO corrected to 15% O_2, dry basis) for each engine, as measured by portable analyzers. The Permit Holder shall compare the average corrected CO concentration measured pursuant to Part 9h to this average corrected CO concentration measured using portable analyzers to establish a portable analyzer correlation factor for each set of portable analyzers and engines used at this site in conjunction with Part 6.

10. In order to demonstrate compliance with Parts 2 and 6-9, Regulation 9-8-502, and 40 CFR 60.4243(b)(2)(ii), the Permit Holder shall maintain the following plans and records on-site. The plans and records shall be made available to District staff upon request. Records shall be retained on-site for a minimum of 5 years from the date of entry. [Basis: Offsets, Cumulative Increase, Regulations 9-8-502.3 and 9-8-502.4, and 40 CFR 60.4243(b)(2)(ii)]
    a. Records of heat input to each engine maintained pursuant to Part 2.
    b. Records of all weekly or monthly monitoring conducted pursuant to Part 6.
    c. Records of monthly monitoring conducted pursuant to Part 7.
    d. Records of quarterly monitoring conducted pursuant to Regulation 9-8-503.
    e. Records of all performance tests conducted pursuant to Part 9, Regulation 9-8-501, and 40 CFR 60.4243(b)(2)(ii).
    f. An engine maintenance plan that satisfies the requirements of 40 CFR 60.4243(b)(2)(ii).
    g. Records of all maintenance conducted on each engine.
    h. Records of start-ups, shut-downs, and malfunctions for each engine. For any malfunctions, the records shall include the cause of the malfunction and the actions taken to prevent such malfunctions in the future.
    i. Records of all notifications required pursuant to Regulation 1 or 40 CFR Parts 60 or 63.

FOR S-3 GAS TREATMENT SYSTEM AND A-1 WASTE GAS FLARE:
[CONDITION # 25010]

1. All waste flush gas generated by the carbon desorption cycle at S-3 shall be vented to the A-1 Waste Gas Flare. Landfill gas delivered from Vasco Road Landfill or treated landfill gas from S-3 may be burned in A-1 or blended with the flush gas prior to combustion in A-1, if the use of this supplemental landfill gas is necessary to ensure proper operation of A-1. The A-1 flare shall be operated continuously during any time that gas is being vented to this flare. [Basis: BACT]

2. The heat input rate to the A-1 Flare shall not exceed 49,460 million BTU (HHV) during any consecutive 12-month period. This limit is based on the full rated input capacity for the flare operating continuously. In order to demonstrate compliance with this part, the A-1 flare shall be equipped with a continuous gas flow meter and recorder, and the owner/operator shall maintain records of the heat input to A-1 for each day, for each calendar month, and for each rolling 12-month period. Heat input shall be calculated using District approved procedures based on measured landfill gas flow rate data and measured landfill gas methane concentration data. The calculated heat input rates shall be recorded in a data acquisition system or electronic spreadsheet. The methane content in the inlet gas shall be monitored and recorded continuously using a gas chromatograph or other District approved device. The flow meters and methane sensor shall be installed and properly calibrated prior to initial operation of A-1 and shall be maintained in good working condition. [Basis: Offsets and Cumulative Increase]

3. The A-1 Flare shall either achieve 98% by weight destruction of the total non-methane organic compounds (NMOC) in the inlet gas or shall emit no more than 30 ppmv of NMOC, expressed as methane and corrected to 3% oxygen, in the exhaust gas from A-1. [Basis: BACT]

4. In order to ensure compliance with Part 3 and to ensure adequate destruction of the toxic air contaminants present in the inlet gas, the owner/operator shall maintain the combustion zone temperature of the A-1 Flare at a minimum temperature of 1400 degrees F, averaged over any 3-hour period. If a source test demonstrates compliance with all applicable requirements at a different temperature, the APCO may revise these minimum temperature requirements in accordance with the procedures identified in Regulation 2-6-414 or 2-6-415 and the following criteria. The minimum combustion zone temperature for the flare shall be equal to the average combustion zone temperature determined during the most recent complying source test minus 50 degrees F, provided that the minimum combustion zone temperature is not less than 1400 degrees F. To demonstrate compliance with this part, the A-1 flare shall be equipped with a temperature monitor with readout display and continuous recorder. One or more thermocouples shall be placed in the primary combustion zone of the flare and these thermocouples shall accurately indicate the combustion zone temperature at all times. [Basis: Regulation 2-5-302 and BACT and]

5. Nitrogen oxide (NOx) emissions from the A-1 flare shall not exceed 0.06 pounds of NOx, expressed as NO2, per million BTU of heat input. Compliance with this emission limit may be demonstrated by not exceeding the following exhaust gas concentration limit: 17 ppmv of NO_x, expressed as NO_2 at 15% oxygen on a dry basis. [Basis: RACT]

6. Carbon monoxide (CO) emissions from the A-1 flare shall not exceed 0.20 pounds of CO per million BTU of heat input. Compliance with this emission limit may be

demonstrated by not exceeding the following exhaust gas concentration limit: 38 ppmv of CO at 15% oxygen on a dry basis. [Basis: RACT]

7. Sulfur Dioxide (SO_2) emissions from the flare (A-1) shall not exceed 6.11 pounds per hour. The Permit Holder shall demonstrate compliance with this SO_2 emission limit by complying with the waste gas concentration limits, monitoring, calculation, and record keeping requirements identified below. [Basis: RACT, Regulation 9-1-302, and Cumulative Increase]

8. The A-1 flare shall be equipped with both local and remote alarms, automatic combustion air control, automatic gas shutoff valves, and automatic start/restart system. [Basis: BACT]

9. In order to demonstrate compliance with Parts 3 through 7 above, the owner/operator shall conduct a compliance demonstration source test at the A-1 Waste Gas Flare within 60 days of initial start-up of A-1 and within 12 months of the previous test date for each subsequent year.

   The source test shall be conducted while the flare is burning waste gas from the carbon desorption process. If the duration of waste gas combustion is insufficient to allow a full source test during the waste gas desorption cycle, the source test shall be conducted while the flare is operating in its normal mode and cycling between desorption cycle on and off. In this case, record the flow rate of desorption gas to the flare, amount of time this gas is flowing to flare per run and the flow rate and time per run for treated landfill gas.

   The Source Test Section of the District shall be contacted to obtain approval of the source test procedures at least 14 days in advance of each source test. The Source Test Section shall be notified of the scheduled test date at least 7 days in advance of each source test. The source test report shall be submitted to the Source Test Section within 60 days of the test date. Each annual source test shall measure or determine the criteria in subparts a-i below. [Basis: RACT, BACT, and 9-1-302]

   a. inlet flow rate of treated landfill gas & flow rate of desorption cycle waste gas to the flare (scfm, dry basis);
   b. concentrations (dry basis) of carbon dioxide (CO_2), nitrogen (N_2), oxygen (O_2), methane (CH_4), and total non-methane organic compounds (NMOC) and total reduced sulfur compounds (see part 11) in the inlet gas to the flare;
   c. inlet heat input rate to the flare in units of MM BTU (HHV) per hour;
   d. stack gas flow rate from the flare (scfm, dry basis);
   e. concentrations (dry basis) of NMOC, NO_x, CO, SO_2, and O_2, in the flare stack gas;
   f. NMOC destruction efficiency achieved by the flare (by weight);
   g. average combustion zone temperature in the flare during the test period;
   h. NO_x, CO, and SO_2 emission rates from the flare in units of pounds per MM BTU and pounds per hour;

10. In order to verify the validity of application data, the owner/operator shall conduct a characterization of both the treated landfill gas from S-3 and the desorption cycle waste gas going to flare concurrent with the annual source test required by Part 10 above. In addition to the compounds listed in Part 10b, the flare inlet gas shall be analyzed for, as a minimum, the organic and sulfur compounds listed below. All concentrations shall be reported on a dry basis. The test report shall be submitted to the Source Test Section

within 60 days of the test date. [Basis: Regulations 2-5-501 and Cumulative Increase] (testing requirements will be clarified)

Organic Compounds
Benzene
Ethyl Benzene
Vinyl Chloride

Sulfur Compounds
Carbon Disulfide
Carbonyl Sulfide
Dimethyl Sulfide
Ethyl Mercaptan
Hydrogen Sulfide
Methyl Mercaptan

E. RECOMMENDATION

The District recommends issuance of an Authority to Construct for the following equipment, subject to permit condition #25009 identified above.

S-1 **LFG-Fired Internal Combustion Engine and Genset**; GE Jenbacher, J 616 GS-E199 engine, JGS 616 GS-L.L; 3012 bhp, 21 MM BTU/hour

S-2 **LFG-Fired Internal Combustion Engine and Genset**; GE Jenbacher, J 616 GS-E199 engine, JGS 616 GS-L.L; 3012 bhp, 21 MM BTU/hour

The District recommends issuance of an Authority to Construct for the following equipment, subject to the permit condition #25010 identified above.

S-3 **Gas Treatment System**; custom design, abated by **A-1 Waste Gas Flare**; Abutec – High Temp Enclosed Flare, 5.64 MM BTU/hr, fired on purge gas, landfill gas, or a blend of these gases.

The District will review and consider all comments received about this project before making a final decision on this matter.

Prepared By: Date:

Flora Chan August 5, 2011
Air Quality Engineer

APPENDIX A

Health Risk Screening Analysis
for Application # 22636

INTEROFFICE MEMORANDUM

June 21, 2011

To: Scott Lutz

Via: Daphne Chong
Glen Long
Carol Allen

From: Flora Chan

Subject: Health Risk Screening Analysis
Application # 22636
Ameresco Vasco Road LLC, Plant # 20432

Summary

This Health Risk Screening Analysis (HRSA) evaluates a proposed new operation for Ameresco's Vasco Road landfill gas to energy facility. The project includes two landfill gas fired IC engines, a carbon desorption process, and a waste gas flare. The maximum project impacts for the proposed operating scenario are: 0.3 in a million cancer risk, 0.32 chronic HI, and 1.0 acute HI. In accordance with Regulation 2, Rule 5 requirements, these health impact levels are acceptable, provided the engines and the flare each comply with TBACT requirements.

Background

This application is for a proposed landfill gas to energy facility that will be located on property owned by Vasco Road Landfill (VRL, Plant # 5095) but that will be operated by an independent company: Ameresco Vasco Road LLC (Plant # 20432). The proposed equipment location is next to the VRL's flare, in the southwest portion of the VRL's property. Vasco Road Landfill employees are considered to be off-site worker receptors for the Ameresco facility; and likewise, Ameresco employees are off-site worker receptors for the Vasco Road Landfill facility.

This HRSA will evaluate the health impacts resulting from the proposed two 3012 bhp internal combustion engines (S-1 and S-2) that will be fired exclusively on landfill gas collected from Vasco Road Landfill and the proposed enclosed waste gas flare (S-3). The HRSA for Application # 22636 was evaluated based on each of the two proposed LFG engines operating continuously at full capacity. The proposed project resulted in a maximum increased cancer risk of 0.3 in a million, a maximum chronic HI of 0.23, and a maximum acute HI of 1.0 for Vasco Road Landfill worker receptors.

Emissions

This projects included two landfill gas fired engines (S-1 and S-2), the gas treatment system (S-3), and the A-1 Waste Gas Flare. All emissions from S-3 will be vented to A-1. The emission points are P-1 and P-2 (from each engine) and P-3 from the A-1 Flare.

The engines and the flare will burn gases that contain numerous toxic organic compounds and several toxic inorganic compounds. The engines and flare will destroy much of these toxic air contaminants (TACs) during combustion, but some residual organic and inorganic toxic compounds will remain in the emission points. In addition, the combustion process will produce secondary toxic compound emissions including: formaldehyde due to burning organic compounds, hydrogen chloride due to burning chlorinated compounds, hydrogen bromide due to burning brominated compounds, and hydrogen fluoride due to burning fluorinated compounds. Toxic emissions from the engines and from the flare are discussed in more detail below. Detailed calculations are available in the attached spreadsheets.

From Engines:
Based on the consultant's gas concentration projections for the flush gas, the District estimates that gas treatment system will remove at least 50% of each TAC from the filtered landfill gas. Formaldehyde emissions are expected to follow a similar trend, and formaldehyde emissions from the engines are estimated to be half of the current formaldehyde emission limit. Since the gas treatment system is not expected to remove any sulfur compounds from the landfill gas, the hydrogen sulfide concentrations are based on the current limits for these engines. The engines are expected to achieve at least 85% by weight destruction efficiency for each individual TAC present in the inlet gas (95% minimum destruction efficiency for hydrogen sulfide.) The maximum expected TAC concentrations in the clean landfill gas and the revised residual and secondary emissions estimates for each engine are summarized in Table 1.

Table 1. TAC Emission Estimates for S-1 and S-2 Engines Vasco Road Landfill Gas

Significant TACs in LFG	Molecular Weight lbs/lb-mol	Estimated Max Cncn. in Raw LFG ppbv	Minimum Destruction Efficiency by Engines	Engine Emission Factor lbs/M scf	Emissions Per Engine lbs/hour	Emissions Per Engine lbs/year	Total at Max Limit lbs/yr
Acrylonitrile	53.06	200	85%	4.113E-06	2.174E-04	1.90	3.65
Benzene	78.11	2500	85%	7.569E-05	4.001E-03	35.04	67.11
Benzyl Chloride	126.59	100	85%	4.906E-06	2.593E-04	2.27	4.35
Carbon Disulfide	76.13	500	85%	1.475E-05	7.798E-04	6.83	13.08
Carbon Tetrachloride	153.82	100	85%	5.962E-06	3.151E-04	2.76	5.29
Chlorobenzene	112.56	100	85%	4.363E-06	2.306E-04	2.02	3.87
Chloroethane (ethyl chloride)	64.51	200	85%	5.001E-06	2.643E-04	2.32	4.43
Chloroform	119.38	100	85%	4.627E-06	2.446E-04	2.14	4.10
Ethyl Benzene	106.17	5000	85%	2.057E-04	1.087E-02	95.26	182.42
Ethylene Dibromide	187.86	100	85%	7.281E-06	3.848E-04	3.37	6.46
Hexane	86.18	2000	85%	6.680E-05	3.531E-03	30.93	59.23
Hydrogen Sulfide	34.08	320000	95%	1.409E-03	7.446E-02	652.27	1249.07
Isopropyl Alcohol	60.10	15000	85%	3.494E-04	1.847E-02	161.77	309.78
Methyl Ethyl Ketone	72.11	15000	85%	4.192E-04	2.216E-02	194.10	371.69
Methylene Chloride	84.93	200	85%	6.584E-06	3.480E-04	3.05	5.84
Perchloroethylene	165.83	500	85%	3.214E-05	1.699E-03	14.88	28.49
Trichloroethylene	131.39	300	85%	1.528E-05	8.075E-04	7.07	13.55
Toulene	92.14	15000	85%	5.357E-04	2.831E-02	248.02	474.96
Vinyl Chloride	62.50	20000	85%	4.845E-04	2.561E-02	224.31	429.55
Xylenes (o, m, and p)	106.17	10000	85%	4.115E-04	2.175E-02	190.52	364.84
Secondary TACs	MW	ppbv		lbs/M scf	lbs/hour	lbs/year	lbs/year
Formaldehyde *	30.03			1.988E-02	1.051E+00	9203.39	17624.08
HCl	36.46	30000	0%	2.826E-03	1.494E-01	1308.62	2505.94
HF	20.01	6000	0%	3.102E-04	1.639E-02	143.61	275.00

From Flare:
District estimates that the TAC concentrations in the waste flush gas will be approximately twice as high as the Vasco Road landfill gas. The waste flush gas will be burned in the A-1 Flare, which will achieve higher destruction efficiencies for each individual TACs than the destruction rates expected for an IC engine. Since the carrier gas and flush/carrier gas blends that may be burned in this flare will contain lower TAC concentrations than the waste flush gas, combustion of the waste flush gas at the maximum flare capacity represents the worst-case scenario. The flare is expected to achieve at least 98% by weight destruction efficiency for each individual TAC present in the inlet gas (99% minimum destruction efficiency for hydrogen sulfide.) The maximum expected TAC concentrations in the waste flush gas and the residual and secondary TAC emission rate estimates for the A-1 Flare and the total project are summarized in Table 2.

Table 2. TAC Emission Estimates for A-1 Flare Burning Waste Flush Gas and for the Project

Significant TACs in LFG	Molecular Weight lbs/lb-mol	Estimated Max Cncn. in Raw LFG ppbv	Flare Control Efficiency	Worst Case Flare Emissions lbs/hour	Worst Case Flare Emissions lbs/year
Acrylonitrile	53.06	200	98%	6.576E-05	0.554
Benzene	78.11	2500	98%	1.210E-03	10.202
Benzyl Chloride	126.59	100	98%	7.843E-05	0.661
Carbon Disulfide	76.13	500	98%	2.359E-04	1.989
Carbon Tetrachloride	153.82	100	98%	9.531E-05	0.804
Chlorobenzene	112.56	100	98%	6.974E-05	0.588
Chloroethane (ethyl chloride)	64.51	200	98%	7.995E-05	0.674
Chloroform	119.38	100	98%	7.397E-05	0.624
Ethyl Benzene	106.17	5000	98%	3.289E-03	27.732
Ethylene Dibromide	187.86	100	98%	1.164E-04	0.981
Hexane	86.18	2000	98%	1.068E-03	9.004
Hydrogen Sulfide	34.08	320000	**99%**	3.378E-02	284.830
Isopropyl Alcohol	60.10	15000	98%	5.585E-03	47.093
Methyl Ethyl Ketone	72.11	15000	98%	6.702E-03	56.505
Methylene Chloride	84.93	200	98%	1.052E-04	0.887
Perchloroethylene	165.83	500	98%	5.138E-04	4.332
Trichloroethylene	131.39	300	98%	2.442E-04	2.059
Toulene	92.14	15000	98%	8.564E-03	72.204
Vinyl Chloride	62.50	20000	98%	7.745E-03	65.301
Xylenes (o, m, and p)	106.17	10000	98%	6.578E-03	55.464
Secondary TACs	MW	ppbv			
Formaldehyde *	30.03			2.554E-03	22.370
HCl	36.46	30000	0%	3.389E-01	2857.189
HF	20.01	6000	0%	3.719E-02	313.551

Additional details about TAC emission calculation procedures and assumptions are provided in the attached spreadsheets.

Modeling Procedures

The ISCST3 air dispersion model was used for this analysis. Since there were no appropriate real meteorological data sets, the SCREEN3 data set was used to determine the maximum 1-hour average ground level concentrations that would result from this project's emissions. The applicant provided the exhaust gas flow rate data for the engines (S-1 and S-2) and the flare (A-1), stack information (P-1, P-2, and P-3), and building parameters. Terrain data from the Altamont, Livermore, Byron Hot Springs and Tassajara were used to determine elevations for all receptors, buildings, and sources.

Instead of entering the emission rate for each compound at each emission point, the District used pre-processed input factors that are a function of the individual compound emission rates, the health effects values for these compounds, exposure adjustment factors, receptor breathing rates, and other conversion factors that are necessary for the health impact calculations. Input factors for the emission points from each engine and from the flare were determined for each of the following scenarios: acute non-cancer, resident chronic non-cancer, worker chronic non-cancer, resident cancer risk, and worker cancer risk.

These input factors were calculated based on the sum of the weighted average emission rates for each compound at each emission point, where the weighted average emission rate for each compound was determined using the average grams/second emission rate for that compound (ER, g/s) $_i$ from each of the three emission points and a health effect value for that compound:

Acute HI Weighted Emission Rate = Σ (ER, g/s)$_i$ / (acute REL)$_i$
Chronic HI Weighted Emission Rate = Σ (ER, g/s)$_i$ / (chronic REL)$_i$
Cancer Risk Weighted Emission Rate = Σ (ER, g/s)$_i$ * (cancer potency factor)$_i$

The acute non-cancer input factors required no additional adjustments.
Acute Non-Cancer Input Factor = Acute HI Weighted Emission Rate

The chronic HI weighted average emission rates were multiplied by 0.1 to convert the 1-hour average concentration produced by the air dispersion model into an annual average concentration, and by the appropriate residential or worker exposure adjustment factors.
Resident Chronic Non-Cancer Input Factor = Chronic REL Wtd. ER * 0.1 * (24/24)*(350/365)
Worker Chronic Non-Cancer Input Factor = Chronic REL Wtd. ER * 0.1 * (8/24)*(245/365)

Similar procedures were used to calculate cancer risk weighted input factors for each emission point, except that resident and worker breathing rates, cancer risk adjustment factors (CRAFs) and additional conversion factors were used to convert the cancer potency factor weighted emission rate into a cancer risk adjusted input factor.
Resident Cancer Risk Input Factor:
= Cancer Risk Wtd. ER * 0.1 * (24/24)*(350/365)*(70/70) * (302)* 1.7 * (1E-6) * (1E6 risk per million)
Worker Cancer Risk Input Factor:
= Cancer Risk Wtd. ER * 0.1 * (8/24)*(245/365)*(40/70) * (447) * 1 * (1E-6) * (1E6 risk per million)

All input factors are summarized in Table A. Additional details about the calculation procedures for these pre-processed input factors are provided in the attached spreadsheets.

Table A. Pre-Processed Input Factors for ISCST3 Air Dispersion Model

	P-1	P-2	P-3
Acute Non-Cancer	2.65E-03	2.65E-03	1.48E-04
Resident Chronic Non-Cancer	1.65E-03	1.65E-03	5.14E-04
Worker Chronic Non-Cancer	3.85E-04	3.85E-04	1.20E-04
Resident Cancer Risk	5.91E-04	5.91E-04	4.88E-05
Worker Cancer Risk	4.63E-05	4.63E-05	3.82E-06

Separate ISCST3 model runs were conducted for the resident and worker scenarios using the appropriate receptor grids for each run. Each model was run using RURAL dispersion coefficients and SCREEN3 meteorological data.

The nearest residential areas to this facility are located to the south and west of the proposed engine and flare locations, outside of Vasco Road Landfill Company's property line. The nearest worker receptors to the Ameresco facility are the employees of Vasco Road Landfill Company.

Results

The proposed project for this application includes the S-1 and S-2 IC Engines burning landfill gas plus the A-1 Flare burning waste gases. The maximum project impacts for the proposed operating scenario are: 0.41 in a million cancer risk, 0.30 chronic HI, and 1.0 acute HI.

The maximum impact points for this project were determined to occur for worker receptors on Vasco Road Landfill Company property. The maximum project impacts are summarized in Table B. The maximum source impacts are summarized in Table C. Aerial photos showing the points of maximum impact are attached.

Table C HRSA Results: Total Project Risk			
	Acute Hazard Index	Chronic Hazard Index	Cancer Risk (per million)
Residential Receptor	1.0	0.04	0.41
Worker Receptor		0.30	0.03

Table C.4. HRSA Results: Source Risks			
	Acute Hazard Index	Chronic Hazard Index	Cancer Risk (per million)
S-1 IC Engine			
Residential Receptor	No Applicable Standard	0.02	0.2
Worker Receptor		0.13	0.015
S-2 IC Engine			
Residential Receptor	No Applicable Standard	0.02	0.2
Worker Receptor		0.13	0.015
A-1 Flare			
Residential Receptor	No Applicable Standard	0.005	0.01
Worker Receptor		0.04	0.001

This project is subject to Regulation 2, Rule 5, NSR of Toxic Air Contaminants. BAAQMD Regulation 2-5-301 requires TBACT for a source if the source risk exceeds either 1.0 in a million cancer risk or 0.2 chronic hazard index. As illustrated in Table C, TBACT triggers, because the source risk for each engine is also greater than 0.2 chronic HI. The primary contributors to the cancer risk impacts are formaldehyde emission from the engines and hydrogen sulfide emission from the flare. The proposed project will comply with BAAQMD Regulation 2-5-302.1 by having a cancer risk of less than 10.0 in a million, provided that S-1, S-2, and A-1 each meet TBACT requirements. Likewise, the proposed project will comply with BAAQMD Regulation 2-5-302.2 by having a chronic HI of less than 1.0, provided the A-1 Flare constitutes TBACT. The proposed project will comply with BAAQMD Regulation 2-5-302.3 by having an acute HI of less than 1.0.

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