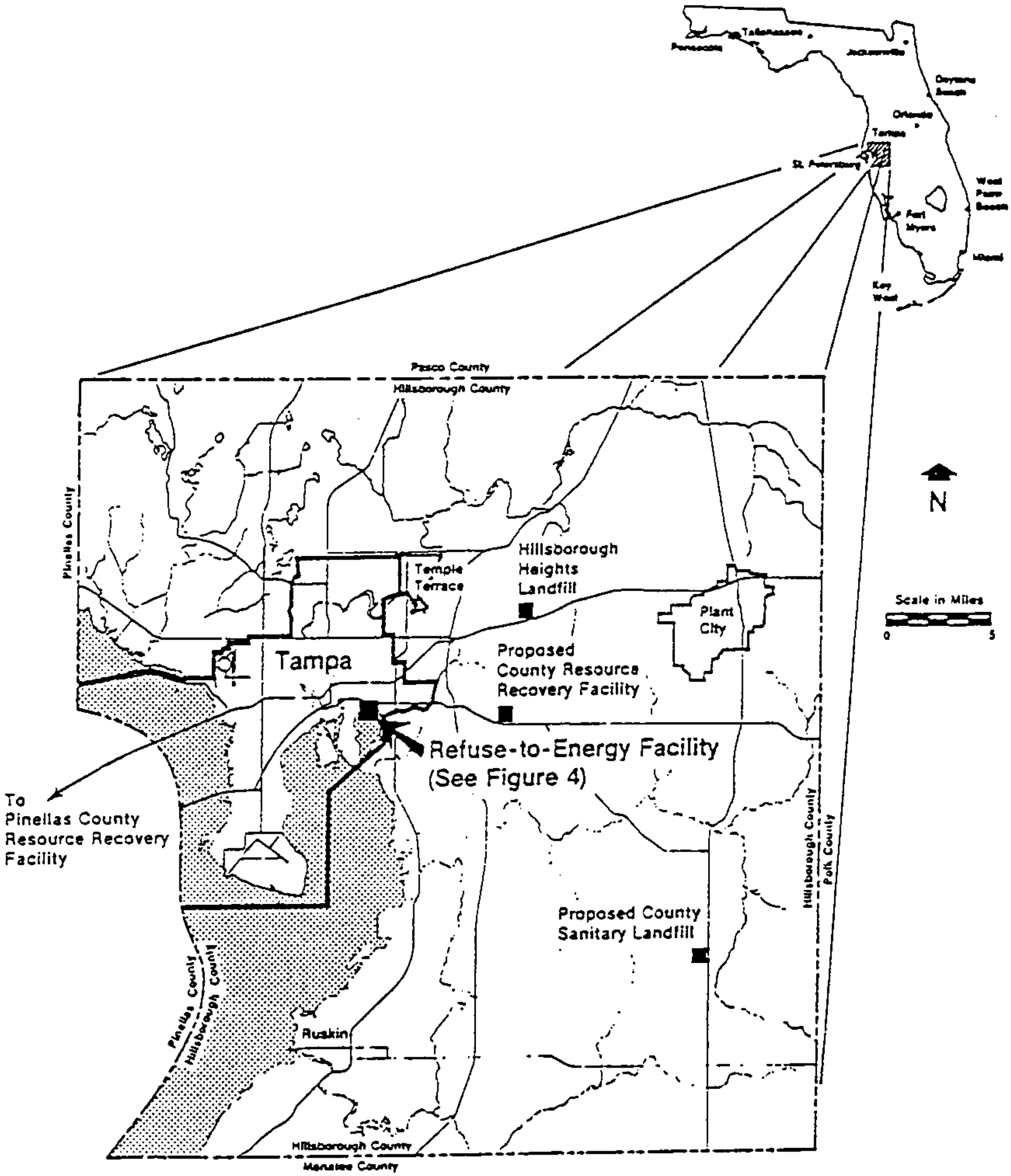
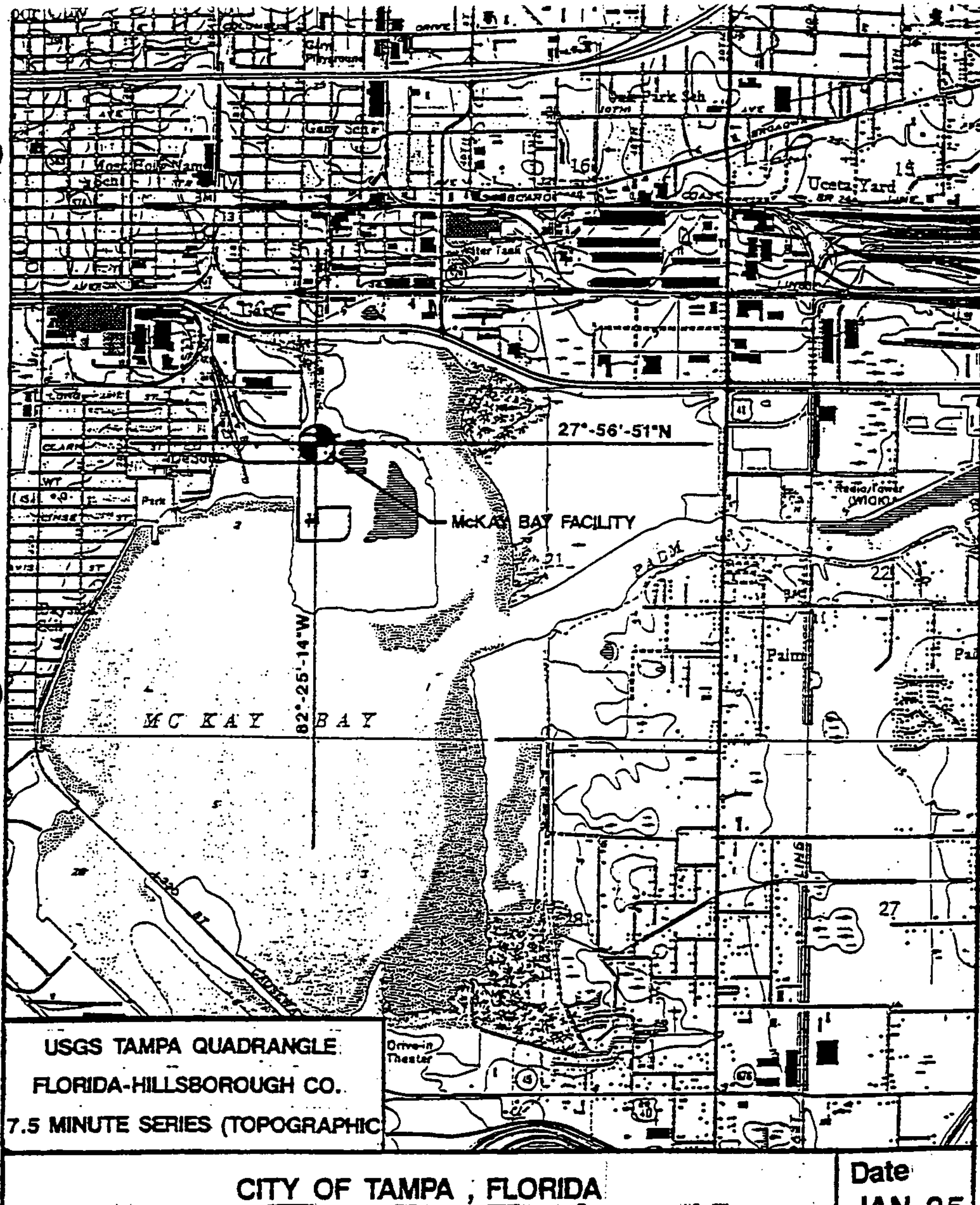


Site Location Map

Figure 1



USGS TAMPA QUADRANGLE
FLORIDA-HILLSBOROUGH CO.
7.5 MINUTE SERIES (TOPOGRAPHIC

CITY OF TAMPA , FLORIDA McKAY BAY REFUSE TO ENERGY FACILITY LOCATION PLAN	Date JAN 95 Figure L-1

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IV
345 COURTLAND STREET
ATLANTA, GEORGIA 30365

JUL - 2 1982

REF: 4AW-AM

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Dr. Richard D. Garrity, Ph.D
Urban Environmental Coordinator
City of Tampa
306 East Jackson Street
Tampa, Florida 33602

Re: PSD-FL-086

Dear Dr. Garrity:

Review of your July and October, 1981, applications to construct a municipal incinerator-cogeneration facility in Tampa, Florida has been completed. The construction is subject to rules for the Prevention of Significant Air Quality Deterioration (PSD) contained in 40 CFR §52.21. The Florida Department of Environmental Regulation performed the preliminary determination concerning the proposed construction and published a request for public comment on March 22, 1982. Comments were submitted by the City of Tampa, the Department of Interior, and the U. S. Environmental Protection Agency and are contained and responded to in the final determination issued May 28, 1982.

Authority to construct a stationary source is hereby granted for the facility described above, subject to the conditions in the permit to construct (enclosed). This authority to construct is based solely on the requirements of 40 CFR §52.21, the federal regulations governing significant deterioration of air quality. It does not apply to NPDES or other permits issued by this agency or by other agencies. The complete analysis which justifies this approval has been fully documented for future reference, if necessary. Please be advised that a violation of any condition issued as part of this approval, as well as any construction which proceeds in material variance with information submitted in your application, will be subject to enforcement action.

This final permitting decision is subject to appeal under 40 CFR §124.19 by petitioning the Administrator of the U. S. EPA within 30 days after receipt of this letter of approval to construct. The petitioner must submit a statement of reasons for the appeal and the Administrator must decide on the petition within a reasonable time period. If the petition is denied, the permit becomes immediately effective. The petitioner may then seek judical review.

Any questions concerning this approval may be directed to Richard S. DuBose, Chief, Air Engineering Section, Air and Waste Management Division at (404) 881-7654.

Sincerely yours,

John A. Little, Deputy

for Charles R. Jeter
Regional Administrator

Enclosures

Appendix B
Emission Factor Calculations

Appendix B
Emission Factor Calculations

B.1 Introduction

In this Appendix, the emission factors for the Tampa McKay Bay Refuse-to-Energy Facility ("Facility") Retrofit stack are based on:

- The Emissions Guidelines (EG) for Municipal Waste Combustors (MWCs), 40 CFR 60 Subpart Cb, as revised (62 FR 45116, August 25, 1997), requirements for the following pollutants. Note that the County proposes to comply with the revised Pb, SO_2, HCl and NO_x limits in this air permit, even though the formal compliance deadline for these pollutants is delayed until August 26, 2002.

  - Particulate Matter (PM)
  - Sulfur Dioxide (SO_2)
  - Hydrogen Chloride (HCl)
  - Carbon Monoxide (CO)
  - Nitrogen Oxides (NOx)
  - Mercury (Hg)
  - Lead (Pb)
  - Cadmium (Cd)
  - Dioxins and furans (total tetra- through octa- PCDD and PCDF)

- The existing Facility's state air operating permit (AO 29-206279) limits for two pollutants not regulated by the EG:

  - Hydrogen Fluoride (HF)
  - Beryllium (Be)

- Permit limits for ammonia slip from comparable facilities using Selective Non-Catalytic Reduction (SNCR) for NOx removal.

- Stack test data for the existing Facility for maximum inlet (uncontrolled) Hg concentrations, and for representing existing Facility emissions in the netting analysis for NOx and SO_2. Stack test data summaries are presented in Appendix E.

As described in the December, 1995, Federal Register announcement promulgating the EG (60 FR 65387, December 19, 1995), the emissions limits in the EG are based on the best demonstrated performance at operating MWC facilities. The Federal Register references EPA studies showing that MWCs with Maximum Achievable Control Technology (MACT) standard air pollution control equipment consisting of a spray dryer absorber (SDA), fabric filter (FF), activated carbon injection, and selective non-catalytic reduction (SNCR) can meet these limits. Since the Facility will have this MACT air pollution control system for each of the four units, and is being designed to meet or exceed the EG, the EG represent a reasonable upper limit on the Facility's emissions.

The flue gas flow rates and composition used to calculate the following air pollutant emission factors are based on the output of the BURN combustion model. BURN is a CDM proprietary mathematical model used to analyze combustion systems by specifying operational parameters and fuel (municipal solid waste) characteristics. The output for this analysis, shown in Appendix C, is based on the Retrofitted Facility's worst-case operating load (see Section 6): combustion of 239.6 tons per day of waste with a higher heating value of 6,000 British Thermal Units per pound of refuse (Btu/lb) in a single combustor unit (furnace and boiler). "Actual" (as opposed to "worst-case") conditions for the existing Facility were also necessary for the netting modeling analysis. This was represented in the BURN run as 250 tons per day of waste with a higher heating value of 5,000 Btu/lb in a single unit. In both the Retrofit and existing cases, the Facility has four units.

Section 4 in the main text discusses the formation mechanisms, air pollution control equipment, and emission limit basis for each of these pollutants.

B.2 Particulate Matter and PM_{10}

For conservatism, all PM was assumed to be respirable particulate matter less than 10 microns in diameter (PM_{10}).

Basis: 0.012 grains per dry standard cubic foot corrected to 7 percent oxygen (gr/dscf @ 7% O_2), consistent with the 1995 EG limit.

1. Dry volumetric flow rate for the Retrofit unit, as calculated by BURN:

   27,289.8 dry standard cubic feet per minute corrected to 7 percent oxygen (dscfm @ 7% O_2)

2. Calculate PM emission rate per unit.

   $$0.012\ \frac{\text{gr}}{\text{dscf}}\ (27289.8)\ \frac{\text{dscf}}{\text{min}}\ \left(\frac{\text{g}}{15.43\ \text{gr}}\right)\ \left(\frac{\text{min}}{60\ \text{sec}}\right) = 0.354\ \text{g/s}$$

3. Calculate PM emission rate for Facility.

   0.354 g/s/unit (4 units) = 1.41 g/s

   $$1.41\ \frac{\text{g}}{\text{sec}}\ \frac{(1\ \text{ton})}{907{,}185\ \text{g}}\ \frac{(60\ \text{sec})}{\text{min}}\ \frac{(60\ \text{min})}{\text{hour}}\ \frac{(24\ \text{hours})}{\text{day}}\ \frac{(365\ \text{days})}{\text{year}} = 49.2\ \text{tons per year}$$

B.3 MWC Acid Gases

Sulfur Dioxide

The SDA/FF will control SO_2 emissions to meet the EG limits: 29 parts per million by volume (ppmv), or reduce emissions by 75 percent, whichever is less stringent (corrected to 7% O_2, dry basis), both over a 24-hour geometric mean, as determined by continuous emissions monitors.

The uncontrolled inlet SO_2 concentration of 600 ppmv (corrected to 7% O_2, dry basis) is roughly equivalent to an upper bound refuse sulfur content of 0.32 percent with 100 percent conversion of sulfur to SO_2. The control system will reduce this inlet concentration by 75 percent to achieve an outlet SO_2 concentration of 150 ppmv (dry, @ 7% O_2) over a 24-hour average. Emission rates based on the two emissions limitations are calculated as follows:

Basis: 29 parts per million on a dry volume basis corrected to 7 percent oxygen (ppmdv @ 7% O_2)

1. Dry volumetric flow rate for the Retrofit unit, as calculated by BURN:

   27,289.8 dry standard cubic feet per minute corrected to 7 percent oxygen (dscfm @ 7% O_2)

   $$27{,}289.8\ \frac{\text{dscf}}{\text{min}}\ \left(\frac{1\ \text{dscm}}{35.31\ \text{dscf}}\right)\ \left(\frac{1\ \text{min}}{60\ \text{sec}}\right) = 12.881\ \text{dscm/sec}$$

2. Calculate SO_2 emission rate for the Retrofit unit.

   $$\frac{29\ \text{moles}\ SO_2}{1 \times 10^6\ \text{moles}}\ \left(\frac{41.6\ \text{moles}}{\text{dscm}}\right)\ \left(\frac{64.07\ \text{g}}{\text{mole}}\right)\ \left(\frac{1 \times 10^6\ \mu\text{g}}{\text{g}}\right) = 77{,}294\ \frac{\mu\text{g}}{\text{dscm}}$$

   $$77{,}294\ \frac{\mu\text{g}}{\text{dscm}}\ \left(\frac{1\ \text{g}}{1 \times 10^6\ \mu\text{g}}\right)\ \left(\frac{12.881\ \text{dscm}}{\text{sec}}\right) = 0.996\ \text{g/sec}$$

3. Calculate SO_2 emission rate for Retrofit Facility.

   0.996 g/s/unit (4 units) = 3.982 g/s

   $$3.982\ \frac{\text{g}}{\text{sec}}\ \left(\frac{1\ \text{ton}}{907{,}185\ \text{g}}\right)\ \left(\frac{60\ \text{sec}}{\text{min}}\right)\ \left(\frac{60\ \text{min}}{\text{hour}}\right)\ \left(\frac{24\ \text{hours}}{\text{day}}\right)\ \left(\frac{365\ \text{days}}{\text{year}}\right) = 138.4\ \text{tons per year}$$

Basis: 600 parts per million on a dry volume basis corrected to 7 percent oxygen (ppmdv @ 7% O_2)

1. Apply 75 percent control efficiency.

   600 ppmdv SO_2 @ 7% O_2 uncontrolled (100% - 75%) = 150 ppmdv SO_2 @ 7% O_2 controlled

2. Calculate SO_2 emission rate for the Retrofit unit.

   $$\frac{150\ \text{moles}\ SO_2}{1 \times 10^6\ \text{moles}}\ \left(\frac{41.6\ \text{moles}}{\text{dscm}}\right)\ \left(\frac{64.07\ \text{g}}{\text{mole}}\right)\ \left(\frac{1 \times 10^6\ \mu\text{g}}{\text{g}}\right) = 399{,}797\ \frac{\mu\text{g}}{\text{dscm}}$$

   $$399{,}797\ \frac{\mu\text{g}}{\text{dscm}}\ \left(\frac{1\ \text{g}}{1 \times 10^6\ \mu\text{g}}\right)\ \left(\frac{12.881\ \text{dscm}}{\text{sec}}\right) = 5.150\ \text{g/sec}$$

3. Calculate SO_2 emission rate for Retrofit Facility.

   5.150 g/s/unit (4 units) = 20.60 g/s

   $$20.60 \frac{g}{sec} \frac{(1\ ton)}{907{,}185\ g} \frac{(60\ sec)}{min} \frac{(60\ min)}{hour} \frac{(24\ hours)}{day} \frac{(365\ days)}{year} = 716.1 \text{ tons per year}$$

Because SO_2 emission rates based on the percent removal efficiency approach result in higher calculated values, the SO_2 emission rate of 20.60 g/s was used in the worst-case dispersion modeling and compliance demonstrations for the Retrofit Facility.

The actual emissions of the existing Facility were used in the modeling analysis to show the net change in SO_2 impacts. Emissions for the existing Facility were based on the highest Facility (4-unit total) stack test result, which occurred in the September, 1985, compliance test run. This result was 139.9 pounds per hour (lb/hr) for the Facility as a whole, or 4.407 g/s/unit.

Hydrogen Chloride

The SDA/FF will control HCl emissions to meet the EG limits: 29 parts per million by volume (ppmv), or reduce emissions by 95 percent, whichever is less stringent (corrected to 7% O_2, dry basis), both as a 3-hour average, as determined by annual stack tests using EPA Method 26.

The uncontrolled inlet HCl concentration of 2,000 ppmv (corrected to 7% O_2, dry basis) is roughly equivalent to an upper bound refuse chlorine content of 0.65 percent with 100 percent conversion of chlorine to HCl. The control system will reduce this inlet concentration by 95 percent to achieve an outlet HCl concentration of 100 ppmv (dry, @ 7% O_2) over a 24-hour average. Emission rates based on the two emissions limitations are calculated as follows:

Basis: 29 parts per million on a dry volume basis corrected to 7 percent oxygen (ppmdv @ 7% O_2)

1. Dry volumetric flow rate for the Retrofit unit, as calculated by BURN:

   27,289.8 dry standard cubic feet per minute corrected to 7 percent oxygen (dscfm @ 7% O_2)

   $$27{,}289.8 \frac{dscf}{min} \frac{(1\ dscm)}{35.31\ dscf} \frac{(1\ min)}{60\ sec} = 12.881 \text{ dscm/sec}$$

2. Calculate HCl emission rate for the unit.

   $$\frac{29 \text{ moles } SO_2}{1 \times 10^6 \text{ moles}} \frac{(41.6 \text{ moles})}{dscm} \frac{(36.46\ g)}{mole} \frac{(1 \times 10^6\ \mu g)}{g} = 43{,}985 \frac{\mu g}{dscm}$$

   $$43{,}985 \frac{\mu g}{dscm} \frac{(1\ g)}{1 \times 10^6\ \mu g} \frac{(12.881\ dscm)}{sec} = 0.567 \text{ g/sec}$$

3. Calculate HCl emission rate for Facility.

0.567 g/s/unit (4 units) = 2.266 g/s

$$2.266 \frac{g}{sec} \left(\frac{1\ ton}{907{,}185\ g}\right) \left(\frac{60\ sec}{min}\right) \left(\frac{60\ min}{hour}\right) \left(\frac{24\ hours}{day}\right) \left(\frac{365\ days}{year}\right) = 78.8 \text{ tons per year}$$

Basis: 2,000 parts per million on a dry volume basis corrected to 7 percent oxygen (ppmdv @ 7% O_2)

1. Apply 95 percent control efficiency.

   2,000 ppmdv HCl @ 7% O_2 uncontrolled (100% - 95%) = 100 ppmdv HCl @ 7% O_2 controlled

2. Calculate HCl emission rate for the unit.

$$\frac{100\ moles\ HCl}{1 \times 10^6\ moles} \left(\frac{41.6\ moles}{dscm}\right) \left(\frac{36.46\ g}{mole}\right) \left(\frac{1 \times 10^6\ \mu g}{g}\right) = 151{,}674 \frac{\mu g}{dscm}$$

$$151{,}674 \frac{\mu g}{dscm} \left(\frac{1\ g}{1 \times 10^6\ \mu g}\right) \left(\frac{12.881\ dscm}{sec}\right) = 1.954\ g/sec$$

3. Calculate HCl emission rate for Facility.

   1.954 g/s/unit (4 units) = 7.815 g/s

$$7.815 \frac{g}{sec} \left(\frac{1\ ton}{907{,}185\ g}\right) \left(\frac{60\ sec}{min}\right) \left(\frac{60\ min}{hour}\right) \left(\frac{24\ hours}{day}\right) \left(\frac{365\ days}{year}\right) = 271.7 \text{ tons per year}$$

Because HCl emission rates based on the percent removal efficiency approach result in higher calculated values, the HCl emission rate of 7.82 g/s was used in the worst-case dispersion modeling and compliance demonstrations for the Facility.

Hydrogen Fluoride

The SDA/FF will be used to reduce HF emissions. The maximum potential emissions of HF are estimated to be 6.0 pounds per hour for the Facility, as a whole, consistent with the current permit limit.

Basis: 6.0 pounds per hour for the Facility

1. Calculate HF emission rate for the unit.

$$6.0 \frac{lb}{hr} \text{ Facility} \div 4 \text{ units} = 1.5\ lb/hr/unit$$

$$1.5 \frac{lb}{hr} \left(\frac{453.6\ g}{lb}\right) \left(\frac{1\ hr}{60\ min}\right) \left(\frac{1\ min}{60\ sec}\right) = 0.189\ g/s$$

2. Calculate HF emission rate for the Facility.

$$6.0\,\frac{lb}{hr}\left(\frac{453.6\,g}{lb}\right)\left(\frac{1\,hr}{60\,min}\right)\left(\frac{1\,min}{60\,sec}\right) = 0.756\ g/s$$

$$6.0\,\frac{lb}{hr}\left(\frac{1\,ton}{2{,}000\,lb}\right)\left(\frac{24\,hr}{day}\right)\left(\frac{365\,days}{year}\right) = 26.3\ \text{tons per year}$$

B.4 Carbon Monoxide

The combustion controls at the Facility will be upgraded and good combustion practices (as described in Section 3 in the main text) will be used to improve combustion efficiency, and reduce CO generation. The resulting 4-hour arithmetic block average CO concentration in the flue gases will be less than or equal to 100 parts per million by volume (ppmv) (corrected to 7% O_2, dry basis), as determined by continuous emissions monitors (CEMs), consistent with the EG.

Basis: 100 parts per million on a dry volume basis corrected to 7 percent oxygen (ppmdv @ 7% O_2)

1. Dry volumetric flow rate for the Retrofit unit, as calculated by BURN:

27,289.8 dry standard cubic feet per minute corrected to 7 percent oxygen (dscfm @ 7% O_2)

$$27{,}289.8\,\frac{dscf}{min}\left(\frac{1\,dscm}{35.31\,dscf}\right)\left(\frac{1\,min}{60\,sec}\right) = 12.881\ dscm/sec$$

2. Calculate CO emission rate for the unit.

$$\frac{100\,moles\,CO}{1 \times 10^{6}\,moles}\left(\frac{41.6\,moles}{dscm}\right)\left(\frac{28.01\,g}{mole}\right)\left(\frac{1 \times 10^{6}\,\mu g}{g}\right) = 116{,}522\ \frac{\mu g}{dscm}$$

$$116{,}522\,\frac{\mu g}{dscm}\left(\frac{1\,g}{1 \times 10^{6}\,\mu g}\right)\left(\frac{12.881\,dscm}{sec}\right) = 1.501\ g/sec$$

3. Calculate CO emission rate for Facility.

$$1.501\ g/s/unit\ (4\ units) = 6.004\ g/s$$

$$6.004\,\frac{g}{sec}\left(\frac{1\,ton}{907{,}185\,g}\right)\left(\frac{60\,sec}{min}\right)\left(\frac{60\,min}{hour}\right)\left(\frac{24\,hours}{day}\right)\left(\frac{365\,days}{year}\right) = 208.7\ \text{tons per year}$$

B.5 Nitrogen Oxides

The combustion controls at the Facility will be upgraded and good combustion practices (as described in Section 3 in the main text) will be used to improve combustion efficiency, and reduce NO_X generation. The resulting 24-hour block arithmetic mean NOx concentration in the flue gases will be at or below equal to 205 parts per million by volume (ppmv) (corrected to 7% O_2, dry basis), as determined by continuous emissions monitors (CEMs), consistent with the EG.

Basis: 205 parts per million on a dry volume basis corrected to 7 percent oxygen (ppmdv @ 7% O_2)

1. Dry volumetric flow rate for the Retrofit unit, as calculated by BURN:

   27,289.8 dry standard cubic feet per minute corrected to 7 percent oxygen (dscfm @ 7% O_2)

   $$27{,}289.8 \ \frac{\text{dscf}}{\text{min}} \left(\frac{1 \text{ dscm}}{35.31 \text{ dscf}}\right) \left(\frac{1 \text{ min}}{60 \text{ sec}}\right) = 12.881 \text{ dscm/sec}$$

2. Calculate NO_2 emission rate for the Retrofit unit.

   $$\frac{205 \text{ moles CO}}{1 \times 10^6 \text{ moles}} \left(\frac{41.6 \text{ moles}}{\text{dscm}}\right) \left(\frac{46.01 \text{ g}}{\text{mole}}\right) \left(\frac{1 \times 10^6 \ \mu\text{g}}{\text{g}}\right) = 392{,}373 \ \frac{\mu\text{g}}{\text{dscm}}$$

   $$392{,}373 \ \frac{\mu\text{g}}{\text{dscm}} \left(\frac{1 \text{ g}}{1 \times 10^6 \ \mu\text{g}}\right) \left(\frac{12.881 \text{ dscm}}{\text{sec}}\right) = 5.054 \text{ g/sec}$$

3. Calculate NO_2 emission rate for Retrofit Facility.

   5.054 g/s/unit (4 units) = 20.216 g/s

   $$20.22 \ \frac{\text{g}}{\text{sec}} \left(\frac{1 \text{ ton}}{907{,}185 \text{ g}}\right) \left(\frac{60 \text{ sec}}{\text{min}}\right) \left(\frac{60 \text{ min}}{\text{hour}}\right) \left(\frac{24 \text{ hours}}{\text{day}}\right) \left(\frac{365 \text{ days}}{\text{year}}\right) = 702.8 \text{ tons per year}$$

The actual emissions of the existing Facility were used in the modeling analysis to show the net change in NO_2 impacts. Emissions for the existing Facility were based on the highest Facility (4-unit total) stack test result, which occurred in the October, 1989, compliance test run. This result was 230.8 pounds per hour (lb/hr) for the Facility as a whole, or 7.270 g/s/unit.

B.6 MWC Metals

Mercury

Mercury (Hg) is made a metallic vapor at the combustion temperatures for municipal solid waste. The activated carbon injection system will adsorb mercury onto the carbon. In addition, the SDA will reduce flue gas temperatures, encouraging mercury condensation onto particulate matter. The downstream FF will then effectively remove particulate matter and carbon particles containing mercury. This system will control Hg emissions to meet the state and EG limits: 70 micrograms per dry standard cubic meter (μg/dscm), or reduce emissions by 85 percent, whichever is less stringent (corrected to 7% O_2), both over a 3-hour arithmetic mean, as determined by annual stack tests using EPA Method 29.

The maximum inlet concentration was estimated from stack test data for the existing Facility. The uncontrolled inlet Hg concentration of 900 μg/dscm (corrected to 7% O_2, dry basis) is the highest single-unit one-hour average stack test result of 875.7 μg/dscm, rounded up, from the October 1996 test series. The control system will reduce this inlet concentration by 85 percent to achieve an outlet

Hg concentration of 135 μg/dscm (corrected to 7% O_2) or less. Emission rates based on the two emissions limitations are calculated as follows:

Basis: 70 micrograms per dry standard cubic meter corrected to 7 percent oxygen (μg/dscm @ 7% O_2)

1. Dry volumetric flow rate for the Retrofit unit, as calculated by BURN:

   27,289.8 dry standard cubic feet per minute corrected to 7 percent oxygen (dscfm @ 7% O_2)

   $$27{,}289.8\ \frac{\text{dscf}}{\text{min}}\ \left(\frac{1\ \text{dscm}}{35.31\ \text{dscf}}\right)\ \left(\frac{1\ \text{min}}{60\ \text{sec}}\right) = 12.881\ \text{dscm/sec}$$

2. Calculate Hg emission rate for the unit.

   $$70\ \frac{\mu g}{\text{dscm}}\ \left(\frac{1\ g}{1 \times 10^6\ \mu g}\right)\ \left(\frac{12.881\ \text{dscm}}{\text{sec}}\right) = 0.000902\ \text{g/sec}$$

3. Calculate Hg emission rate for Facility.

   0.000902 g/s/unit (4 units) = 0.0036 g/s

   $$0.0036\ \frac{g}{\text{sec}}\ \left(\frac{1\ \text{ton}}{907{,}185\ g}\right)\ \left(\frac{60\ \text{sec}}{\text{min}}\right)\ \left(\frac{60\ \text{min}}{\text{hour}}\right)\ \left(\frac{24\ \text{hours}}{\text{day}}\right)\ \left(\frac{365\ \text{days}}{\text{year}}\right) = 0.125\ \text{tons/year}$$

Basis: 900 micrograms per dry standard cubic meter corrected to 7 percent oxygen (μg/dscm @ 7% O_2)

1. Apply 85 percent control efficiency.

   900 μg/dscm Hg @ 7% O_2 uncontrolled (100% - 85%) = 135 μg/dscm Hg @ 7% O_2 controlled

2. Calculate Hg emission rate for the unit.

   $$135\ \frac{\mu g}{\text{dscm}}\ \left(\frac{1\ g}{1 \times 10^6\ \mu g}\right)\ \left(\frac{12.881\ \text{dscm}}{\text{sec}}\right) = 0.00174\ \text{g/sec}$$

3. Calculate Hg emission rate for Facility.

   0.00174 g/s/unit (4 units) = 0.0070 g/s

   $$0.0070\ \frac{g}{\text{sec}}\ \left(\frac{1\ \text{ton}}{907{,}185\ g}\right)\ \left(\frac{60\ \text{sec}}{\text{min}}\right)\ \left(\frac{60\ \text{min}}{\text{hour}}\right)\ \left(\frac{24\ \text{hours}}{\text{day}}\right)\ \left(\frac{365\ \text{days}}{\text{year}}\right) = 0.242\ \text{tons/year}$$

Because Hg emission rates based on the percent removal efficiency approach result in higher calculated values, the Hg emission rate of 0.0070 g/s was used in the worst-case dispersion modeling and compliance demonstrations for the Facility.

Lead

Lead (Pb) liquefies at the combustion temperatures for municipal solid waste, but condenses onto fly ash in the flue gases. This process is assisted by the cooling provided by the SDA. The downstream FF will then effectively remove the particulate matter containing Pb. The SDA/FF will control Pb emissions to at or below the EG limit: 440 micrograms per dry standard cubic meter corrected to 7 percent oxygen ($\mu g/dscm$ @ 7% O_2). Compliance will be based on a 3-hour arithmetic mean, as determined by annual stack tests using EPA Method 29.

Basis: 440 micrograms per dry standard cubic meter corrected to 7 percent oxygen ($\mu g/dscm$ @ 7% O_2)

1. Dry volumetric flow rate for the Retrofit unit, as calculated by BURN:

   27,289.8 dry standard cubic feet per minute corrected to 7 percent oxygen (dscfm @ 7% O_2)

   $$27{,}289.8 \frac{dscf}{min} \left(\frac{1\ dscm}{35.31\ dscf}\right) \left(\frac{1\ min}{60\ sec}\right) = 12.881\ dscm/sec$$

2. Calculate Pb emission rate for the unit.

   $$440 \frac{\mu g}{dscm} \left(\frac{1\ g}{1 \times 10^6\ \mu g}\right) \left(\frac{12.881\ dscm}{sec}\right) = 0.005671\ g/sec$$

3. Calculate Pb emission rate for Facility.

   0.00567 g/s/unit (4 units) = 0.0227 g/s

   $$0.0227 \frac{g}{sec} \left(\frac{1\ ton}{907{,}185\ g}\right) \left(\frac{60\ sec}{min}\right) \left(\frac{60\ min}{hour}\right) \left(\frac{24\ hours}{day}\right) \left(\frac{365\ days}{year}\right) = 0.788\ tons/year$$

Cadmium

Cadmium (Cd) is in the flue gases primarily as particulate matter, and will be controlled by the FF to at or below the EG limit: 40 micrograms per dry standard cubic meter corrected to 7 percent oxygen ($\mu g/dscm$ @ 7% O_2). Compliance will be based on a 3-hour arithmetic mean, as determined by annual stack tests using EPA Method 29.

Basis: 40 micrograms per dry standard cubic meter corrected to 7 percent oxygen ($\mu g/dscm$ @ 7% O_2)

1. Dry volumetric flow rate for the Retrofit unit, as calculated by BURN:

   27,289.8 dry standard cubic feet per minute corrected to 7 percent oxygen (dscfm @ 7% O_2)

   $$27{,}289.8\ \frac{\text{dscf}}{\text{min}}\ \left(\frac{1\ \text{dscm}}{35.31\ \text{dscf}}\right)\left(\frac{1\ \text{min}}{60\ \text{sec}}\right) = 12.881\ \text{dscm/sec}$$

2. Calculate Cd emission rate for the unit.

   $$40\ \frac{\mu g}{\text{dscm}}\ \left(\frac{1\ g}{1 \times 10^{6}\ \mu g}\right)\left(\frac{12.881\ \text{dscm}}{\text{sec}}\right) = 0.000515\ \text{g/sec}$$

3. Calculate Cd emission rate for Facility.

   0.000515 g/s/unit (4 units) = 0.0021 g/s

   $$0.0021\ \frac{g}{\text{sec}}\ \left(\frac{1\ \text{ton}}{907{,}185\ g}\right)\left(\frac{60\ \text{sec}}{\text{min}}\right)\left(\frac{60\ \text{min}}{\text{hour}}\right)\left(\frac{24\ \text{hours}}{\text{day}}\right)\left(\frac{365\ \text{days}}{\text{year}}\right) = 0.072\ \text{tons/year}$$

Beryllium

Beryllium (Be) can be present in the flue gases as particulate matter, and will be controlled by the FF. The maximum potential emissions of Be are estimated to be 0.00046 pounds per hour for the Facility, as a whole, consistent with the current permit limit.

Basis: 0.00046 pounds per hour for the Facility

1. Calculate Be emission rate for the unit.

   $$0.00046\ \frac{\text{lb}}{\text{hr}}\ \text{Facility} \div 4\ \text{units} = 0.000115\ \text{lb/hr/unit}$$

   $$0.000115\ \frac{\text{lb}}{\text{hr}}\ \left(\frac{453.6\ g}{\text{lb}}\right)\left(\frac{1\ \text{hr}}{60\ \text{min}}\right)\left(\frac{1\ \text{min}}{60\ \text{sec}}\right) = 1.45 \times 10^{-5}\ \text{g/s}$$

2. Calculate Be emission rate for the Facility.

   $$0.00046\ \frac{\text{lb}}{\text{hr}}\ \left(\frac{453.6\ g}{\text{lb}}\right)\left(\frac{1\ \text{hr}}{60\ \text{min}}\right)\left(\frac{1\ \text{min}}{60\ \text{sec}}\right) = 5.80 \times 10^{-5}\ \text{g/s}$$

   $$0.00046\ \frac{\text{lb}}{\text{hr}}\ \left(\frac{1\ \text{ton}}{2{,}000\ \text{lb}}\right)\left(\frac{24\ \text{hr}}{\text{day}}\right)\left(\frac{365\ \text{days}}{\text{year}}\right) = 0.00201\ \text{tons per year}$$

B.7 MWC Organics

Dioxins and Furans

The Retrofit Facility will use good combustion practices (see Section 3 in the main text) to reduce formation of dioxins and furans (PCDD/PCDF), the SDA to condense PCDD/PCDF onto particulate matter in the flue gas, and the FF to remove the particulate matter containing PCDD/PCDF. PCDD/PCDF concentrations will be controlled by this system to at or below the EG limit: 30 nanograms per dry standard cubic meter corrected to 7 percent oxygen (ng/dscm @ 7% O_2). Compliance will be based on a 4-hour arithmetic mean, as determined by annual stack tests using EPA Reference Method 26.

Basis: 30 nanograms per dry standard cubic meter corrected to 7 percent oxygen (ng/dscm @ 7% O_2)

1. Dry volumetric flow rate for the Retrofit unit, as calculated by BURN:

   27,289.8 dry standard cubic feet per minute corrected to 7 percent oxygen (dscfm @ 7% O_2)

   $$27{,}289.8\ \frac{\text{dscf}}{\text{min}}\left(\frac{1\ \text{dscm}}{35.31\ \text{dscf}}\right)\left(\frac{1\ \text{min}}{60\ \text{sec}}\right) = 12.881\ \text{dscm/sec}$$

2. Calculate PCDD/PCDF emission rate for the unit.

   $$30\ \frac{\text{ng}}{\text{dscm}}\ \frac{(1\ \text{g})}{1 \times 10^{9}\ \text{ng}}\ \frac{(12.881\ \text{dscm})}{\text{sec}} = 3.864 \times 10^{-7}\ \text{g/sec}$$

3. Calculate PCDD/PCDF emission rate for Facility.

   $$3.864 \times 10^{-7}\ \text{g/s/unit}\ \ (4\ \text{units}) = 1.546 \times 10^{-6}\ \text{g/s}$$

   $$1.546 \times 10^{-6}\ \frac{\text{g}}{\text{sec}}\ \frac{(1\ \text{ton})}{907{,}185\ \text{g}}\ \frac{(60\ \text{sec})}{\text{min}}\ \frac{(60\ \text{min})}{\text{hour}}\ \frac{(24\ \text{hrs})}{\text{day}}\ \frac{(365\ \text{days})}{\text{year}} = 5.37 \times 10^{-5}\ \frac{\text{tons}}{\text{year}}$$

B.8 Ammonia

The Retrofit Facility will have SNCR for NO_X control. The vendor for this system has not been selected, and it is not currently known whether the reagent will be ammonia or urea. With either ammonia or urea, there will be some unreacted reagent that will "slip" out of the stack. Ammonia is regulated as a hazardous air pollutant, and the FDEP has a guideline Ambient Reference Concentration for ammonia. Urea is not regulated as a hazardous air pollutant and does not have an Ambient Reference Concentration. Therefore, for the purposes of performing a worst-case impacts analysis for the Facility Retrofit, it was assumed that ammonia would be the SNCR reagent. A maximum upper bound concentration for unreacted ammonia in the flue gases was estimated to be 50 parts per million by volume (ppmv) (corrected to 7% O_2, dry basis), based on recent permit approvals for ammonia-based SNCR systems (FDEP PSD Permit, Lee County Solid Waste Energy Recovery Facility, No. PSD-FL-151, July 20, 1992; NYSDEC Permit to Operate, Onandaga County, NY, Resource Recovery Facility, No. 7-3142-00028, November 16, 1995; and NJDEP Permit to Construct, Mercer and Atlantic Counties, NJ, Resource Recovery Facility, Log No. 01-92-1730, July 24, 1996). It is likely that the Retrofit Tampa McKay Bay Facility will have stack concentrations substantially less than this.

Basis: 50 parts per million on a dry volume basis corrected to 7 percent oxygen (ppmdv @ 7% O_2)

1. Dry volumetric flow rate for the Retrofit unit, as calculated by BURN:

   27,289.8 dry standard cubic feet per minute corrected to 7 percent oxygen (dscfm @ 7% O_2)

   $$27{,}289.8\ \frac{\text{dscf}}{\text{min}}\ \left(\frac{1\ \text{dscm}}{35.31\ \text{dscf}}\right)\ \left(\frac{1\ \text{min}}{60\ \text{sec}}\right) = 12.881\ \text{dscm/sec}$$

2. Calculate ammonia (NH_3) emission rate for the Retrofit unit.

   $$\frac{50\ \text{moles}\ NH_3}{1 \times 10^6\ \text{moles}}\ \left(\frac{41.6\ \text{moles}}{\text{dscm}}\right)\ \left(\frac{17.03\ \text{g}}{\text{mole}}\right)\ \left(\frac{1 \times 10^6\ \mu\text{g}}{\text{g}}\right) = 35{,}422\ \frac{\mu\text{g}}{\text{dscm}}$$

   $$35{,}422\ \frac{\mu\text{g}}{\text{dscm}}\ \left(\frac{1\ \text{g}}{1 \times 10^6\ \mu\text{g}}\right)\ \left(\frac{12.881\ \text{dscm}}{\text{sec}}\right) = 0.456\ \text{g/sec}$$

3. Calculate NH_3 emission rate for Retrofit Facility.

   0.456 g/s/unit (4 units) = 1.825 g/s

   $$1.825\ \frac{\text{g}}{\text{sec}}\ \left(\frac{1\ \text{ton}}{907{,}185\ \text{g}}\right)\ \left(\frac{60\ \text{sec}}{\text{min}}\right)\ \left(\frac{60\ \text{min}}{\text{hour}}\right)\ \left(\frac{24\ \text{hours}}{\text{day}}\right)\ \left(\frac{365\ \text{days}}{\text{year}}\right) = 63.4\ \text{tons per year}$$

Appendix C
BURN Model Runs

Appendix C
BURN Model Runs

CDM's proprietary combustion model, BURN, was run to estimate flue gas composition, temperature, and flow rates for seven combinations of waste heat content and feed rate, for both the existing Facility, and the future Facility after the proposed upgrade. Section 6.0 describes these cases, and the input and output information for the BURN model itself.

This appendix contains the output for the three most pertinent cases of the 14 modeled:

- 100 percent of nominal load with a reference waste of 5,000 Btu/lb for the existing Facility.
- 115 percent of nominal load with a waste of 6,000 Btu/lb for the future Facility (this was determined to be the worst case for dispersion modeling).
- 100 percent of nominal load with a reference waste of 5,000 Btu/lb for the future Facility.

The parameters and output information shown in each of these print-outs are for a single unit (out of the total of four units at the Facility).

Nominal Case

BURN - Version 4.01 COMBUSTION ANALYSIS: RUN ___ FOR Tampa __/__/__

100% MCR
5,000 Btu/lb

DATA FILE USED FOR THIS ANALYSIS: T231.IN

Existing Conditions 250 tpd

WASTE FEED STREAMS

NAME	WEIGHT FIRED in Wet LB/Hr	Carbon	Hydrogen	Sulfur	Fe(OH)3	Al(OH)3	Oxygen
		PERCENT (DRY BASIS)					
WASTE	20833.0	35.939	4.792	.126	00.000	00.000	31.653
COMPOSITE (LB)	20833.	5933.67	791.17	20.83	.00	.00	5225.88
COMPOSITE MOLS	0.	494.06	392.44	.65	.00	.00	163.31
COMPOSITE (% DRY BASIS)		35.94	4.79	.13	.00	.00	31.65

PERCENT (DRY BASIS)

	Nitrogen	Chlorine	CaCO3	Inert	Iron	Aluminum	Bromine	Pct.H2O	BTU/LB
# 1	.631	.504	00.000	26.356	00.000	00.000	00.000	20.750	6309.6
(LB)	104.11	83.29	.00	4351.35	.00	.00	.00	4322.85	5000.4
MOLS	3.72	2.35	.00	4351.35	.00	.00	.00	240.16	
% DRY	.63	.50	.00	26.36	.00	.00	.00		

	DRY BASIS		WET BASIS	
THE MODIFIED DULONG HEATING VALUE IS:	6294.1	BTU/LB	4988.1	BTU/LB
THE MODIFIED CHANG HEATING VALUE IS:	6392.9	BTU/LB	5066.4	BTU/LB
THE BOIE HEATING VALUE IS:	6309.6	BTU/LB	5000.4	BTU/LB
THE MODIFIED VONDRACEK HEATING VALUE IS:	4600.2	BTU/LB	3645.7	BTU/LB
THE AVERAGE ESTIMATED HEATING VALUE IS:	5899.2	BTU/LB	4675.1	BTU/LB
THE INPUT WASTE HEATING VALUE IS:	6309.6	BTU/LB	5000.4	BTU/LB

DAILY CHARGE RATE EQUALS: 250.0 TONS PER 24-HOUR DAY.

RUN CONDITIONS AS INPUT

```
AMBIENT AIR:  73.0  DEG. F ; PRESSURE 1.0 ATM; ABSOLUTE HUMIDITY .013000
AMBIENT AIR HAS A RELATIVE HUMIDITY OF:  74.5 PERCENT
AVAILABLE PREHEATED AIR          .0 ACTUAL CFM    AT     73.0  DEG. F
OPERATING TEMPERATURES: MINIMUM OF       .0, MAXIMUM OF 50000.0  DEG. F
FURNACE WATER COOLED, 100.00 % OF AREA; BOILER WATER COOLED, 100.00 % OF AREA
TEMPERATURES MODERATED WITH  AIR  AND ELEVATED WITH GAS
STEAM CONDITIONS: PRESSURE - 1000.  PSIA   ; TEMPERATURE -  900.  DEG. F
TEMPERATURE ( DEG. F ): PROCESS WATER 60. FEEDWATER  60.
FLUE GASES LEAVE THE BOILER AT:   525.0  DEG. F , QUENCHER AT      .0  DEG. F
FLUE GASES LEAVE THE SUBCOOLER AT:    .0  DEG. F
MAXIMUM SUBCOOLER WATER DISCHARGE TEMPERATURE IS:   95.0  DEG. F
STACK DIAM. IS    1.2  F, HEIGHT  160.0  F, VELOCITY =    45.0  FT/SEC
             0. BTU/HR  IS ABSORBED IN THE PRIMARY COMBUSTION CHAMBER
RESIDUE IS WATER QUENCHED AND LEAVES SYSTEM AT  350.0  DEG. F
UNBURNED PERCENTAGES OF FEED - CARBON     .5, IRON    00.0, ALUMINUM   00.0
AFTERBURNER TEMPERATURE:       .0  DEG. F ;OPERATING FACTOR: 100.00 % OF DESIGN
ATMOSPHERIC STABILITY CLASS IS:  0; DESIGN % EXCESS AIR IS:  115.0
```

NOTE: GAS FLOW RATES EXPRESSED IN SCFM ARE AT 60 Deg. F AND 1.0 Atm.

SUMMARY OF FURNACE OPERATIONS

Furnace Flue Gas Sensible Heat Content (SENH) as a Function of Tgas

SENH = A + B*T + C*T*T + D*T*T*T

A = -.2583374E+07 C = .3963910E+01

B = .4281965E+05 D = -.3493828E-03

At Tgas = 1910.26 DEG. F , SENH = .9124278E+08 BTU/HR

GAS ANALYSIS AFTER FURNACE

COMPONENT	VOLUME % DRY BASIS	VOLUME % WET BASIS	MOLS PER MINUTE	LB/HR	
CO2	9.217	8.090	8.193	21634.9	
SO2	.1220E-01	.1071E-01	.1085E-01	41.7	107. PPMV - WET
N2	79.44	69.73	70.62	118705.8	
O2	11.29	9.905	10.03	19260.8	
HCl	.4404E-01	.3866E-01	.3915E-01	85.7	387. PPMV - WET
HBr	.0000	.0000	.0000	.0	0. PPMV - WET
H2O		12.23	12.38	13374.6	
TOTAL	100.0	100.0	101.3	173103.4	

	PERCENT SO2 TO SO3	DEWPOINT DEG. F	EQUIVALENT SO3 ppmw	EQUIVALENT SO3 ppmd
SULFURIC ACID	1	245.41	1.	1.
DEWPOINT FROM	3	263.36	3.	4.
OXIDATION OF	5	272.03	5.	6.
SO2 TO SO3	8	280.19	9.	10.
AT THIS LOCATION	10	284.12	11.	12.
IN THE SYSTEM	15	291.39	16.	18.

EQUILIBRIUM SO3 (USUALLY NOT ATTAINED) AT 1910.3 DEG. F

EQUILIBRIUM CONSTANT FOR SO2+0.5O2-->SO3 IS: .125

EQUILIBRIUM SO3 IS THEN: 53. ppm (wet basis)

PREHEATED AIR	.00	ACFM	(ENTHALPY:	0. BTU/HR)
	.00	SCFM	.00	LB/HR
COMBUSTION AIR	35434.50	ACFM		
	34569.71	SCFM	156516.50	LB/HR
BURNER AIR	.00	ACFM		
	.00	SCFM	.00	LB/HR
COOLING AIR	.00	ACFM		
	.00	SCFM	.00	LB/HR
COOLING WATER	.00	GAL/MIN	.00	LB/HR

WITHOUT COOLING OR FUEL USE BUT USING 0. ACFM OF PREHEATED AIR, THE FURNACE TEMPERATURE IS: 1910. DEG. F ; A TEMPERATURE OF 1788. DEG. F WAS USED TO JUDGE POTENTIAL DISSOCIATION OF $CaCO_3$, $Fe(OH)_3$, AND $Al(OH)_3$.

FLUE GAS	175132.10	ACFM	AT	1910.3	DEG. F
	38402.29	SCFM	AT	60.0	DEG. F

BURNER FUEL USE .00 CFM (.00 FT3/HR) GAS
EQUAL TO .0 BTU/HR

QUENCH TANK MAKEUP 2.92 GAL/MIN

RESIDUE ASSUMED TO LEAVE HOT ZONE AT 350.0 DEG. F
RESIDUE WEIGHT (75.00 % SOLIDS) 5841.36 LB/HR
(DRY) 4381.02 LB/HR

UNBURNED CARBON IN ASH: .677 PERCENT OF TOTAL ASH (INCLUDING CARBON)
HEATING VALUE OF RESIDUE (DRY BASIS): 95.5 BTU/LB OR 418206. BTU/HR

NET HEAT RELEASE (BTU/HR)

1. PRIMARY

FEED	103754300.
FUEL	0.
AIR HEAT	2619104.
TOTAL	106373400.

2. AFTERBURNER

FUEL	0.
AIR HEAT	0.
GRAND TOTAL	106373400.

HEAT LOSSES	BTU/HR	PERCENT OF FEED HEAT CONTENT	PERCENT OF TOTAL HEAT RELEASE
RADIATION	698987.	.67 PERCENT	.7 PERCENT
MOISTURE	14188290.	13.62 PERCENT	13.3 PERCENT
DRY GAS	91242780.	87.59 PERCENT	85.4 PERCENT
RESIDUE	773339.	.74 PERCENT	.7 PERCENT

DESIGN EXCESS AIR (ON FEED) IS 115.00 PERCENT
ACTUAL EXCESS AIR (ON FEED) IS 115.01 PERCENT
ACTUAL EXCESS AIR (ON TOTAL COMBUSTIBLE) IS 115.01 PERCENT

EQUILIBRIUM THERMAL NOX CONCENTRATION IS 306.0 PPM (VOLUME)
PERCENT FUEL NITROGEN CONVERTED TO NOx= 69.672 PERCENT
FUEL NITROGEN NOx (Estimated by Soete) = 852.173 PPM (VOLUME)

THE EQUILIBRIUM CONSTANT FOR $2HCl+.5O_2 \rightarrow Cl_2+H_2O$ IS: .0697
THE EQUILIBRIUM CONSTANT FOR $2HBr+.5O_2 \rightarrow Br_2+H_2O$ IS: .0104

EQUILIBRIUM CHLORINE CONCENTRATION AT 1910.3 DEG. F IS:
.657 ppm (Wet Basis)
.748 ppm (Dry Basis)

SO_2 UNCONTROLLED EMISSION RATE IS 5.26 GM/SEC EQUAL TO 41.65 LB/HR
HCl UNCONTROLLED EMISSION RATE IS 10.80 GM/SEC EQUAL TO 85.56 LB/HR
HBr UNCONTROLLED EMISSION RATE IS .00 GM/SEC EQUAL TO .00 LB/HR

WITH ACID GAS CONTROL AT .0 PERCENT,

SO2 CONTROLLED EMISSION RATE IS	5.26	GM/SEC	EQUAL TO	41.65	LB/HR
HCl CONTROLLED EMISSION RATE IS	10.80	GM/SEC	EQUAL TO	85.56	LB/HR
HBr CONTROLLED EMISSION RATE IS	.00	GM/SEC	EQUAL TO	.00	LB/HR

	PERCENT SO2 TO SO3	DEWPOINT DEG. F	EQUIVALENT SO3 ppmw	EQUIVALENT SO3 ppmd
SULFURIC ACID	1	245.41	1.	1.
DEWPOINT FROM	3	263.36	3.	4.
OXIDATION OF	5	272.03	5.	6.
SO2 TO SO3	8	280.19	9.	10.
AT THIS LOCATION	10	284.12	11.	12.
IN THE SYSTEM	15	291.39	16.	18.

EQUILIBRIUM SO3 (USUALLY NOT ATTAINED) AT 1910.3 DEG. F
EQUILIBRIUM CONSTANT FOR SO2+0.5O2-->SO3 IS: .125
EQUILIBRIUM SO3 IS THEN: 53. ppm (wet basis)

SUMMARY OF BOILER OPERATION CALCULATIONS

BOILER STEAM PRODUCTION	49035.0	LB/HR
PRESSURE	1000.0	PSIA
TEMPERATURE	900.0	DEG. F

FEEDWATER TEMPERATURE:	60.0	DEG. F
FEEDWATER ENTHALPY:	28.4	BTU/LB
PRODUCT STEAM ENTHALPY:	1448.2	BTU/LB
ENTHALPY CHANGE:	1419.7	BTU/LB

NOTE: THE PERCENT OXIDATION OF FLUE GAS SO2 AT WHICH THE SULFURIC ACID DEWPOINT EQUALS THE FEEDWATER TEMPERATURE IS: .00 PERCENT.

PRODUCT STEAM USE TO HEAT CONDENSATE RETURN
FROM 0. DEG. F TO FEEDWATER TEMPERATURE IS: 1987.7 LB/HR

NET STEAM PRODUCTION AFTER FEEDWATER HEATING IS: 47047.3 LB/HR

NOTE!! - IF ACTUAL CONDENSATE RETURN IS ALREADY AT FEEDWATER TEMPERATURE, ADD BACK THE FEEDWATER HEATING STEAM USE TO THE NET STEAMING RATE!!

SATURATION TEMPERATURE AT PRODUCT STEAM PRESSURE: 544.6 DEG. F

THE STEAM CARRIES: 355.4 DEG. F OF SUPERHEAT

FLUE GAS TEMPERATURE AT BOILER EXIT 525. DEG. F

RADIATION LOSS 688090. BTU/HR OR .75 % OF SENSIBLE HEAT AT BOILER INLET

WITH REFERENCE TO TOTAL ENTHALPY INPUT TO THE COMBUSTION SYSTEM,
THE BOILER EFFICIENCY IS: 65.19 PERCENT

WITH REFERENCE TO FEED HHV ENTHALPY INPUT TO THE COMBUSTION SYSTEM,
THE BOILER EFFICIENCY IS: 66.57 PERCENT

MEAN MOLECULAR WEIGHT OF GASES
(DRY BASIS) 29.95
(WET BASIS) 28.49

TOTAL GAS FLOW RATE	LB/MIN	LB/HR	ACFM
(DRY BASIS)	2662.15	159728.90	--
(WET BASIS)	2885.25	173115.30	72814.9

EFFLUENT GAS HUMIDITY .0838 (MASS H2O/MASS BONE DRY GAS)

GAS DEW POINT IS 122.1 DEG. F

SUMMARY OF STACK REHEATING OPERATION
===================================
TARGET STACK TEMPERATURE IS: .0 DEG. F

NO STACK REHEAT ANALYSIS REQUESTED.

SUMMARY OF STACK CALCULATIONS AFTER SYSTEM

STACK DIAMETER OF 5.86 FEET USED FOR CALCULATIONS

NATURAL DRAFT 1.052E+00 IN H2O
FRICTION LOSS 4.498E-01 IN H2O
VELOCITY HEAD 2.470E-02 IN H2O
MINIMUM FAN PRESSURE-5.772E-01 IN H2O
EXIT VELOCITY 45.0 FT/SEC

TOTAL FLOW @ STACK CONDITIONS 72694.8 CFM
STACK TEMPERATURE IS: 524.1 DEG. F

FLOW CORRECTED TO 12% CO2 (DRY, 1 ATM, 68 F/20 C)) 26304.2 CFM
FLOW CORRECTED TO 7% O2 (DRY, 1 ATM, 68 F/20 C)) 23764.6 CFM

MEAN MOLECULAR WEIGHT OF GASES
(DRY BASIS) 29.95
(WET BASIS) 28.49

TOTAL GAS FLOW RATE	LB/MIN	LB/HR	ACFM
(DRY BASIS)	2662.15	159728.90	--
(WET BASIS)	2885.25	173115.30	72814.9

EFFLUENT GAS HUMIDITY .0838 (MASS H2O/MASS BONE DRY GAS)

GAS DEW POINT IS 122.1 DEG. F

SUMMARY OF STACK VISIBILITY ANALYSIS
===================================

THIS ANALYSIS DETERMINES THE DISTANCE ABOVE THE STACK TOP WHERE THE PLUME (AFTER REHEAT) JUST VANISHES. FOR FINITE WINDSPEED, THERE WILL BE A HORIZONTAL DISPLACEMENT. ALSO, THE STACK REHEAT VIA USE OF AVAILABLE PREHEATED AIR, FUEL AND STEAM WHICH JUST RENDERS THE PLUME NON-VISIBLE ARE CALCULATED (STARTING AFTER ANY PROGRAMMED REHEAT).

THE FLUE GAS TEMPERATURE IS HIGH ENOUGH AND/OR THE HUMIDITY LOW ENOUGH THAT THE PLUME-AMBIENT INTERACTION SHOULD NOT PRODUCE A VISIBLE PLUME. VISIBILITY ANALYSIS DISCONTINUED.

CALCULATIONS COMPLETE

BURN - Version 4.01 COMBUSTION ANALYSIS: RUN ___ FOR Tampa ___/___/___

DATA FILE USED FOR THIS ANALYSIS: T112.IN

115% MCR
6,000 Btu/lb
Future Case

WASTE FEED STREAMS

NAME	WEIGHT FIRED in Wet LB/Hr	Carbon	Hydrogen	Sulfur	Fe(OH)3	Al(OH)3	Oxygen
		PERCENT (DRY BASIS)					
WASTE	19966.0	35.939	4.792	.126	00.000	00.000	31.653
COMPOSITE (LB)	19966.	6823.33	909.79	23.95	.00	.00	6009.42
COMPOSITE MOLS	0.	568.14	451.28	.75	.00	.00	187.79
COMPOSITE (% DRY BASIS)		35.94	4.79	.13	.00	.00	31.65

PERCENT (DRY BASIS)

	Nitrogen	Chlorine	CaCO3	Inert	Iron	Aluminum	Bromine	Pct.H2O	BTU/LB
# 1	.631	.504	00.000	26.356	00.000	00.000	00.000	4.910	6309.6
(LB)	119.72	95.78	.00	5003.77	.00	.00	.00	980.39	5999.8
MOLS	4.27	2.70	.00	5003.77	.00	.00	.00	54.47	
% DRY	.63	.50	.00	26.36	.00	.00	.00		

	DRY BASIS		WET BASIS	
THE MODIFIED DULONG HEATING VALUE IS:	6294.1	BTU/LB	5985.1	BTU/LB
THE MODIFIED CHANG HEATING VALUE IS:	6392.9	BTU/LB	6079.0	BTU/LB
THE BOIE HEATING VALUE IS:	6309.6	BTU/LB	5999.8	BTU/LB
THE MODIFIED VONDRACEK HEATING VALUE IS:	4600.2	BTU/LB	4374.3	BTU/LB
THE AVERAGE ESTIMATED HEATING VALUE IS:	5899.2	BTU/LB	5609.5	BTU/LB
THE INPUT WASTE HEATING VALUE IS:	6309.6	BTU/LB	5999.8	BTU/LB ✓

DAILY CHARGE RATE EQUALS: 239.6 TONS PER 24-HOUR DAY. ✓

RUN CONDITIONS AS INPUT

AMBIENT AIR: 73.0 DEG. F ; PRESSURE 1.0 ATM; ABSOLUTE HUMIDITY .013000
AMBIENT AIR HAS A RELATIVE HUMIDITY OF: 74.5 PERCENT
AVAILABLE PREHEATED AIR .0 ACTUAL CFM AT 73.0 DEG. F
OPERATING TEMPERATURES: MINIMUM OF .0, MAXIMUM OF 50000.0 DEG. F
FURNACE WATER COOLED, 100.00 % OF AREA; BOILER WATER COOLED, 100.00 % OF AREA
TEMPERATURES MODERATED WITH AIR AND ELEVATED WITH GAS
STEAM CONDITIONS: PRESSURE - 1000. PSIA ; TEMPERATURE - 900. DEG. F
TEMPERATURE (DEG. F): PROCESS WATER 60. FEEDWATER 400.
FLUE GASES LEAVE THE BOILER AT: 450.0 DEG. F , QUENCHER AT 290.0 DEG. F
FLUE GASES LEAVE THE SUBCOOLER AT: .0 DEG. F
MAXIMUM SUBCOOLER WATER DISCHARGE TEMPERATURE IS: 95.0 DEG. F
STACK DIAM. IS 1.2 F, HEIGHT 160.0 F, VELOCITY = 45.0 FT/SEC
0. BTU/HR IS ABSORBED IN THE PRIMARY COMBUSTION CHAMBER
RESIDUE IS WATER QUENCHED AND LEAVES SYSTEM AT 350.0 DEG. F
UNBURNED PERCENTAGES OF FEED - CARBON .5, IRON 00.0, ALUMINUM 00.0
AFTERBURNER TEMPERATURE: .0 DEG. F ;OPERATING FACTOR: 115.00 % OF DESIGN
ATMOSPHERIC STABILITY CLASS IS: 0; DESIGN % EXCESS AIR IS: 100.0

NOTE: GAS FLOW RATES EXPRESSED IN SCFM ARE AT 60 Deg. F AND 1.0 Atm.

SUMMARY OF FURNACE OPERATIONS

Furnace Flue Gas Sensible Heat Content (SENH) as a Function of Tgas

SENH = A + B*T + C*T*T + D*T*T*T

A =	-.2687891E+07	C =	.4145047E+01
B =	.4455083E+05	D =	-.3744222E-03

At Tgas = 2161.98 DEG. F , SENH = .1092207E+09 BTU/HR

GAS ANALYSIS AFTER FURNACE

COMPONENT	VOLUME % DRY BASIS	VOLUME % WET BASIS	MOLS PER MINUTE	LB/HR	
CO2	9.912	8.935	9.422	24878.7	
SO2	.1312E-01	.1183E-01	.1247E-01	48.0	118. PPMV - WET
N2	79.47	71.64	75.55	126988.8	
O2	10.55	9.513	10.03	19259.8	
HCl	.4736E-01	.4270E-01	.4502E-01	98.5	427. PPMV - WET
HBr	.0000	.0000	.0000	.0	0. PPMV - WET
H2O		9.859	10.40	11228.1	
TOTAL	100.0	100.0	105.5	182501.8	

	PERCENT SO2 TO SO3	DEWPOINT DEG. F	EQUIVALENT SO3 ppmw	EQUIVALENT SO3 ppmd
SULFURIC ACID	1	242.66	1.	1.
DEWPOINT FROM	3	260.90	4.	4.
OXIDATION OF	5	269.71	6.	7.
SO2 TO SO3	8	278.00	9.	10.
AT THIS LOCATION	10	282.01	12.	13.
IN THE SYSTEM	15	289.40	18.	20.

EQUILIBRIUM SO3 (USUALLY NOT ATTAINED) AT 2162.0 DEG. F
EQUILIBRIUM CONSTANT FOR SO2+0.5O2-->SO3 IS: .055
EQUILIBRIUM SO3 IS THEN: 35. ppm (wet basis)

PREHEATED AIR	.00	ACFM	(ENTHALPY:	0. BTU/HR)
	.00	SCFM	.00	LB/HR
COMBUSTION AIR	37904.55	ACFM		
	36979.47	SCFM	167426.80	LB/HR
BURNER AIR	.00	ACFM		
	.00	SCFM	.00	LB/HR
COOLING AIR	.00	ACFM		
	.00	SCFM	.00	LB/HR
COOLING WATER	.00	GAL/MIN	.00	LB/HR

WITHOUT COOLING OR FUEL USE BUT USING 0. ACFM OF PREHEATED AIR, THE FURNACE TEMPERATURE IS: 2162. DEG. F ; A TEMPERATURE OF 2029. DEG. F WAS USED TO JUDGE POTENTIAL DISSOCIATION OF CaCO3, Fe(OH)3, AND Al(OH)3.

FLUE GAS	201720.20	ACFM	AT	2162.0	DEG. F
	39985.55	SCFM	AT	60.0	DEG. F

BURNER FUEL USE .00 CFM (.00 FT3/HR) GAS
EQUAL TO .0 BTU/HR

QUENCH TANK MAKEUP 3.35 GAL/MIN

RESIDUE ASSUMED TO LEAVE HOT ZONE AT 350.0 DEG. F
RESIDUE WEIGHT (75.00 % SOLIDS) 6717.18 LB/HR
(DRY) 5037.89 LB/HR

UNBURNED CARBON IN ASH: .677 PERCENT OF TOTAL ASH (INCLUDING CARBON)
HEATING VALUE OF RESIDUE (DRY BASIS): 95.5 BTU/LB OR 480910. BTU/HR

NET HEAT RELEASE (BTU/HR)

1. PRIMARY	
FEED	119310700.
FUEL	0.
AIR HEAT	2801675.
TOTAL	122112400.
2. AFTERBURNER	
FUEL	0.
AIR HEAT	0.
GRAND TOTAL	122112400.

HEAT LOSSES	BTU/HR	PERCENT OF FEED HEAT CONTENT	PERCENT OF TOTAL HEAT RELEASE
RADIATION	698205.	.58 PERCENT	.6 PERCENT
MOISTURE	11911240.	9.94 PERCENT	9.7 PERCENT
DRY GAS	109220700.	91.18 PERCENT	89.1 PERCENT
RESIDUE	889290.	.74 PERCENT	.7 PERCENT

DESIGN EXCESS AIR (ON FEED) IS 100.00 PERCENT
ACTUAL EXCESS AIR (ON FEED) IS 100.01 PERCENT
ACTUAL EXCESS AIR (ON TOTAL COMBUSTIBLE) IS 100.01 PERCENT

EQUILIBRIUM THERMAL NOX CONCENTRATION IS 674.3 PPM (VOLUME)
PERCENT FUEL NITROGEN CONVERTED TO NOx= 73.152 PERCENT
FUEL NITROGEN NOx (Estimated by Soete) = 988.146 PPM (VOLUME)

THE EQUILIBRIUM CONSTANT FOR 2HCl+.5O2-->Cl2+H2O IS: .0425
THE EQUILIBRIUM CONSTANT FOR 2HBr+.5O2-->Br2+H2O IS: .0020

EQUILIBRIUM CHLORINE CONCENTRATION AT 2162.0 DEG. F IS:
.594 ppm (Wet Basis)
.659 ppm (Dry Basis)

SO2 UNCONTROLLED EMISSION RATE IS	6.05	GM/SEC	EQUAL TO	47.89 LB/HR
HCl UNCONTROLLED EMISSION RATE IS	12.42	GM/SEC	EQUAL TO	98.39 LB/HR
HBr UNCONTROLLED EMISSION RATE IS	.00	GM/SEC	EQUAL TO	.00 LB/HR

WITH ACID GAS CONTROL AT .0 PERCENT,					
SO2 CONTROLLED EMISSION RATE IS	6.05	GM/SEC	EQUAL TO	47.89	LB/HR
HCl CONTROLLED EMISSION RATE IS	12.42	GM/SEC	EQUAL TO	98.39	LB/HR
HBr CONTROLLED EMISSION RATE IS	.00	GM/SEC	EQUAL TO	.00	LB/HR

	PERCENT SO2 TO SO3	DEWPOINT DEG. F	EQUIVALENT SO3 ppmw	EQUIVALENT SO3 ppmd
SULFURIC ACID	1	242.66	1.	1.
DEWPOINT FROM	3	260.90	4.	4.
OXIDATION OF	5	269.71	6.	7.
SO2 TO SO3	8	278.00	9.	10.
AT THIS LOCATION	10	282.01	12.	13.
IN THE SYSTEM	15	289.40	18.	20.

EQUILIBRIUM SO3 (USUALLY NOT ATTAINED) AT 2162.0 DEG. F
EQUILIBRIUM CONSTANT FOR SO2+0.5O2-->SO3 IS: .055
EQUILIBRIUM SO3 IS THEN: 35. ppm (wet basis)

SUMMARY OF BOILER OPERATION CALCULATIONS

BOILER STEAM PRODUCTION	84191.4	LB/HR
PRESSURE	1000.0	PSIA
TEMPERATURE	900.0	DEG. F

FEEDWATER TEMPERATURE:	400.0	DEG. F
FEEDWATER ENTHALPY:	374.8	BTU/LB
PRODUCT STEAM ENTHALPY:	1448.2	BTU/LB
ENTHALPY CHANGE:	1073.4	BTU/LB

NOTE: THE PERCENT OXIDATION OF FLUE GAS SO2 AT WHICH THE SULFURIC ACID DEWPOINT EQUALS THE FEEDWATER TEMPERATURE IS: 100.00 PERCENT.

PRODUCT STEAM USE TO HEAT CONDENSATE RETURN FROM 300. DEG. F TO FEEDWATER TEMPERATURE IS: 7133.9 LB/HR

NET STEAM PRODUCTION AFTER FEEDWATER HEATING IS: 77057.5 LB/HR

NOTE!! - IF ACTUAL CONDENSATE RETURN IS ALREADY AT FEEDWATER TEMPERATURE, ADD BACK THE FEEDWATER HEATING STEAM USE TO THE NET STEAMING RATE!!

SATURATION TEMPERATURE AT PRODUCT STEAM PRESSURE: 544.6 DEG. F

THE STEAM CARRIES: 355.4 DEG. F OF SUPERHEAT

FLUE GAS TEMPERATURE AT BOILER EXIT 450. DEG. F

RADIATION LOSS 688065. BTU/HR OR .63 % OF SENSIBLE HEAT AT BOILER INLET

WITH REFERENCE TO TOTAL ENTHALPY INPUT TO THE COMBUSTION SYSTEM, THE BOILER EFFICIENCY IS: 73.71 PERCENT

WITH REFERENCE TO FEED HHV ENTHALPY INPUT TO THE COMBUSTION SYSTEM,
THE BOILER EFFICIENCY IS: 75.14 PERCENT

MEAN MOLECULAR WEIGHT OF GASES
(DRY BASIS) 30.03
(WET BASIS) 28.85

TOTAL GAS FLOW RATE	LB/MIN	LB/HR	ACFM
(DRY BASIS)	2854.56	171273.70	--
(WET BASIS)	3041.86	182511.80	70042.2

EFFLUENT GAS HUMIDITY .0656 (MASS H2O/MASS BONE DRY GAS)

GAS DEW POINT IS 114.4 DEG. F

SUMMARY OF DRY SCRUBBER OPERATIONS

DRY SCRUBBER EXIT TEMPERATURE 290.0 DEG. F

DRY SCRUBBER OPERATIONS SUMMARY

CONTROL EFFICIENCY: 99.50 PERCENT HCl + HBr REMOVAL
95.00 PERCENT SO2 REMOVAL

LIME ASSAY: 90.00 PERCENT ACTIVE CaO
SLURRY FEED STOICHIOMETRY: 250.00 PERCENT OF HCl,HBr +SO2
SLURRY FEED AT: 5.00 PERCENT SOLIDS

LIME FEED RATE AT: 327.00 LB/HR
SLURRY FEED RATE AT: 744.51 GAL/HR

GAS ANALYSIS AFTER DRY SCRB

COMPONENT	VOLUME % DRY BASIS	VOLUME % WET BASIS	MOLS PER MINUTE	LB/HR	
CO2	9.918	8.453	9.422	24878.7	
SO2	.6565E-03	.5596E-03	.6237E-03	2.4	6. PPMV - WET
N2	79.52	67.78	75.55	126988.8	
O2	10.56	8.999	10.03	19259.8	
HCl	.2370E-03	.2020E-03	.2251E-03	.5	2. PPMV - WET
HBr	.0000	.0000	.0000	.0	0. PPMV - WET
H2O		14.77	16.46	17781.6	
TOTAL	100.0	100.0	111.5	188911.8	

SUPPLEMENTAL WATER USE .63 GAL/MIN

	PERCENT SO2 TO SO3	DEWPOINT DEG. F	EQUIVALENT SO3 ppmw	EQUIVALENT SO3 ppmd
SULFURIC ACID	1	205.54	0.	0.
DEWPOINT FROM	3	221.17	0.	0.
OXIDATION OF	5	228.69	0.	0.
SO2 TO SO3	8	235.76	0.	1.

AT THIS LOCATION	10	239.16	1.	1.
IN THE SYSTEM	15	245.44	1.	1.

EQUILIBRIUM SO3 (USUALLY NOT ATTAINED) AT 2162.0 DEG. F
EQUILIBRIUM CONSTANT FOR SO2+0.5O2-->SO3 IS: .055
EQUILIBRIUM SO3 IS THEN: 2. ppm (wet basis)

SUMMARY OF STACK REHEATING OPERATION
===================================
TARGET STACK TEMPERATURE IS: .0 DEG. F

NO STACK REHEAT ANALYSIS REQUESTED.

SUMMARY OF STACK CALCULATIONS AFTER SYSTEM

STACK DIAMETER OF 5.36 FEET USED FOR CALCULATIONS

NATURAL DRAFT 6.625E-01 IN H2O
FRICTION LOSS 6.456E-01 IN H2O
VELOCITY HEAD 3.245E-02 IN H2O
MINIMUM FAN PRESSURE 1.550E-02 IN H2O
EXIT VELOCITY 45.0 FT/SEC

TOTAL FLOW @ STACK CONDITIONS 60894.2 CFM
STACK TEMPERATURE IS: 289.1 DEG. F

FLOW CORRECTED TO 12% CO2 (DRY, 1 ATM, 68 F/20 C)) 30248.2 CFM
FLOW CORRECTED TO 7% O2 (DRY, 1 ATM, 68 F/20 C)) 27289.8 CFM

MEAN MOLECULAR WEIGHT OF GASES
(DRY BASIS) 30.02
(WET BASIS) 28.25

TOTAL GAS FLOW RATE	LB/MIN	LB/HR	ACFM
(DRY BASIS)	2852.17	171130.20	--
(WET BASIS)	3148.79	188927.60	61013.1

EFFLUENT GAS HUMIDITY .1040 (MASS H20/MASS BONE DRY GAS)

GAS DEW POINT IS 129.1 DEG. F

SUMMARY OF STACK VISIBILITY ANALYSIS
====================================

THIS ANALYSIS DETERMINES THE DISTANCE ABOVE THE STACK TOP WHERE THE PLUME (AFTER REHEAT) JUST VANISHES. FOR FINITE WINDSPEED, THERE WILL BE A HORIZONTAL DISPLACEMENT. ALSO, THE STACK REHEAT VIA USE OF AVAILABLE PREHEATED AIR, FUEL AND STEAM WHICH JUST RENDERS THE PLUME NON-VISIBLE ARE CALCULATED (STARTING AFTER ANY PROGRAMMED REHEAT).

THE FLUE GAS TEMPERATURE IS HIGH ENOUGH AND/OR THE HUMIDITY LOW ENOUGH THAT THE PLUME-AMBIENT INTERACTION SHOULD NOT PRODUCE A VISIBLE PLUME. VISIBILITY ANALYSIS DISCONTINUED.

CALCULATIONS COMPLETE

Nominal Case

BURN - Version 4.01 COMBUSTION ANALYSIS: RUN ___ FOR Tampa ___/___/___
Future
100% MCR
5,000 Btu/lb

DATA FILE USED FOR THIS ANALYSIS: T232.IN

WASTE FEED STREAMS

NAME	WEIGHT FIRED in Wet LB/Hr	Carbon	Hydrogen	Sulfur	Fe(OH)3	Al(OH)3	Oxygen
		PERCENT (DRY BASIS)					
WASTE	20833.0	35.939	4.792	.126	00.000	00.000	31.653
COMPOSITE (LB)	20833.	5933.67	791.17	20.83	.00	.00	5225.88
COMPOSITE MOLS	0.	494.06	392.44	.65	.00	.00	163.31
COMPOSITE (% DRY BASIS)		35.94	4.79	.13	.00	.00	31.65

PERCENT (DRY BASIS)

	Nitrogen	Chlorine	CaCO3	Inert	Iron	Aluminum	Bromine	Pct.H2O	BTU/LB
# 1	.631	.504	00.000	26.356	00.000	00.000	00.000	20.750	6309.6
(LB)	104.11	83.29	.00	4351.35	.00	.00	.00	4322.85	5000.4
MOLS	3.72	2.35	.00	4351.35	.00	.00	.00	240.16	
% DRY	.63	.50	.00	26.36	.00	.00	.00		

	DRY BASIS		WET BASIS	
THE MODIFIED DULONG HEATING VALUE IS:	6294.1	BTU/LB	4988.1	BTU/LB
THE MODIFIED CHANG HEATING VALUE IS:	6392.9	BTU/LB	5066.4	BTU/LB
THE BOIE HEATING VALUE IS:	6309.6	BTU/LB	5000.4	BTU/LB
THE MODIFIED VONDRACEK HEATING VALUE IS:	4600.2	BTU/LB	3645.7	BTU/LB
THE AVERAGE ESTIMATED HEATING VALUE IS:	5899.2	BTU/LB	4675.1	BTU/LB
THE INPUT WASTE HEATING VALUE IS:	6309.6	BTU/LB	5000.4	BTU/LB

DAILY CHARGE RATE EQUALS: 250.0 TONS PER 24-HOUR DAY.

RUN CONDITIONS AS INPUT

AMBIENT AIR: 73.0 DEG. F ; PRESSURE 1.0 ATM; ABSOLUTE HUMIDITY .013000
AMBIENT AIR HAS A RELATIVE HUMIDITY OF: 74.5 PERCENT
AVAILABLE PREHEATED AIR .0 ACTUAL CFM AT 73.0 DEG. F
OPERATING TEMPERATURES: MINIMUM OF .0, MAXIMUM OF 50000.0 DEG. F
FURNACE WATER COOLED, 100.00 % OF AREA; BOILER WATER COOLED, 100.00 % OF AREA
TEMPERATURES MODERATED WITH AIR AND ELEVATED WITH GAS
STEAM CONDITIONS: PRESSURE - 1000. PSIA ; TEMPERATURE - 900. DEG. F
TEMPERATURE (DEG. F): PROCESS WATER 60. FEEDWATER 400.
FLUE GASES LEAVE THE BOILER AT: 450.0 DEG. F , QUENCHER AT 290.0 DEG. F
FLUE GASES LEAVE THE SUBCOOLER AT: .0 DEG. F
MAXIMUM SUBCOOLER WATER DISCHARGE TEMPERATURE IS: 95.0 DEG. F
STACK DIAM. IS 1.2 F, HEIGHT 160.0 F, VELOCITY = 45.0 FT/SEC
0. BTU/HR IS ABSORBED IN THE PRIMARY COMBUSTION CHAMBER
RESIDUE IS WATER QUENCHED AND LEAVES SYSTEM AT 350.0 DEG. F
UNBURNED PERCENTAGES OF FEED - CARBON .5, IRON 00.0, ALUMINUM 00.0
AFTERBURNER TEMPERATURE: .0 DEG. F ;OPERATING FACTOR: 100.00 % OF DESIGN
ATMOSPHERIC STABILITY CLASS IS: 0; DESIGN % EXCESS AIR IS: 100.0

NOTE: GAS FLOW RATES EXPRESSED IN SCFM ARE AT 60 Deg. F AND 1.0 Atm.

SUMMARY OF FURNACE OPERATIONS

Furnace Flue Gas Sensible Heat Content (SENH) as a Function of Tgas
SENH = A + B*T + C*T*T + D*T*T*T

A = -.2427097E+07 C = .3771068E+01
B = .4022654E+05 D = -.3324059E-03

At Tgas = 2014.76 DEG. F , SENH = .9120874E+08 BTU/HR

GAS ANALYSIS AFTER FURNACE

COMPONENT	VOLUME % DRY BASIS	VOLUME % WET BASIS	MOLS PER MINUTE	LB/HR	
CO2	9.912	8.632	8.193	21634.9	
SO2	.1312E-01	.1143E-01	.1085E-01	41.7	114. PPMV - WET
N2	79.47	69.21	65.70	110431.3	
O2	10.55	9.190	8.723	16748.6	
HCl	.4736E-01	.4125E-01	.3915E-01	85.7	412. PPMV - WET
HBr	.0000	.0000	.0000	.0	0. PPMV - WET
H2O		12.91	12.25	13234.4	
TOTAL	100.0	100.0	94.92	162176.4	

	PERCENT SO2 TO SO3	DEWPOINT DEG. F	EQUIVALENT SO3 ppmw	EQUIVALENT SO3 ppmd
SULFURIC ACID	1	247.54	1.	1.
DEWPOINT FROM	3	265.50	3.	4.
OXIDATION OF	5	274.17	6.	7.
SO2 TO SO3	8	282.33	9.	10.
AT THIS LOCATION	10	286.27	11.	13.
IN THE SYSTEM	15	293.53	17.	20.

EQUILIBRIUM SO3 (USUALLY NOT ATTAINED) AT 2014.8 DEG. F
EQUILIBRIUM CONSTANT FOR SO2+0.5O2-->SO3 IS: .087
EQUILIBRIUM SO3 IS THEN: 43. ppm (wet basis)

PREHEATED AIR	.00	ACFM	(ENTHALPY: 0. BTU/HR)	
	.00	SCFM	.00	LB/HR
COMBUSTION AIR	32962.33	ACFM		
	32157.87	SCFM	145596.70	LB/HR
BURNER AIR	.00	ACFM		
	.00	SCFM	.00	LB/HR
COOLING AIR	.00	ACFM		
	.00	SCFM	.00	LB/HR
COOLING WATER	.00	GAL/MIN	.00	LB/HR

WITHOUT COOLING OR FUEL USE BUT USING 0. ACFM OF PREHEATED AIR, THE FURNACE TEMPERATURE IS: 2015. DEG. F ; A TEMPERATURE OF 1908. DEG. F WAS USED TO JUDGE POTENTIAL DISSOCIATION OF $CaCO_3$, $Fe(OH)_3$, AND $Al(OH)_3$.

FLUE GAS	171369.50	ACFM	AT	2014.8	DEG. F
	35990.40	SCFM	AT	60.0	DEG. F

BURNER FUEL USE .00 CFM (.00 FT3/HR) GAS
EQUAL TO .0 BTU/HR

QUENCH TANK MAKEUP 2.92 GAL/MIN

RESIDUE ASSUMED TO LEAVE HOT ZONE AT 350.0 DEG. F
RESIDUE WEIGHT (75.00 % SOLIDS) 5841.36 LB/HR
(DRY) 4381.02 LB/HR

UNBURNED CARBON IN ASH: .677 PERCENT OF TOTAL ASH (INCLUDING CARBON)
HEATING VALUE OF RESIDUE (DRY BASIS): 95.5 BTU/LB OR 418206. BTU/HR

NET HEAT RELEASE (BTU/HR)

1. PRIMARY

FEED	103754300.
FUEL	0.
AIR HEAT	2436376.
TOTAL	106190600.

2. AFTERBURNER

FUEL	0.
AIR HEAT	0.

GRAND TOTAL 106190600.

HEAT LOSSES	BTU/HR	PERCENT OF FEED HEAT CONTENT	PERCENT OF TOTAL HEAT RELEASE
RADIATION	698230.	.67 PERCENT	.7 PERCENT
MOISTURE	14039610.	13.48 PERCENT	13.2 PERCENT
DRY GAS	91208740.	87.56 PERCENT	85.6 PERCENT
RESIDUE	773339.	.74 PERCENT	.7 PERCENT

DESIGN EXCESS AIR (ON FEED) IS 100.00 PERCENT
ACTUAL EXCESS AIR (ON FEED) IS 100.01 PERCENT
ACTUAL EXCESS AIR (ON TOTAL COMBUSTIBLE) IS . 100.01 PERCENT

EQUILIBRIUM THERMAL NOX CONCENTRATION IS 416.9 PPM (VOLUME)
PERCENT FUEL NITROGEN CONVERTED TO NOx= 69.755 PERCENT
FUEL NITROGEN NOx (Estimated by Soete) = 910.365 PPM (VOLUME)

THE EQUILIBRIUM CONSTANT FOR $2HCl+.5O_2 \rightarrow Cl_2+H_2O$ IS: .0560
THE EQUILIBRIUM CONSTANT FOR $2HBr+.5O_2 \rightarrow Br_2+H_2O$ IS: .0051

EQUILIBRIUM CHLORINE CONCENTRATION AT 2014.8 DEG. F IS:
.512 ppm (Wet Basis)
.587 ppm (Dry Basis)

SO_2 UNCONTROLLED EMISSION RATE IS 5.26 GM/SEC EQUAL TO 41.65 LB/HR
HCl UNCONTROLLED EMISSION RATE IS 10.80 GM/SEC EQUAL TO 85.56 LB/HR
HBr UNCONTROLLED EMISSION RATE IS .00 GM/SEC EQUAL TO .00 LB/HR

WITH ACID GAS CONTROL AT .0 PERCENT,

SO2 CONTROLLED EMISSION RATE IS 5.26 GM/SEC EQUAL TO 41.65 LB/HR

HCl CONTROLLED EMISSION RATE IS 10.80 GM/SEC EQUAL TO 85.56 LB/HR

HBr CONTROLLED EMISSION RATE IS .00 GM/SEC EQUAL TO .00 LB/HR

	PERCENT SO2 TO SO3	DEWPOINT DEG. F	EQUIVALENT SO3 ppmw	EQUIVALENT SO3 ppmd
SULFURIC ACID	1	247.54	1.	1.
DEWPOINT FROM	3	265.50	3.	4.
OXIDATION OF	5	274.17	6.	7.
SO2 TO SO3	8	282.33	9.	10.
AT THIS LOCATION	10	286.27	11.	13.
IN THE SYSTEM	15	293.53	17.	20.

EQUILIBRIUM SO3 (USUALLY NOT ATTAINED) AT 2014.8 DEG. F
EQUILIBRIUM CONSTANT FOR SO2+0.5O2-->SO3 IS: .087
EQUILIBRIUM SO3 IS THEN: 43. ppm (wet basis)

SUMMARY OF BOILER OPERATION CALCULATIONS

BOILER STEAM PRODUCTION		69047.4	LB/HR
PRESSURE	1000.0	PSIA	
TEMPERATURE	900.0	DEG. F	

FEEDWATER TEMPERATURE:	400.0	DEG. F
FEEDWATER ENTHALPY:	374.8	BTU/LB
PRODUCT STEAM ENTHALPY:	1448.2	BTU/LB
ENTHALPY CHANGE:	1073.4	BTU/LB

NOTE: THE PERCENT OXIDATION OF FLUE GAS SO2 AT WHICH THE SULFURIC ACID DEWPOINT EQUALS THE FEEDWATER TEMPERATURE IS: 100.00 PERCENT.

PRODUCT STEAM USE TO HEAT CONDENSATE RETURN
FROM 300. DEG. F TO FEEDWATER TEMPERATURE IS: 5850.7 LB/HR

NET STEAM PRODUCTION AFTER FEEDWATER HEATING IS: 63196.7 LB/HR

NOTE!! - IF ACTUAL CONDENSATE RETURN IS ALREADY AT FEEDWATER TEMPERATURE, ADD BACK THE FEEDWATER HEATING STEAM USE TO THE NET STEAMING RATE!!

SATURATION TEMPERATURE AT PRODUCT STEAM PRESSURE: 544.6 DEG. F

THE STEAM CARRIES: 355.4 DEG. F OF SUPERHEAT

FLUE GAS TEMPERATURE AT BOILER EXIT 450. DEG. F

RADIATION LOSS 688090. BTU/HR OR .75 % OF SENSIBLE HEAT AT BOILER INLET

WITH REFERENCE TO TOTAL ENTHALPY INPUT TO THE COMBUSTION SYSTEM,
THE BOILER EFFICIENCY IS: 69.52 PERCENT

WITH REFERENCE TO FEED HHV ENTHALPY INPUT TO THE COMBUSTION SYSTEM, THE BOILER EFFICIENCY IS: 70.86 PERCENT

MEAN MOLECULAR WEIGHT OF GASES
(DRY BASIS) 30.03
(WET BASIS) 28.48

TOTAL GAS FLOW RATE	LB/MIN	LB/HR	ACFM
(DRY BASIS)	2482.37	148942.00	--
(WET BASIS)	2703.14	162188.20	63043.9

EFFLUENT GAS HUMIDITY .0889 (MASS H20/MASS BONE DRY GAS)

GAS DEW POINT IS 124.1 DEG. F

SUMMARY OF DRY SCRUBBER OPERATIONS

DRY SCRUBBER EXIT TEMPERATURE 290.0 DEG. F

DRY SCRUBBER OPERATIONS SUMMARY

CONTROL EFFICIENCY: 99.50 PERCENT HCl + HBr REMOVAL
95.00 PERCENT SO2 REMOVAL

LIME ASSAY: 90.00 PERCENT ACTIVE CaO
SLURRY FEED STOICHIOMETRY: 250.00 PERCENT OF HCl,HBr +SO2
SLURRY FEED AT: 5.00 PERCENT SOLIDS

LIME FEED RATE AT: 284.36 LB/HR
SLURRY FEED RATE AT: 647.44 GAL/HR

GAS ANALYSIS AFTER DRY SCRB

COMPONENT	VOLUME % DRY BASIS	VOLUME % WET BASIS	MOLS PER MINUTE	LB/HR	
CO2	9.918	8.165	8.193	21634.9	
SO2	.6565E-03	.5405E-03	.5424E-03	2.1	5. PPMV - WET
N2	79.52	65.47	65.70	110431.3	
O2	10.56	8.693	8.723	16748.6	
HCl	.2370E-03	.1951E-03	.1958E-03	.4	2. PPMV - WET
HBr	.0000	.0000	.0000	.0	0. PPMV - WET
H2O		17.67	17.74	19154.2	
TOTAL	100.0	100.0	100.3	167971.4	

SUPPLEMENTAL WATER USE .99 GAL/MIN

	PERCENT SO2 TO SO3	DEWPOINT DEG. F	EQUIVALENT SO3 ppmw	EQUIVALENT SO3 ppmd
SULFURIC ACID	1	209.14	0.	0.
DEWPOINT FROM	3	224.62	0.	0.
OXIDATION OF	5	232.07	0.	0.
SO2 TO SO3	8	239.07	0.	1.

AT THIS LOCATION	10	242.44	1.	1.
IN THE SYSTEM	15	248.65	1.	1.

EQUILIBRIUM SO3 (USUALLY NOT ATTAINED) AT 2014.8 DEG. F
EQUILIBRIUM CONSTANT FOR SO2+0.5O2-->SO3 IS: .087
EQUILIBRIUM SO3 IS THEN: 2. ppm (wet basis)

SUMMARY OF STACK REHEATING OPERATION
===================================
TARGET STACK TEMPERATURE IS: .0 DEG. F

NO STACK REHEAT ANALYSIS REQUESTED.

SUMMARY OF STACK CALCULATIONS AFTER SYSTEM

STACK DIAMETER OF 5.09 FEET USED FOR CALCULATIONS

NATURAL DRAFT 6.625E-01 IN H2O
FRICTION LOSS 6.804E-01 IN H2O
VELOCITY HEAD 3.245E-02 IN H2O
MINIMUM FAN PRESSURE 5.031E-02 IN H2O
EXIT VELOCITY 45.0 FT/SEC

TOTAL FLOW @ STACK CONDITIONS 54821.6 CFM
STACK TEMPERATURE IS: 289.1 DEG. F

FLOW CORRECTED TO 12% CO2 (DRY, 1 ATM, 68 F/20 C)) 26304.2 CFM
FLOW CORRECTED TO 7% O2 (DRY, 1 ATM, 68 F/20 C)) 23732.5 CFM

MEAN MOLECULAR WEIGHT OF GASES
(DRY BASIS) 30.02
(WET BASIS) 27.90

TOTAL GAS FLOW RATE	LB/MIN	LB/HR	ACFM
(DRY BASIS)	2480.29	148817.20	--
(WET BASIS)	2799.81	167988.40	54928.7

EFFLUENT GAS HUMIDITY .1288 (MASS H20/MASS BONE DRY GAS)

GAS DEW POINT IS 135.9 DEG. F

SUMMARY OF STACK VISIBILITY ANALYSIS
====================================

THIS ANALYSIS DETERMINES THE DISTANCE ABOVE THE STACK TOP WHERE THE PLUME (AFTER REHEAT) JUST VANISHES. FOR FINITE WINDSPEED, THERE WILL BE A HORIZONTAL DISPLACEMENT. ALSO, THE STACK REHEAT VIA USE OF AVAILABLE PREHEATED AIR, FUEL AND STEAM WHICH JUST RENDERS THE PLUME NON-VISIBLE ARE CALCULATED (STARTING AFTER ANY PROGRAMMED REHEAT).

THE FLUE GAS TEMPERATURE IS HIGH ENOUGH AND/OR THE HUMIDITY LOW ENOUGH THAT THE PLUME-AMBIENT INTERACTION SHOULD NOT PRODUCE A VISIBLE PLUME. VISIBILITY ANALYSIS DISCONTINUED.

CALCULATIONS COMPLETE

Appendix D
Tampa International Airport
Wind Roses

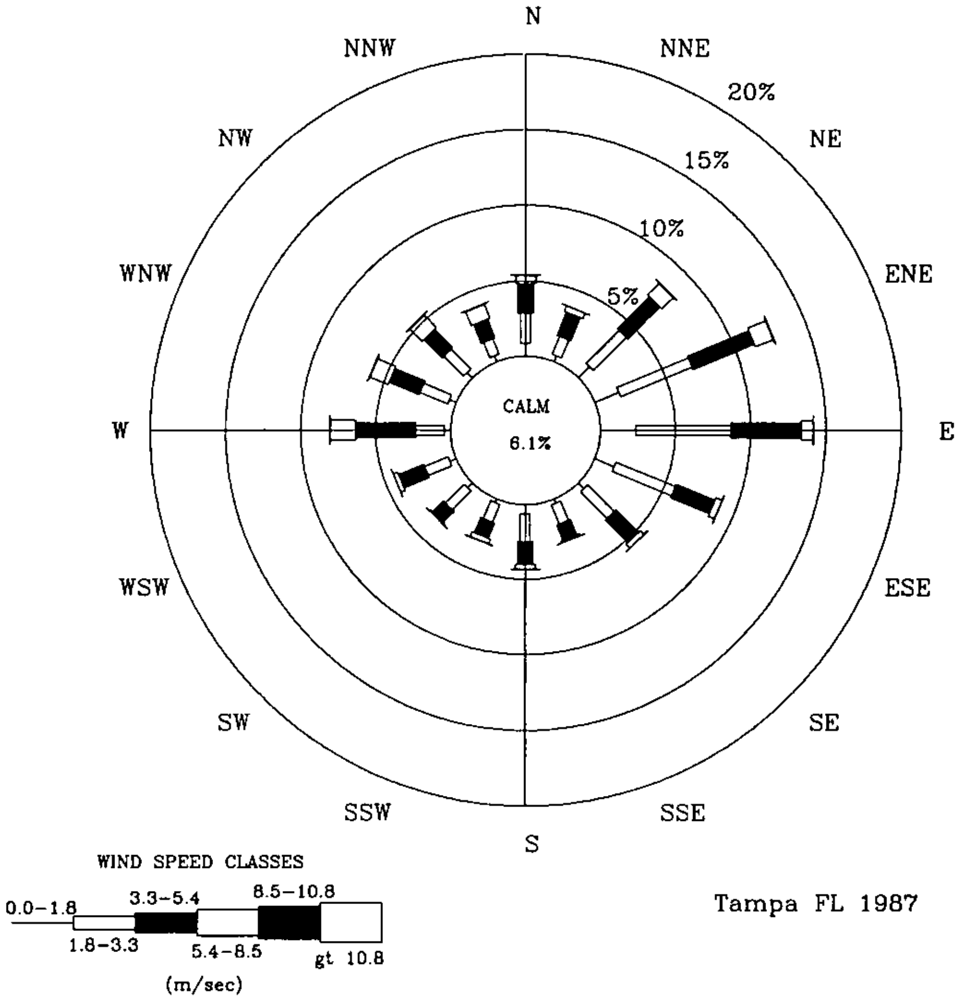


Figure 1. 1987 Windrose for Tampa International Airport, Florida.

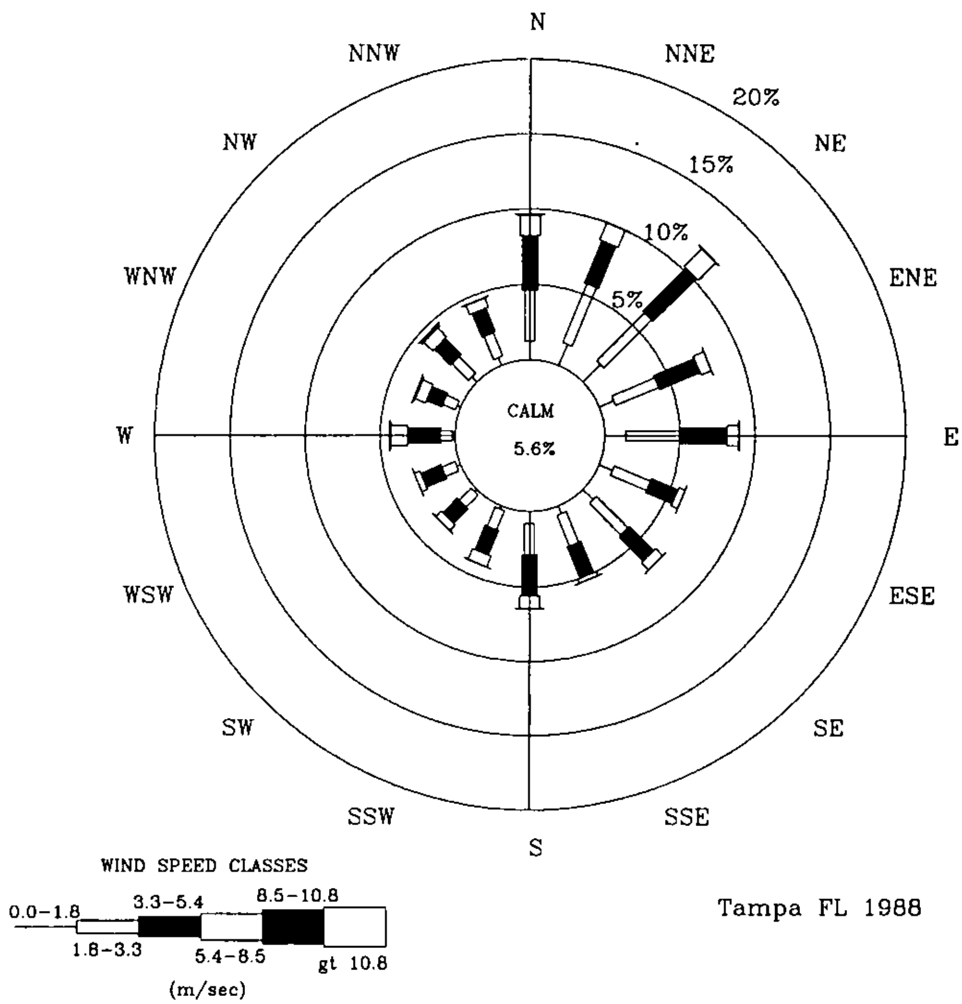


Figure 2. 1988 Windrose for Tampa International Airport, Florida.

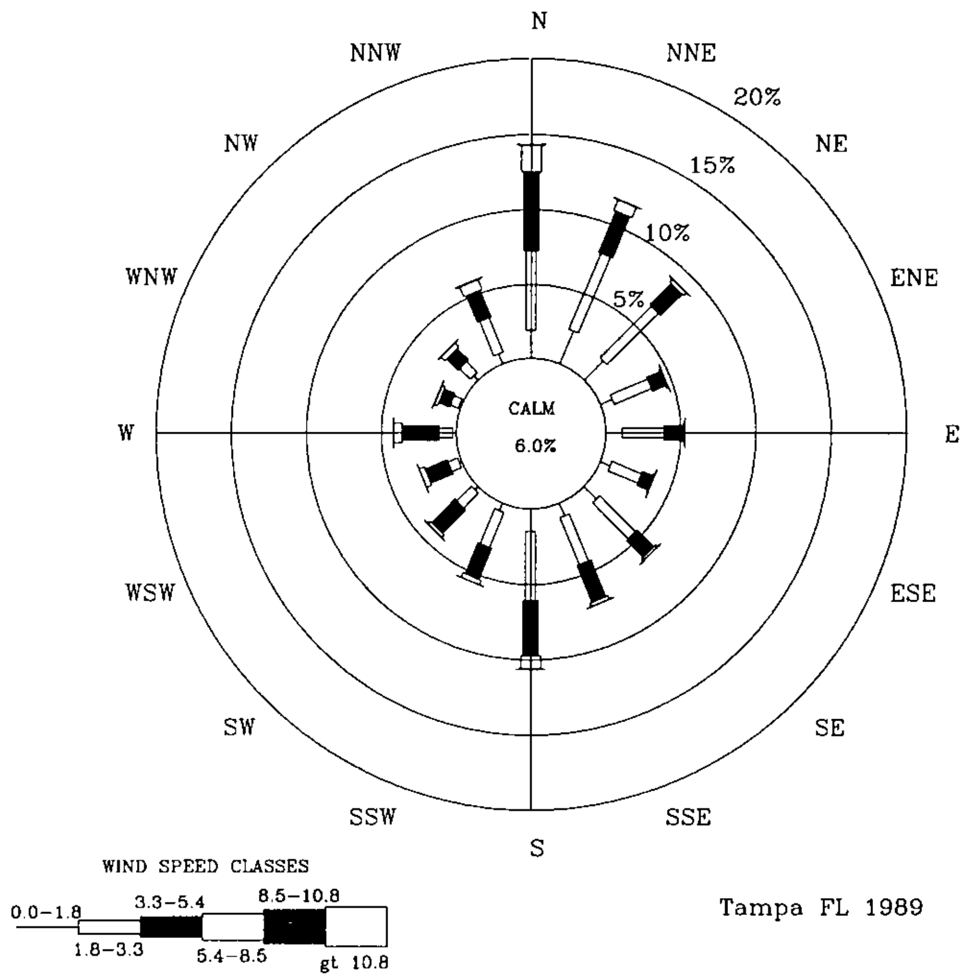


Figure 3. 1989 Windrose for Tampa International Airport, Florida.

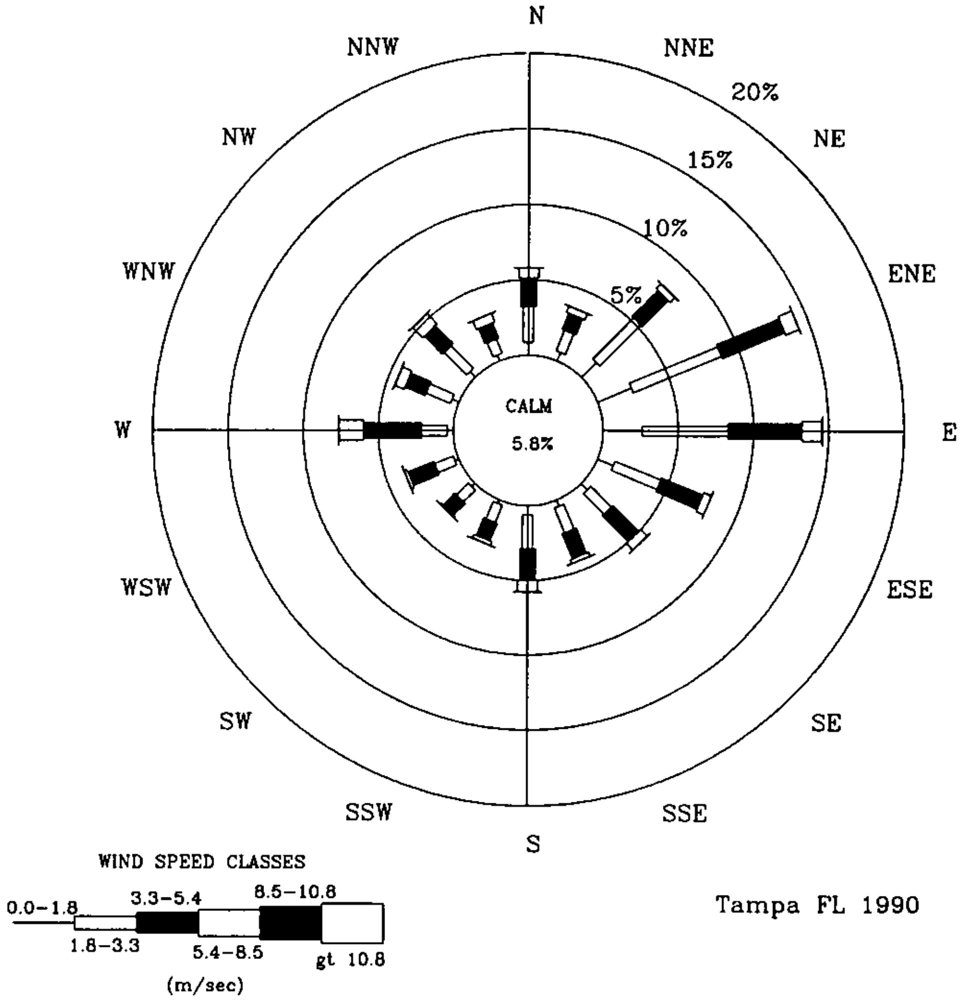


Figure 4. 1990 Windrose for Tampa International Airport, Florida.

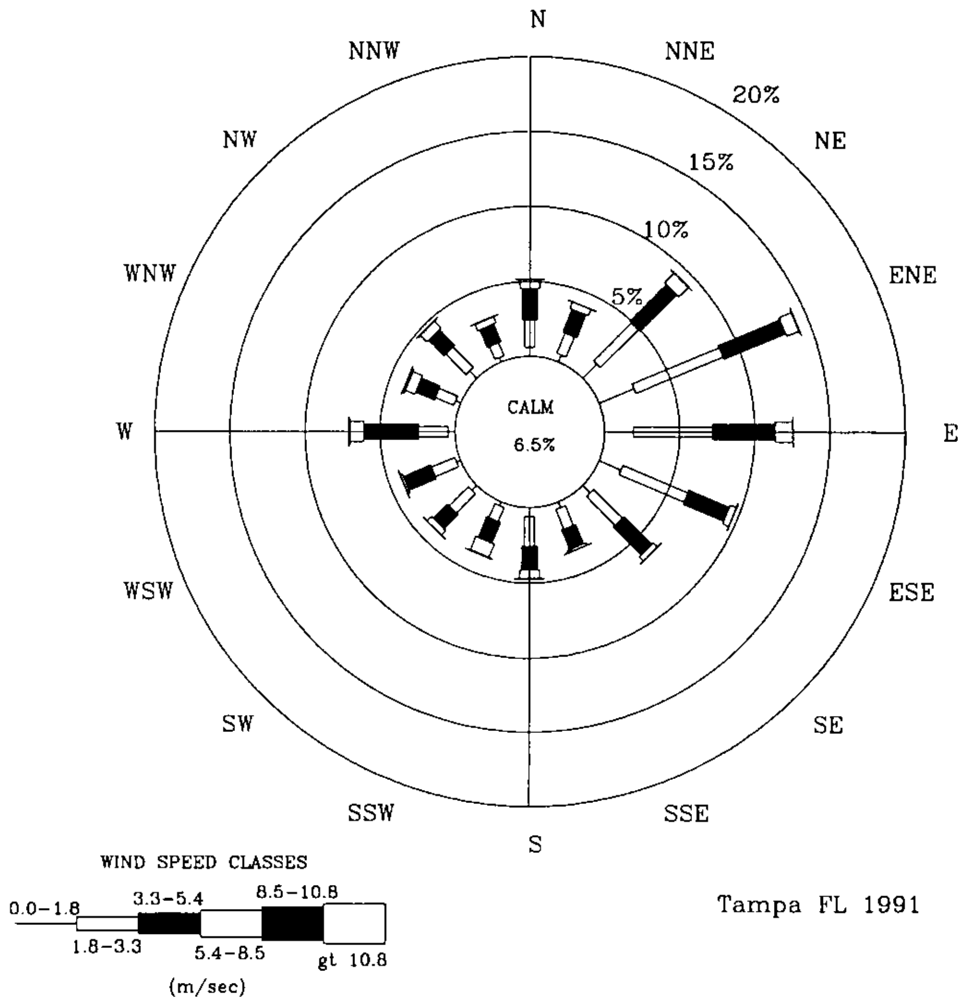


Figure 5. 1991 Windrose for Tampa International Airport, Florida.

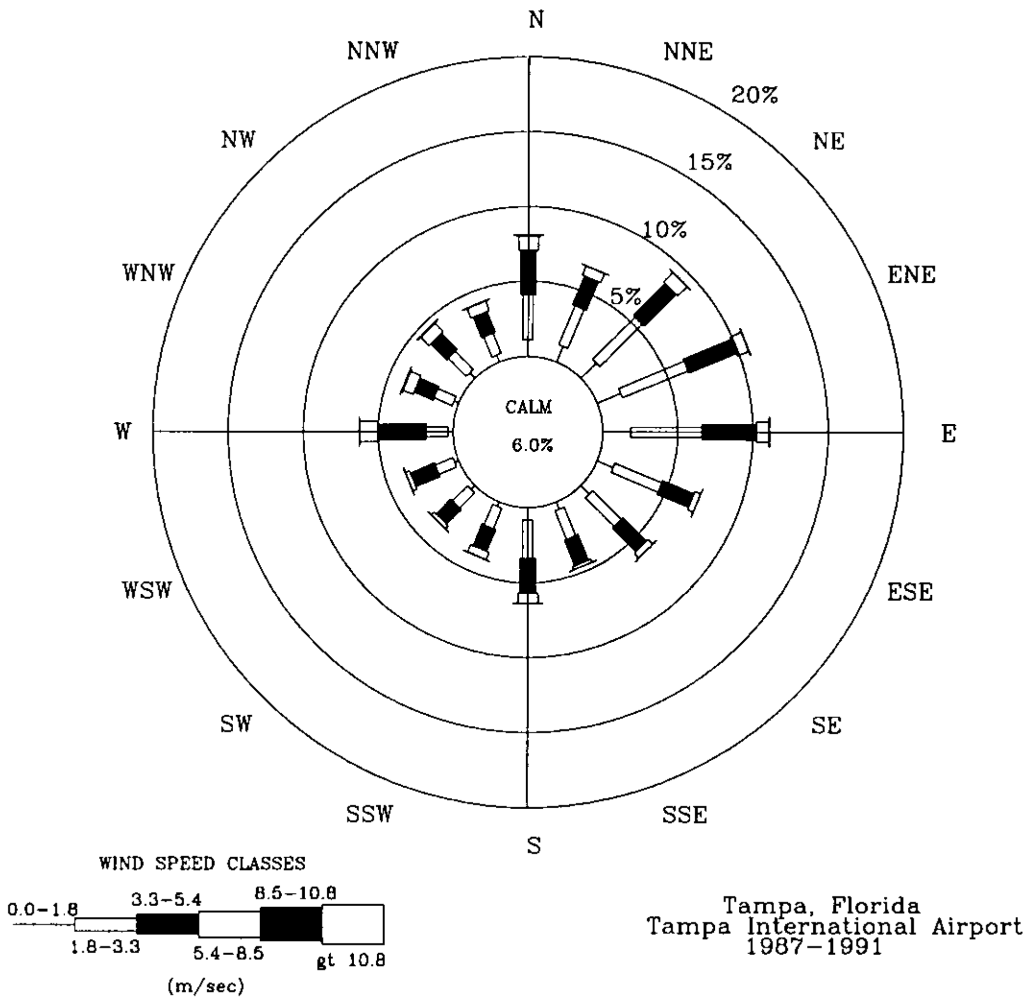


Figure 6. 1987-1991 Windrose for Tampa International Airport, Florida.

Appendix E
Stack Test Data Summary Sheets

MCKAY BAY REFUSE-TO-ENERGY FACILITY
EMISSIONS SUMMARY

	Permit Limits	September 1985	October 1987
Particulate	27.9 lb/hr 0.025 gr/dscf at 12% CO_2	8.07 lb/hr 0.0088 gr/dscf at 12% CO_2	10.4 lb/hr 0.012 gr/dscf at 12% CO_2
SO_2	170.0 lb/hr	139.9 lb/hr	79.7 lb/hr
NO_x	300.0 lb/hr	94.8 lb/hr	135.8 lb/hr
Lead	3.1 lb/hr	0.4 lb/hr	0.3 lb/hr
Fluoride	6.0 lb/hr	2.3 lb/hr	
Mercury	0.6 lb/hr	0.36 lb/hr	
VOC	9.0 lb/hr	2.7 lb/hr	
Beryllium	0.00046 lb/hr	<0.00008 lb/hr	

	December 1988	October 1989	October 1990
Particulate	13.6 lb/hr 0.016 gr/dscf at 12% CO_2	9.4 lb/hr 0.009 gr/dscf at 12% CO_2	7.3 lb/hr 0.008 gr/dscf at 12% CO_2
SO_2	92.1 lb/hr	111.6 lb/hr	123.2 lb/hr
NO_x	173.2 lb/hr	230.7 lb/hr	169.2 lb/hr
Lead	0.3 lb/hr	0.3 lb/hr	0.13 lb/hr
Fluoride			
Mercury			
VOC			
Beryllium			

	August 1991	October 1991	November 1992
Particulate		10.8 lb/hr 0.014 gr/dscf at 12% CO^2	8.87 lb/hr 0.012 gr/dscf at 12% CO^2
SO^2		88.5 lb/hr	
NO^x		148.8 lb/hr	
Lead		0.32 lb/hr	.193 lb/hr
Fluroide	1.60 lb/hr		
Mercury	0.053 lb/hr		
VOC	1.21 lb/hr		
Beryllium	<0.000041 lb/hr		

g:emission.sum

	November 1993	October 1994	October 1995
Particulate	12.2 lb/hr 0.016 gr/dscf at 12% CO^2	11.9 lb/hr 0.0166 gr/dscf at 12% CO^2	18.5 lb/hr 0.0213 gr/dscf at 12% CO^2
SO^2			
NO^x			
Lead	0.24 lb/hr	0.325 lb/hr	0.366 lb/hr
Fluoride			
Mercury	0.079 lb/hr	0.093 lb/hr	0.059 lb/hr
VOC			
Beryllium			
Cadmium		0.0206 lb/hr	0/0216 lb/hr

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g:emission.sum

October 1996

Particulate	4.1 lb/hr 0.0048 gr/dscf at 12% CO^2
SO^2	
NO^x	
Lead	0.079 lb/hr
Fluoride	
Mercury	0.068 lb/hr
VOC	
Beryllium	

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Acceptance Test, 1985
Facility at max load.

Clean Air Engineering, Inc.

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LIST OF TABLES (Continued)

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INTRODUCTION

This report presents the test data and results of the test program conducted by Clean Air Engineering, Inc. for Waste Management, Inc.

The testing took place at the McKay Bay Refuse-to-Energy Project located in Tampa, Florida.

The work is authorized by Waste Management, Inc.'s purchase order number 211076.

The purpose of the testing was to determine if each unit was in compliance with the applicable state and federal codes.

The field portion of the testing was coordinated among the following personnel:

Mr. W. Hooper	Waste Management, Inc.
Mr. M. Schioth	F.L. Smidth & Company
Mr. R. Nestechal	Volund, USA
Mr. C. Gonzalez	Hillsborough County Environmental Protection Commission
Mr. G. Grotecloss	Office of Environmental Coordination, City of Tampa, Florida
Mr. J. Chapman	Clean Air Engineering, Inc.

The tests were conducted during the week of September 16, 1985.

DESCRIPTION OF INSTALLATION AND PROCESS

The tests described in this report were conducted on the flue gases from four (4) refuse-fired boilers. The boilers are designated as Units 1 through 4 at the McKay Bay Refuse to Energy Project.

The particulate emissions of flyash are controlled by four (4) electrostatic precipitators.

Information concerning the operating conditions of the precipitators and boilers is held by plant personnel.

DISCUSSION OF RESULTS

The test conditions and results are presented in the Summary of Results Tables beginning on page 2 - 2. Additional results and test parameters are given in Section 5.

A complete copy of the raw test data and a computer analysis of that data showing the point by point isokinetic percentages are included in the appendix.

Emission Rates

The emission rate results can be summarized as follows:

1) The sulfur dioxide emission rate averaged 28.2, 33.3, 27.5, and 50.9 lb/hr for units 1 - 4 respectively.

2) The fluoride emission rate averaged 0.35, 0.41, 0.64, and 0.90 lb/hr for units 1 - 4 respectively.

3) The mercury emission rate averaged 0.07, 0.08, 0.10, and 0.11 lb/hr for units 1 - 4 respectively.

4) The lead emission rate averaged 0.10, 0.10, 0.09, and 0.11 lb/hr for units 1 - 4 respectively.

5) The beryllium emission rates were less than the detectable limits of the method used. This limit averaged less than 0.0013 lb/hr for each unit.

6) The carbon monoxide emission rates averaged 5.3, 6.1, 4.8, and 5.7 lb/hr for units 1 - 4 respectively.

7) The total hydrocarbon (propane basis) emission rates averaged 0.87, 0.37, 0.71, and 0.72 lb/hr for units 1 - 4 respectively.

8) The nitrogen oxide emission rates, averaged 11.1, 25.0, and 30.4 lb/hr for units 2 - 4 respectively. The results from unit 1 were inconclusive due to a problem with the samping apparatus.

DISCUSSION OF RESULTS (Continued)

Outlet Particulate Emission Rates

The outlet particulate concentration, in gr/dscf @ 12% CO_2, had a three test run average of 0.0153, 0.0218, 0.0023, and 0.0124 for units 1, 2, 3, and 4 respectively for testing performed September 16-18, 1985. During a second set of three test runs performed on September 19, 1985 the average particulate concentration, in gr/dscf @ 12% CO_2, was .0130, .0115, .0028, and .0077 for units 1-4 respectively.

Several problems were encountered during the testing progam some of which were resolved on site, some of which resulted in the elimination of incorrect data.

For the first set of runs (1-6) performed on September 16-18, 1985, a black tar like substance was observed on the glassware leading to the filter media. Attempts to locate the source of this substance indicated that it was a result of the glass tape used in the test probe construction. Due to the high flue gas temperature and negative pressure, the glass tape adhesive apparently volitalized and leaked through the asbestos packing into the gas sampling system. The problem was corrected prior to the testing on September 19, 1985. Therefore, the particulate results obtained during runs 1-6 may be biased high and the particulate result from the September 19 testing should be used.

DISCUSSION OF RESULTS (Continued)

Problems In The Field

Isolated conditions and other problems experienced in the field are summarized here according to unit number and test run affected.

Unit 2

- Run 1 failed its final leak check. However, the data was reported without correction since the %O_2 and moisture indicate the leak developed when the sampling train was bumped after the completion of sampling.

- Runs 1-3 contained some flue gas temperatures that were outliers due to the cooling effect from outside air leaking past the test port seals and lowering the temperature reading. These temperatures were adjusted to meet the average of the majority of temperatures.

Unit 3

- Runs 4-6 exceeded the allowable isokinetic variance. This situation baises the particulate and fluoride concentration toward the low side but does not effect the sulfur dioxide results.

- Run 6 filter weight was lower after testing. Apparently some of of the filter was not recovered after the test. A zero weight gain was assumed for that test run.

Unit 4

- Runs 4-6 contained some flue gas temperatures that were outlyers due to the cooling effect from outside air leaking past the test port seals and lowering the temperature reading. These temperatures were adjusted to meet the average of the majority of temperatures.

- The results of run 5 are not reported because the final leak check failed.

To the best of our knowledge the enclosed data is representative and complete.

Respectfully submitted,

CLEAN AIR ENGINEERING, INC.

John A. Chapman
Vice President,
Research & Development

Daniel H. Pepoon
Manager,
Special Projects

JAC/DHP/cef
345101/84

TABLE I
SUMMARY OF RESULTS
UNIT #1 - OUTLET

Run No.	1	2	3
Date, 1985	September 16	September 17	September 17
Time (Approx.)	6:35 PM to 8:40 PM	11:20 AM to 1:30 PM	4:00 PM to 6:00 PM
Test Method	EPA M5	EPA M5	EPA M5
Gas Temperature, °F	570	564	560
Gas Moisture, Volume %	14.1	14.0	13.6
Gas Volume			
ACFM	97,990	86,970	91,220
DSCFM	43,260	38,720	40,850
Particulate			
GR/DSCF	.0084	.0177	.0042
GR/DSCF @ 12% CO_2	.0121	.0272	.0067
Sulfur Dioxide			
$LBx10^{-5}$/DSCF	1.580	1.330	.3727
PPM, dry	95.1	80.0	22.4
LB/HR	41.0	34.5	9.13
Fluorides			
$LBx10^{-7}$/DSCF	1.95	1.49	.749
LB/HR	.51	.35	.18

TABLE II
SUMMARY OF RESULTS
UNIT #2 - OUTLET

Run No.	1	2	3
Date, 1985	September 16	September 17	September 17
Time (Approx.)	6:35 PM to 9:00 PM	11:00 AM to 1:05 PM	4:00 PM to 6:00 PM
Test Method	EPA M5	EPA M5	EPA M5
Gas Temperature, °F	540	542	544
Gas Moisture, Volume %	16.0	14.8	12.0
Gas Volume			
ACFM	87,170	85,560	88,160
DSCFM	38,840	38,590	40,940
Particulate			
GR/DSCF	.0120	.0093	.0232
GR/DSCF @ 12% CO_2	.0187	.0123	.0340
Sulfur Dioxide			
$LBx10^{-5}$/DSCF	1.635	1.560	1.052
PPM, dry	98.3	93.9	63.3
LB/HR	38.1	36.1	25.8
Fluorides			
$LBx10^{-7}$/DSCF	1.02	2.03	2.11
LB/HR	.24	.47	.52

Clean Air Engineering, Inc.

TABLE III
SUMMARY OF RESULTS
UNIT #3 - OUTLET

Run No.	4	5	6
Date, 1985	September 18	September 18	September 18
Time (Approx.)	11:35 AM to 1:20 PM	5:30 PM to 7:30 PM	8:25 PM to 10:30 PM
Test Method	EPA M5	EPA M5	EPA M5
Gas Temperature, °F	540	543	548
Gas Moisture, Volume %	15.8	15.4	14.9
Gas Volume			
ACFM	77,670	82,320	79,300
DSCFM	34,740	36,850	35,550
Particulate			
GR/DSCF	.0029	.0018	.0010
GR/DSCF @ 12% CO_2	.0042	.0027	.0014
Sulfur Dioxide			
$LBx10^{-5}$/DSCF	.9016	1.202	1.745
PPM, dry	54.2	72.3	105
LB/HR	18.8	26.6	37.2
Fluorides			
$LBx10^{-7}$/DSCF	2.27	4.07	2.61
LB/HR	.47	.90	.56

TABLE IV
SUMMARY OF RESULTS
UNIT #4 - OUTLET

Run No.	4	5	6
Date, 1985	September 18	September 18	September 18
Time (Approx.)	11:35 AM to 1:30 PM	4:30 PM to 6:30 PM	8:25 PM to 11:00 PM
Test Method	EPA M5	EPA M5	EPA M5
Gas Temperature, °F	535	522	533
Gas Moisture, Volume %	14.1	-----	15.2
Gas Volume			
ACFM	92,720	86,320	94,750
DSCFM	42,430	39,820	42,850
Particulate			
GR/DSCF	.0115	-----	.0040
GR/DSCF @ 12% CO_2	.0192	-----	.0055
Sulfur Dioxide			
LBx10^{-5}/DSCF	1.441	-----	2.528
PPM, dry	86.7	-----	152
LB/HR	36.7	-----	65.0
Fluorides			
LBx10^{-7}/DSCF	3.69	-----	3.32
LB/HR	.94	-----	.85

TABLE V
SUMMARY OF RESULTS
UNIT #1 - OUTLET

Run No.	7	8	9
Date, 1985	September 19	September 19	September 19
Time (Approx.)	1:20 PM to 3:20 PM	6:20 PM to 7:55 PM	9:30 PM to 11:05 PM
Test Method	EPA M5	EPA M5	EPA M5
Gas Temperature, °F	530	547	558
Gas Moisture, Volume %	11.8	10.6	15.1
Gas Volume			
ACFM	81,960	86,650	89,370
DSCFM	38,680	40,730	39,470
Particulate			
GR/DSCF	.0081	.0105	.0080
GR/DSCF @ 12% CO_2	.0152	.0134	.0103
Mercury			
$LBx10^{-8}$/DSCF	1.88	2.09	4.59
LB/HR	.044	.051	.109
Lead			
$LBx10^{-8}$/DSCF	5.33	3.53	3.70
LB/HR	.124	.086	.088
Beryllium			
$LBx10^{-10}$/DSCF	<5.38	<4.97	<4.69
LB/HR	<.0012	<.0012	<.0011

Mercury Avg: $\frac{8.56}{3}$ lbx10^{-8}/dscf × 35.31 cu ft/cu meter × 453.59 g/lb × 10^6 ug/g

$= \frac{1371}{3}$ ug/dscm

= 457 ug/dscm

TABLE VI
SUMMARY OF RESULTS
UNIT #2 - OUTLET

Run No.	7	8	9
Date, 1985	September 19	September 19	September 19
Time (Approx.)	1:30 PM to 3:05 PM	5:50 PM to 8:50 PM	9:15 PM to 10:50 PM
Test Method	EPA M5	EPA M5	EPA M5
Gas Temperature, °F	532	540	540
Gas Moisture, Volume %	14.5	12.9	13.1
Gas Volume			
ACFM	82,390	82,660	82,490
DSCFM	37,610	38,160	37,970
Particulate			
GR/DSCF	.0068	.0072	.0082
GR/DSCF @ 12% CO_2	.0117	.0123	.0107
Mercury			
$LBx10^{-8}$/DSCF	4.50	1.83	4.06
LB/HR	.102	.042	.092
Lead			
$LBx10^{-8}$/DSCF	4.34	3.98	4.63
LB/HR	.098	.091	.106
Beryllium			
$LBx10^{-10}$/DSCF	<5.49	<5.24	<5.20
LB/HR	<.0012	<.0012	<.0012

Mercury Avg = 3.46 $\frac{lb \times 10^{-8}}{dscf} \times 35.31 \frac{dscf}{dscm} \times 453.59 \, g/lb \times 10^6 \, \mu g/g = 554.7 \, \mu g/dscm$

TABLE VII
SUMMARY OF RESULTS
UNIT #3 - OUTLET

Run No.	7	8	9
Date, 1985	September 19	September 19	September 19
Time (Approx.)	12:20 PM to 1:50 PM	4:15 PM to 5:45 PM	8:00 PM to 9:25 PM
Test Method	EPA M5	EPA M5	EPA M5
Gas Temperature, °F	546	545	552
Gas Moisture, Volume %	16.9	17.3	14.2
Gas Volume			
ACFM	77,330	77,330	77,330
DSCFM	33,860	33,720	34,750
Particulate			
GR/DSCF	.0033	.0041	.0029
GR/DSCF @ 12% CO_2	.0040	.0049	.0036
Mercury			
$LBx10^{-8}$/DSCF	6.09	5.10	3.19
LB/HR	.124	.103	.067
Lead			
$LBx10^{-8}$/DSCF	4.42	4.41	4.79
LB/HR	.090	.089	.100
Beryllium			
$LBx10^{-10}$/DSCF	<6.22	<6.30	<6.14
LB/HR	<.0013	<.0013	<.0013

Mercury Avg = 4.79 $\frac{lb \times 10^{-8}}{dscf}$ × 35.31 $\frac{dscf}{dscm}$ × 453.59 g/lb × 10^6 μg/g = 767.7 μg/dscm

TABLE VIII
SUMMARY OF RESULTS
UNIT #4 - OUTLET

Run No.	7	8	9
Date, 1985	September 19	September 19	September 19
Time (Approx.)	12:05 PM to 1:45 PM	4:20 PM to 5:50 PM	7:55 PM to 9:25 PM
Test Method	EPA M5	EPA M5	EPA M5
Gas Temperature, °F	546	537	528
Gas Moisture, Volume %	13.0	14.9	11.6
Gas Volume			
ACFM	91,150	90,080	84,640
DSCFM	41,730	40,690	40,130
Particulate			
GR/DSCF	.0077	.0018	.0047
GR/DSCF @ 12% CO_2	.0116	.0024	.0094
Mercury			
$LBx10^{-8}$/DSCF	6.76	2.99	3.08
LB/HR	.169	.073	.074
Lead			
$LBx10^{-8}$/DSCF	4.70	4.68	4.35
LB/HR	.118	.114	.105
Beryllium			
$LBx10^{-10}$/DSCF	<5.28	<5.25	<5.50
LB/HR	<.0013	<.0013	<.0013

mercury avg = 4.28 lbx10⁻⁸/dscf × 35.31 dscf/dscm × 453.59 g/lb × 10⁶ ug/g = 685.0 ug/dscm

TABLE IX
SUMMARY OF RESULTS
UNIT #1 - OUTLET

Run #	1	2	3
Date, 1985	September 16	Spetember 17	September 17
Time (Approx.)	6:35 PM to 7:40 PM	10:20 AM to 11:20 AM	11:50 AM to 12:50 PM
Test Method	EPA M10/25A	EPA M10/25A	EPA M10/25A
Gas Temperature, °F	570	564	564
Gas Moisture, Volume %	14.1	14.0	14.0
Gas Volume			
ACFM	97,990	86,970	86,970
DSCFM	43,260	38,720	38,720
Carbon Monoxide			
PPM, Dry	40	25	25
LB x 10^{-6}/DSCF	2.9	1.8	1.8
LB/HR	7.5	4.2	4.2
Total Hydrocarbons**			
PPM, Wet	5	1.5	1.5
LB x 10^{-6}/SCF	.57	.17	.17
LB/HR	1.7	.46	.46

**Propane Basis

TABLE X
SUMMARY OF RESULTS
UNIT #2 - OUTLET

Run #	1	2	3
Date, 1985	September 17	Spetember 17	September 17
Time (Approx.)	1:40 PM to 2:40 PM	3:30 PM to 4:30 PM	5:00 PM to 6:00 PM
Test Method	EPA M10/25A	EPA M10/25A	EPA M10/25A
Gas Temperature, °F	542	542	544
Gas Moisture, Volume %	14.8	13.4	12.0
Gas Volume			
ACFM	85,560	86,860	88,160
DSCFM	38,590	39,765	40,940
Carbon Monoxide			
PPM, Dry	40	30	35
LB x 10^{-6}/DSCF	2.9	2.2	2.5
LB/HR	6.7	5.2	6.3
Total Hydrocarbons**			
PPM, Wet	1.5	1.0	1.0
LB x 10^{-6}/SCF	.17	.11	.11
LB/HR	.47	.32	.32

**Propane Basis

TABLE XI
SUMMARY OF RESULTS
UNIT #3 - OUTLET

Run #	1	2	3*
Date, 1985	September 18	Spetember 18	September 18
Time (Approx.)	10:25 AM to 11:25 AM	12:00 PM to 1:00 PM	1:25 PM to 2:50 PM
Test Method	EPA M10/25A	EPA M10/25A	EPA M10/25A
Gas Temperature, °F	540	540	540
Gas Moisture, Volume %	15.8	15.8	15.8
Gas Volume			
ACFM	77,570	77,570	77,570
DSCFM	34,740	34,740	34,740
Carbon Monoxide			
PPM, Dry	40	30	25
LB x 10^{-6}/DSCF	2.9	2.2	1.8
LB/HR	6.1	4.5	3.8
Total Hydrocarbons**			
PPM, Wet	2.5	1.5	3.5
LB x 10^{-6}/SCF	.29	.17	.40
LB/HR	.71	.42	.99

*Inclement weather disturbed test equipment extending test run.
**Propane Basis

TABLE XII
SUMMARY OF RESULTS
UNIT #4 - OUTLET

Run #	1	2*	3
Date, 1985	September 18	Spetember 18	September 18
Time (Approx.)	6:20 PM to 7:20 PM	7:20 PM to 8:40 PM	8:40 PM to 9:40 PM
Test Method	EPA M10/25A	EPA M10/25A	EPA M10/25A
Gas Temperature, °F	522	528	533
Gas Moisture, Volume %	15.2	15.2	15.2
Gas Volume			
ACFM	86,320	90,535	94,750
DSCFM	39,820	41,335	42,850
Carbon Monoxide			
PPM, Dry	30	30	35
LB x 10^{-6}/DSCF	2.2	2.2	2.5
LB/HR	5.2	5.4	6.5
Total Hydrocarbons**			
PPM, Wet	1.5	3.0	2.0
LB x 10^{-6}/ SCF	.17	.34	.23
LB/HR	.48	1.00	.69

*Test equipment malfunction extending run.
**Propane Basis

TABLE XIII
SUMMARY OF RESULTS
NOx TESTING - UNIT #2
SEPTEMBER 17, 1985

Run #	Time	$LBx10^{-5}$/DSCF	Average $LBx10^{-5}$/DSCF	PPM Dry	Average PPM Dry	Avg. LB/HR
1A	1:46 PM	.4875		40.8		
B	1:58 PM	.7063		59.2		
C	2:10 PM	.5238		43.9		
D	2:22 PM	.0000*		.0*		
E	2:36 PM	.4258	.5359	35.7	44.9	12.8
2A	2:56 PM	.3744		31.4		
B	3:10 PM	.5801		48.6		
C	3:23 PM	.5492		54.4		
D	3:35 PM	.0000*		.0*		
E	3:49 PM	.2671	.4677	22.4	39.2	11.2
3A	4:06 PM	.2978		24.9		
B	4:18 PM	.4570		38.3		
C	4:20 PM	.3582		30.0		
D	4:45 PM	.4710		39.4		
E	4:57 PM	.3805	.3929	31.9	32.9	9.4

*Not included in average.

Note: 39,765 DSCFM used to calculate LB/HR.

TABLE XIV
SUMMARY OF RESULTS
NOx TESTING - UNIT #3
SEPTEMBER 18, 1985

Run #	Time	$LBx10^{-5}/DSCF$	Average $LBx10^{-5}/DSCF$	PPM Dry	Average PPM Dry	Avg. LB/HR
1A	10:51 AM	1.8554		155.4		
B	11:02 AM	1.4035		117.6		
C	11:17 AM	1.0743		90.0		
D	11:29 AM	1.3568	1.4225	113.6	119.1	29.7
2A	11:49 AM	1.8674		156.4		
B	12:04 PM	.8330		69.8		
C	12:18 PM	1.5338		128.5		
D	12:31 PM	1.5709		131.6		
E	12:45 PM	1.6999	1.5010	142.4	125.7	31.3
3A	1:50 PM	.8331		69.8		
B	2:04 PM	.2265		19.0		
C	2:19 PM	.9464		79.3		
D	2:35 PM	.6882	.6736	57.6	56.4	14.0

Note: 34,740 DSCFM used to calculate LB/HR.

TABLE XV
SUMMARY OF RESULTS
NOx TESTING - UNIT #4
SEPTEMBER 18, 1985

Run #	Time	$LBx10^{-5}/DSCF$	Average $LBx10^{-5}/DSCF$	PPM Dry	Average PPM Dry	Avg. LB/HR
1A	5:45 PM	1.8673		156.4		
B	5:57 PM	1.2384		103.7		
C	6:09 PM	.6011		50.3		
D	6:21 PM	1.0889		91.2		
E	6:33 PM	1.2191	1.2030	102.1	100.7	28.7
2A	6:45 PM	1.6099		134.8		
B	6:57 PM	1.3876		116.2		
C	7:09 PM	1.4937		125.1		
D	7:21 PM	1.5281		128.0		
E	7:33 PM	.9714	1.3981	81.4	117.1	33.4
3A	7:45 PM	1.0740		90.0		
B	7:57 PM	.9070		76.0		
C	8:09 PM	1.3785		115.5		
D	8:21 PM	1.4920	1.2129	125.0	101.6	29.0

Note: 39,820 DSCFM used to calculate LB/HR.

PARAMETER SHEET

UNIT #1 - OUTLET

RUN NO.	1	2	3
P_b	30.20	30.24	30.24
P_s	30.02	30.06	29.98
V_m	50.13	43.88	46.40
$\overline{DH}$	1.14	.920	1.000
$\overline{T_m}$	120	114	108
V_{mstd}	46.68	41.32	44.16
V_{lc}	163	143	148
V_{wstd}	7.68	6.74	6.97
B_{wo}	.1412	.1402	.1363
$\%O_2$	11.8	12.4	12.4
$\%CO_2$	8.3	7.8	7.5
M_d	29.80	29.74	29.70
M_s	28.13	28.10	28.10
C_p	.840	.840	.840
$\overline{T_s}$	570	564	560
$\overline{(DP)^{1/2}}$	.792	.705	.740
V_s	62.81	55.75	58.47
A_s	26	26	26
A_n	.000341	.000341	.000341
%I	98.0	96.9	98.2
Y_d	1.0110	1.0110	1.0110
θ	84.0	84.0	84.0
M_n	.0253	.0475	.0121
DH@	1.750	1.750	1.750

Clean Air Engineering, Inc.

SAMPLE CALCULATIONS - Unit #2 NOx Test Run 1A

13. Sample Volume, Standard Conditions, Dry Basis

$$Vsc = 17.64\ (Vf - 25)\ [(Pf/Tf) - (Pi/Ti)]$$

$$= 17.64\ (2084 - 25)\ [(29.50/460 + 76) - (2.34/460 + 94)]$$

$$= 1845.6$$

14. Total NO_2 Per Sample

$$NO_2 = 2\ (Kc)\ (A)\ (Df)$$

$$= 2\ (774.8)\ (.093)\ (1)$$

$$= 144.1$$

15. Sample Concentration, LB/DSCF

$$LB/DSCF = \frac{(6.243 \times 10\ \ )\ (\ NO_2)}{(Vsc)}$$

$$= \frac{(6.243 \times 10^{-5})\ (144.1)}{(1845.6)}$$

$$= .4875 \times 10^{-5}$$

16. Sample Concentration, PPM, Dry

$$PPM,\ Dry = (LB/DCSF)\ (8.376 \times 10^6)$$

$$= (.4875 \times 10^{-5})\ (8.376 \times 10^6)$$

$$= 40.8$$

17. NOx Emission Rate, LB/HR

$$LB/HR = (LB/DSCF^*)\ (Qstd)\ (60)$$

$$= (.5359 \times 10^{-5})\ (39{,}765)\ (60)$$

$$= 12.8$$

*Average of 4 flasks.

PARAMETER SHEET

UNIT #2 - OUTLET

RUN NO.	1	2	3
P_b	30.20	30.24	30.24
P_s	30.05	30.06	30.02
V_m	41.33	42.29	53.88
$\overline{DH}$	.930	.930	1.07
$\overline{T_m}$	108	112	115
V_{mstd}	38.96	39.64	50.26
V_{lc}	157	146	145
V_{wstd}	7.39	6.88	6.83
B_{wo}	.1595	.1478	.1196
$\%O_2$	12.0	11.4	11.9
$\%CO_2$	7.7	8.8	8.2
M_d	29.71	29.86	29.79
M_s	27.84	28.11	28.38
C_p	.840	.840	.840
$\overline{T_s}$	540	542	544
$\overline{(DP)^{1/2}}$	.712	.701	.725
V_s	55.88	54.85	56.51
A_s	26	26	26
A_n	.000341	.000341	.000349
%I	91.1	93.3	108.9
Y_d	1.0029	1.0029	1.0029
Θ	84.0	84.0	84.0
M_n	.0303	.0238	.0756
DH@	1.920	1.920	1.920

Clean Air Engineering, Inc.

PARAMETER SHEET

UNIT #3 - OUTLET

RUN NO.	4	5	6
P_b	30.30	30.30	30.30
P_s	30.11	30.08	30.09
V_m	51.02	55.11	48.72
$\overline{DH}$	.820	.910	.860
$\overline{T_m}$	105	103	98
V_{mstd}	48.50	52.59	46.90
V_{lc}	193	203	174
V_{wstd}	9.09	9.56	8.20
B_{wo}	.1578	.1538	.1487
$\%O_2$	11.7	12.0	11.1
$\%CO_2$	8.3	8.0	8.8
M_d	29.80	29.76	29.85
M_s	27.93	27.95	28.09
C_p	.840	.840	.840
$\overline{T_s}$	540	543	548
$\overline{(DP)^{1/2}}$	.636	.673	.648
V_s	49.79	52.77	50.84
A_s	26	26	26
A_n	.000341	.000341	.000341
%I	126.8	129.6	119.8
Y_d	1.0029	1.0029	1.0029
θ	84.0	84.0	84.0
M_n	.0090	.0063	.0031
DH@	1.920	1.920	1.920

PARAMETER SHEET

UNIT #4 - OUTLET

RUN NO.	4	5	6
P_b	30.30	30.30	30.30
P_s	30.04	30.08	30.01
V_m	46.43	1.96**	47.66
$\overline{DH}$	1.05	.930	1.10
$\overline{T_m}$	114	118	115
V_{mstd}	43.82	1.84	44.91
V_{lc}	152.4	88.0	170.5
V_{wstd}	7.18	4.14	8.03
B_{wo}	.1407	.6930	.1517
$\%O_2$	12.8	16.0	11.1
$\%CO_2$	7.2	4.0	8.8
M_d	29.66	29.28	29.85
M_s	28.02	21.46	28.05
C_p	.840	.840	.840
$\overline{T_s}$	535	522	533
$\overline{(DP)^{1/2}}$	.761	.714	.779
V_s	59.44	63.26	60.74
A_s	26	26	26
A_n	.000341	.000341	.000341
$\%I$	93.8	10.2	95.2
Y_d	1.0110	1.0110	1.0110
θ	84.0	84.0	84.0
M_n	.0327	.0384	.0116
DH@	1.750	1.750	1.750

** Corrected for final leak rate per EPA Method 5

PARAMETER SHEET

UNIT #1 - OUTLET

RUN NO.	7	8	9
P_b	30.26	30.26	30.26
P_s	30.02	30.03	30.03
V_m	43.80	45.68	48.46
$\overline{DH}$	.850	.940	1.000
$\overline{T_m}$	113	92	92
V_{mstd}	40.94	44.33	47.03
V_{lc}	116	112	178
V_{wstd}	5.46	5.28	8.38
B_{wo}	.1177	.1063	.1513
$\%O_2$	13.6	10.6	10.7
$\%CO_2$	6.4	9.4	9.3
M_d	29.57	29.93	29.92
M_s	28.21	28.66	28.11
C_p	.840	.840	.840
$\overline{T_s}$	530	547	558
$\overline{(DP)^{½}}$	.677	.715	.727
V_s	52.54	55.54	57.29
A_s	26	26	26
A_n	.000341	.000341	.000341
$\%I$	96.1	98.8	108.2
Y_d	1.0013	1.0013	1.0013
Θ	84.0	84.0	84.0
D_n	.0215	.0303	.0244
DH@	1.834	1.834	1.834

Clean Air Engineering, Inc.

PARAMETER SHEET

UNIT #2 - OUTLET

RUN NO.	7	8	9
P_b	30.26	30.26	30.26
P_s	30.04	30.04	30.04
V_m	43.83	44.52	45.12
$\overline{DH}$	.830	.830	.840
$\overline{T_m}$	123	105	109
V_{mstd}	40.16	42.09	42.36
V_{1c}	145	132	136
V_{wstd}	6.83	6.22	6.41
B_{wo}	.1453	.1287	.1314
$\%O_2$	13.1	13.1	11.0
$\%CO_2$	7.0	7.0	9.2
M_d	29.64	29.64	29.91
M_s	27.95	28.15	28.35
C_p	.840	.840	.840
$\overline{T_s}$	532	540	540
$\overline{(DP)^{1/2}}$	.677	.678	.679
V_s	52.81	52.99	52.88
A_s	26	26	26
A_n	.000341	.000341	.000341
%I	97.0	100.2	101.3
Y_d	.9987	.9987	.9987
θ	84.0	84.0	84.0
M_n	.0176	.0196	.0225
DH@	1.725	1.725	1.725

PARAMETER SHEET

UNIT #3 - OUTLET

RUN NO.	7	8	9
P_b	30.26	30.26	30.26
P_s	30.05	30.05	30.04
V_m	37.75	36.70	37.32
$\overline{DH}$	.730	.730	.730
$\overline{T_m}$	111	102	97
V_{mstd}	35.45	35.02	35.93
V_{lc}	153	156	126
V_{wstd}	7.21	7.35	5.93
B_{wo}	.1689	.1734	.1418
$\%O_2$	9.8	9.8	10.4
$\%CO_2$	10.0	10.0	9.8
M_d	29.99	29.99	29.98
M_s	27.97	27.91	28.29
C_p	.840	.840	.840
$\overline{T_s}$	546	545	552
$\overline{(DP)^{½}}$	.631	.631	.633
V_s	49.57	49.57	49.57
A_s	26	26	26
A_n	.000341	.000341	.000341
$\%I$	95.1	94.3	93.9
Y_d	1.0029	1.0029	1.0029
Θ	84.0	84.0	84.0
M_n	.0076	.0092	.0068
DH@	1.920	1.920	1.420

PARAMETER SHEET

UNIT #4 - OUTLET

RUN NO.	7	8	9
P_b	30.26	30.26	30.26
P_s	30.00	30.00	30.05
V_m	44.74**	44.29	41.88
$\overline{DH}$	1.01	1.000	.890
$\overline{T_m}$	120	111	105
V_{mstd}	41.73	41.96	40.08
V_{lc}	132	156	112
V_{wstd}	6.22	7.35	5.28
B_{wo}	.1297	.1490	.1163
$\%O_2$	12.1	11.0	14.2
$\%CO_2$	8.0	9.0	6.0
M_d	29.76	29.88	29.53
M_s	28.24	28.11	28.10
C_p	.840	.840	.840
$\overline{T_s}$	546	537	528
$\overline{(DP)^{1/2}}$	.747	.740	.700
V_s	58.43	57.74	54.26
A_s	26	26	26
A_n	.000341	.000341	.000341
%I	90.8	93.7	90.7
Y_d	1.0110	1.0110	1.0110
θ	84.0	84.0	84.0
M_n	.0207	.0049	.0121
DH@	1.750	1.750	1.750

** Corrected for final leak rate per EPA Method 5

Clean Air Engineering, Inc.

PARAMETER SHEET
NO_x TESTS
Kc = 774.8

RUN #	FLASK #	Vf	Ti	Pi	Tf	Pf	Df	A
1A	18	2084	94	2.34	76	29.50	1	.093
1B	19	2100	93	2.24	77	29.10	1	.134
1C	26	2129	90	2.24	75	28.80	1	.100
1D	13	2085	91	2.24	77	29.20	1	.000
1E	38	2092	103	3.04	76	28.61	1	.077
2A	4	2038	96	2.24	77	30.30	1	.072
2B	110	1996	100	2.44	75	30.30	1	.109
2C	36	2090	97	2.14	75	28.10	1	.119
2D	105	2044	96	2.14	75	28.10		.000
2E	263	2053	98	2.44	78	28.50	1	.048
3A	123	1993	99	2.24	77	32.30	1	.060
3B	102	2016	90	2.64	75	30.30	1	.086
3C	9	2111	104	2.24	74	32.30	1	.077
3D	71	2117	94	2.24	76	32.30	1	.101
3E	103	2020	10	2.24	76	28.50	1	.067

PARAMETER SHEET
NO_x TESTS
Kc = 774.8

RUN #	FLASK #	Vf	Ti	Pi	Tf	Pf	Df	A
1A	15	2075	85	3.40	76	29.62	1	.340
1B	6	2067	87	2.80	78	29.52	1	.260
1C	11	2073	91	.80	80	29.32	1	.212
1D	3	2045	84	2.70	82	30.02	1	.252
2A	76	2074	87	3.10	80	29.22	1	.338
2B	34	2093	89	1.90	79	29.32	1	.160
2C	106	2048	88	1.90	79	29.02	1	.285
2D	10	2077	94	1.90	78	30.22	1	.310
2E	111	2020	88	2.00	78	29.02	1	.311
3A	25	2110	86	1.90	78	29.22	1	.161
3B	107	2011	85	1.90	78	29.42	1	.042
3C	16	2088	88	1.90	78	29.52	1	.183
3D	35	2090	81	1.90	80	29.82	1	.134

PARAMETER SHEET
NO_X TESTS
Kc = 774.8

RUN #	FLASK #	Vf	Ti	Pi	Tf	Pf	Df	A
1A	13	2085	78	1.50	78	29.42	1	.364
1B	19	2100	82	1.50	77	29.22	1	.242
1C	110	1996	84	1.70	77	29.52	1	.112
1D	71	2117	80	2.10	78	29.42	1	.211
1E	105	2044	79	2.30	79	29.92	1	.230
2A	4	2038	79	2.00	78	30.22	1	.310
2B	38	2092	81	1.80	79	29.62	1	.270
2C	103	2020	79	1.90	78	29.62	1	.280
2D	9	2111	81	1.90	79	29.62	1	.299
2E	18	2084	82	1.90	78	29.62	1	.188
3A	36	2090	80	1.90	79	29.62	1	.208
3B	123	1993	82	1.80	78	29.72	1	.169
3C	26	2129	81	1.70	79	29.72	1	.275
3D	263	2053	82	1.90	79	30.22	1	.290

EMISSIONS TEST REPORT

MCKAY BAY REFUSE TO ENERGY PLANT

OCTOBER 2 - 5, 1989

Prepared For:

CITY OF TAMPA
ENVIRONMENTAL COORDINATION
306 EAST JACKSON STREET
TAMPA, FLORIDA 33602

Prepared By:

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.
5119 NORTH FLORIDA AVENUE
TAMPA, FLORIDA 33603

NOVEMBER 6, 1989

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I. SUMMARY

From October 2 through 5, 1989, Environmental Engineering Consultants, Inc. conducted annual compliance emissions tests at the McKay Bay Refuse-to-Energy Facility in Tampa, Florida. The sources tested were four steam boilers burning municipal garbage to generate electricity.

Compliance with specified emissions limits was determined using EPA Method 5 for particulate matter, Method 6 for sulfur dioxide, Method 7A for nitrogen oxides, Method 9 for opacity, and Method 12 for lead. These methods, except for Method 9 opacity, were performed simultaneously during each test run. One opacity determination was performed on each stack during a particulate test run.

The tests were conducted by Carl Fink, Byron Burrows, Jim Root, Stuart Dawson, and Don Wilcox of Environmental Engineering Consultants, Inc. with the assistance and cooperation of the employees of Tampa Waste Management Energy Systems.

A summary of the test results is shown in Table 1 through 8. The total emissions (sum of the average emission for each unit) in comparison to allowable emissions per FDER Permit No. A029-114760 are as follows:

Emission Type	Total Emission	Allowable Emissions
Particulate	9.4 lb/hr 0.009 gr/dscf-12%	27.9 lb/hr 0.025 gr/dscf-12%
Lead	0.3 lb/hr	3.1 lb/hr
Sulfur Dioxide	111.6 lb/hr	170.0lb/hr

Emission Type	Total Emission	Allowable Emissions
Nitrogen Oxide	223.8 lb/hr	300.0 lb/hr
Opacity	None greater than 15% opacity	Not to exceed 15% from each stack

All emission rates were determined according to the procedures required by the Florida Department of Environmental Regulation and the tested facility was found to be in compliance with applicable emissions standards.

I hereby certify that these results are true and correct and were obtained by the procedures and methods described herein.

Respectfully Submitted;

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

Carl F. Fink
Test Supervisor
Senior Environmental Engineer

TABLE 1

TEST SUMMATION

PLANT: McKay Bay RTE

SOURCE: Unit #1

DATE: 10-5-89

RUN NO.	SAMPLE VOL. (DSCF)	FLOWRATE (ACFM)	FLOWRATE (DSCFM)	MOISTURE (%)	STACK TEMP. (deg F)	ISOKINETICS (%)	CARBON DIOXIDE (%)	PARTICULATE CONCENTRATION (gr/DSCF-12%)	PARTIC. EMISSIONS (lb/hr)
1	38.1207	78625	33696	15.41	575	101.9	8.7	0.0075	1.57
2	38.5911	78944	34087	15.83	562	101.9	8.6	0.0066	1.38
3	41.3671	87478	37734	15.12	571	98.7	8.4	0.0085	1.92
Average		81683	35172	15.45	569	100.8	8.6	0.0075	1.62

TABLE 2

TEST SUMMATION

PLANT: McKay Bay RTE

SOURCE: Unit #2

DATE: 10-4-89

RUN NO.	SAMPLE VOL. (DSCF)	FLOWRATE (ACFM)	FLOWRATE (DSCFM)	MOISTURE (%)	STACK TEMP. (deg F)	ISOKINETICS (%)	CARBON DIOXIDE (%)	PARTICULATE CONCENTRATION (gr/DSCF-12%)	PARTIC. EMISSIONS (lb/hr)
1	42.6913	90150	39426	16.15	547	97.5	8.4	0.0046	1.54
2	43.9900	91155	40584	14.66	545	97.6	6.6	0.0045	1.57
3	44.0435	91101	41001	14.15	540	96.7	8.5	0.0025	0.89
Average		90802	40337	14.99	544	97.3	7.8	0.0039	1.33

TABLE 3

TEST SUMMATION

PLANT: McKay Bay RTE

SOURCE: Unit #3

DATE: 10-3-89

RUN NO.	SAMPLE VOL. (DSCF)	FLOWRATE (ACFM)	FLOWRATE (DSCFM)	MOISTURE (%)	STACK TEMP. (deg F)	ISOKINETICS (%)	CARBON DIOXIDE (%)	PARTICULATE CONCENTRATION (gr/DSCF-12%)	PARTIC. EMISSIONS (lb/hr)
1	39.4019	80987	33645	15.09	612	105.5	9.0	0.0092	2.67
2	37.5453	82920	33393	17.58	612	101.2	9.0	0.0164	4.68
3	36.1848	83149	33524	17.30	613	97.2	8.8	0.0143	4.12
Average		82352	33521	16.66	612	101.3	8.9	0.0133	3.82

TABLE 4

TEST SUMMATION

PLANT: McKay Bay RTE

SOURCE: Unit #4

DATE: 10-2-89

RUN NO.	SAMPLE VOL. (DSCF)	FLOWRATE (ACFM)	FLOWRATE (DSCFM)	MOISTURE (%)	STACK TEMP. (deg F)	ISOKINETICS (%)	CARBON DIOXIDE (%)	PARTICULATE CONCENTRATION (gr/DSCF-12%)	PARTIC. EMISSIONS (lb/hr)
1	46.2705	102360	37393	17.65	718	111.4	8.2	0.0044	0.97
2	48.2553	95872	42439	15.48	539	102.4	8.2	0.0107	2.65
3	46.8094	94445	41965	15.31	536	100.4	8.1	0.0173	4.20
Average		97559	40599	16.15	598	104.8	8.2	0.0108	2.61

TABLE 5

TEST SUMMATION

PLANT: McKay Bay RTE

PARAMETER: Lead

SOURCE/DATE	RUN NUMBER	LEAD EMISSIONS (lb/hr)
Unit #1	1	0.05
10-5-89	2	0.01
	3	0.03

	Average	0.03
Unit #2	1	0.04
10-4-89	2	0.03
	3	0.02

	Average	0.03
Unit #3	1	0.07
10-3-89	2	0.15
	3	0.27

	Average	0.16
Unit #4	1	0.03
10-2-89	2	0.09
	3	0.17

	Average	0.09

Total Lead Emissions - All Units: 0.31

TABLE 6

TEST SUMMATION

PLANT: McKay Bay Refuse-to-Energy Facility

PARAMETER: Sulfur Dioxide (SO_2)

SOURCE/DATE	RUN NUMBER	SULFUR DIOXIDE CONCENTRATION (mg/dscm)	SULFUR DIOXIDE EMISSIONS (lb/hr)
UNIT #1	1	200.3	25.3
10-5-89	2	126.5	16.2
	3	129.6	18.3

	AVERAGE		19.9
UNIT #2	1	201.8	29.8
10-4-89	2	232.9	35.4
	3	449.9	69.1

	AVERAGE		44.8
UNIT #3	1	209.3	26.4
10-3-89	2	197.2	24.7
	3	262.9	33.0

	AVERAGE		28.0
UNIT #4	1	51.1	7.2
10-2-89	2	178.0	28.3
	3	135.2	21.2

	AVERAGE		18.9

Total Sulfur Dioxide Emissions - All Boilers: 111.6 lb/hr

TABLE 7

TEST SUMMATION

PLANT: McKay Bay Refuse-to-Energy Facility

PARAMETER: Nitrogen Oxides

Source/Date	Run Number	Nitrogen Oxides Concentration (mg/dscm)	Nitrogen Oxides Emissions (lb/hr)
Unit #1	1	363.6	45.9
10-5-89	2	311.0	39.7
	3	383.2	54.2
		-----	----
	Average	352.6	46.6
Unit #2	1	415.4	61.4
10-4-89	2	494.9	75.2
	3	420.3	64.6
		-----	----
	Average	443.6	67.0
Unit #3	1	425.0	53.6
10-3-89	2	414.0	51.8
	3	536.2	67.3
		-----	----
	Average	458.4	57.6
Unit #4	1	396.6	50.0
10-2-89	2	528.6	66.1
	3	496.7	62.4
		-----	----
	Average	474.0	59.5

Total Nitrogen Oxides Emissions - All Units: 223.8

TABLE 8

TEST SUMMATION

PLANT: McKay Bay RTE

PARAMETER: Opacity

SOURCE/DATE	AVERAGE OPACITY (%)	MAXIMUM 6 MIN. AVG. OPACITY (%)
West Stack Unit 1/Unit 2 10-4-89	1	4
East Stack Unit 3/Unit 4 10-2-89	1	3

APPENDIX A

DATA SUMMARIES AND CALCULATIONS

SOURCE TESTING NOMENCLATURE AND DIMENSIONS

An: Cross sectional area of nozzle, $ft.^2$

As: Cross sectional area of stack, $ft.^2$

Bws: Water vapor in the gas stream, proportion by volume

Ca: Concentration of particulate matter in stack gas at actual conditions, gr/acf

Cs: Concentration of particulate matter in stack gas at standard conditions, gr/dscf

Cs50: Concentration corrected to 50% excess air

Cs12: Concentration corrected to 12% carbon dioxide

Cp: Pitot tube coefficient

Dn: Diameter of nozzle, inches

E: Source emission rate, lbs/hr

EA: Excess air

Ef: Ratio of pounds of particulate matter per unit of heat combustion (oxygen based), lb/MMBTU

Fd: Ratio of standard volume of gas produced per unit of heat combustion (oxygen based), dscf/MBTU

I: Percent of isokinetic sampling

Md: Molecular weight of stack gas, dry basis, lb/lb-mole

Ms: Molecular weight of stack gas, wet basis, lb/lb-mole

Mn: Total particulate collected, less acetone blank correction; grams

Pb: Barometric pressure at test site, in. Hg

Ps: Absolute stack gas pressure, in.Hg.

Qa: Volumetric flowrate, actual conditions, ACFM

Qs: Volumetric flowrate, dry at standard conditions, DSCFM

Time: Duration of test, minutes

SOURCE TESTING NOMENCLATURE AND DIMENSIONS

CONTINUED

Tm: Absolute average dry gas meter temperature, ^{o}R

Ts: Absolute average stack gas temperature, ^{o}R

Vlc: Total volume of liquid collected in impingers and silica gel, ml

Vm: Volume of gas sampled under actual conditions, DCF

Vms: Volume of gas sampled corrected to standard conditions, DSCF

Vs: Stack gas velocity, ft/sec

Vw: Volume of water in sample corrected to standard conditions, SCF

Y: Dry gas meter calibration factor

dP: Velocity head, in H20

dH: Average pressure differential across orifice meter, in. H_2O

SUMMARY OF TEST DATA

Plant: McKay Bay RTE

Source: Unit #1

Date: 10-5-89

Emission: Particulate/Lead

	RUN 1	RUN 2	RUN 3
Test Interval:	0815-0933	1126-1300	1208-1324
Test Time, min.:	70	70	70
Stack Area, sq. ft.:	26	26	26
Nozzle Diameter, in.:	0.275	0.275	0.275
Barometric Pressure, in. Hg.:	30.03	30.04	30.04
Absolute Stack Pressure, in. Hg.:	29.74	29.72	29.72
Volume Liquid Collected, ml.:	147.4	154.1	156.5
Stack Moisture Content, %:	15.41	15.83	15.12
Stack Gas Temperature, deg F:	575	562	571
Sample Volume, DSCF:	38.1207	38.5911	41.3671
Gas Velocity, FPS:	50.401	50.605	56.076
Gas Flowrate, ACFM:	78625	78944	87478
Gas Flowrate, DSCFM:	33696	34087	37734
Percent Isokinetic, %:	101.9	101.9	98.7
Particulate Matter Collected, g:	0.0134	0.0118	0.0159
Particulate Concentration, grains/DSCF:	0.0054	0.0047	0.0059
Particulate Concentration,grains/DSCF-12%:	0.0075	0.0066	0.0085
Particulate Emissions, lb/hr:	1.57	1.38	1.92
Lead Collected, mg :	0.450	0.075	0.225
Lead Emissions, lb/hr :	0.053	0.009	0.027

SUMMARY OF TEST DATA

Plant: McKay Bay RTE

Date: 10-4-89

Source: Unit #2

Emission: Particulate/Lead

	RUN 1	RUN 2	RUN 3
Test Interval:	0830-0948	1040-1158	1235-1352
Test Time, min.:	70	70	70
Stack Area, sq. ft.:	26	26	26
Nozzle Diameter, in.:	0.275	0.275	0.275
Barometric Pressure, in. Hg.:	30.03	30.03	30.01
Absolute Stack Pressure, in. Hg.:	29.77	29.74	29.72
Volume Liquid Collected, ml.:	174.6	160.4	154.1
Stack Moisture Content, %:	16.15	14.66	14.15
Stack Gas Temperature, deg F:	547	545	540
Sample Volume, DSCF:	42.6913	43.9900	44.0435
Gas Velocity, FPS:	57.789	58.433	58.398
Gas Flowrate, ACFM:	90150	91155	91101
Gas Flowrate, DSCFM:	39426	40584	41001
Percent Isokinetic, %:	97.5	97.6	96.7
Particulate Matter Collected, g:	0.0126	0.0129	0.0072
Particulate Concentration, grains/DSCF:	0.0046	0.0045	0.0025
Particulate Concentration,grains/DSCF-12%:	0.0065	0.0082	0.0036
Particulate Emissions, lb/hr:	1.54	1.57	0.89
Lead Collected, mg :	0.300	0.250	0.150
Lead Emissions, lb/hr :	0.037	0.031	0.018

SUMMARY OF TEST DATA

Plant: McKay Bay RTE

Source: Unit #3

Date: 10-3-89

Emission: Particulate/Lead

	RUN 1	RUN 2	RUN 3
Test Interval:	0900-1020	1128-1243	1235-1352
Test Time, min.:	70	70	70
Stack Area, sq. ft.:	26.00	26.00	26.00
Nozzle Diameter, in.:	0.275	0.275	0.275
Barometric Pressure, in. Hg.:	30.03	30.04	30
Absolute Stack Pressure, in. Hg.:	29.74	29.71	29.68
Volume Liquid Collected, ml.:	148.7	170.0	160.7
Stack Moisture Content, %:	15.09	17.58	17.30
Stack Gas Temperature, deg F:	612	612	613
Sample Volume, DSCF:	39.4019	37.5453	36.1848
Gas Velocity, FPS:	51.915	53.154	53.301
Gas Flowrate, ACFM:	80987	82920	83149
Gas Flowrate, DSCFM:	33645	33393	33524
Percent Isokinetic, %:	105.5	101.2	97.2
Particulate Matter Collected, g:	0.0236	0.0398	0.0336
Particulate Concentration, grains/DSCF:	0.0092	0.0164	0.0143
Particulate Concentration,grains/DSCF-12%:	0.0123	0.0218	0.0195
Particulate Emissions, lb/hr:	2.67	4.68	4.12
Lead Collected, mg :	0.600	1.300	2.200
Lead Emissions, lb/hr :	0.068	0.153	0.270

SUMMARY OF TEST DATA

Plant: McKay Bay RTE

Source: Unit #4

Date: 10-2-89

Emission: Particulate/Lead

	RUN 1	RUN 2	RUN 3
Test Interval:	0900-1021	1115-1236	1340-1503
Test Time, min.:	70	70	70
Stack Area, sq. ft.:	26.00	26.00	26.00
Nozzle Diameter, in.:	0.275	0.275	0.275
Barometric Pressure, in. Hg.:	29.97	29.99	29.97
Absolute Stack Pressure, in. Hg.:	29.65	27.66	29.65
Volume Liquid Collected, ml.:	210.6	187.6	179.7
Stack Moisture Content, %:	17.65	15.48	15.31
Stack Gas Temperature, deg F:	718	539	536
Sample Volume, DSCF:	46.2705	48.2553	46.8094
Gas Velocity, FPS:	65.615	61.456	60.542
Gas Flowrate, ACFM:	102360	95872	94445
Gas Flowrate, DSCFM:	37393	42439	41965
Percent Isokinetic, %:	111.4	102.4	100.4
Particulate Matter Collected, g:	0.0091	0.0228	0.0354
Particulate Concentration, grains/DSCF:	0.0030	0.0073	0.0117
Particulate Concentration,grains/DSCF-12%:	0.0044	0.0107	0.0173
Particulate Emissions, lb/hr:	0.97	2.65	4.20
Lead Collected, mg :	0.250	0.750	1.400
Lead Emissions, lb/hr :	0.027	0.087	0.166

CALCULATIONS

PLANT: McKay Bay RTE

SOURCE: Unit #1

DATE: 10-5-89

RUN NO.	1		2		3	
Cp=	0.84		0.84		0.84	
Y=	0.983		0.983		0.983	
Dn=	0.275	inches	0.275	inches	0.275	inches
An=	4.125E-04	sq. ft.	4.125E-04	sq. ft.	4.125E-04	sq. ft.
Pb =	30.03	in Hg	30.04	in Hg	30.04	in Hg
Ps =	29.74	in Hg	29.72	in Hg	29.72	in Hg
As =	26	sq. ft.	26	sq. ft.	26	sq. ft.
Time=	70	min	70	min	70	min
Vm =	39.468	DCF	40.68	DCF	43.782	DCF
dH=	1.15	in. H2O	1.21	in. H2O	1.44	in. H2O
Tm=	541	deg R	551	deg R	553	deg R
Ts=	1035	deg R	1022	deg R	1031	deg R
Vlc=	147.4	ml.	154.1	ml.	156.5	ml.
SQRTdP=	0.6295		0.6353		0.7015	
CO2=	8.7	%	8.6	%	8.4	%
O2=	10.7	%	10.8	%	11	%
CO+N2=	80.6	%	80.6	%	80.6	%
Mn=	0.0134	grams	0.0118	grams	0.0159	grams
Lead=	0.450	mg	0.075	mg	0.225	mg
Vms=	38.1207	DSCF	38.5911	DSCF	41.3671	DSCF
Vw=	6.9425	SCF	7.2581	SCF	7.3712	SCF
Bws=	0.1541		0.1583		0.1512	
Md=	29.820		29.808		29.784	
Ms=	27.999		27.939		28.002	
Vs=	50.4008	FPS	50.6052	FPS	56.0758	FPS
Qs=	33696	DSCFM	34087	DSCFM	37734	DSCFM
Qa=	78625	ACFM	78944	ACFM	87478	ACFM
I=	101.9	%	101.9	%	98.7	%
Cs=	0.0054	gr/DSCF	0.0047	gr/DSCF	0.0059	gr/DSCF
Cs12=	0.0075	gr/DSCF	0.0066	gr/DSCF	0.0085	gr/DSCF
E=	1.57	lb/hr	1.38	lb/hr	1.92	lb/hr
Epb=	0.05262	lb/hr	0.00876	lb/hr	0.02715	lb/hr

Vm(std)=17.64*Vm*Y*(Pb+dH/13.6)
Vw=.0471*Vlc
Bws=Vw/Vw+Vm(std)
Md=0.44(%CO2)+0.32(%O2)+0.28(%CO+%N2)
Ms=Md(1-Bws)+18*Bws
Vs=85.49*Cp*SQRTdPavg*SQRT(Ts/Ps*Ms)
Qs=1058*(1-Bws)*Vs*As*(Ps/Ts)
Qa=60*As*Vs
I=100*Vm(std)*As/Theta*Qs*An
Cs=15.43*Mn/Vm(std)
Cs12=Cs*12/CO2
E=Cs*Qs/116.67
Epb=1.323E-4*Lead*Qs/Vms

CALCULATIONS

PLANT: McKay Bay RTE

SOURCE: Unit #3

DATE: 10-3-89

RUN NO.	1		2		3	
Cp=	0.84		0.84		0.84	
Y=	0.983		0.983		0.983	
Dn=	0.275	inches	0.275	inches	0.275	inches
An=	4.125E-04	sq. ft.	4.125E-04	sq. ft.	4.125E-04	sq. ft.
Pb =	30.03	in Hg	30.04	in Hg	30	in Hg
Ps =	29.74	in Hg	29.71	in Hg	29.68	in Hg
As =	26	sq. ft.	26	sq. ft.	26	sq. ft.
Time=	70	min	70	min	70	min
Vm =	39.25	DCF	39.82	DCF	38.62	DCF
dH=	1.15	in. H2O	1.19	in. H2O	1.13	in. H2O
Tm=	520	deg R	554	deg R	557	deg R
Ts=	1072	deg R	1072	deg R	1073	deg R
Vlc=	148.7	ml.	170	ml.	160.7	ml.
SQRTdP=	0.6379		0.6493		0.6505	
CO2=	9	%	9	%	8.8	%
O2=	10.3	%	10.4	%	10.6	%
CO+N2=	80.7	%	80.6	%	80.6	%
Mn=	0.0236	grams	0.0398	grams	0.0336	grams
Lead=	0.6	mg	1.3	mg	2.2	mg
Vms=	39.4019	DSCF	37.5453	DSCF	36.1848	DSCF
Vw=	7.0038	SCF	8.0070	SCF	7.5690	SCF
Bws=	0.1509		0.1758		0.1730	
Md=	29.252		29.856		29.832	
Ms=	28.0632		27.7720		27.7852	
Vs=	51.9147	FPS	53.1538	FPS	53.3009	FPS
Qs=	33645	DSCFM	33393	DSCFM	33524	DSCFM
Qa=	80987	ACFM	82920	ACFM	83149	ACFM
I=	105.5	%	101.2	%	97.2	%
Cs=	0.0092	gr/DSCF	0.0164	gr/DSCF	0.0143	gr/DSCF
Cs12=	0.0123	gr/DSCF	0.0218	gr/DSCF	0.0195	gr/DSCF
E=	2.67	lb/hr	4.68	lb/hr	4.12	lb/hr
Epb=	0.06778	lb/hr	0.15297	lb/hr	0.26966	lb/hr

Vm(std)=17.64*Vm*Y*(Pb+dH/13.6)
Vw=.0471*Vlc
Bws=Vw/Vw+Vm(std)
Md=0.44(%CO2)+0.32(%O2)+0.28(%CO+%N2)
Ms=Md(1-Bws)+18*Bws
Vs=85.49*Cp*SQRTdPavg*SQRT(Ts/Ps*Ms)
Qs=1058*(1-Bws)*Vs*As*(Ps/Ts)
Qa=60*As*Vs
I=100*Vm(std)*As/Theta*Qs*An
Cs=15.43*Mn/Vm(std)
Cs12=Cs*12/CO2
E=Cs*Qs/116.67
Epb=1.323E-4*Lead*Qs/Vms

CALCULATIONS

PLANT: McKay Bay RTE

SOURCE: Unit #2

DATE: 10-4-89

RUN NO.	1		2		3	
Cp=	0.84		0.84		0.84	
Y=	0.983		0.983		0.983	
Dn=	0.275	inches	0.275	inches	0.275	inches
An=	4.125E-04	sq. ft.	4.125E-04	sq. ft.	4.125E-04	sq. ft.
Pb =	30.03	in Hg	30.03	in Hg	30.01	in Hg
Ps =	29.77	in Hg	29.74	in Hg	29.72	in Hg
As =	26	sq. ft.	26	sq. ft.	26	sq. ft.
Time=	70	min	70	min	70	min
Vm =	44.228	DCF	46.77	DCF	47.01	DCF
dH=	1.51	in. H2O	1.59	in. H2O	1.66	in. H2O
Tm=	541	deg R	556	deg R	558	deg R
Ts=	1007	deg R	1005	deg R	1000	deg R
Vlc=	174.6	ml.	160.4	ml.	154.1	ml.
SQRTdP=	0.7308		0.7389		0.7436	
CO2=	8.4	%	6.6	%	8.5	%
O2=	11.1	%	12.9	%	10.9	%
CO+N2=	80.5	%	80.5	%	80.6	%
Mn=	0.0126	grams	0.0129	grams	0.0072	grams
Lead=	0.300	mg	0.250	mg	0.150	mg
Vms=	42.6913	DSCF	43.9900	DSCF	44.0435	DSCF
Vw=	8.2237	SCF	7.5548	SCF	7.2581	SCF
Bws=	0.1615		0.1466		0.1415	
Md=	29.788		29.572		29.796	
Ms=	27.8840		27.8759		28.1271	
Vs=	57.7886	FPS	58.4326	FPS	58.3979	FPS
Qs=	39426	DSCFM	40584	DSCFM	41001	DSCFM
Qa=	90150	ACFM	91155	ACFM	91101	ACFM
I=	97.5	%	97.6	%	96.7	%
Cs=	0.0046	gr/DSCF	0.0045	gr/DSCF	0.0025	gr/DSCF
Cs12=	0.0065	gr/DSCF	0.0082	gr/DSCF	0.0036	gr/DSCF
E=	1.54	lb/hr	1.57	lb/hr	0.89	lb/hr
Epb=	0.03665	lb/hr	0.03051	lb/hr	0.01847	lb/hr

Vm(std)=17.64*Vm*Y*(Pb+dH/13.6)
Vw=.0471*Vlc
Bws=Vw/Vw+Vm(std)
Md=0.44(%CO2)+0.32(%O2)+0.28(%CO+%N2)
Ms=Md(1-Bws)+18*Bws
Vs=85.49*Cp*SQRTdPavg*SQRT(Ts/Ps*Ms)
Qs=1058*(1-Bws)*Vs*As*(Ps/Ts)
Qa=60*As*Vs
I=100*Vm(std)*As/Theta*Qs*An
Cs=15.43*Mn/Vm(std)
Cs12=Cs*12/CO2
E=Cs*Qs/116.67
Epb=1.323E-4*Lead*Qs/Vms

CALCULATIONS

PLANT: McKay Bay RTE

SOURCE: Unit #4

DATE: 10-2-89

RUN NO.	1		2		3	
Cp=	0.84		0.84		0.84	
Y=	0.983		0.983		0.983	
Dn=	0.275	inches	0.275	inches	0.275	inches
An=	4.125E-04	sq. ft.	4.125E-04	sq. ft.	4.125E-04	sq. ft.
Pb =	29.97	in Hg	29.99	in Hg	29.97	in Hg
Ps =	29.65	in Hg	29.66	in Hg	29.65	in Hg
As =	26	sq. ft.	26	sq. ft.	26	sq. ft.
Time=	70	min	70	min	70	min
Vm =	48.638	DCF	51.2	DCF	49.43	DCF
dH=	1.87	in. H2O	1.97	in. H2O	1.84	in. H2O
Tm=	549	deg R	554	deg R	551	deg R
Ts=	1178	deg R	999	deg R	996	deg R
Vlc=	210.6	ml.	187.6	ml.	179.7	ml.
SQRTdP=	0.7625		0.7797		0.7689	
CO2=	8.2	%	8.2	%	8.1	%
O2=	11.2	%	11.4	%	11.4	%
CO+N2=	80.6	%	80.4	%	80.5	%
Mn=	0.0091	grams	0.0228	grams	0.0354	grams
Lead=	0.25	mg	0.75	mg	1.4	mg
Vms=	46.2705	DSCF	48.2553	DSCF	46.8094	DSCF
Vw=	9.9193	SCF	8.8360	SCF	8.4639	SCF
Bws=	0.1765		0.1548		0.1531	
Md=	29.76		29.768		29.752	
Ms=	27.6840		27.9467		27.9524	
Vs=	65.6154	FPS	61.4564	FPS	60.5415	FPS
Qs=	37393	DSCFM	42439	DSCFM	41965	DSCFM
Qa=	102360	ACFM	95872	ACFM	94445	ACFM
I=	111.4	%	102.4	%	100.4	%
Cs=	0.0030	gr/DSCF	0.0073	gr/DSCF	0.0117	gr/DSCF
Cs12=	0.0044	gr/DSCF	0.0107	gr/DSCF	0.0173	gr/DSCF
E=	0.97	lb/hr	2.65	lb/hr	4.20	lb/hr
Epb=	0.02673	lb/hr	0.08727	lb/hr	0.16605	lb/hr

Vm(std)=17.64*Vm*Y*(Pb+dH/13.6)
Vw=.0471*Vlc
Bws=Vw/Vw+Vm(std)
Md=0.44(%CO2)+0.32(%O2)+0.28(%CO+%N2)
Ms=Md(1-Bws)+18*Bws
Vs=85.49*Cp*SQRTdPavg*SQRT(Ts/Ps*Ms)
Qs=1058*(1-Bws)*Vs*As*(Ps/Ts)
Qa=60*As*Vs
I=100*Vm(std)*As/Theta*Qs*An
Cs=15.43*Mn/Vm(std)
Cs12=Cs*12/CO2
E=Cs*Qs/116.67
Epb=1.323E-4*Lead*Qs/Vms

EPA METHOD 6 SO2 CALCULATIONS

PLANT: McKAY BAY REFUSE-TO-ENERGY

DATE: OCTOBER 2-5,1989

UNIT #1

RUN NO.	1		2		3	
Vm=	20.290	liters	20.375	liters	20.290	liters
Pb=	30.03	"Hg	30.04	"Hg	30.04	"Hg
Tm=	539.5	deg R	547.5	deg R	549.5	deg R
Qs=	33696	DSCFM	34087	DSCFM	37734	DSCFM
Y=	0.990		0.990		0.990	
Vms=	0.01972	DSCM	0.01952	DSCM	0.01937	DSCM
SO2=	3.95	mg	2.47	mg	2.51	mg
C=	200.27	mg/dscm	126.52	mg/dscm	129.58	mg/dscm
E=	25.28	lb/hr	16.15	lb/hr	18.31	lb/hr

UNIT #2

RUN NO.	1		2		3	
Vm=	20.325	liters	20.395	liters	20.285	liters
Pb=	30.03	"Hg	30.03	"Hg	30.01	"Hg
Tm=	537.8	deg R	550	deg R	555.5	deg R
Qs=	39426	DSCFM	40584	DSCFM	41001	DSCFM
Y=	0.990		0.990		0.990	
Vms=	0.01981	DSCM	0.01944	DSCM	0.01913	DSCM
SO2=	4.00	mg	4.53	mg	8.61	mg
C=	201.82	mg/dscm	232.94	mg/dscm	449.90	mg/dscm
E=	29.80	lb/hr	35.41	lb/hr	69.10	lb/hr

UNIT #3

RUN NO.	1		2		3	
Vm=	20.040	liters	20.040	liters	20.335	liters
Pb=	30.03	"Hg	30.04	"Hg	30.00	"Hg
Tm=	544.5	deg R	551.5	deg R	559.0	deg R
Qs=	33645	DSCFM	33393	DSCFM	33524	DSCFM
Y=	0.990		0.990		0.990	
Vms=	0.01930	DSCM	0.01906	DSCM	0.01905	DSCM
SO2=	4.04	mg	3.76	mg	5.01	mg
C=	209.31	mg/dscm	197.24	mg/dscm	262.88	mg/dscm
E=	26.38	lb/hr	24.67	lb/hr	33.01	lb/hr

UNIT #4

RUN NO.	1		2		3	
Vm=	20.590	liters	20.335	liters	20.720	liters
Pb=	29.97	"Hg	29.99	"Hg	29.97	"Hg
Tm=	545.5	deg R	557.5	deg R	549.0	deg R
Qs=	37393	DSCFM	42439	DSCFM	41965	DSCFM
Y=	0.990		0.990		0.990	
Vms=	0.01975	DSCM	0.01910	DSCM	0.01975	DSCM
SO2=	1.01	mg	3.40	mg	2.67	mg
C=	51.13	mg/dscm	177.98	mg/dscm	135.17	mg/dscm
E=	7.16	lb/hr	28.29	lb/hr	21.25	lb/hr

Vms=0.01764*Vm*Y*Pb/Tm   C=SO2/Vms   E=6.243E-8*C*Qs*60

METHOD 7A NOx CALCULATIONS

PLANT: McKay Bay RTE SOURCE: Unit No. 1

DATE: 10-5-89

RUN 1

SAMPLE NO. =	1	2	3	4
FLASK VOL. =	2000 ml	2031 ml	2025 ml	2018 ml
Pi=	0.43 "Hg	0.53 "Hg	0.53 "Hg	0.53 "Hg
Pf=	30.08 "Hg	29.08 "Hg	28.78 "Hg	29.28 "Hg
Ti=	299 K	298.5 K	300 K	300.5 K
Tf=	299 K	299 K	300 K	300.5 K
Vsc=	1917.9 ml	1875.7 ml	1844.3 ml	1867.3 ml
HSF=	76 ug	67 ug	68 ug	62 ug
Qs=	33696 DSCFM	33696 DSCFM	33696 DSCFM	33696 DSCFM
C=	396 mg/dscm	357 mg/dscm	369 mg/dscm	332 mg/dscm
E=	50.0 lb/hr	45.1 lb/hr	46.5 lb/hr	41.9 lb/hr

RUN 2

SAMPLE NO. =	1	2	3	4
FLASK VOL. =	2003 ml	1990 ml	2032 ml	2032 ml
Pi=	0.54 "Hg	0.54 "Hg	0.44 "Hg	0.54 "Hg
Pf=	28.18 "Hg	30.08 "Hg	28.88 "Hg	28.28 "Hg
Ti=	305 K	302.5 K	306 K	305 K
Tf=	301 K	301 K	301 K	301 K
Vsc=	1779.2 ml	1888.7 ml	1857.5 ml	1811.8 ml
HSF=	58 ug	56 ug	56 ug	58 ug
Qs=	34087 DSCFM	34087 DSCFM	34087 DSCFM	34087 DSCFM
C=	326 mg/dscm	297 mg/dscm	301 mg/dscm	320 mg/dscm
E=	41.6 lb/hr	37.9 lb/hr	38.5 lb/hr	40.9 lb/hr

RUN 3

SAMPLE NO. =	1	2	3	4
FLASK VOL. =	2029 ml	2005 ml	1994 ml	1993 ml
Pi=	0.54 "Hg	0.44 "Hg	0.44 "Hg	0.44 "Hg
Pf=	28.28 "Hg	28.88 "Hg	28.78 "Hg	28.88 "Hg
Ti=	308 K	306 K	303.5 K	303.5 K
Tf=	300 K	300 K	300 K	300 K
Vsc=	1815.6 ml	1838.7 ml	1821.8 ml	1827.3 ml
HSF=	52 ug	79 ug	81 ug	68 ug
Qs=	37734 DSCFM	37734 DSCFM	37734 DSCFM	37734 DSCFM
C=	286 mg/dscm	430 mg/dscm	445 mg/dscm	372 mg/dscm
E=	40.5 lb/hr	60.7 lb/hr	62.8 lb/hr	52.6 lb/hr

$$Vsc = 9.7928 * (Vf-25) * [(Pf/Tf) - (Pi/Ti)]$$

$$C = (HSF) * 10{,}000/Vsc$$

$$E = (6.243E-8) * C * Qs * 60$$

METHOD 7A NOx CALCULATIONS

PLANT: McKay Bay RTE SOURCE: Unit No. 2

DATE: 10-4-89

RUN 1

SAMPLE NO. =	1	2	3	4
FLASK VOL. =	2000 ml	2031 ml	2025 ml	2018 ml
Pi=	0.83 "Hg	0.63 "Hg	0.68 "Hg	0.78 "Hg
Pf=	28.80 "Hg	27.60 "Hg	29.20 "Hg	28.80 "Hg
Ti=	299 K	298 K	298.5 K	299 K
Tf=	295 K	295.5 K	296 K	296 K
Vsc=	1834.5 ml	1793.3 ml	1887.5 ml	1848.0 ml
HSF=	62 ug	76 ug	81 ug	87 ug
Qs=	39426 DSCFM	39426 DSCFM	39426 DSCFM	39426 DSCFM
C=	338 mg/dscm	424 mg/dscm	429 mg/dscm	471 mg/dscm
E=	49.9 lb/hr	62.6 lb/hr	63.4 lb/hr	69.5 lb/hr

RUN 2

SAMPLE NO. =	1	2	3	4
FLASK VOL. =	2003 ml	1990 ml	2032 ml	2032 ml
Pi=	0.93 "Hg	0.68 "Hg	0.53 "Hg	0.88 "Hg
Pf=	28.40 "Hg	29.20 "Hg	28.60 "Hg	28.60 "Hg
Ti=	304 K	302 K	305 K	302 K
Tf=	296 K	296.5 K	296 K	296.5 K
Vsc=	1799.2 ml	1851.8 ml	1864.9 ml	1838.5 ml
HSF=	87 ug	90 ug	93 ug	94 ug
Qs=	40584 DSCFM	40584 DSCFM	40584 DSCFM	40584 DSCFM
C=	484 mg/dscm	486 mg/dscm	499 mg/dscm	511 mg/dscm
E=	73.5 lb/hr	73.9 lb/hr	75.8 lb/hr	77.7 lb/hr

RUN 3

SAMPLE NO. =	1	2	3	4
FLASK VOL. =	2029 ml	2005 ml	1994 ml	2003 ml
Pi=	0.81 "Hg	0.51 "Hg	0.76 "Hg	0.86 "Hg
Pf=	27.90 "Hg	28.20 "Hg	28.20 "Hg	28.00 "Hg
Ti=	307.5 K	307 K	309.5 K	305 K
Tf=	296 K	296.5 K	296.5 K	295.5 K
Vsc=	1798.1 ml	1811.9 ml	1786.6 ml	1780.8 ml
HSF=	94 ug	86 ug	61 ug	61 ug
Qs=	41001 DSCFM	41001 DSCFM	41001 DSCFM	41001 DSCFM
C=	523 mg/dscm	475 mg/dscm	341 mg/dscm	343 mg/dscm
E=	80.3 lb/hr	72.9 lb/hr	52.4 lb/hr	52.6 lb/hr

$Vsc = 9.7928 * (Vf-25) * [(Pf/Tf) - (Pi/Ti)]$

$C = (HSF) * 10,000/Vsc$

$E = (6.243E-8) * C * Qs * 60$

METHOD 7A NOx CALCULATIONS

PLANT: McKay Bay RTE SOURCE: Unit No. 3

DATE: 10-3-89

RUN 1

SAMPLE NO. =	1	2	3	4
FLASK VOL. =	2000 ml	2031 ml	2025 ml	2018 ml
Pi=	0.63 "Hg	0.53 "Hg	0.53 "Hg	0.53 "Hg
Pf=	27.63 "Hg	28.63 "Hg	28.03 "Hg	28.58 "Hg
Ti=	299 K	298.5 K	299.5 K	303 K
Tf=	297 K	296 K	296.5 K	296.5 K
Vsc=	1758.5 ml	1865.2 ml	1816.9 ml	1847.1 ml
HSF=	73 ug	81 ug	68 ug	88 ug
Qs=	33645 DSCFM	33645 DSCFM	33645 DSCFM	33645 DSCFM
C=	415 mg/dscm	434 mg/dscm	374 mg/dscm	476 mg/dscm
E=	52.3 lb/hr	54.7 lb/hr	47.2 lb/hr	60.0 lb/hr

RUN 2

SAMPLE NO. =	1	2	3	4
FLASK VOL. =	2003 ml	1990 ml	2032 ml	2032 ml
Pi=	0.64 "Hg	0.54 "Hg	0.54 "Hg	0.54 "Hg
Pf=	27.43 "Hg	29.63 "Hg	27.73 "Hg	28.83 "Hg
Ti=	304 K	305 K	308 K	302 K
Tf=	296.5 K	296.5 K	297 K	297.5 K
Vsc=	1751.2 ml	1888.9 ml	1800.6 ml	1869.5 ml
HSF=	81 ug	73 ug	75 ug	73 ug
Qs=	33393 DSCFM	33393 DSCFM	33393 DSCFM	33393 DSCFM
C=	463 mg/dscm	386 mg/dscm	417 mg/dscm	390 mg/dscm
E=	57.9 lb/hr	48.3 lb/hr	52.1 lb/hr	48.8 lb/hr

RUN 3

SAMPLE NO. =	1	2	3	4
FLASK VOL. =	2029 ml	2005 ml	1994 ml	2003 ml
Pi=	0.4 "Hg	0.5 "Hg	0.5 "Hg	0.6 "Hg
Pf=	27.73 "Hg	28.03 "Hg	27.63 "Hg	27.88 "Hg
Ti=	308.5 K	306.5 K	305 K	305 K
Tf=	298.5 K	298.5 K	298.5 K	299 K
Vsc=	1797.7 ml	1789.1 ml	1753.2 ml	1768.0 ml
HSF=	91 ug	89 ug	91 ug	110 ug
Qs=	33524 DSCFM	33524 DSCFM	33524 DSCFM	33524 DSCFM
C=	506 mg/dscm	497 mg/dscm	519 mg/dscm	622 mg/dscm
E=	63.6 lb/hr	62.5 lb/hr	65.2 lb/hr	78.1 lb/hr

Vsc = 9.7928 * (Vf-25) * [(Pf/Tf) - (Pi/Ti)]
C = (HSF) * 10,000/Vsc
E = (6.243E-8) * C * Qs * 60

METHOD 7A NOx CALCULATIONS

PLANT: McKay Bay RTE SOURCE: Unit No. 4

DATE: 10-2-89

RUN 1

SAMPLE NO. =	1	2	3	4
FLASK VOL. =	2000 ml	2031 ml	2025 ml	2018 ml
Pi=	0.57 "Hg	0.47 "Hg	0.47 "Hg	0.47 "Hg
Pf=	28.03 "Hg	28.33 "Hg	28.23 "Hg	28.63 "Hg
Ti=	302 K	302 K	302.5 K	302.5 K
Tf=	295 K	295 K	295.5 K	295.5 K
Vsc=	1801.2 ml	1856.0 ml	1840.6 ml	1860.6 ml
HSF=	66 ug	68 ug	76 ug	82 ug
Qs=	33645 DSCFM	33645 DSCFM	33645 DSCFM	33645 DSCFM
C=	366 mg/dscm	366 mg/dscm	413 mg/dscm	441 mg/dscm
E=	46.2 lb/hr	46.2 lb/hr	52.0 lb/hr	55.5 lb/hr

RUN 2

SAMPLE NO. =	1	2	3	4
FLASK VOL. =	2003 ml	1990 ml	2032 ml	2032 ml
Pi=	0.49 "Hg	0.49 "Hg	0.39 "Hg	0.39 "Hg
Pf=	27.93 "Hg	29.73 "Hg	28.03 "Hg	27.63 "Hg
Ti=	304.5 K	305 K	304.5 K	306 K
Tf=	296 K	296 K	296 K	296 K
Vsc=	1796.6 ml	1901.8 ml	1836.0 ml	1809.6 ml
HSF=	93 ug	95 ug	100 ug	100 ug
Qs=	33393 DSCFM	33393 DSCFM	33393 DSCFM	33393 DSCFM
C=	518 mg/dscm	500 mg/dscm	545 mg/dscm	553 mg/dscm
E=	64.8 lb/hr	62.5 lb/hr	68.1 lb/hr	69.1 lb/hr

RUN 3

SAMPLE NO. =	1	2	3	4
FLASK VOL. =	2029 ml	2005 ml	1994 ml	2003 ml
Pi=	0.37 "Hg	0.37 "Hg	0.47 "Hg	0.47 "Hg
Pf=	27.93 "Hg	28.03 "Hg	27.63 "Hg	27.53 "Hg
Ti=	305 K	304.5 K	306 K	307 K
Tf=	295.5 K	296 K	296 K	296.5 K
Vsc=	1831.1 ml	1812.6 ml	1770.3 ml	1768.9 ml
HSF=	100 ug	86 ug	91 ug	80 ug
Qs=	33524 DSCFM	33524 DSCFM	33524 DSCFM	33524 DSCFM
C=	546 mg/dscm	474 mg/dscm	514 mg/dscm	452 mg/dscm
E=	68.6 lb/hr	59.6 lb/hr	64.6 lb/hr	56.8 lb/hr

Vsc = 9.7928 * (Vf-25) * [(Pf/Tf) - (Pi/Ti)]
C = (HSF) * 10,000/Vsc
E = (6.243E-8) * C * Qs * 60

WHEELABRATOR MCKAY BAY, INC.
TAMPA, FLORIDA

Client Reference No: Letter Agreement
CAE Project No: 7784-1

PROJECT OVERVIEW

Table 1-1:
Summary of Test Results

Source / Constituent	Sampling Method	Average Emission	Permit Limit[1]
Unit 1 ESP Outlet			
Particulate (gr/dscf @ 12% CO_2)	EPA M5	0.0065	0.025
Particulate (lb/hr)	EPA M5	1.39	
Lead (lb/hr)	BIF Metals	0.0182	
Mercury (ug/dscm @ 7% O_2)	EPA M101A	132	
Mercury (lb/hr)	EPA M101A	0.0124	
Unit 2 ESP Outlet			
Particulate (gr/dscf @ 12% CO_2)	EPA M5	0.0055	0.025
Particulate (lb/hr)	EPA M5	1.17	
Lead (lb/hr)	BIF Metals	0.0293	
Mercury (ug/dscm @ 7% O_2)	EPA M101A	147	
Mercury (lb/hr)	EPA M101A	0.0133	
Unit 3 ESP Outlet			
Particulate (gr/dscf @ 12% CO_2)	EPA M5	0.0037	0.025
Particulate (lb/hr)	EPA M5	0.83	
Lead (lb/hr)	BIF Metals	0.0137	
Mercury (ug/dscm @ 7% O_2)	EPA M101A	111	
Mercury (lb/hr)	EPA M101A	0.0103	
Unit 4 ESP Outlet			
Particulate (gr/dscf @ 12% CO_2)	EPA M5	0.0035	0.025
Particulate (lb/hr)	EPA M5	0.71	
Lead (lb/hr)	BIF Metals	0.0182	
Mercury (ug/dscm @ 7% O_2)	EPA M101A	373	
Mercury (lb/hr)	EPA M101A	0.0322	
Combined Units 1 through 4			
Particulate (lb/hr)	EPA M5	4.1	27.9
Lead (lb/hr)	BIF Metals	0.079	3.1
Mercury (lb/hr)	EPA M101A	0.068	0.6

[1] Permit limits obtained from Wheelabrator McKay Bay, Inc. permit number: AO29-206279 issued pursuant to Section 403.087, Florida Statutes.

The test conditions and results of analysis are presented in Table 2-1 through Table 2-10 on pages 2-1 through 2-10.

Post-It™ brand fax transmittal memo 7671 | # of pages ▸ 5

To Cynthia Hibbard	From D. Strobridge
Co.	Co.
Dept.	Phone #
Fax #	Fax #

WHEELABRATOR MCKAY BAY, INC.
TAMPA, FLORIDA

Client Reference No: Letter Agreement
CAE Project No: 7784-1

RESULTS

Table 2-7:
Unit 1 ESP Outlet - Mercury Emissions

Run No.	1	2	3	Average
Date (1996)	October 3	October 3	October 3	
Start Time (approx.)	07:30	10:05	12:57	
Stop Time (approx.)	09:41	12:34	15:02	
Gas Conditions				
O_2 Oxygen (dry volume %)	11.2	11.3	11.5	11.3
CO_2 Carbon dioxide (dry volume %)	8.3	8.3	8.4	8.3
T_s Temperature (°F)	501	500	498	500
B_{ws} Moisture (volume %)	15.76	15.06	14.65	15.16
Volumetric Flow Rate				
Q_a Actual conditions (acfm)	78,730	78,030	76,760	77,840
Q_{std} Standard conditions (dscfm)	36,250	36,270	35,930	36,150
Mercury				
C Concentration, standard conditions (µg/dscm)	99.6	109	66.0	91.4
C Corrected to 7% O_2 (µg/dscm)	143	157	97.5	132
C Corrected to 12% CO_2 (µg/dscm)	144.020	156.974	94.234	131.742
E Emission rate (lb/hr)	0.0135	0.0148	0.00888	0.0124

WHEELABRATOR MCKAY BAY, INC.
TAMPA, FLORIDA

Client Reference No: Letter Agreement
CAE Project No: 7784-1

RESULTS

Table 2-8:
Unit 2 ESP Outlet - Mercury Emissions

Run No.	1	2	3	Average
Date (1996)	October 3	October 3	October 3	
Start Time (approx.)	07:30	10:17	12:52	
Stop Time (approx.)	09:41	12:27	15:02	
Gas Conditions				
O_2 Oxygen (dry volume %)	11.1	11.4	11.5	11.3
CO_2 Carbon dioxide (dry volume %)	8.5	8.2	8.1	8.3
T_s Temperature (°F)	513	519	521	518
B_{ws} Moisture (volume %)	15.91	15.21	15.76	15.63
Volumetric Flow Rate				
Q_a Actual conditions (acfm)	75,540	78,560	78,920	77,670
Q_{std} Standard conditions (dscfm)	34,300	35,710	35,530	35,200
Mercury				
C Concentration, standard conditions (µg/dscm)	103	128	71.3	101
C Corrected to 7% O_2 (µg/dscm)	147	188	105	147
C Corrected to 12% CO_2 (µg/dscm)	146.025	187.702	105.891	146.473
E Emission rate (lb/hr)	0.0133	0.0172	0.00951	0.0133

WHEELABRATOR MCKAY BAY, INC.
TAMPA, FLORIDA

Client Reference No: Letter Agreement
CAE Project No: 7784-1

RESULTS

Table 2-9:
Unit 3 ESP Outlet - Mercury Emissions

Run No.	1	2	3	Average
Date (1996)	October 1	October 1	October 1	
Start Time (approx.)	07:40	10:28	13:19	
Stop Time (approx.)	09:55	12:50	15:29	
Gas Conditions				
O_2 Oxygen (dry volume %)	11.8	11.9	12.0	11.9
CO_2 Carbon dioxide (dry volume %)	8.0	7.9	7.9	7.9
T_s Temperature (°F)	533	530	534	532
B_{wo} Moisture (volume %)	15.58	14.88	14.92	15.12
Volumetric Flow Rate				
Q_a Actual conditions (acfm)	86,210	86,740	85,700	86,220
Q_{std} Standard conditions (dscfm)	38,500	39,120	38,480	38,700
Mercury				
C Concentration, standard conditions (μg/dscm)	65.1	44.4	105	71.4
C Corrected to 7% O_2 (μg/dscm)	99.5	68.6	164	111
C Corrected to 12% CO_2 (μg/dscm)	97.690	67.425	159.096	108.070
E Emission rate (lb/hr)	0.00939	0.00650	0.0151	0.0103

WHEELABRATOR MCKAY BAY, INC.
TAMPA, FLORIDA

Client Reference No: Letter Agreement
CAE Project No: 7784-1

RESULTS

Table 2-10: Unit 4 ESP Outlet - Mercury Emissions

Run No.		1	2	3	Average
Date (1996)		October 1	October 1	October 1	
Start Time (approx.)		07:40	10:24	13:02	
Stop Time (approx.)		09:51	12:36	15:13	
Gas Conditions					
O_2	Oxygen (dry volume %)	12.0	12.0	12.0	12.0
CO_2	Carbon dioxide (dry volume %)	7.8	7.6	7.6	7.7
T_s	Temperature (°F)	474	472	480	476
B_{wo}	Moisture (volume %)	15.12	15.44	16.03	15.53
Volumetric Flow Rate					
Q_a	Actual conditions (acfm)	75,350	74,930	79,040	76,440
Q_{std}	Standard conditions (dscfm)	36,010	35,760	37,120	36,300
Mercury					
C	Concentration, standard conditions (µg/dscm)	80.0	555	81.9	239
C	Corrected to 7% O_2 (µg/dscm)	126	866	128	373
C	Corrected to 12% CO_2 (µg/dscm)	123.109	875.666	129.311	376.028
E	Emission rate (lb/hr)	0.0108	0.0743	0.0114	0.0322

Application

City of Tampa, Florida
Environmental Services

McKay Bay Refuse-to-Energy Facility
Air Pollution Control Equipment and
Facility Improvements

Source Modification Construction
Air Permit Application

Volume II

Application for Air Permit-
Long Form No. 62-210.900(1)

Prepared by:

Camp Dresser & McKee Inc.
Tampa, Florida

RTP Environmental Associates Inc.
Green Brook, New Jersey

September 1997

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BUREAU OF
AIR REGULATION

CDM Camp Dresser & McKee Inc.

consulting
engineering
construction
operations

1715 North Westshore Boulevard, Suite 875
Tampa, Florida 33607
Tel: 813 281-2900 Fax: 813 288-8787

50th 1947-1997 Anniversary

September 12, 1997

Mr. Clair Fancy, Chief
Bureau of Air Regulation
Florida Department of Environmental Protection
MS 5505
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Subject: City of Tampa McKay Bay Refuse to Energy Facility
Air Pollution Control (APC) Retrofit

0570127-002-AC

Dear Mr. Fancy:

Accompanying this letter are 5 copies of Tampa's Source Modification Construction Air Permit Application to allow the construction of new APC equipment and other Facility improvements in order to meet the Emission Guidelines for Municipal Waste Combustors [pursuant to 40 CFR 60 Subpart Cb as adopted in FAC 62-204.800(8)]. Also enclosed is a check in the amount of two hundred fifty dollars ($250), the permit fee quoted by Mr. Al Verona and Ms. Theresa Heron.

If you have any questions or comments, do not hesitate to contact me.

Sincerely,

CAMP DRESSER & McKEE INC.

Daniel E. Strobridge
Associate

c: J. Campbell, Hillsborough County EPC
N. McCann, City of Tampa
D. Elias, RTP
D. Dee, Landers and Parsons

S:\TAMPA\MCKAYAPC\TB97.010

CITY OF TAMPA   TAMPA, FLORIDA   NO. 490894

DEPT. OF ENVIR. PROTECTION   3655245   08 05 97   0490894

INVOICE #	P/O NUMBER	FND	DEP	ACCT. NO.	OBJ.	GROSS AMOUNT	DISC. AMOUNT	NET AMOUNT
0000797	Y1806183	440	180	534101	4906	250.00		250.00
								250.00

DETACH HERE BEFORE DEPOSITING

CITY OF TAMPA
TAMPA, FLORIDA

POOL CASH

NO. 490894

VOID - 90 DAYS AFTER DATE OF ISSUE

05 AUG 97

FIRST UNION NATIONAL BANK OF FLORIDA

0490894 63-1012/632

PAY TWO HUNDRED FIFTY AND/00/100 DOLLARS--------------

$250.00 AMOUNT

TO THE ORDER OF

DEPT. OF ENVIR. PROTECTION
2600 BLAIRSTONE RD.
TALLAHASSEE FL 32399

MAYOR

DIRECTOR OF FINANCE

⑈490894⑈ ⑆063210125⑆ 2079910007148⑈

CITY OF TAMPA **TAMPA, FLORIDA** NO. 490775

ENVIRONMENTAL PROTECTION COM 2516942 08 05 97 0490775

INVOICE #	P/O NUMBER	FND	DEP	ACCT. NO.	OBJ.	GROSS AMOUNT	DISC. AMOUNT	NET AMOUNT
0000797	Y1806184	440	180	534101	4906	800.00		800.00
								800.00

DETACH HERE BEFORE DEPOSITING

CITY OF TAMPA
TAMPA, FLORIDA

POOL CASH

NO. 490775

VOID - 90 DAYS AFTER DATE OF ISSUE

05 AUG 97

FIRST UNION NATIONAL BANK OF FLORIDA

0490775 63-1012/632

PAY EIGHT HUNDRED AND 00/100 DOLLARS------------------

$800.00 AMOUNT

TO THE ORDER OF

ENVIRONMENTAL PROTECTION COM
MISSION OF HILLS CTY (EPC/HC
1900 9TH AVENUE
TAMPA FL 33605

MAYOR

DIRECTOR OF FINANCE

⑈490775⑈ ⑆063210125⑆ 2079910007148⑈

CDM Camp Dresser & McKee Inc.

consulting
engineering
construction
operations

1715 North Westshore Boulevard, Suite 875
Tampa, Florida 33607
Tel: 813 281-2900 Fax: 813 288-8787

50th 1947-1997 Anniversary

September 12, 1997

Mr. Jerry Campbell, Senior Professional Engineer
Hillsborough County Environmental Protection Commission
1410 North 21st Street
Tampa, Florida 33605

Subject: City of Tampa McKay Bay Refuse to Energy Facility
Air Pollution Control (APC) Retrofit

Dear Mr. Campbell:

Accompanying this letter is 1 copy of Tampa's Source Modification Construction Air Permit Application to allow the construction of new APC equipment and other Facility improvements in order to meet the Emission Guidelines for Municipal Waste Combustors [pursuant to 40 CFR 60 Subpart Cb as adopted in FAC 62-204.800(8)]. Also enclosed is a check in the amount of eight hundred dollars ($800), the permit fee.

If you have any questions or comments, do not hesitate to contact me.

Sincerely,

CAMP DRESSER & McKEE INC.

Daniel E. Strobridge
Associate

c: C. Fancy, FDEP
N. McCann, City of Tampa
D. Elias, RTP
D. Dee, Landers and Parsons

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