Bay Area Air Quality Management District

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Permit Evaluation
and
Statement of Basis
for
MAJOR FACILITY REVIEW PERMIT

for

Ameresco Vasco Road, LLC
Facility #E0432

Facility Address:
4001 North Vasco Road
Livermore, CA 94551

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June 2016

Application Engineer: Flora Chan
Site Engineer: Flora Chan

Application: 22637

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PERMIT EVALUATION AND STATEMENT OF BASIS

for

INITIAL MAJOR FACILITY REVIW PERMIT

(INITIAL TITLE V PERMIT)

Ameresco Vasco Road, LLC; Site #E0432;

Application #22637

A. BACKGROUND

This facility is subject to the Operating Permit requirements of Title V of the federal Clean Air Act, Part 70 of Volume 40 of the Code of Federal Regulations (CFR), and BAAQMD Regulation 2, Rule 6, Major Facility Review (MFR) because it is a major facility as defined by BAAQMD Regulation 2-6-212. It is a major facility because it has the "potential to emit," as defined by BAAQMD Regulation 2-6-218, more than 100 tons/year of a regulated air pollutant and more than 10 tons/year of a hazardous air pollutant. This facility will be permitted to emit more than 100 tons/year of carbon monoxide (CO) and more than 10 tons/year of formaldehyde. Therefore, this facility is required to have an MFR permit pursuant to Regulation 2-6-301.

Major Facility Operating permits (Title V permits) must meet specifications contained in 40 CFR Part 70 as contained in BAAQMD Regulation 2, Rule 6. The permits must contain all "applicable requirements" (as defined in BAAQMD Regulation 2-6-202), monitoring requirements, recordkeeping requirements, and reporting requirements. The permit holders must submit reports of all monitoring at least every six months and compliance certifications at least every year.

In the Bay Area, state and District requirements are also applicable requirements and are included in the permit. These requirements can be federally enforceable or non-federally enforceable. All applicable requirements are contained in Sections I through VI of the permit.

Each facility in the Bay Area is assigned a facility identifier that consists of a letter and a 4-digit number. This identifier is also considered to be the identifier for the permit. The identifier for this facility is E0432.

B. FACILITY DESCRIPTION

Ameresco Vasco Road, LLC (Facility # E0432) is a new landfill gas energy recovery facility that is located in Livermore, CA on property that is owned by Vasco Road Landfill (VRL), Facility # A5095.[1] Ameresco Vasco Road's equipment is located in the southwest portion of the VRL landfill property, adjacent to the VRL flare station. The Ameresco Vasco Road equipment includes two internal combustion engines (S-1 and S-2), a gas treatment system (S-3), and a waste gas flare (A-1). Initial operation began in February 2014.

The Ameresco Vasco Road facility receives landfill gas collected from the Vasco Road Landfill,[2] processes this landfill gas to remove contaminants, and recovers the energy in this gas by burning it in internal combustion engines that power electrical generators. The gas cleaning system and energy recovery operations are discussed in detail below.

Gas Treatment System:

Landfill gas contains numerous contaminants such as: siloxanes, chlorinated and fluorinated compounds, hydrogen sulfide and other sulfur compounds. When landfill gas is combusted, these contaminants create particles and acid gases that can interfere with the proper functioning of internal combustion (IC) engines or damage engine parts. To extend the operating life of their engines and to minimize the risk of engine damage, Ameresco Vasco Road uses 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 MMBTU/hr enclosed flare to control purge emissions.

[1] Republic Services Vasco Road, LLC, owns and operates the Vasco Road Landfill (VRL), which is an active municipal solid waste disposal site. The VRL waste disposal facility has a separate owner and a separate SIC code from the Ameresco Vasco Road energy facility. Therefore, these sites are considered to be distinct facilities for the purposes of Title V applicability. The VRL waste disposal facility is also subject to Title V, and it has a separate Title V Operating Permit, which was last amended on January 27, 2015. The Statement of Basis for the Title V Renewal Permit for Site # A5095 contains a detailed explanation of the Title V permit for the VRL facility.

[2] Landfills generate a mixture of gases called landfill gas (LFG) via a biological waste decomposition process. Landfill gas contains about 50% methane and 45% carbon dioxide, with the balance being nitrogen, oxygen, and trace amounts of VOCs and sulfur compounds. Without controls, landfill gas seeps from the landfill surface resulting in significant VOC, toxic, and greenhouse gas emissions. Prior to the construction of the Ameresco energy facility, Republic Services Vasco Road, LLC controlled the landfill gas emissions from the Vasco Road Landfill by using system of blowers and buried pipes to continuously extract landfill gas from the landfill and by burning this collected landfill gas in enclosed flares.

Energy Recovery Operations:

Treated landfill gas from S-3 will be delivered to the S-1 and S-2 LFG-Fired IC Engines and Gensets, where it will be burned as fuel. The S-1 and S-2 engines are GE Jenbacher, Year 2012, JGS 616 GS-L.L, lean burn, 4-stroke, 16 cylinder engines. Each engine has a maximum permitted heat input rate of 20.012 MM BTU (HHV) per hour. Each IC engine has a maximum rated output of 3012 bhp. Each genset has a nominal power output of 2.18 MW (4.4 MW for the two gensets combined).

Emissions:

The maximum permitted emissions from this new facility are described in detail in the Engineering Evaluations for Applications # 22636 (see Appendices C). The maximum permitted emission levels for this facility are summarized in the following table.

Table 1. Maximum Permitted Emissions for Ameresco Vasco Road, LLC (Site # E0432)

		CO tons/year	NO_x tons/year	SO_2 tons/year	POC tons/year	PM_{10} tons/year
S-1	LFG-Fired IC Engine	100.252	16.709	11.741	5.185	2.785
S-2	LFG-Fired IC Engine	100.252	16.709	11.741	5.185	2.785
S-3 & A-1	Gas Cleaning System & Waste Gas Flare	4.941	1.482	26.773	0.741	0.423
Total	Site # B0432	205.445	34.900	50.254	11.111	5.992

C. PERMIT CONTENT

The legal and factual basis for the permit follows. The permit sections are described in the order presented in the permit.

I. Standard Conditions

This section contains administrative requirements and conditions that apply to all facilities. If the Title IV (Acid Rain) requirements for certain fossil-fuel fired electrical generating facilities or the accidental release (40 CFR § 68) programs apply, the section will contain a standard condition pertaining to these programs. This permit does not include Title IV or accidental release provisions.

Many of these conditions derive from 40 CFR § 70.6, Permit Content, which dictates certain standard conditions that must be placed in the permit. The language that the District has developed for many of these requirements has been adopted into the BAAQMD Manual of Procedures, Volume II, Part 3, Section 4, and therefore must appear in the permit.

The standard conditions also contain references to BAAQMD Regulation 1 and Regulation 2. These are the District's General Provisions and Permitting rules.

II. Equipment

This section of the permit lists all permitted or significant sources. Each source is identified by an S and a number (e.g., S-24).

Permitted sources are those sources that require a BAAQMD operating permit pursuant to BAAQMD Rule 2-1-302.

Significant sources are those sources that have a potential to emit of more than 2 tons of a "regulated air pollutant," as defined in BAAQMD Rule 2-6-222, per year or 400 pounds of a "hazardous air pollutant," as defined in BAAQMD Rule 2-6-210, per year. This facility has no unpermitted significant sources.

All abatement (control) devices that control permitted or significant sources are listed. Each abatement device whose primary function is to reduce emissions is identified by an A and a number (e.g., A-24). If a source is also an abatement device, such as when an engine controls VOC emissions, it will be listed in the abatement device table but will have an "S" number. An abatement device may also be a source (such as a thermal oxidizer that burns fuel) of secondary emissions. If the primary function of a device is to control emissions, it is considered an abatement (or "A") device. If the primary function of a device is a non-control function, the device is considered to be a source (or "S").

The equipment section is considered to be part of the facility description. It contains information that is necessary for applicability determinations, such as fuel types, contents or sizes of tanks, etc. This information is part of the factual basis of the permit.

Each of the permitted sources has previously been issued either an authority to construct or a permit to operate pursuant to the requirements of BAAQMD Regulation 2, Permits. These permits are issued in accordance with state law and the District's regulations. The capacities in the permitted sources table are the maximum allowable capacities for each source, pursuant to Standard Condition I.J and Regulation 2-1-403.

III. Generally Applicable Requirements

This section of the permit lists requirements that generally apply to all sources at a facility including insignificant sources and portable equipment that may not require a District permit. If a generally applicable requirement applies specifically to a source that is permitted or significant,

the standard will also appear in Section IV and the monitoring for that requirement will appear in Sections IV and VII of the permit. Parts of this section apply to all facilities (e.g., particulate, architectural coating, odorous substance, and sandblasting standards). In addition, standards that apply to insignificant or unpermitted sources at a facility (e.g., refrigeration units that use more than 50 pounds of an ozone-depleting compound) are placed in this section.

Unpermitted sources are exempt from normal District permits pursuant to an exemption in BAAQMD Regulation 2, Rule 1. They may, however, be specifically described in a Title V permit if they are considered "significant sources" as defined in BAAQMD Regulation 2-6-239. This facility has no unpermitted significant sources.

IV. Source-Specific Applicable Requirements

This section of the permit lists the applicable requirements that apply to permitted or significant sources. These applicable requirements are contained in tables that pertain to one or more sources that have the same requirements. The order of the requirements is:

- District Rules.
- SIP Rules (if any) are listed following the corresponding District rules. SIP rules are District rules that have been approved by EPA for inclusion in the California State Implementation Plan. SIP rules are "federally enforceable" and a "Y" (yes) indication will appear in the "Federally Enforceable" column. If the SIP rule is the current District rule, separate citation of the SIP rule is not necessary and the "Federally Enforceable" column will have a "Y" for "yes". If the SIP rule is not the current District rule, the SIP rule or the necessary portion of the SIP rule is cited separately after the District rule. The SIP portion will be federally enforceable; the non-SIP version will not be federally enforceable, unless EPA has approved it through another program.
- Other District requirements, such as the Manual of Procedures, as appropriate.
- Federal requirements (other than SIP provisions).
- BAAQMD permit conditions. The text of BAAQMD permit conditions is found in Section VI of the permit.
- Federal permit conditions. The text of Federal permit conditions, if any, is found in Section VI of the permit.

Section IV of the permit contains citations to all of the applicable requirements. The text of the requirements is found in the regulations, which are readily available on the District or EPA websites, or in the permit conditions, which are found in Section VI of the permit. All monitoring requirements are cited in Section IV. Section VII is a cross-reference between the limits and monitoring requirements. A discussion of monitoring is included in Section C.VII of this permit evaluation and statement of basis.

Complex Applicability Determinations:

The NSPS requirements for MSW Landfills (40 CFR Part 60, Subpart WWW) do not apply to the S-1 and S-2 LFG-Fired IC Engines or the S-3 Gas Treatment System, because the landfill gas that is burned in these engines has been purchased from a separate entity: Republic Vasco Road LLC. Republic Vasco Road LLC. has satisfied the requirements of 40 CFR Part 60.752(b)(2)(iii) by routing the gas to a treatment system that processes the collected gas for subsequent sale or use.

The NSPS requirements for Stationary Spark Ignition Internal Combustion Engines (40 CFR Part 60, Subpart JJJJ) apply to new spark-ignited internal combustion engines that were manufactured on or after July 1, 2007. The engines at this facility have an original manufacture year of 2012. The Subpart ZZZZ NESHAP defines new area source engines as engines that commenced construction on or after June 12, 2006 (40 CFR Part 63.6590(a)(2)(iii)). The engines at this facility commenced construction in 2012 and are therefore considered new engines under the Subpart ZZZZ NESHAP. In accordance with 40 CFR Part 63.6590(c), new RICE must comply with Subpart ZZZZ by meeting the requirements of 40 CFR Part 60, Subpart JJJJ. The applicable sections of the NSPS and NESHAP are identified in Table IV-A.

The formaldehyde limit in Condition 25009, part 8, has been raised from 0.64 lb/hr to 1.27 lb/hr after startup. The risk assessment for the project was revised and the risk was found to be within the limits in BAAQMD Regulation 2, Rule 5, New Source Review for Toxic Air Contaminants. This limit is not federally enforceable.

V. Schedule of Compliance

A schedule of compliance is required in all Title V permits pursuant to BAAQMD Regulation 2-6-409.10 which provides that a major facility review permit shall contain the following information and provisions:

"409.10 A schedule of compliance containing the following elements:

- 10.1 A statement that the facility shall continue to comply with all applicable requirements with which it is currently in compliance;
- 10.2 A statement that the facility shall meet all applicable requirements on a timely basis as requirements become effective during the permit term; and
- 10.3 If the facility is out of compliance with an applicable requirement at the time of issuance, revision, or reopening, the schedule of compliance shall contain a plan by which the facility will achieve compliance. The plan shall contain deadlines for each item in the plan. The schedule of compliance shall also contain a requirement for submission of progress reports by the facility at least every six months. The progress reports shall contain the dates by which each item in the plan was achieved and an explanation of why any dates in the schedule of compliance were not or will not be met, and any preventive or corrective measures adopted."

Since the District has not determined that the facility is out of compliance with an applicable requirement, the schedule of compliance for this permit contains only sections 2-6-409.10.1 and 2-6-409.10.2.

VI. Permit Conditions

During the Title V permit development, the District has reviewed the existing permit conditions, deleted the obsolete conditions, and, as appropriate, revised the conditions for clarity and enforceability. Each permit condition is identified with a unique numerical identifier, up to five digits.

When necessary to meet Title V requirements, additional monitoring, recordkeeping, or reporting requirements have been added to the permit.

All changes to existing permit conditions are clearly shown in "strike-out/underline" format in the proposed permit. When the permit is issued, all "strike-out" language will be deleted and all "underline" language will be retained, subject to consideration of comments received.

The existing permit conditions are derived from previously issued District Authorities to Construct (A/C) or Permits to Operate (P/O). Permit conditions may also be imposed or revised as part of the annual review of the facility by the District pursuant to California Health and Safety Code (H&SC) § 42301(e), through a variance pursuant to H&SC § 42350 et seq., an order of abatement pursuant to H&SC § 42450 et seq., or as an administrative revision initiated by District staff. After issuance of the Title V permit, permit conditions will be revised using the procedures in Regulation 2, Rule 6, Major Facility Review.

Sources that were modified or constructed since the District began issuing new source review permits will have permits that contain throughput limits, and these limits are reflected in the Title V permit. These limits have previously undergone District review, and are considered to be the legally binding "emission level" for purposes of 2-234.1 and 2-1-234.2.

If there are conditions that are obsolete or that have no regulatory basis, they will be deleted from the permit.

Conditions may also be deleted due to the following:

- Redundancy in recordkeeping requirements.
- Redundancy in other conditions, regulations and rules.
- The condition has been superseded by other regulations and rules.
- The equipment has been taken out of service or is exempt.
- The event has already occurred (i.e. initial or start-up source tests).

The regulatory basis is listed following each condition. The regulatory basis may be a rule or regulation. The District is also using the following terms for regulatory basis:

- BACT: This term is used for a condition imposed by the Air Pollution Control Officer (APCO) to ensure compliance with the Best Available Control Technology in Regulation 2-2-301.
- Cumulative Increase: This term is used for a condition imposed by the APCO which limits a source's operation to the operation described in the permit application pursuant to BAAQMD Regulation 2-1-403.
- Offsets: This term is used for a condition imposed by the APCO to ensure compliance with the use of offsets for the permitting of a source or with the banking of emissions from a source pursuant to Regulation 2, Rules 2 and 4.
- PSD: This term is used for a condition imposed by the APCO to ensure compliance with a Prevention of Significant Deterioration permit issued pursuant to Regulation 2, Rule 2.

In the case of this proposed initial Title V permit for Site # E0432, the only permit condition changes were to correct the bases for several parts of Conditions # 25009 and # 25010.

VII. Applicable Limits and Compliance Monitoring Requirements

This section of the permit is a summary of numerical limits and related monitoring requirements for each source. The summary includes a citation for each monitoring requirement, frequency of monitoring, and type of monitoring. The applicable requirements for monitoring are completely contained in Sections IV, Source-Specific Applicable Requirements, and VI, Permit Conditions, of the permit.

The District has reviewed all monitoring and has determined the existing monitoring is adequate with the following exceptions.

The tables below contain only the limits for which there is no monitoring or inadequate monitoring in the applicable requirements. The District has examined the monitoring for other limits and has determined that monitoring is adequate to provide a reasonable assurance of compliance. Calculations for potential to emit will be provided in the discussion when no monitoring is proposed due to the size of a source.

Monitoring decisions are typically the result of a balancing of several different factors including: 1) the likelihood of a violation given the characteristics of normal operation, 2) degree of variability in the operation and in the control device, if there is one, 3) the potential severity of impact of an undetected violation, 4) the technical feasibility and probative value of indicator monitoring, 5) the economic feasibility of indicator monitoring, and 6) whether there is some other factor, such as a different regulatory restriction applicable to the same operation, that also provides some assurance of compliance with the limit in question.

These factors are the same as those historically applied by the District in developing monitoring for applicable requirements**.** It follows that, although Title V calls for a re-examination of all monitoring**,** there is a presumption that these factors have been appropriately balanced and incorporated in the District's prior rule development and/or permit issuance. It is possible that, where a rule or permit requirement has historically had no monitoring associated with it, no monitoring may still be appropriate in the Title V permit if, for instance, there is little likelihood of a violation**.** Compliance behavior and associated costs of compliance are determined in part by the frequency and nature of associated monitoring requirements. As a result, the District will generally revise the nature or frequency of monitoring requirements only when it can support a conclusion that existing monitoring is inadequate**.**

SO_2 Sources

S# & Description	Emission Limit Citation	Federally Enforceable Emission Limit	Monitoring
LFG-Fired IC Engines (S-1 and S-2) and Waste Gas Flare (A-1)	BAAQMD 9-1-301	Property Line Ground Level Limits: $\leq$ 0.5 ppm for 3 minutes, AND $\leq$ 0.25 ppm for 60 minutes, AND $\leq$0.05 ppm for 24 hours	None

SO_2 Discussion:

Potential to Emit for S-1 LFG-Fired IC Engine [(1)]: 4.318 tons/year of SO_2
Potential to Emit for S-2 LFG-Fired IC Engine [(1)]: 4.318 tons/year of SO_2
Potential to Emit for A-1 Waste Gas Flare [(2)]: 12.247 tons/year of SO_2

(1) Maximum potential annual SO_2 emissions from the engines were determined based on the maximum possible operating rate and the annual average sulfur content limit for the fuel (150 ppmv of sulfur).

(19.733 MM BTU/hour)/(496.9 MM BTU/MM ft^3 LFG)*(150 ft^3 S/MM ft^3 LFG)*(1 ft^3 SO_2/1 ft^3 S)/(387 ft^3 SO_2/1 lbmol SO_2)*(64.06 lbs SO_2/1 lbmol)*(8760 hours/year)/(2000 lbs/ton)
= 4.318 tons/year of SO_2 per engine

(2) Maximum potential annual SO_2 emissions from the flare were determined based on the maximum landfill gas sulfur content for Keller Canyon Landfill Gas (300 ppmv of TRS), the maximum possible landfill gas throughput rate to Ameresco (418,000 MM BTU/year), and the engine emissions above (8.637 tons/year for two engines).
(418,000 MM BTU/year)*(1E6 BTU/1 MM BTU)/(496.9 BTU/ft^3 LFG)*(300 ft^3 S/1E6 ft^3 LFG)/
(387 ft^3 S/1 lbmol S)*(1 lbmol SO_2/1 lbmol S)*(64.06 lbs SO_2/1 lbmol SO_2)/(2000 lbs SO_2/ton SO_2)
= 20.884 tons/year of SO_2 total for Ameresco Keller Canyon Site

(20.884 tons/year) - (8.637 tons/year) = 12.247 tons/year of SO_2 from A-1 Flare

BAAQMD 9-1-301: As shown above, the SO_2 emissions from these landfill gas fired combustion devices are not substantial. In addition, this facility is subject to federally enforceable limits that will ensure compliance with the Regulation 9-1-302 gas stream emission limit of 300 ppmv of SO_2 in the exhaust from the flare and each engine. Based on the source-specific landfill gas sulfur content limits, the SO_2 concentrations in the exhaust streams from the engines are expected to be less than 10% of this 9-1-302 outlet SO_2 concentration limit. Based on the maximum annual sulfur throughout data above, the concentration of SO_2 in the flare exhaust is expected to be an average of 213 ppmv at 0% O_2, or about 111 ppmv of SO_2 at a typical flare exhaust oxygen concentration of 10%, which is 47% of the 9-1-302 limit. Modeling analyses conducted at another landfill site found that sources such as landfill gas flares that are complying with the Regulation 9-1-302 limit will also comply with the ground level concentration limits listed in Regulation 9-1-301. Since the landfill gas combustion devices have a medium to high margin of compliance with the Regulation 9-1-302 outlet SO_2 concentration limit, the District expects that these devices will also have a medium to high margin of compliance with the Regulation 9-1-301 ground level concentration limit based on the modeling analysis discussed above. This facility is currently required to monitor the sulfur content in the raw and treated landfill gases on a monthly basis to demonstrate compliance with the annual average sulfur content limits, and this facility is required to conduct annual SO_2 testing on the engines and flare. Monitoring for ground level SO_2 concentrations in addition to this existing sulfur content and SO_2 emissions monitoring would not be appropriate given the medium to high margin of compliance expected for these ground level SO_2 limits.

PM Sources

S# & Description	Emission Limit Citation	Federally Enforceable Emission Limit	Monitoring
LFG-Fired IC Engines (S-1 and S-2) and Waste Gas Flare (A-1)	BAAQMD 6-1-301 and SIP 6-301	No darker than: Ringelmann 1.0 for 3 minutes in any hour	None
LFG-Fired IC Engines (S-1 and S-2) and Waste Gas Flare (A-1)	BAAQMD 6-1-310 and SIP 6-310	≤ 0.15 grains/dscf	None

PM Discussion:

Potential to Emit for S-1 LFG-Fired IC Engine (1): 2.585 tons/year of PM_{10}
Potential to Emit for S-2 LFG-Fired IC Engine (1): 2.585 tons/year of PM_{10}
Potential to Emit for A-1 Waste Gas Flare (2): 1.212 tons/year of PM_{10}

(1) Maximum potential PM_{10} emissions for these engines are based on the maximum possible operating rate and the manufacturer's guaranteed emission limit of 0.1 g/bhp-hr.

(2677 bhp)*(0.1 g/bhp-hr)*(8760 hrs/yr)/(453.6 g/lbs)/(2000 lbs/ton) = 2.585 tons/year of PM_{10}

(2) Maximum potential PM_{10} emissions from the flare were determined based on the maximum possible operating rate and the manufacturer's guaranteed emission limit of 0.001 lbs/hr/scfm of LFG, which is equal to 33 lbs/MM scf of CH4. This is about twice the AP-42 emission factor of 17 lbs/MM scf of CH4.

(0.001 lbs/hr / scfm of LFG)*(276.7 scfm LFG)*(8760 hours/year)/(2000 lbs/ton) = 1.212 tons/year of PM_{10}

BAAQMD 6-1-301 and SIP 6-301 for Landfill Gas Combustion Devices: Visible particulate emissions are not normally associated with combustion of gaseous fuels, such as natural gas, propane, or landfill gas. Since particulate emissions from each unit are not substantial (< 3 tons/year per unit), and it is highly unlikely that violations of the Ringelmann 1.0 limit would occur, periodic monitoring for the Ringelmann 1.0 limit is not justified.

BAAQMD 6-1-310 and SIP 6-310 for Landfill Gas Combustion Devices: BAAQMD Regulation 6-1-310 and SIP 6-310 limit filterable particulate (FP) emissions in the stack from any source to 0.15 grains per dry standard cubic foot (gr/dscf) of exhaust volume. Based on the manufacturer's guaranteed emission rates for these devices, the IC engines will each emit 0.022 gr/dscf of exhaust at 0% oxygen and the flare will emit 0.024 gr/dscf of exhaust at 0% oxygen. The grain loading limit (0.15 gr/dscf) is far above any expected PM emissions for these devices, and the compliance ratio is at least 6:1. Since maximum potential PM emissions from the landfill gas combustion devices are not substantial, an excess of the emission standard is highly unlikely, and

PM_{10} monitoring is costly, it would not be appropriate to require periodic monitoring for PM_{10} emissions from the landfill gas combustion devices listed above.

H_2S Sources

S# & Description	Emission Limit Citation	Non-Federally Enforceable Emission Limit	Monitoring
LFG-Fired IC Engines (S-1 and S-2) and Waste Gas Flare (A-1)	BAAQMD 9-2-301	Property Line Ground Level Limits: ≤ 0.06 ppm, averaged over 3 minutes and ≤ 0.03 ppm, averaged over 60 minutes	None

H_2S Discussion:

Potential to Emit for S-1 LFG-Fired IC Engine: 0.115 tons/year of H_2S
Potential to Emit for S-2 LFG-Fired IC Engine: 0.115 tons/year of H_2S
Potential to Emit for A-1 Waste Gas Flare: 0.222 tons/year of H_2S

BAAQMD 9-2-301: BAAQMD Regulation 9-2-301 limits the ground level concentration of hydrogen sulfide (H_2S) at the property line of each facility. Since landfill gas contains H_2S, any source that processes landfill gas at this site may result in H_2S emissions. During combustion, H_2S is readily converted to SO_2 and very little residual H_2S remains in the combustion exhaust streams. In addition, combustion exhaust streams undergo significant dispersion between the exhaust point and the property line. The District expects these combustion sources to result in negligible ground level H_2S concentrations at the property line. The health risk screening analysis for this facility confirmed that ground level H_2S concentrations are expected to be well below the reference exposure levels for H_2S, on which the above limits were based. Since ground level H_2S monitoring would be very expensive and violations of these limits are highly unlikely, it would not be appropriate to require this facility to conduct fence-line H_2S monitoring.

VIII. Test Methods

This section of the permit lists test methods that are associated with standards in District or other rules. It is included only for reference. In most cases, the test methods in the rules are source test methods that can be used to determine compliance but are not required on an ongoing basis. They are not "applicable requirements" as defined by Regulation 2-6-239.

If a rule or permit condition requires ongoing testing, the requirement will also appear in Section IV of the permit.

IX. Permit Shield

The District rules allow two types of permit shields. The permit shield types are defined as follows: (1) A provision in a major facility review permit explaining that specific federally enforceable regulations and standards do not apply to a source or group of sources, or (2) A provision in a major facility review permit explaining that specific federally enforceable applicable requirements for monitoring, recordkeeping and/or reporting are subsumed because other applicable requirements for monitoring, recordkeeping, and reporting in the permit will assure compliance with all emission limits.

The second type of permit shield is allowed by EPA's "White Paper 2 for Improved Implementation of the Part 70 Operating Permits Program." The District uses the second type of permit shield for all streamlining of monitoring, recordkeeping, and reporting requirements in Title V permits. The District's program does not allow other types of streamlining in Title V permits.

This facility has no permit shields.

X. Revision History

This section of the permit summarizes each revision to the permit. The District is proposing to modify the existing permit conditions by correcting the bases for several parts. This change is identified here in Section X.

XI. Glossary

This section of the permit defines and explains acronyms, abbreviations, and other terms that are used in this permit.

D. ALTERNATIVE OPERATING SCENARIOS

No alternate operating scenario has been requested for this facility.

E. COMPLIANCE STATUS

The responsible official for Ameresco Keller Canyon LLC submitted a signed Certification Statement form with submittal of the application for renewal of the Title V permit, dated March 13, 2008, and an updated signed Certification Statement, dated July 27, 2015. On this form, the responsible official certified that the following four statements are true:

- Based on information and belief formed after reasonable inquiry, the source(s) identified in the Applicable Requirements and Compliance Summary form that is(are) in compliance will continue to comply with the applicable requirement(s);
- Based on information and belief formed after reasonable inquiry, the source(s) identified in the Applicable Requirements and Compliance Summary form will comply with future-effective applicable requirement(s), on a timely basis;
- Based on information and belief formed after reasonable inquiry, information on application forms, all accompanying reports, and other required certifications is true, accurate, and complete;
- All fees required by Regulation 3, including Schedule P have been paid.

F. DIFFERENCES BETWEEN THE APPLICATION AND THE PROPOSED PERMIT

The Title V permit application was originally submitted on March 17, 2008, before the facility had been constructed. This version is the basis for constructing the proposed Title V permit. Changes to the equipment descriptions and permit conditions include the following:

The District has assigned a source number (S-3) to the TSA Gas Cleaning System and an abatement device number (A-1) to the TSA Waste Gas Flare. The flare was described in the Title V permit application but did not have an assigned A-#. The carbon desorption phase of the gas cleaning is an inherent part of this process and the operation of the A-1 Waste Gas Flare. However, the applicant did not describe this desorption step of the gas cleaning process as a separate source number from the flare.

The District has approved modifications to the permit conditions for the equipment at this facility after the authority to construct was first issued and after the permits to operate were issued. All permit condition modifications are discussed in the reports in the attached appendices.

APPENDIX A

GLOSSARY

ACT
Federal Clean Air Act

AP-42
An EPA Document "Compilation of Air Pollution Emission Factors" that is used to estimate emissions from numerous source types. It is available electronically from EPA's web site at: http://www.epa.gov/ttn/chief/ap42/index.html

APCO
Air Pollution Control Officer: Head of Bay Area Air Quality Management District

API
American Petroleum Institute

ARB
Air Resources Board

ASTM
American Society for Testing and Materials

ATC
Authority to Construct

ATCM
Airborne Toxic Control Measure

BAAQMD
Bay Area Air Quality Management District

BACT
Best Available Control Technology

BARCT
Best Available Retrofit Control Technology

Basis
The underlying authority that allows the District to impose requirements.

C1
An organic chemical compound with one carbon atom, for example: methane

C3
An organic chemical compound with three carbon atoms, for example: propane

C5
An organic chemical compound with five carbon atoms, for example: pentane

C6
An organic chemical compound with six carbon atoms, for example: hexane

CAA
The federal Clean Air Act

CAAQS
California Ambient Air Quality Standards

CAPCOA
California Air Pollution Control Officers Association

CARB
California Air Resources Board (same as ARB)

CCR
California Code of Regulations

CEC
California Energy Commission

CEQA
California Environmental Quality Act

CEM
A "continuous emissions monitor" is a monitoring device that provides a continuous direct measurement of some pollutant (e.g. NO_x concentration) in an exhaust stream.

CFR
The Code of Federal Regulations. 40 CFR contains the implementing regulations for federal environmental statutes such as the Clean Air Act. Parts 50-99 of 40 CFR contain the requirements for air pollution programs.

CH4 or CH_4
Methane

CI
Compression Ignition

CIWMB
California Integrated Waste Management Board

CO
Carbon Monoxide

CO2 or CO_2
Carbon Dioxide

CO2e
Carbon Dioxide Equivalent. A carbon dioxide equivalent emission rate is the emission rate of a greenhouse gas compound that has been adjusted by multiplying the mass emission rate by the global warming potential of the greenhouse gas compound. These adjusted emission rates for individual compounds are typically summed together, and the total is also referred to as the carbon dioxide equivalent (CO2e) emission rate.

CT
Combustion Zone Temperature

Cumulative Increase
The sum of permitted emissions from each new or modified source since a specified date pursuant to BAAQMD Rule 2-1-403, Permit Conditions (as amended by the District Board on 7/17/91) and SIP Rule 2-1-403, Permit Conditions (as approved by EPA on 6/23/95). Used to determine whether threshold-based requirements are triggered.

District
The Bay Area Air Quality Management District

E6, E9, E12
Very large or very small number values are commonly expressed in a form called scientific notation, which consists of a decimal part multiplied by 10 raised to some power. For example, 4.53 E6 equals (4.53) x (10^6) = (4.53) x (10 x 10 x 10 x 10 x 10 x 10) = 4,530,000. Scientific notation is used to express large or small numbers without writing out long strings of zeros.

EG
Emission Guidelines

EO
Executive Order

EPA
The federal Environmental Protection Agency.

ETP
Effluent Treatment Plant

Excluded
Not subject to any District regulations.

Federally Enforceable, FE
All limitations and conditions which are enforceable by the Administrator of the EPA including those requirements developed pursuant to 40 CFR Part 51, subpart I (NSR), Part 52.21 (PSD), Part 60 (NSPS), Part 61 (NESHAPs), Part 63 (MACT), and Part 72 (Permits Regulation, Acid Rain), including limitations and conditions contained in operating permits issued under an EPA-approved program that has been incorporated into the SIP.

FP
Filterable Particulate as measured by BAAQMD Method ST-15, Particulate.

FR
Federal Register

GDF
Gasoline Dispensing Facility

GHG
Greenhouse Gas

GLM
Ground Level Monitor

grains
1/7000 of a pound

GWP
Global Warming Potential. A comparison of the ability of each greenhouse gas to trap heat in the atmosphere relative to that of carbon dioxide over a specific time period.

H2S or H_2S
Hydrogen Sulfide

H2SO4 or H_2SO_4
Sulfuric Acid

H&SC
Health and Safety Code

HAP
Hazardous Air Pollutant. Any pollutant listed pursuant to Section 112(b) of the Act. Also refers to the program mandated by Title I, Section 112, of the Act and implemented by 40 CFR Part 63.

Hg
Mercury

HHV
Higher Heating Value. The quantity of heat evolved as determined by a calorimeter where the combustion products are cooled to 60 °F and all water vapor is condensed to liquid.

IC
Internal Combustion

LEA
Local Enforcement Agency

LFG
Landfill gas

LHV
Lower Heating Value. Similar to the higher heating value (see HHV) except that the water produced by the combustion is not condensed but retained as vapor at 60 °F.

Long ton
2200 pounds

Major Facility
A facility with potential emissions of: (1) at least 100 tons per year of regulated air pollutants, (2) at least 10 tons per year of any single hazardous air pollutant, and/or (3) at least 25 tons per year of any combination of hazardous air pollutants, or such lesser quantity of hazardous air pollutants as determined by the EPA administrator.

MAX or Max.
Maximum

MFR
Major Facility Review. The District's term for the federal operating permit program mandated by Title V of the Federal Clean Air Act and implemented by District Regulation 2, Rule 6.

MIN or Min.
Minimum

MOP
The District's Manual of Procedures.

MSDS
Material Safety Data Sheet

MSW
Municipal solid waste

MTBE
methyl tertiary-butyl ether

MW
Molecular weight

N2 or N_2
Nitrogen

NA
Not Applicable

NAAQS
National Ambient Air Quality Standards

NESHAPS
National Emission Standards for Hazardous Air Pollutants. See in 40 CFR Parts 61 and 63.

NMHC
Non-methane Hydrocarbons (Same as NMOC)

NMOC
Non-methane Organic Compounds (Same as NMHC)

NO2 or NO_2
Nitrogen Dioxide

NOx or NO_x
Oxides of nitrogen.

NSPS
Standards of Performance for New Stationary Sources. Federal standards for emissions from new stationary sources. Mandated by Title I, Section 111 of the Federal Clean Air Act, and implemented by 40 CFR Part 60 and District Regulation 10.

NSR
New Source Review. A federal program for pre-construction review and permitting of new and modified sources of pollutants for which criteria have been established in accordance with Section 108 of the Federal Clean Air Act. Mandated by Title I of the Federal Clean Air Act and implemented by 40 CFR Parts 51 and 52 and District Regulation 2, Rule 2. (Note: There are additional NSR requirements mandated by the California Clean Air Act.)

O2 or O_2
Oxygen

Offset Requirement
A New Source Review requirement to provide federally enforceable emission offsets for the emissions from a new or modified source. Applies to emissions of POC, NOx, PM10, and SO2.

PERP
Portable Equipment Registration Program

Phase II Acid Rain Facility
A facility that generates electricity for sale through fossil-fuel combustion and is not exempted by 40 CFR 72 from Titles IV and V of the Clean Air Act.

POC
Precursor Organic Compounds

PM
Particulate Matter

PM10 or PM_{10}
Particulate matter with aerodynamic equivalent diameter of less than or equal to 10 microns

PM2.5 or $PM_{2.5}$
Particulate matter with aerodynamic equivalent diameter of less than or equal to 2.5 microns

PSD
Prevention of Significant Deterioration. A federal program for permitting new and modified sources of those air pollutants for which the District is classified "attainment" of the National Air Ambient Quality Standards. Mandated by Title I of the Act and implemented by both 40 CFR Part 52 and District Regulation 2, Rule 2.

PTO
Permit to Operate

PV or P/V Valve
Pressure/Vacuum Valve

Regulated Organic Liquid
“Regulated organic liquids” are those liquids which require permits, or which are subject to some regulation, when processed at a liquid-handling operation. For example, for refinery marine terminals, regulated organic liquids are defined as “organic liquids” in Regulation 8, Rule 44.

RICE
Reciprocating Internal Combustion Engine

RMP
Risk Management Plan

RWQCB
Regional Water Quality Control Board

S
Sulfur

SCR
A "selective catalytic reduction" unit is an abatement device that reduces NO_x concentrations in the exhaust stream of a combustion device. SCRs utilize a catalyst, which operates within a specific temperature range, and injected ammonia to promote the conversion of NO_x compounds to nitrogen gas.

Short ton
2000 pounds

SIP
State Implementation Plan. State and District programs and regulations approved by EPA and developed in order to attain the National Air Ambient Quality Standards. Mandated by Title I of the Act.

SO2 or SO_2
Sulfur dioxide

SO3 or SO_3
Sulfur trioxide

SSM
Startup, Shutdown, or Malfunction

SSM Plan
A plan, which states the procedures that will be followed during a startup, shutdown, or malfunction, that is prepared in accordance with the general NESHAP provisions (40 CFR Part 63, Subpart A) and maintained on site at the facility.

TAC
Toxic Air Contaminant (as identified by CARB)

TBACT
Best Available Control Technology for Toxics

THC
Total Hydrocarbons includes all NMHC plus methane (same as TOC).

therm
100,000 British Thermal Units

Title V
Title V of the federal Clean Air Act. Requires a federally enforceable operating permit program for major and certain other facilities.

TOC
Total Organic Compounds includes all NMOC plus methane (same as THC).

TPH
Total Petroleum Hydrocarbons

TRMP
Toxic Risk Management Policy

TRS
Total Reduced Sulfur, which is a measure of the amount of sulfur-containing compounds in a gas stream, typically a fuel gas stream, including, but not limited to, hydrogen sulfide. The TRS content of a fuel gas determines the concentration of SO_2 that will be present in the combusted fuel gas, since sulfur compounds are converted to SO_2 by the combustion process.

TSP
Total Suspended Particulate

TVP
True Vapor Pressure

VMT
Vehicle Miles Traveled

VOC
Volatile Organic Compounds

Symbols:

<	=	less than
>	=	greater than
≤	=	less than or equal to
≥	=	greater than or equal to

Units of Measure:

atm	=	atmospheres
bbl	=	barrel of liquid (42 gallons)
bhp	=	brake-horsepower
btu	=	British Thermal Unit
BTU	=	British Thermal Unit
°C	=	degrees Centigrade
cfm	=	cubic feet per minute
dscf	=	dry standard cubic feet
°F	=	degrees Fahrenheit
ft^3	=	cubic feet
g	=	grams
gal	=	gallon
gpm	=	gallons per minute
gr	=	grains
hp	=	horsepower
hr	=	hour
in	=	inches
kW	=	kilowatts
lb	=	pound
lbmol	=	pound-mole
m^2	=	square meter
m^3	=	cubic meters
Mg	=	mega grams
min	=	minute
mm	=	millimeter
MM	=	million
MM BTU	=	million BTU
M cf	=	one thousand cubic feet
MM cf	=	one million cubic feet
MW	=	megawatts
ppb	=	parts per billion
ppbv	=	parts per billion, by volume
ppm	=	parts per million
ppmv	=	parts per million, by volume
ppmw	=	parts per million, by weight
psia	=	pounds per square inch, absolute
psig	=	pounds per square inch, gauge
scf	=	standard cubic feet
scfm	=	standard cubic feet per minute
sdcf	=	standard dry cubic feet
sdcfm	=	standard dry cubic feet per minute
yd	=	yard
yd^3	=	cubic yards
yr	=	year

APPENDIX B

Engineering Evaluation
Permit Application No. 22636

Final 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

October 17, 2011

Prepared By:

Flora Chan

Air Quality Engineer

and

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Supervising Air Quality Engineer

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Landfill Gas to Energy Plant Including: Two IC Engines, a LFG Treatment System, and a Waste Gas Flare

Final Engineering Evaluation

Ameresco Vasco Road, LLC

PLANT # 20432

APPLICATION # 22636

G. BACKGROUND

This application is for the installation of a proposed landfill gas to energy facility that will be located at 4001 North Vasco Road in Livermore in Alameda County. The proposed landfill gas to energy plant will be located on leased property that is owned Republic Services Vasco Road, LLC. The energy plant will be operated by an independent company: Ameresco Vasco Road, LLC (Plant # 20432).

Republic Services Vasco Road, LLC operates the Vasco Road Landfill (VRL) facility, Plant # 5095. The VRL includes an active municipal solid waste landfill equipped with landfill gas collection and control equipment. The proposed landfill gas to energy facility will treat landfill gas collected from VRL and burn the treated landfill gas in IC engine / generator sets to produce electricity. The proposed energy plant equipment will be located in the southwest portion of the VRL landfill property, adjacent to the VRL flare station.

Ameresco Vasco Road, LLC (or "Ameresco") is applying for an Authority to Construct and Permit to Operate for the following new emission units: two 3012 bhp internal combustion engines (S-1 and S-2) that will be fired exclusively on treated landfill gas, a landfill gas treatment system (S-3), and a 5.64 MM BTU/hour enclosed waste gas flare (A-1). The gas treatment system includes two processes: (1) pretreatment of the raw LFG collected from VRL and (2) regeneration of the treatment system's absorption media. The landfill gas pretreatment processes consist of filtration, compression, refrigeration, and a silica gel-based absorption system that removes siloxanes from the LFG prior to combustion in the engines. This pretreatment process is a closed system without exhaust vents. The silica gel-based absorption media must be periodically regenerated. This regeneration process produces a waste gas stream of air and organic compounds. This waste gas stream is blended with treated landfill gas and burned in the enclosed flare (A-1) to control the organic emissions from the absorption media regeneration process.

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.

H. 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:

Landfill Gas to Energy Plant Including: Two IC Engines, a LFG Treatment System, and a Waste Gas Flare

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

Landfill Gas to Energy Plant Including: Two IC Engines, a LFG Treatment System, and a Waste Gas Flare

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 $\leq$ 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
Toluene	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
Toluene	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
Toluene	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

I. 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 Ameresco 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 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 "Revisiting 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 dry 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.

Regulation 2, Rule 6 (Major Facility Review)

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.

J. PERMIT CONDITIONS

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 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

K. PUBLIC NOTICE, COMMENTS, AND RESPONSES

Regulation 2, Rule 2, Section 405 requires that the District publicize the District's preliminary decisions on new major facilities, major modifications of existing major facilities, PSD analyses, and MACT determinations. Regulation 2-2-405 identifies the notification criteria and requires a minimum 30-day public comment period for these types of projects. This new landfill gas to energy facility will result in more than 100 tons per year of carbon monoxide (CO), and this application will result in more than 100 tons per year of CO emission increases. Therefore, this project constitutes a new major facility and is subject to these public notice requirements.

On August 11, 2011, the District posted the following documents on the District website: the Preliminary Engineering Evaluation for this application and a notice inviting written comment on the District's decisions regarding this project. On August 11, 2011, the District also notified the applicant, EPA, CARB, and adjacent air districts in writing about this project and the location of the relevant documents on the District website. On August 18, 2011, a notice inviting public comment on this project was

published in the Tri-Valley Herald. The District accepted comments on this project through September 30, 2011. Therefore, the District has satisfied the public noticing requirements of Regulation 2-2-405.

During the public comment period, an adjacent air district, San Joaquin Valley Air Pollution Control District (SJAPCD), contacted the District to discuss the BACT determination for the IC engines. However, JSVAPCD later decided to not provide any formal comments on this project.

On September 30, 2011, Mr. Patrick Sullivan of SCS Engineers submitted comments on this project on behalf of Waste Management of Alameda County. Waste Management has a similar project under review by the District. SCS Engineers' comments support the District's BACT determination for the IC engines and the District's decision to issue an Authority to Construct for this project.

The District has considered the comments received on this project and has determined that the preliminary decisions are appropriate.

L. 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.

Prepared By: Date:

Flora Chan October 17, 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
Toluene	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
Toluene	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.

Prepared by: Flora Chan

Date: June 21, 2011

APPENDIX C

February 9, 2014 Memorandum Regarding Change in Formaldehyde Limit for Engines

Application# 22636; Plant # 20432
Ameresco Vasco Road, LLC
Landfill Gas to Energy Plant Including Two IC Engines, a LFG Treatment System, and a Waste Gas Flare
4001 North Vasco Road, Livermore, CA

Permit to Operate Report

This application for operating two IC engines, a LFG treatment system and a waste gas flare at 4001 North Vasco Road in Livermore. Authority to Construct (AC) was issued on 10/20/2011. The proposed systems started up on 2/22/2014.

Revised risk screen analysis was approved on November 4, 2014 with the as-built parameters and we have changed the formaldehyde limits based on the HRSA results.

The District recommends issuance of a Permit to Operate for the following equipment, subject to permit condition #25009 identified above.

S-1 **LFG-Fired Internal Combustion Engine and Genset**; Year 2012, 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**; year 2012, GE Jenbacher, J 616 GS-E199 engine, JGS 616 GS-L.L; 3012 bhp, 21 MM BTU/hour

The District recommends issuance of a Permit to Operate 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.

F. Chan 2/9/2014

Flora Chan Date
AQ Engineer

Permit Conditions: 25009 & 25010

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~~ 1.27 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.

11. The owner/operator shall have the engines' (S-1 and S-2) stack exhaust outlet at least 32.33 feet above grade and the stack width no more than 25 inches.
[Basis: Regulation 2-5]

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

1. All waste flush gas generated by the 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

APPENDIX D

Amendment to Health Risk Screening Analysis
February 4, 2014

INTEROFFICE MEMORANDUM

November 4, 2014

To: Flora Chan **Via:** Daphne Chong

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: 0.03 in a million cancer risk, 0.30 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 0.03 in a million, a maximum chronic HI of 0.3, 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: 0.03 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.

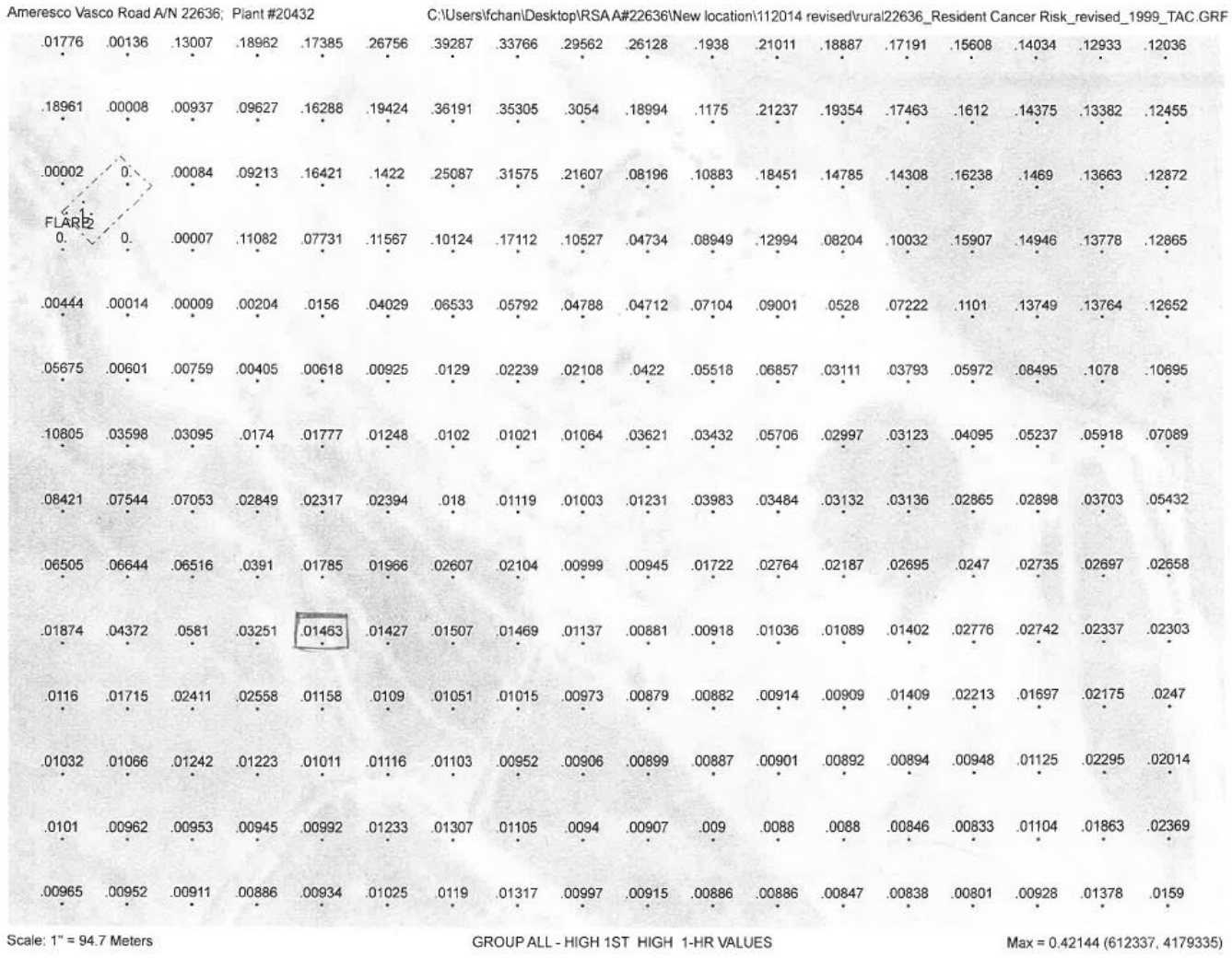
Table C HRSA Results: Total Project Risk			
	Acute Hazard Index	Chronic Hazard Index	Cancer Risk (per million)
Residential Receptor	1.0	0.05	0.014
Worker Receptor		0.30	0.03

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	0.07
Worker Receptor		0.13	0.016
S-2 IC Engine			
Residential Receptor	No Applicable Standard	0.02	0.07
Worker Receptor		0.13	0.016
A-1 Flare			
Residential Receptor	No Applicable Standard	0.006	0.0006
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.

Prepared by:	Date:
Flora Chan	November 4, 2014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.08421 .07544 .07053 .02849 .02317 .02394 .018 .01119 .01003 .01231 .03983 .03484 .03132 .03136 .02865 .02898 .03703 .05432
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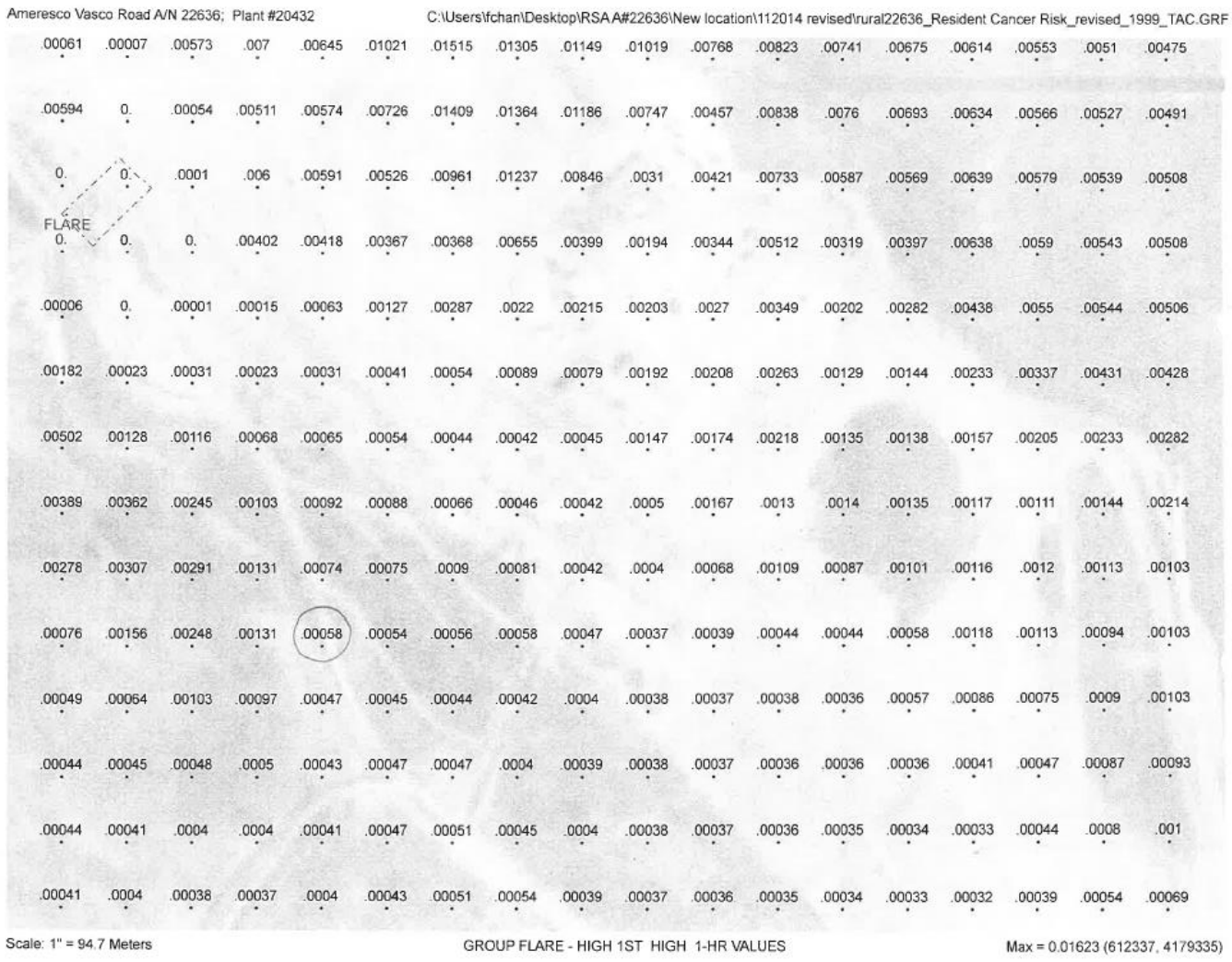
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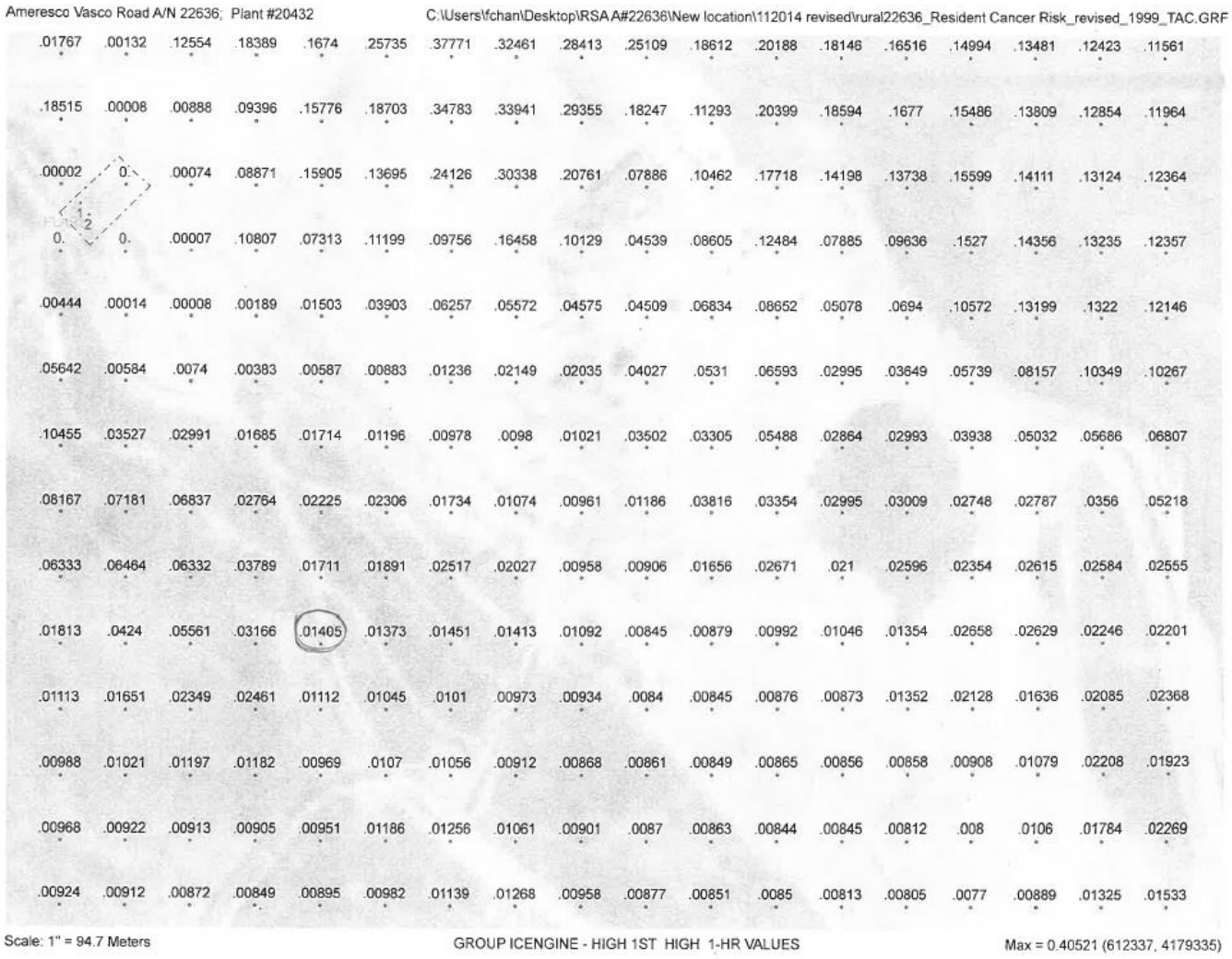
Ameresco Vasco Road A/N 22636; Plant #20432
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1
2
0. 0. .00007 .10807 .07313 .11199 .09756 .16458 .10129 .04539 .08605 .12484 .07885 .09636 .1527 .14356 .13235 .12357
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.00924 .00912 .00872 .00849 .00895 .00982 .01139 .01268 .00958 .00877 .00851 .0085 .00813 .00805 .0077 .00889 .01325 .01533
Scale: 1" = 94.7 Meters
GROUP ICENGINE - HIGH 1ST HIGH 1-HR VALUES
Max = 0.40521 (612337, 4179335)

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*** Ameresco Vasco Road A/N 22636;  Plant #20432                    ***
*** Model Executed on 11/04/14 at 11:22:05 ***
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              99_TAC.DTA
Output File - C:\Users\fchan\Desktop\RSA A#22636\New location\112014 revised\rural22636_Resident Cancer Risk_revised_19
              99_TAC.LST
   Met File - H:\Engineering\STAFF\FWC\A# 22636 Ameresco Vasco Road\screen3.asc

      Number of sources -          3
Number of source groups -          3
    Number of receptors -       5400
```

*** POINT SOURCE DATA ***

SOURCE ID	NUMBER PART. CATS.	EMISSION RATE (GRAMS/SEC)	X (METERS)	Y (METERS)	BASE ELEV. (METERS)	STACK HEIGHT (METERS)	STACK TEMP. (DEG.K)	STACK EXIT VEL. (M/SEC)	STACK DIAMETER (METERS)	BUILDING EXISTS	EMISSION RATE SCALAR VARY BY
1	0	0.59100E-03	612102.6	4179171.0	253.7	9.85	743.71	22.61	0.63	NO	
2	0	0.59100E-03	612108.9	4179162.5	251.8	9.85	743.71	22.60	0.63	NO	
FLARE	0	0.48800E-04	612090.2	4179163.2	255.1	9.14	1283.15	17.23	0.61	NO	

*** SOURCE IDs DEFINING SOURCE GROUPS ***

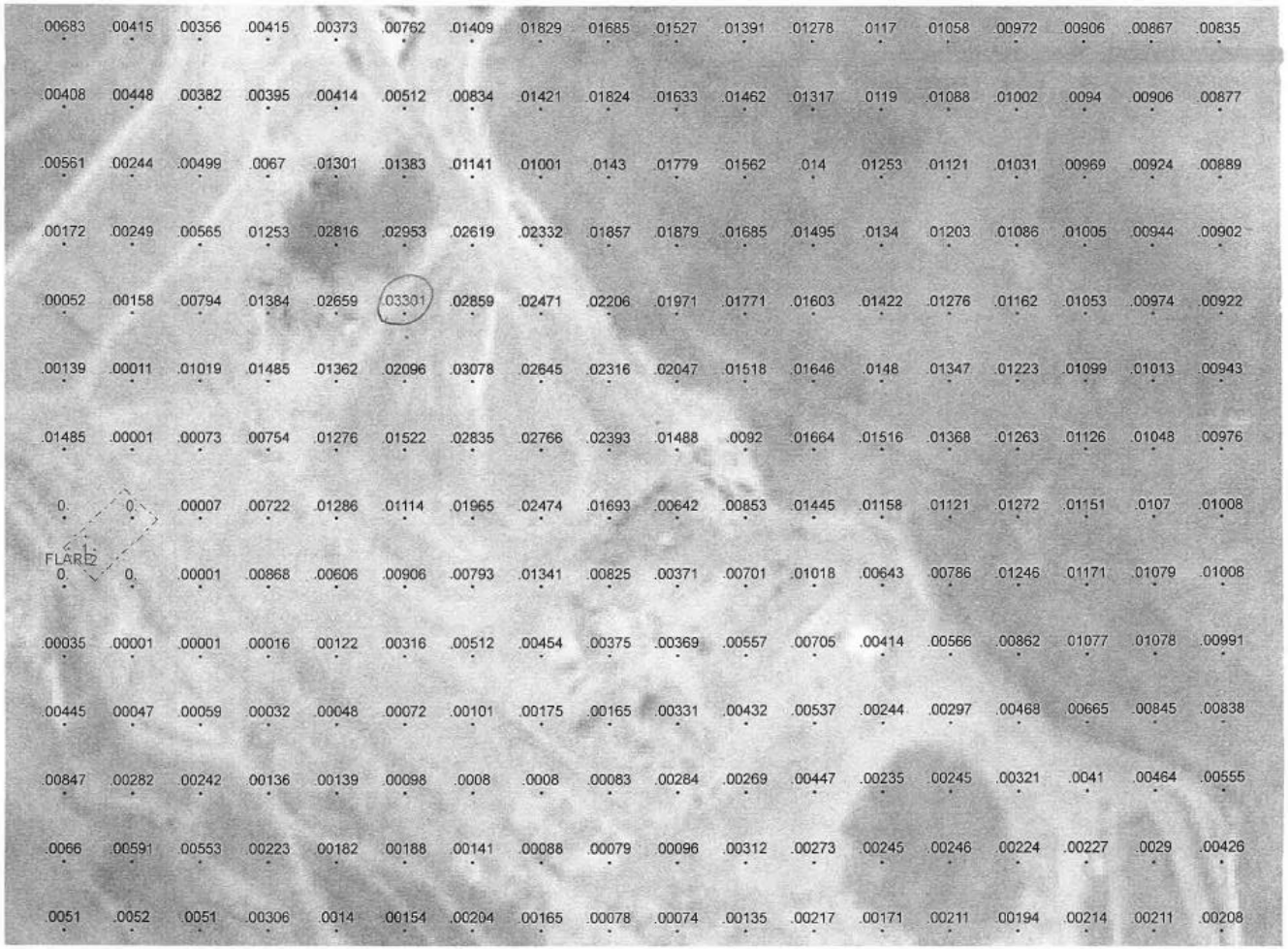
GROUP ID	SOURCE IDs
ICENGINE	1 , 2 ,
FLARE	FLARE ,
ALL	1 , 2 , FLARE ,

*** THE SUMMARY OF HIGHEST 1-HR RESULTS ***

** CONC OF TAC IN MICROGRAMS/M**3 **

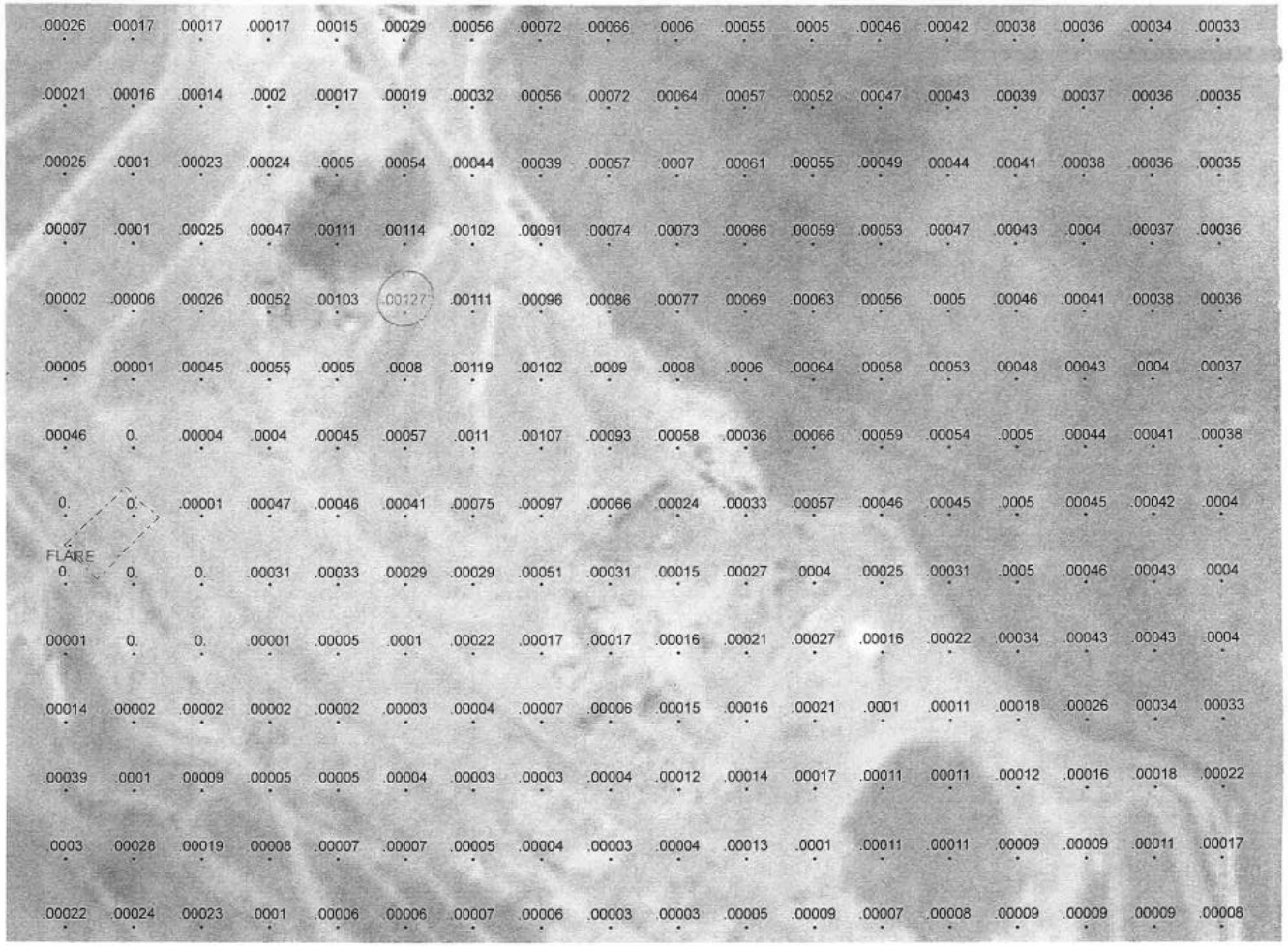
GROUP ID	AVERAGE CONC	DATE (YYMMDDHH)	RECEPTOR (XR, YR, ZELEV, ZFLAG)	OF TYPE	NETWORK GRID-ID
ICENGINE HIGH 1ST HIGH VALUE IS	0.40521	ON 99012024: AT (612337.00, 4179335.00, 312.90, 0.00)		DC	NA
FLARE HIGH 1ST HIGH VALUE IS	0.01623	ON 99012024: AT (612337.00, 4179335.00, 312.90, 0.00)		DC	NA
ALL HIGH 1ST HIGH VALUE IS	0.42144	ON 99012024: AT (612337.00, 4179335.00, 312.90, 0.00)		DC	NA

Ameresco Vasco Road A/N 22636; Plant #20432 C:\Users\fchan\Desktop\RSA A#22636\New location\112014 revised\rural22636_Worker Cancer Risk_revised_1999_TAC.GRF



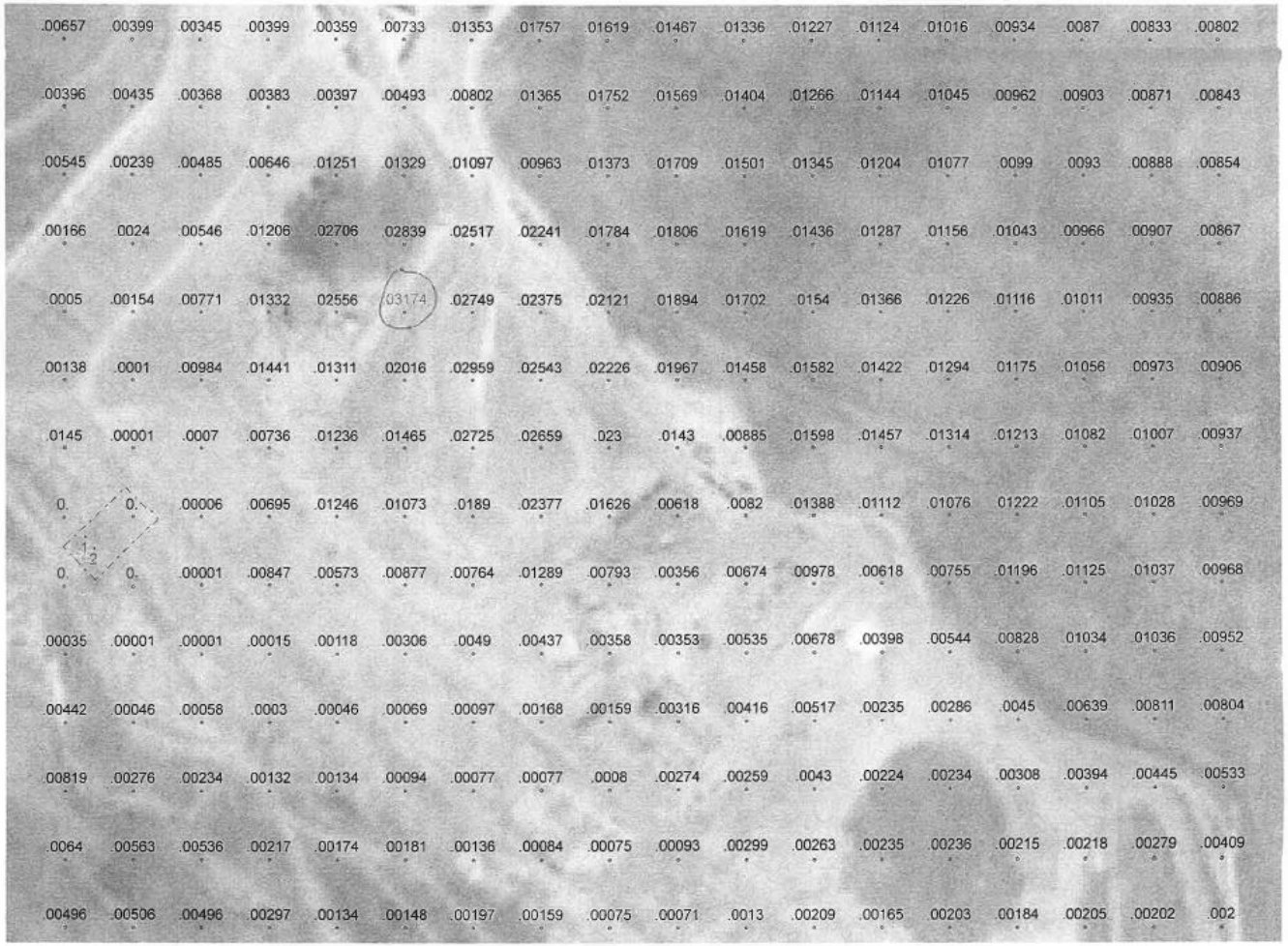
Scale: 1" = 95.1 Meters GROUP ALL - HIGH 1ST HIGH 1-HR VALUES Max = 0.03301 (612337, 4179335)

Ameresco Vasco Road A/N 22636; Plant #20432 C:\Users\fchan\Desktop\RSA A#22636\New location\112014 revised\rural22636_Worker Cancer Risk_revised_1999_TAC.GRF



Scale: 1" = 95.1 Meters GROUP FLARE - HIGH 1ST HIGH 1-HR VALUES Max = 0.00127 (612337, 4179335)

Ameresco Vasco Road A/N 22636; Plant #20432 C:\Users\fchan\Desktop\RSA A#22636\New location\112014 revised\rural22636_Worker Cancer Risk_revised_1999_TAC.GRF



Scale: 1" = 95.1 Meters GROUP ICENGINE - HIGH 1ST HIGH 1-HR VALUES Max = 0.03174 (612337, 4179335)

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*** ISCST3 - VERSION 02035 ***
*** Ameresco Vasco Road A/N 22636;  Plant #20432                    ***
*** Model Executed on 11/04/14 at 11:52:32 ***
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              _TAC.DTA
Output File - C:\Users\fchan\Desktop\RSA A#22636\New location\112014 revised\rural22636_Worker Cancer Risk_revised_1999
              _TAC.LST
   Met File - H:\Engineering\STAFF\FWC\A# 22636 Ameresco Vasco Road\screen3.asc

      Number of sources -          3
Number of source groups -          3
    Number of receptors -       5400
```

*** POINT SOURCE DATA ***

SOURCE ID	NUMBER PART. CATS.	EMISSION RATE (GRAMS/SEC)	X (METERS)	Y (METERS)	BASE ELEV. (METERS)	STACK HEIGHT (METERS)	STACK TEMP. (DEG.K)	STACK EXIT VEL. (M/SEC)	STACK DIAMETER (METERS)	BUILDING EXISTS	EMISSION RATE SCALAR VARY BY
1	0	0.46300E-04	612102.6	4179171.0	253.7	9.85	743.71	22.60	0.63	NO	
2	0	0.46300E-04	612108.9	4179162.5	251.8	9.85	743.71	22.60	0.63	NO	
FLARE	0	0.38200E-05	612090.2	4179163.2	255.1	9.14	1283.15	17.23	0.61	NO	

*** SOURCE IDs DEFINING SOURCE GROUPS ***

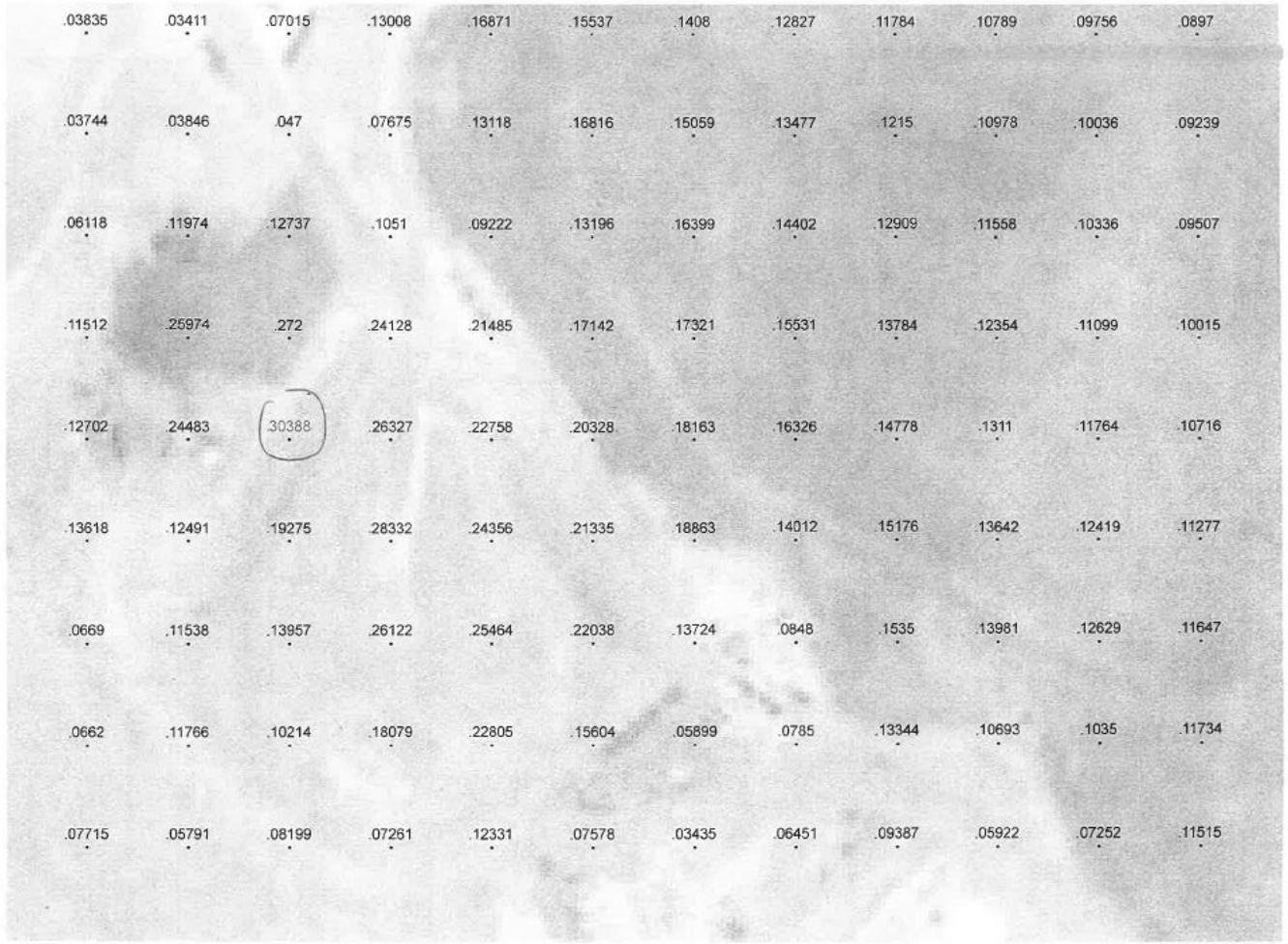
GROUP ID	SOURCE IDs
ICENGINE	1 , 2 ,
FLARE	FLARE ,
ALL	1 , 2 , FLARE ,

*** THE SUMMARY OF HIGHEST 1-HR RESULTS ***

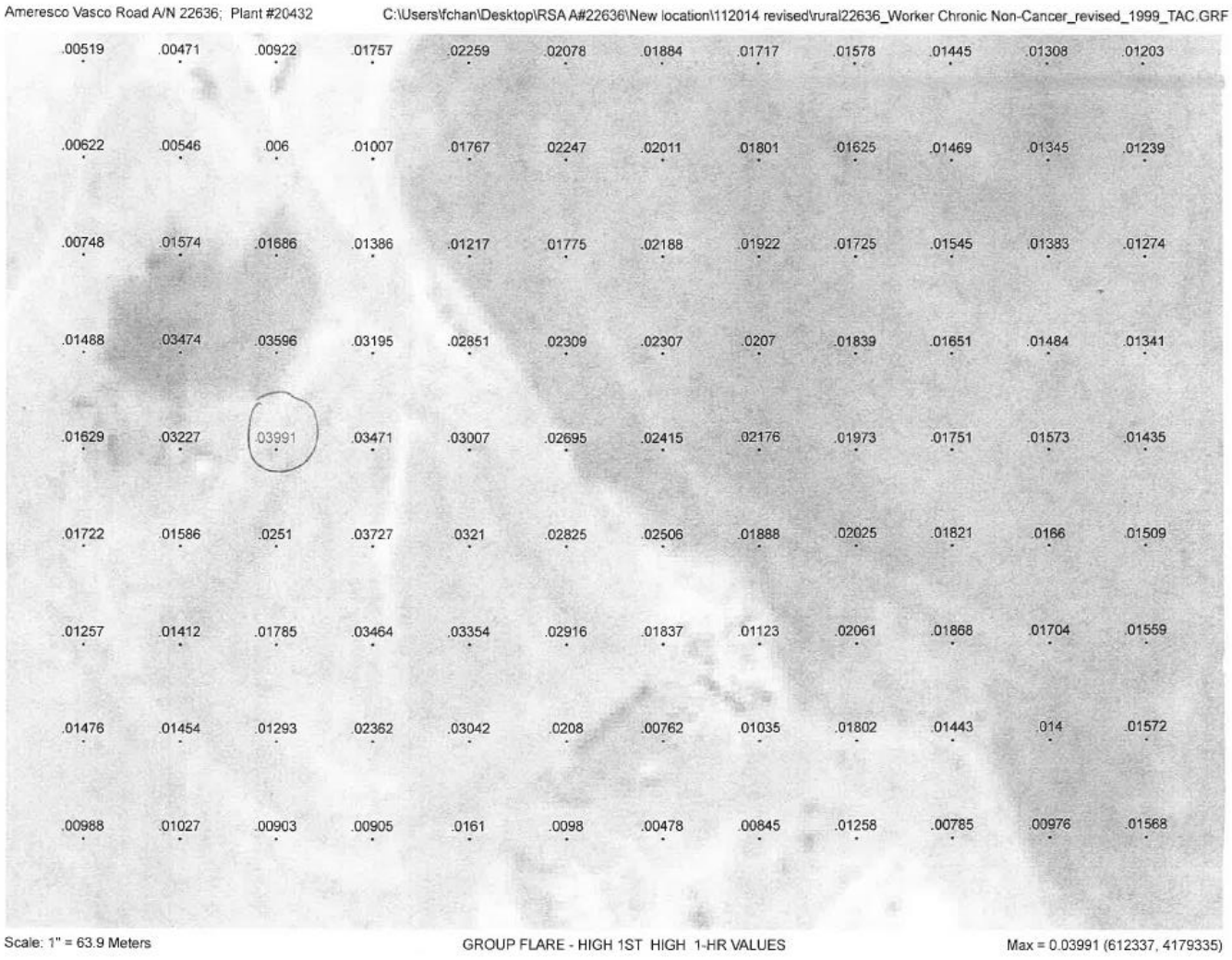
** CONC OF TAC IN MICROGRAMS/M**3 **

GROUP ID	AVERAGE CONC	DATE (YYMMDDHH)	RECEPTOR (XR, YR, ZELEV, ZFLAG)	OF TYPE	NETWORK GRID-ID
ICENGINE HIGH	1ST HIGH VALUE IS 0.03174	ON 99012024:	AT (612337.00, 4179335.00, 312.90, 0.00)	DC	NA
FLARE HIGH	1ST HIGH VALUE IS 0.00127	ON 99012024:	AT (612337.00, 4179335.00, 312.90, 0.00)	DC	NA
ALL HIGH	1ST HIGH VALUE IS 0.03301	ON 99012024:	AT (612337.00, 4179335.00, 312.90, 0.00)	DC	NA

Ameresco Vasco Road A/N 22636; Plant #20432 C:\Users\fchan\Desktop\RSA A#22636\New location\112014 revised\rural22636_Worker Chronic Non-Cancer_revised_1999_TAC.GRF



Scale: 1" = 63.9 Meters GROUP ALL - HIGH 1ST HIGH 1-HR VALUES Max = 0.30388 (612337, 4179335)


Ameresco Vasco Road A/N 22636; Plant #20432
C:\Users\fchan\Desktop\RSA A#22636\New location\112014 revised\rural22636_Worker Chronic Non-Cancer_revised_1999_TAC.GRF
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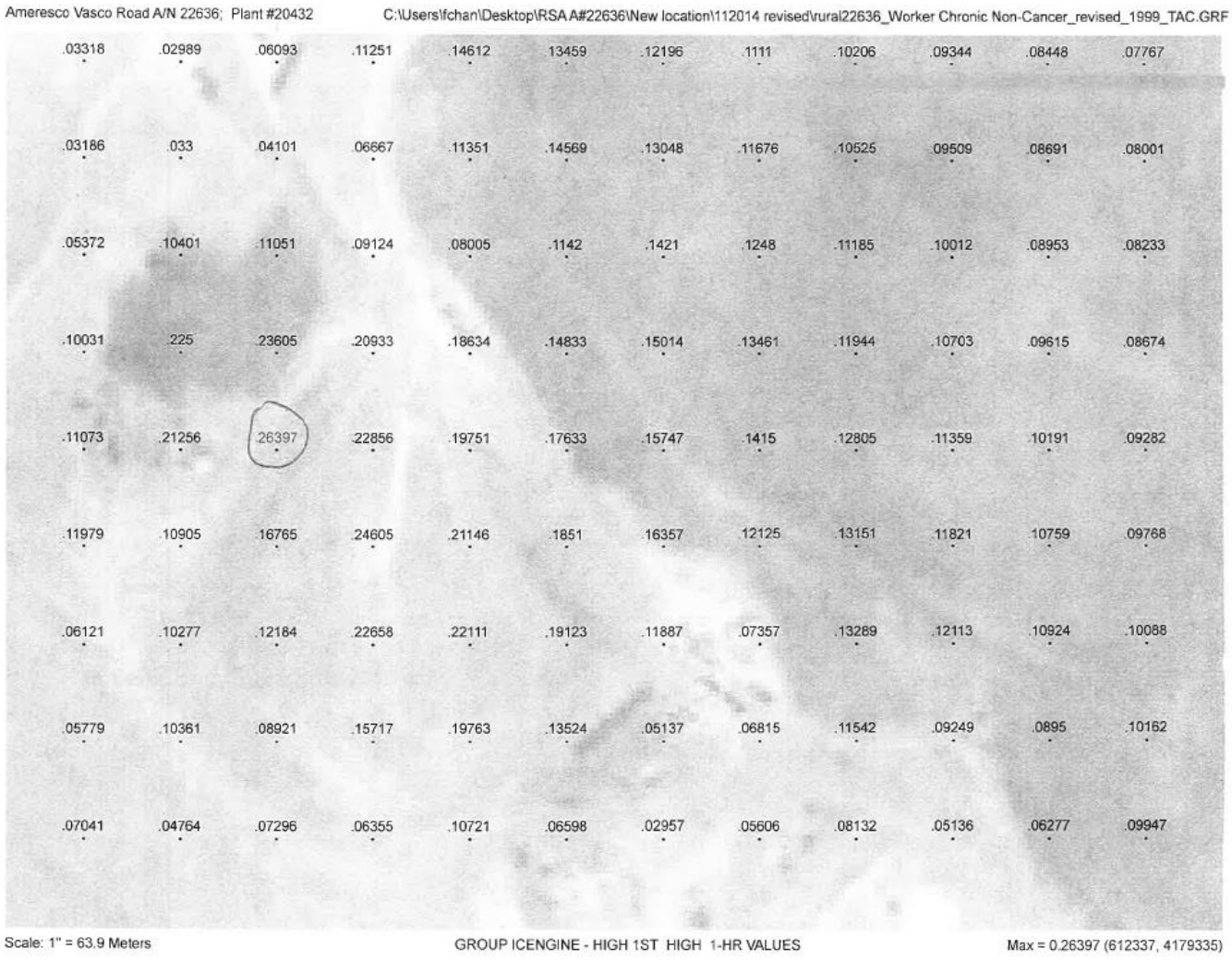
.00622 .00546 .006 .01007 .01767 02247 .02011 .01801 .01625 .01469 .01345 .01239
.00748 .01574 .01686 .01386 .01217 .01775 .02188 .01922 .01725 .01545 .01383 .01274
.01488 .03474 .03596 .03195 .02851 02309 .02307 .0207 .01839 .01651 .01484 .01341
.01629 .03227 .03991 .03471 .03007 .02695 .02415 .02176 .01973 .01751 .01573 .01435
.01722 .01586 .0251 .03727 .0321 .02825 .02506 .01888 .02025 .01821 .0166 .01509
.01257 .01412 .01785 .03464 .03354 .02916 .01837 .01123 .02061 .01868 .01704 .01559
.01476 .01454 .01293 .02362 .03042 .0208 .00762 .01035 .01802 .01443 .014 .01572
.00988 .01027 .00903 .00905 .0161 .0098 .00478 .00845 .01258 .00785 .00976 .01568
Scale: 1" = 63.9 Meters
GROUP FLARE - HIGH 1ST HIGH 1-HR VALUES
Max = 0.03991 (612337, 4179335)


Ameresco Vasco Road A/N 22636; Plant #20432
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.10031 .225 .23605 .20933 .18634 .14833 .15014 .13461 .11944 .10703 .09615 .08674
.11073 .21256 .26397 .22856 .19751 .17633 .15747 .1415 .12805 .11359 .10191 .09282
.11979 .10905 .16765 .24605 .21146 .1851 .16357 .12125 .13151 .11821 .10759 .09768
.06121 .10277 .12184 .22658 .22111 .19123 .11887 .07357 .13289 .12113 .10924 .10088
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.07041 .04764 .07296 .06355 .10721 .06598 .02957 .05606 .08132 .05136 .06277 .09947
Scale: 1" = 63.9 Meters
GROUP ICENGINE - HIGH 1ST HIGH 1-HR VALUES
Max = 0.26397 (612337, 4179335)

```
*** ISCST3 - VERSION 02035 ***
*** Ameresco Vasco Road A/N 22636;  Plant #20432                    ***
*** Model Executed on 11/04/14 at 14:04:17 ***
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Output File - C:\Users\fchan\Desktop\RSA A#22636\New location\112014 revised\rural22636_Worker Chronic Non-Cancer_revis
              ed_1999_TAC.LST
   Met File - H:\Engineering\STAFF\FWC\A# 22636 Ameresco Vasco Road\screen3.asc

     Number of sources -          3
Number of source groups -          3
    Number of receptors -       5400
```

*** POINT SOURCE DATA ***

SOURCE ID	NUMBER PART. CATS.	EMISSION RATE (GRAMS/SEC)	X (METERS)	Y (METERS)	BASE ELEV. (METERS)	STACK HEIGHT (METERS)	STACK TEMP. (DEG.K)	STACK EXIT VEL. (M/SEC)	STACK DIAMETER (METERS)	BUILDING EXISTS	EMISSION RATE SCALAR VARY BY
1	0	0.38500E-03	612102.6	4179171.0	253.7	9.85	743.71	22.60	0.63	NO	
2	0	0.38500E-03	612108.9	4179162.5	251.8	9.85	743.71	22.60	0.63	NO	
FLARE	0	0.12000E-03	612090.2	4179163.2	255.1	9.14	1283.15	17.23	0.61	NO	

*** SOURCE IDs DEFINING SOURCE GROUPS ***

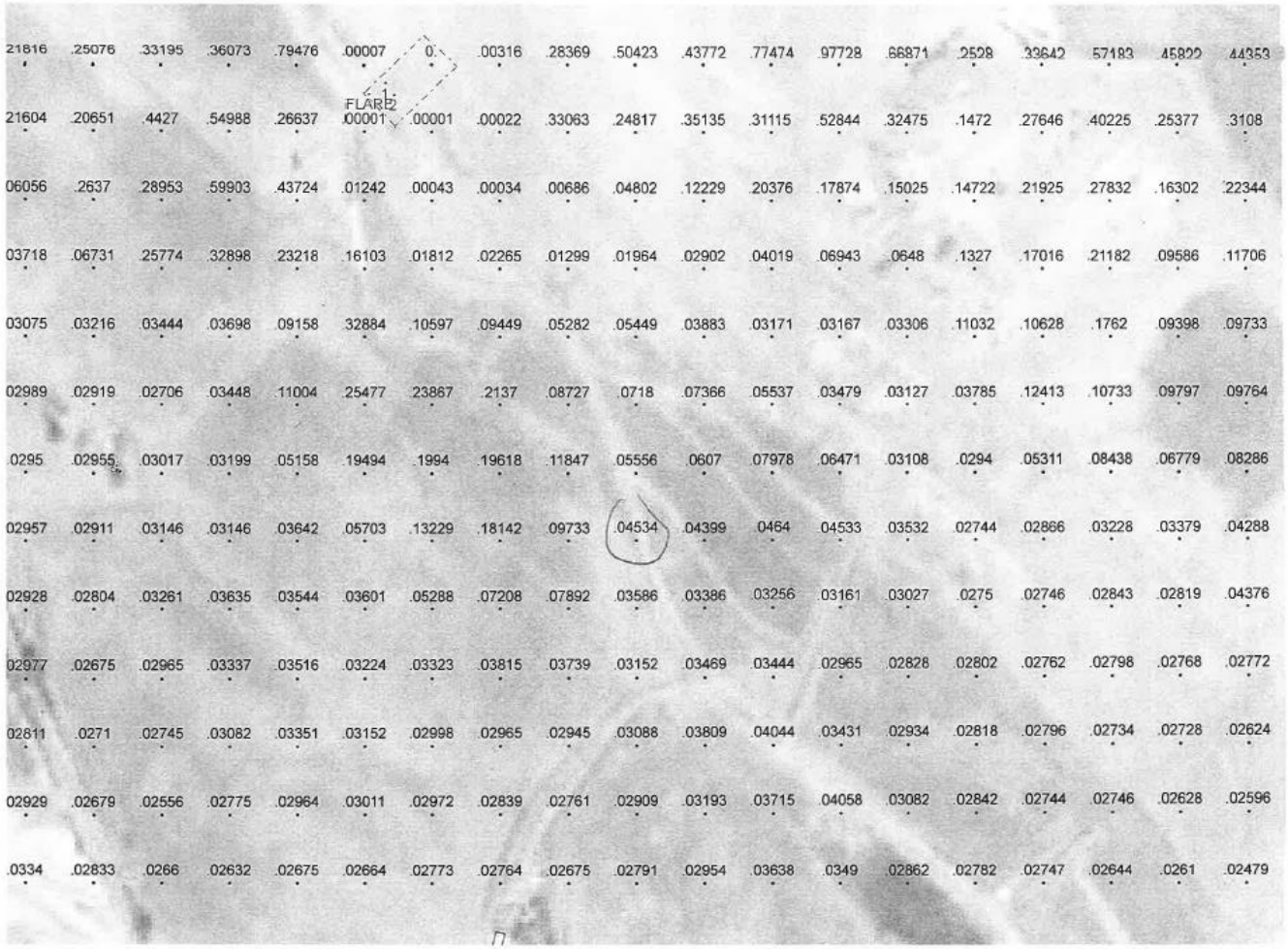
GROUP ID	SOURCE IDs
ICENGINE	1 , 2 ,
FLARE	FLARE ,
ALL	1 , 2 , FLARE ,

*** THE SUMMARY OF HIGHEST 1-HR RESULTS ***

** CONC OF TAC IN MICROGRAMS/M**3 **

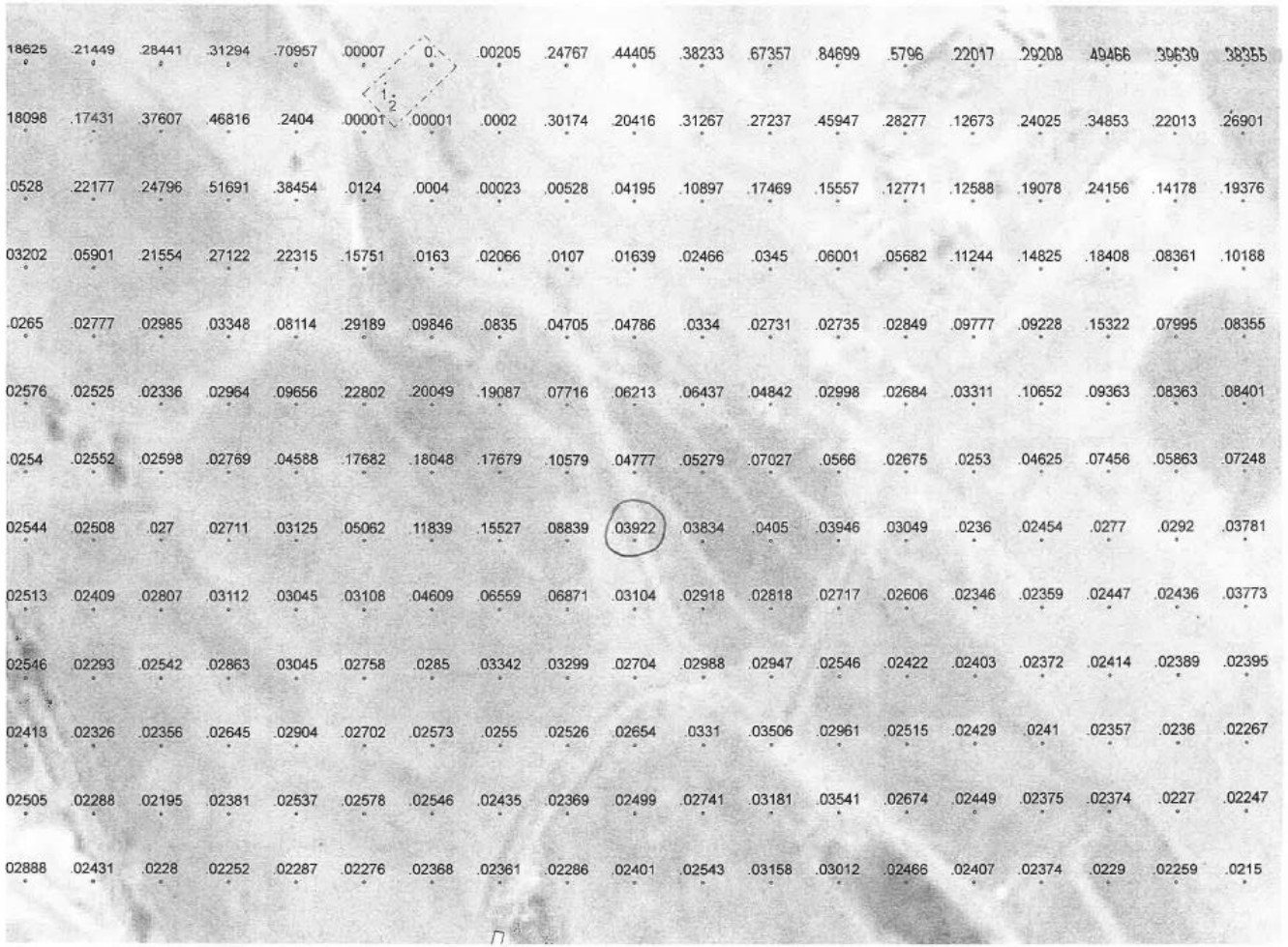
GROUP ID		AVERAGE CONC	DATE (YYMMDDHH)	RECEPTOR (XR, YR, ZELEV, ZFLAG)	OF	TYPE	NETWORK GRID-ID
ICENGINE	HIGH 1ST HIGH VALUE IS	0.26397	ON 99012024:	AT (612337.00, 4179335.00, 312.90, 0.00)	DC		NA
FLARE	HIGH 1ST HIGH VALUE IS	0.03991	ON 99012024:	AT (612337.00, 4179335.00, 312.90, 0.00)	DC		NA
ALL	HIGH 1ST HIGH VALUE IS	0.30388	ON 99012024:	AT (612337.00, 4179335.00, 312.90, 0.00)	DC		NA

Ameresco Vasco Road A/N 22636; Plant #20432 C:\Users\fchan\Desktop\RSA A#22636\New location\112014 revised\rural22636_Resident Chronic Non-Cancer_revised_1999_TAC.GRF



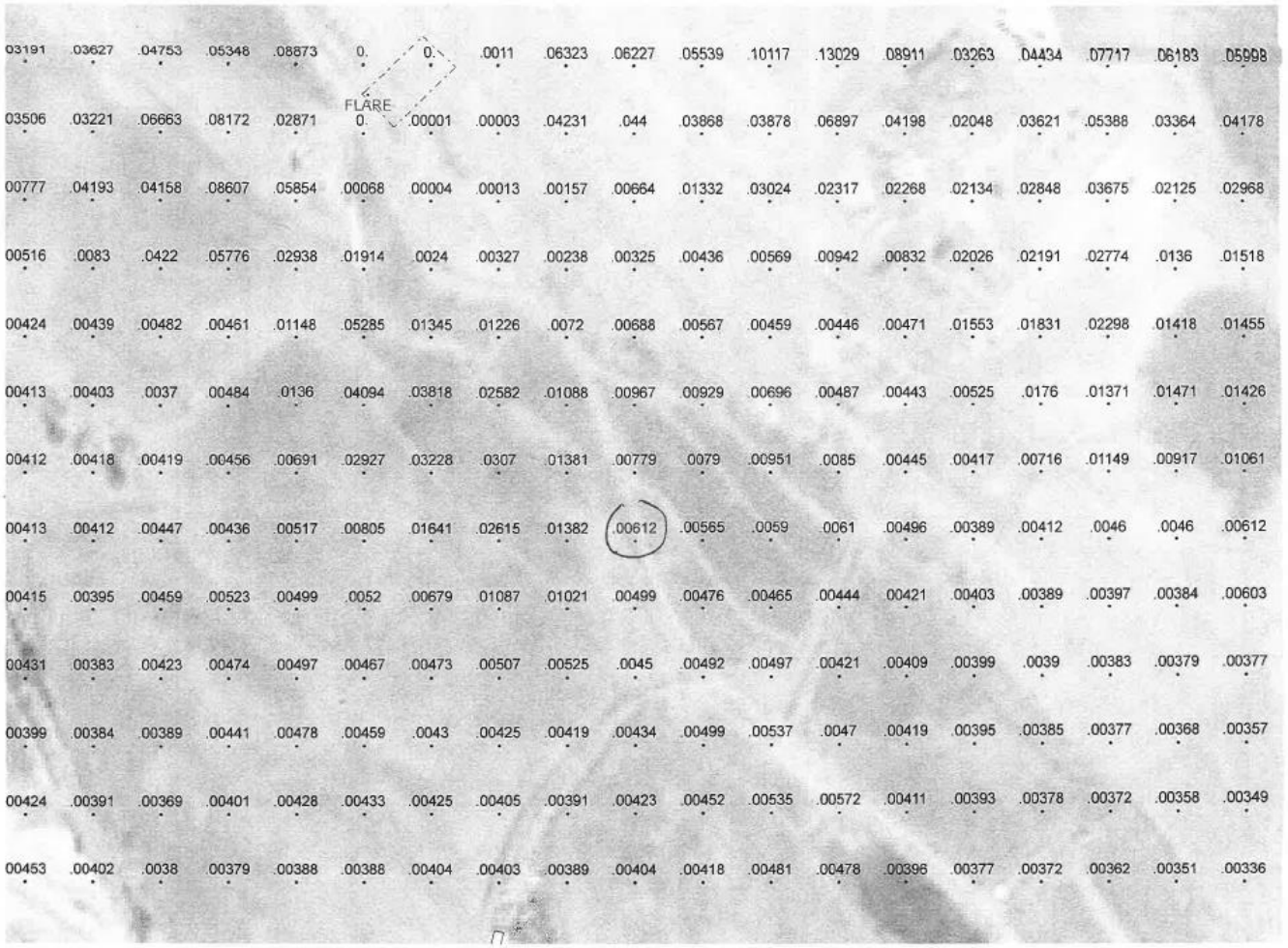
Scale: 1" = 95.5 Meters GROUP ALL - HIGH 1ST HIGH 1-HR VALUES Max = 1.30223 (612337, 4179335)

Ameresco Vasco Road A/N 22636; Plant #20432 C:\Users\fchan\Desktop\RSA A#22636\New location\112014 revised\rural22636_Resident Chronic Non-Cancer_revised_1999_TAC.GRF



Scale: 1" = 95.5 Meters GROUP ICENGINE - HIGH 1ST HIGH 1-HR VALUES Max = 1.13128 (612337, 4179335)

Ameresco Vasco Road A/N 22636; Plant #20432 C:\Users\fchan\Desktop\RSA A#22636\New location\112014 revised\rural22636_Resident Chronic Non-Cancer_revised_1999_TAC.GRF



Scale: 1" = 95.5 Meters GROUP FLARE - HIGH 1ST HIGH 1-HR VALUES Max = 0.17095 (612337, 4179335)

```
*** ISCST3 - VERSION 02035 ***
*** Ameresco Vasco Road A/N 22636;  Plant #20432                    ***
*** Model Executed on 11/04/14 at 13:52:09 ***
 Input File - C:\Users\fchan\Desktop\RSA A#22636\New location\112014 revised\rural22636_Resident Chronic Non-Cancer_rev
              ised_1999_TAC.DTA
Output File - C:\Users\fchan\Desktop\RSA A#22636\New location\112014 revised\rural22636_Resident Chronic Non-Cancer_rev
              ised_1999_TAC.LST
   Met File - H:\Engineering\STAFF\FWC\A# 22636 Ameresco Vasco Road\screen3.asc

      Number of sources -          3
Number of source groups -          3
    Number of receptors -       5400
```

*** POINT SOURCE DATA ***

SOURCE ID	NUMBER PART. CATS.	EMISSION RATE (GRAMS/SEC)	X (METERS)	Y (METERS)	BASE ELEV. (METERS)	STACK HEIGHT (METERS)	STACK TEMP. (DEG.K)	STACK EXIT VEL. (M/SEC)	STACK DIAMETER (METERS)	BUILDING EXISTS	EMISSION RATE SCALAR VARY BY
1	0	0.16500E-02	612102.6	4179171.0	253.7	9.85	743.71	22.60	0.63	NO	
2	0	0.16500E-02	612108.9	4179162.5	251.8	9.85	743.71	22.60	0.63	NO	
FLARE	0	0.51400E-03	612090.2	4179163.2	255.1	9.14	1283.15	17.23	0.61	NO	

*** SOURCE IDs DEFINING SOURCE GROUPS ***

GROUP ID	SOURCE IDs
ICENGINE	1 , 2 ,
FLARE	FLARE ,
ALL	1 , 2 , FLARE ,

*** THE SUMMARY OF HIGHEST 1-HR RESULTS ***

** CONC OF TAC IN MICROGRAMS/M**3 **

GROUP ID	AVERAGE CONC	DATE (YYMMDDHH)	RECEPTOR (XR, YR, ZELEV, ZFLAG)	OF TYPE	NETWORK GRID-ID
ICENGINE HIGH 1ST HIGH VALUE IS	1.13128	ON 99012024: AT (612337.00, 4179335.00, 312.90, 0.00)		DC	NA
FLARE HIGH 1ST HIGH VALUE IS	0.17095	ON 99012024: AT (612337.00, 4179335.00, 312.90, 0.00)		DC	NA
ALL HIGH 1ST HIGH VALUE IS	1.30223	ON 99012024: AT (612337.00, 4179335.00, 312.90, 0.00)		DC	NA