STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION

TWIN TOWERS OFFICE BUILDING
2600 BLAIR STONE ROAD
TALLAHASSEE, FLORIDA 32301-8241

BOB GRAHAM
GOVERNOR

VICTORIA J. TSCHINKEL
SECRETARY

December 23, 1986

Mr. Wayne Aronson
Air Programs Branch
Air, Pesticides, and Toxics
 Management Division
U.S. EPA - Region IV
345 Courtland Street, N.E.
Atlant, Georgia 30365

Dear Mr. Aronson:

Re: Final Determination - South Broward County Resource Recovery Facility

In response to Mr. Bruce Miller's request of October 9, 1986, and several recent discussions with Barry Andrews we have prepared the final determination for the above referenced project and have enclosed a copy of the public notice. Because we have the final determination on our word processor, we will make any changes that you wish and send you a corrected copy of the appropriate pages the next day. Please call any changes directly to Barry Andrews at (904)488-1344.

Sincerely,

C. H. Fancy, P.E.
Deputy Chief
Bureau of Air Quality
 Management

CHF/ks

cc: Tom Henderson
Gary Carlson
Isidore Goldman

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ELECTRICAL POWER PLANT ON A SITE TO BE LOCATED NEAR FORT LAUDERDALE, FLORIDA

Application number PA 85-21 for certification to authorize construction eration of an electrical power plant near Fort Lauderdale, Florida, is ing before the Department of Environmental Regulation, pursuant to a Electrical Power Plant Siting Act, Part II, Chapter 403, F.S. Certifi- of this power plant would allow construction and operation of a new ce of air pollution which would consume an increment of air quality res- ces. The department review has resulted in an assessment of the preven- of significant deterioration impacts and a determination of the Best Avai- e Control Technology necessary to control the emission of air pollutants m this source.

2. The proposed 248 acre resource recovery and landfill site is located in unincorporated Broward County at the southeast quadrant of the intersection of U.S. 441 and State Road 84. The facility site is directly across the South Fork New River Canal from a Florida Power and Light Company power plant. The proposed plant will consist initially of a 68.5 MW unit Solid Waste-Fired Energy Recovery facility. The power plant will be owned by a vendor with Broward County as the prime customer or "anchor tenant" of the project.

3. The Department of Environmental Regulation is evaluating the application for the proposed power plant. Certification of the plant would allow its construction and operation. The application is available for public inspection at the addresses listed below.

STATE OF FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32301

STATE OF FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION
South Florida District Office
3301 Gun Club Road
West Palm Beach, Florida 33402

BROWARD COUNTY RESOURCE RECOVERY OFFICE
Room 521, 115 South Andrews Avenue
Fort Lauderdale, Florida 33301

SOUTH FLORIDA WATER MANAGEMENT DISTRICT
3301 Gun Club Road
West Palm Beach, Florida 33402

BROWARD COUNTY RIVERLAND BRANCH LIBRARY
2710 West Davie Boulevard
Fort Lauderdale, Florida 33312

MAIN LIBRARY
100 South Andrews Avenue
Fort Lauderdale, Florida 33301

4. Pursuant to Section 403.508, Florida Statutes, the certification hearing will be held by the Division of Administrative Hearings on November 12, 1985, at 9:30 a.m. in the Auditorium, Davie-Cooper City Library, 4600 S.W. 82nd Avenue, Davie, Florida, in order to take written or oral testimony on the to the consideration of the site. Need for the facility has been predetermined by the Public Service Commission at a separate hearing. Written comments may be sent to William J. Kendrick (Hearing Officer) at Division of Administrative Hearings, 2009 Apalachee Parkway, Tallahassee, Florida, 32301 on or before November 5, 1985.

5. Pursuant to 403.508, F.S.: "(a) Parties to the proceeding shall include: the applicant; the Public Service Commission; the Division of State Planning; the water management district as defined in Chapter 373, in whose jurisdiction the proposed electrical power plant is to be located; and the Department. (b) Upon the filing with the Department of a notice of intent to be a party at least 15 days prior to the date set for the land use hearing, the following shall also be parties to the proceeding:

1. Any county or municipality in whose jurisdiction the proposed electrical power plant is to be located.

2. Any state agency not listed in paragraph (a) as to matters within its jurisdiction.

3. Any domestic non-profit corporation or association formed in whole or in part to promote conservation or natural beauty; to protect the environment, personal health, or other biological values; to preserve historical sites; to promote consumer interests; to represent labor, commercial or industrial groups; or to promote orderly development of the area in which the proposed electrical power plant is to be located. (c) Notwithstanding paragraph (4) (d), failure of an agency described in subparagraphs (4) (b) 1 and (4) (b) 2 to file a notice of intent to be a party within the time provided herein shall constitutes a waiver of the right of the agency to participate as a party in the proceedings. (d) Other parties may include any person, including those persons enumerated in paragraph (4) (b) who failed to timely file a notice of intent to be a party, whose substantial interests are affected and being determined by the proceeding and who timely file a motion to intervene pursuant to Chapter 120, F.S., and applicable rules. Intervention pursuant to this paragraph may be granted at the discretion of the designated hearing officer and upon such conditions as he may prescribe any time prior to 15 days before the commencement of the certification hearing. (e) Any agency whose properties or works are being affected pursuant to s.403.509 (2) shall be made a party upon the request of the department or the applicant.

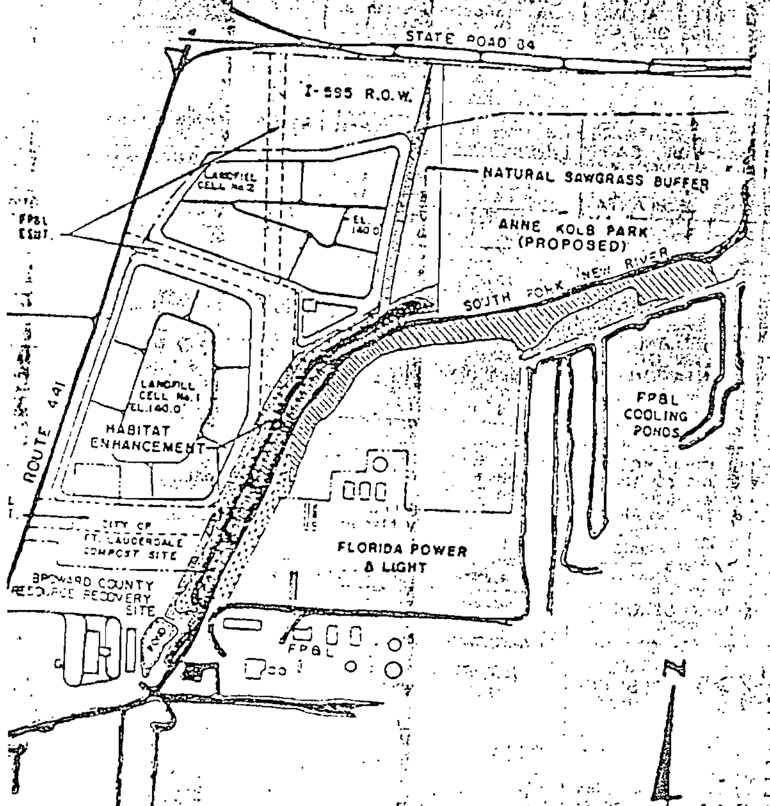
6. When appropriate, any person may be given an opportunity to present oral or written communications to the designated hearing officer. If the designated hearing officer proposes to consider such communication, then all parties shall be given an opportunity to cross-examine or challenge or rebut such communications.

7. Notices of petitions made prior to the hearing should be made in writing to:

Mr. William J. Kendrick
Division of Administrative Hearings
Oakland Office Building
2009 Apalachee Parkway

8. Those wishing to intervene in these proceedings must be represented by an attorney or other person who can be determined to be qualified to appear in administrative proceedings pursuant to Chapter 120, F.S., or Chapter 17-103.020, FAC.

9. This Public Notice is also provided in compliance with the federal Coastal Zone Management Act, as specified in 15 CFR Part 930, Subpart D. Public comments on the applicant's federal consistency certification should be directed to the Federal Consistency Coordinator, Division of Environmental Permitting, Department of Environmental Regulation.



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NOTICE OF CERTIFICATION HEARING ON AN APPLICATION TO CONSTRUCT AND OPERATE AN ELECTRICAL POWER PLANT ON A SITE TO BE LOCATED NEAR FORT LAUDERDALE, FLORIDA

1. Application number PA 85-21 for certification to authorize construction and operation of an electrical power plant near Fort Lauderdale, Florida, is now pending before the Department of Environmental Regulation, pursuant to the Florida Electrical Power Plant Siting Act, Part II, Chapter 403, F.S. Certification of this power plant would allow construction and operation of a new source of air pollution which would consume an increment of air quality resources. The department review has resulted in an assessment of the prevention of significant deterioration impacts and a determination of the Best Available Control Technology necessary to control the emission of air pollutants from this source.

2. The proposed 248 acre resource recovery and landfill site is located in unincorporated Broward County at the southeast quadrant of the intersection of U.S. 441 and State Road 84. The facility site is directly across the South Fork New River Canal from a Florida Power and Light Company power plant. The proposed plant will consist initially of a 68.5 MW unit Solid Waste-Fired Energy Recovery facility. The power plant will be owned by a vendor with Broward County as the prime customer or "anchor tenant" of the project.

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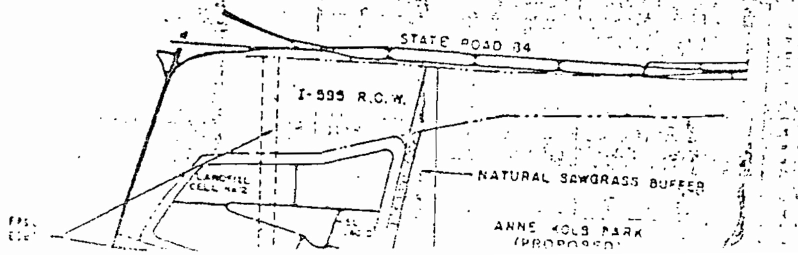

Final Determination and Permit

South Broward County Resource Recovery Facility

Broward County, Florida

PSD-FL-105

Prevention of Significant Deterioration

40 CFR 52.21

Review performed by Florida Department of
Environmental Regulation

December 19, 1986

I. INTRODUCTION

Pursuant to Section 403.505, Florida Statutes, South Broward Resource Recovery Project, Inc. (County) applied to the Florida Department of Environmental Regulation (DER) in April 1985 for certification of a steam electric generating, solid waste energy recovery facility at a site near the intersection of the U.S. Route 441 and State Road 84 in Broward County, Florida. After a thorough review by DER, including public hearings, the Florida Power Plant Siting Board issued a site certification to the County. At the time, DER believed that such a site certification constituted a legal prevention of significant deterioration (PSD) permit under Chapter 17-2.500 of the Florida air pollution regulations which had been approved by the U.S. Environmental Protection Agency (EPA) on December 22, 1983. In the summer of 1985, EPA became aware that the Florida Electrical Power Plant Siting Act (PPSA) under which the site certification was issued, restricts the authority of the State of Florida to implement any regulation pertaining to power plants other than those set out in the Act. Consequently, EPA determined that the Florida PSD regulations are superceded by the PPSA, and could not legally be approved by EPA as part of the State Implementation Plan (SIP) since the PPSA does not comply in part (as to PPSA covered sources) with EPA PSD regulations both procedurally and substantively. Thus, EPA concluded that the South Broward County SWA resource recovery facility (RRF), could not be granted a valid PSD permit under PPSA.

Broward County applied to DER for a PSD permit. By that time, DER had been given authority by EPA to conduct the technical and administrative steps of the federal PSD permitting process.

The applicant plans to construct a 3300 tons per day (TPD) solid waste-to-energy facility to be located near the intersection of the U.S. Route 441 and State Road 84 in Broward County, Florida. The municipal solid waste (MSW) will be combusted to produce steam for power generation.

The present plans are to construct three 750 ton per day MSW incinerators. An ultimate maximum capacity of 3300 tons per day is anticipated in the future which will require the addition of a fourth incinerator. The applicant requests that each unit be permitted at 115% of their rated capacity.

At rated capacity each of the three energy recovery units will have an approximate heat input of 281 million Btu per hour based on a heat content of 4,500 Btu/lb for MSW. Each incinerator will be scheduled to operate 8760 hours per year and on this basis the tonnage of the various air pollutants emitted were calculated.

II. Rule Applicability

The proposed site of the South Broward County RRF is in an area designated as nonattainment for ozone under 40 CFR 81.310, and attainment for all other criteria pollutants.

New major sources which emit attainment pollutants regulated under the Clean Air Act in amounts greater than certain significance levels, are subject to 40 CFR 52.21, Prevention of Significant Deterioration (PSD). The significance levels are specified by the PSD regulations.

New major sources in Broward County which are subject to the PPSA and which are major for a nonattainment pollutant will be subject to 40 CFR 52.24, statutory restriction on new stationary sources (construction ban). New municipal incinerators capable of charging greater than 50 TPD are also subject to 40 CFR 60, Subpart E, New Source Performance Standards (NSPS).

New municipal incinerators with a charging rate equal to or greater than 50 TPD are also subject to Florida Rule 17-2.600(1)(c).

The applicant is proposing the construction of a facility capable of handling and incinerating 2588 TPD of municipal solid waste. In the future, the facility will be expanded to handle and incinerate 3300 TPD of MSW.

The average annual emissions from the unit for all regulated pollutants have been estimated by the applicant.

The proposed source has the potential to emit more than 100 tons per year of one or more regulated pollutants and is, therefore, subject to review for Prevention of Significant Deterioration (PSD) under 40 CFR 52.21. PSD review includes, among other requirements, a determination of Best Available Control Technology (BACT) and an air quality impact analysis for each attainment and noncriteria pollutant that would be emitted in a significant amount. For the proposed source, the applicant has addressed PSD review for the nine pollutants which will be emitted in significant amounts: PM, SO_2, CO, NO_x, Pb, Hg, Be, fluorides, and sulfuric acid mist.

The proposed source will emit less than 100 TPY of VOC (precursor of ozone), and is thus not subject to the construction ban of 40 CFR 52.24. The proposed incinerator will have a charging rate of 2588 tons per day, and thus is subject to NSPS and 17-2.600(1)(c). NSPS requires that the source meet a particulate emission rate of 0.08 grains per dry standard cubic foot (gr/dscf), corrected to 12% CO_2. Regulation 17-2.600(1)(c) requires each incinerator to emit no more than .08 gr/dscf particulate corrected to 50% excess air.

III. Preliminary Determination

The proposed source will result in significant emissions of the criteria pollutants PM, SO_2, CO, NO_x, and lead, and of the non-criteria pollutants beryllium, mercury, fluorides, and sulfuric acid mist.

The review required under the prevention of significant deterioration (PSD) regulations for these pollutants includes:

Compliance with all applicable SIP, NSPS, and National Emission Standards for Hazardous Pollutants (NESHAP) regulations

BACT

An analysis of existing air quality;

A PSD increment analysis (for SO_2 and PM only);

An Ambient Air Quality Standards (AAQS) analysis;

An analysis of impacts on soils, vegetation, visibility, and growth-related air quality impacts, and;

A "Good Engineering Practice" (GEP) stack height determination.

The analysis of existing air quality generally relies on preconstruction monitoring data collected in accordance with EPA-approved methods. The PSD increment and AAQS analyses depend on air quality dispersion modeling carried out in accordance with EPA guidelines. BACT is specified on a case-by-case basis considering environmental, economic, and energy impacts.

Based on these required analyses, the Department has reasonable assurance that the proposed units at the South Broward County RRF, as described in this report and subject to the conditions of approval proposed herein, will employ BACT, will not cause or contribute to a violation of any PSD increment or ambient air quality standard, and will comply with all appplicable air pollution regulations. A discussion of all review components follows.

IV. Control Technology Review

a. BACT Determination

40 CFR 52.21 (j) requires that each pollutant subject to PSD review must be controlled by BACT. Nine pollutants are subject

to BACT. The BACT emission limits proposed by the Department are summarized as follows:

Pollutant	BACT
Particulate Matter	0.015 gr/dscf, corrected to 12% CO_2
Sulfur Dioxide	2.8 lb/ton
Nitrogen Oxides	5.0 lb/ton
Carbon Monoxide	0.8 lb/ton
Lead	0.009 lb/ton*
Mercury	2300 grams/day*
Beryllium	8.4×10^{-6} lb/ton
Fluorides	0.016 lb/ton*
Sulfuric Acid Mist	7.7×10^{-3} lb/ton*

*These emission limitations are based on the determination that BACT is a scrubber and high efficiency particulate control (0.015 gr/dscf, corrected to 12% CO_2). The emission limit for mercury is for each unit.

Also included as proposed permit conditions are limits on opacity, and VOC. These limits are required to insure the emissions of VOC do not exceed the threshold level for applicability of the construction ban.

The applicant plans to construct a 3300 ton per day (TPD) solid waste-to-energy facility to be located near the intersection of the U.S. Route 441 and State Road 84 in Broward County, Florida. The municipal solid waste (MSW) will be combusted to produce steam for power generation.

The present plans are to construct a 2250 ton per day MSW processing facility and later add an additional 1050 TPD capacity. The initial ultimate plant capacity is 2588 TPD MSW 115% of rated capacity. The applicant desires to permit the facility at this ultimate capacity.

Each of the three energy recovery units will have an approximate maximum heat input of 281 million Btu per hour based on a heat content of 4,500 Btu/lb for RDF. Each incinerator will be scheduled to operate 8760 hours per year and on this basis the tonnage of the various air pollutants emitted were calculated.

Based upon air pollutant emission factors provided by the applicant, the calculated total annual tonnage of regulated air pollutants emitted from the units to the atmosphere is listed as follows:

Pollutant		Maximum Annual Emissions (tons/Year)	PSD Significant Emissions Rate (tons/year)
Particulate	(PM)	328	25
Sulfur Dioxide	(SO_2)	2319	40
Nitrogen Dioxide	(NO)	2361	40
Carbon Monoxide	(CO)	378	100
Ozone	(O_3)	57 (VOC)	40
Lead	(Pb)	128	0.6
Mercury	(Hg)	3.9	0.1
Beryllium	(Be)	0.0040	0.0004
Fluorides	(F)	109	3
Sulfuric Acid Mist	(H_2SO_4)	200	7

BACT Determination Requested by the Applicant:

The following emission limits are based upon a unit ton of MSW charged.

PM -	0.67 lbs	CO -	0.80 lbs	Hg -	0.0083 lbs
SO_2 -	4.95 lbs	Pb -	0.027 lbs	F -	0.16 lbs
NOx -	5.00 lbs	Be -	8.4×10^{-6}	VOC -	0.12 lbs

An electrostatic precipitator (ESP) will be used to control the particulate, Pb, Hg, and Be emissions. Design and operating procedures will control the emission of VOC, CO and NO_x. The firing of only RDF, a low sulfur content fuel, will limit SO_2.

Each MSW incinerator will have a charging rate more than 50 tons per day, and therefore, is subject to the provisions of 40 CFR 60.50, Subpart E, New Source Performance Standards (NSPS). The NSPS standard regulates only particulate matter. The particulate matter standard is 0.08 grains/dscf, corrected to 12% CO_2. This NSPS was promulgated in 1971 and no longer reflects state-of-the-art for control of particulate emissions. Recent stack testing data for MSW incinerators indicates that both electrostatic precipitator and fabric filter control technology are capable of controlling particulate emissions well below the applicant's proposal of 0.03 grains/dscf. Based on the control technology available a particulate matter emission limit of 0.015 grains/dscf corrected to 12% CO_2 is judged to represent BACT. All the other requirements as set forth in the NSPS, Subpart E, will apply.

The Department has determined the emission limit for SO_2 to be 2.8 pounds per ton of MSW charged into the incinerator. MSW components that appear to be major contributors of sulfur include rubber, plastics, leather, paper, and paper products.

The SO_2 emission limit was determined to be BACT by evaluating limits set for similar facilities in Florida and other states, determinations which have indicated that an emission limit of 2.8 pounds per ton of MSW charged is reasonable based on the heat content of the fuel. The amount of SO_2 emitted would be comparable to the burning of distillate oil having less than a 0.5% sulfur content. Burning low sulfur fuel is one acceptable method of controlling SO_2 emissions. The installation of a flue gas desulfurization system to control SO_2 emissions alone is not warranted when burning MSW.

The emission limit determined as BACT for mercury is equal to the National Emission for Hazardous Air Pollutants (NESHAPs), 40 CFR 61.50, Subpart E. The BACT is determined to be 2300 grams per day for each unit. This level of mercury emissions is judged to be reasonable based on test data from similar facilities and the degree of control that will be provided by the acid gas and particulate control equipment which have been determined to be BACT for this facility.

This level of mercury emissions is not considered to have a major impact on the environment.

The uncontrolled emission of beryllium, according to the California report, when firing MSW is estimated to be 6.2×10^{-6} pounds per million Btu. Uncontrolled beryllium emissions would be approximately 11 grams per 24 hours or 0.01 TPY. The operating temperature of the particulate matter emission control device will be below 500°F. Operation below this temperature is necessary to force adsorption/condensation of beryllium oxides, present in the flue gas stream onto available fly ash particles for subsequent removal by the particulate control device. The annual beryllium emissions are estimated at 0.0007 tons per year. This amount of beryllium emitted is considered to have a negligible impact on the environment. The emission factor of 8.4×10^{-6} lb/ton MSW proposed by the applicant is judged to be BACT. If, however, beryllium containing waste as defined in the National Emission Standards for Hazardous Air Pollutants (NESHAPs), Subpart C, Subsection 61.31(g), is charged into the incinerator, emissions of beryllium to the atmosphere shall not exceed 10 grams per 24 hours or an ambient concentration of 0.01

ug/m^3, 30 day average. Compliance with this beryllium emission limit will be in accordance with the NESHAPs, Subpart C.

The applicant has projected abated lead and fluoride(s) emissions to be 128 and 109 tons per year respectively. Projected sulfuric acid mist emissions are as high as 200 tons per year. These amounts are well in excess of the significant emission rates given in Florida Administrative Code Rule 17-2.500, Table 500-2.

With respect to lead emissions, two conditions are needed to achieve high removal efficiencies of metallic compounds emitted at refuse burning facilities: (1) operation of particulate matter control equipment at temperatures below 260°C (500°F), and (2) consistently efficient removal of submicron fly ash particles. The maximum temperature of the incinerator combustion gases at the inlet to the particulate control device is estimated to be 475°F. At this temperature the particulate control equipment would be capable of removing the lead emissions from the flue gas stream.

When flue gas temperatures are lowered below 260°C (500°F), metallic compounds are removed from the vapor phase by adsorption and condensation preferentially on fine particles with submicron particles receiving the highest concentrations of metals. Properly designed and operational fabric filter systems appear at this time to offer the best method for consistent and efficient removal of fine (and in particular submicron) fly ash. Removal efficiencies of fine fly ash using these systems can be in excess of 99% with respect to MSW incinerators. Studies have indicated the weight percent of submicron particles emitted from combustion is on the order of 45% which clearly indicates the need for efficient control of particles in this range.

The emission limit judged to be reasonable for lead is based on test results similar facilities and the degree of emission control that will be provided by the control equipment which has been determined to be BACT for this facility. In accordance with data contained in the California Air Resources Board (CARB) report on resource recovery facilities, the highest uncontrolled lead emission rate from refuse-fired incinerators tested is 16,000 ug/MJ. Based on a heating value of 4,500 Btu per pound of refuse and the control efficiency reported for lead emissions using the required BACT (scrubber and particulate control of 0.015 gr/dscf, corrected to 12% CO_2) and emission limitation of 0.009 lbs per ton of refuse charged is judged to be reasonable as BACT for lead emissions. Recent testing of a similar facility (Westchester, NY) indicates that for the average of 14 runs, lead emissions represented 1.4% of particulate emitted. This emission level is consistent with the BACT determination when the allowable particulate emission limit is taken into consideration.

Emissions of fluoride originate from a number of sources in the refuse. The mechanisms of governing fluoride release and formation of hydrogen fluoride at refuse-burning facilities are probably similar to those for hydrogen chloride. The control of fluorides can be reduced at refuse-burning plants by removal of selected refuse components with high fluoride contents, and the use of flue gas control equipment. In view of the fact that it is proposed to incinerate materials that contain fluoride, BACT for the control of fluorides is installation of a flue gas scrubber system. The addition of a scrubber system would also provide control for SO_2 emissions addressed earlier in this analysis as well as other acid gases which will be addressed in other sections of the analysis. Once again, the emission limit has been based on test results from similar facilities and the control equipment required for this facility.

During combustion of municipal solid waste, NO_x is formed in high temperature zones in and around the furnace flame by the oxidation of atmospheric nitrogen and nitrogen in the waste. The two primary variables that affect the formation of NO_x are the temperature and the concentration of oxygen. Techniques such as the method of fuel firing to provide correct distribution of combustion air between overfire and underfire air, exhaust gas recirculation, and decreased heat release rates have been used to reduce NO_x emission. A few add-on control techniques such as catalytic reduction with ammonia and thermal de-NO_x are still experimental and are not considered to be demonstrated technology for the proposed project. State-of-the-art control of the combustion variables wil be used to limit NO_x emissions at 5.0 pounds per ton charged. This level of control is judged to represent BACT.

Carbon monoxide is a product of incomplete combustion where there is insufficient air. Incomplete combustion will also result in the emissions of solid carbon particulates in the form of smoke or soot and unburned and/or partially oxidized hydrocarbons. Incomplete combustion results in the loss of heat energy to the boiler. The applicant proposes that good equipment design and practice plus continuous CO monitors are BACT for carbon monoxide. The department feels that an emission limit for carbon monoxide which would correspond to optimum combustion is needed. Based on technical information relating good combustion practices for the control of dioxin emissions and BACT determinations from other states, a limit of 0.8 pounds per ton of MSW charged is judged to represent BACT for carbon monoxide emissions.

Furthermore, CO has a calorific value of 4347 Btu/lb and when discharged to the atmosphere represents lost heat energy. Since heat energy is used to produce the steam which drives the generator to produce electric power, there is a strong economic incentive to minimize CO emissions.

Hydrocarbon emissions, like carbon monoxide emissions, result from incomplete oxidation of carbon compounds. Control of CO and HC emissions can be mutually supportive events. BACT for hydrocarbons is good combustion practices which correspond to the carbon monoxide limitation above.

Sulfur dioxide produced by combustion of sulfur containing materials can be oxidized to SO_3 which can then combine with water vapor to produce sulfuric acid mist. The applicant has estimated sulfuric acid mist emissions could be as high as 200 tons per year. This facility, thus, has the potential to be major for sulfuric acid mist and additional control is warranted. Flue gas scrubbers have demonstrated 90+% control of sulfuric acid mist emissions and are considered to be BACT for this proposed facility. As was the case with fluoride, the emission limit has been based on test results and the degree of control expected from the scrubber.

The type of air pollutants emitted when incinerating plastics depends on the atomic composition of the polymer. Plastics composed of only carbon and hydrogen or carbon, hydrogen and oxygen form carbon dioxide and water when completely combusted. Incomplete combustion yields carbon monoxide as the major pollutant.

Plastics containing nitrogen as a heteroatom yield molecular nitrogen, some NO_x, carbon dioxide, and water when completely combusted. Complete combustion of plastics containing halogen or sulfur heteroatoms form acid gases such as hydrogen chloride, hyrdogen fluoride, sulfur dioxide, carbon dioxide, and water. Halogen or sulfur compounds can form from incomplete combustion of the plastic. Polyvinyl chloride (PVC), one of the many polymers, has been implicated as causing the most serious disposal problem due to the release of hydrogen chloride (HCl) gas when incinerated. This problem has long been realized resulting in other polymers being used in packaging. For example, the weight percent of chlorine in polyurethane is 2.4, with only trace amounts in polyethylene and polystyrene, as compare to the weight percent of 45.3 in PVC.

A recent study of MSW incineration performed for the USEPA has indicated that the plastics content of refuse is expected to grow by from 300-400% from the year 1968 to 2000. This increase can be expected to increase uncontrolled HCl emissions from municipal waste incineration by roughly 400% from 1970 to the year 2000. Potential emissions of stated HCl from the incinerator are estimated to be as high as 5252 tons per year based on an emission factor of 11.12 lbs per ton of MSW incinerated.

Emissions of HCl at refuse incineration facilities can be reduced by removal of selected refuse components with high chlorine contents (source separation), combustion modification, and the use of flue gas control equipment. Although the combustor configuration may influence the amount of chlorine conversion, combustion modification is not a viable means of controlling HCl emissions.

Potential emissions of HCl can be reduced significantly by removing plastic items from the waste stream. This is particularly true when the plastics are the PVC type explained earlier. With the exception of limited recycling efforts, source separation of plastics has not been demonstrated and costs are uncertain at this time. In addition to this, the combustion of plastics may be favorable due to their relatively high heat of combustion.

Plastic materials have a high heat of combustion, for example, coated milk cartons - 11,300 Btu/lb, latex - 10,000 Btu/lb and polyethylene 20,000 Btu/lb. For comparison, newspaper and wood have a heat content of 8,000 Btu/lb, and kerosene 18,900 Btu/lb. Here again there is economic incentive to obtain as complete combustion as possible.

At this time flue gas controls are the most conventional means of reducing HCl emissions at refuse burning facilities. Based on the estimates of HCl emissions and the trend for increases due to higher percentages of plastics in future waste streams, the installation of a scrubber to control the acid gases would provide an added benefit of controlling HCl emissions.

An analysis of a proposal to construct a MSW incinerator in 1986 would not be complete unless the subject of dioxins was addressed.

Dioxin is a hazardous material that has received widespread public concern. It is found in trace amounts whenever substances containing chlorine (for example, plant and animal tissues and plastics) are burned. It is also an impurity that can be found in some herbicides, such as "2,4,5-T".

The applicant has stated that flue gas temperatures in excess of 1600°F (measured at the furnace outlet) result in greater than 99.99% destruction of dioxin. It has been proposed that the furnace will achieve gas temperatures in the radiant section of the furnace of approximately 2200°F. This temperatures combined with an exposure of at least two seconds is proposed as an effective control for dioxins.

Although the subject of dioxin is new, and relatively little is known, two important things stand out: 1) dioxin is readily minimized in properly designed and operated BACT-equipped facilities, and 2) very small amounts cause demonstrable health effects in experimental animals. Although most of the reduction in dioxin emissions is believed to take place in the combustion chamber, the installation of acid gas control and a high efficiency particulate control device (grain loading not to exceed 0.015 gr/dscf) has been reported to provide an additional control strategy to remove dioxins from the flue gases based on the assumption which is thought by many that dioxins can be adsorbed on the surface of particulate matter. Thus, the greater the TSP collection, especially submicron particles, the better the dioxin control.

Throughout this BACT determination much emphasis has been placed on the controls that are needed to satisfy the BACT requirements. Although the department does not have the authority to stipulate the type of control equipment that should be used on a facility (i.e., ESP vs. baghouse; dry vs. wet scrubber), a dry scrubber used in conjunction with fine particulate control appears to be the best method for controlling emissions from this type of facility.

Electrostatic precipitators (ESP's) without acid gas control remove total suspended particulates (TSP) only, collecting submicron particles with difficulty. Submicron particle collection can be done, but as with any control, effectiveness and reliability are questionable in this area. The justification for acid gas controls is clearly demonstrated in this analysis and test data show fabric filters to be less sensitive to changes in flue gas volumes, inlet concentrations, in particle resistivity than ESP's which have been historically employed at most refuse burning facilities.

The recommendation that a dry scrubber baghouse combination should be used as the control strategy for the resource recovery facility is not warranted if the economic costs of installing and operating the recommended control technology outweigh the benefits of controlling the pollutants that would be controlled by the equipment.

The applicant has stated that systems which would control SO_2 with 70 percent efficiency would result in costs which equate to 4.6 to 6.5 million (1983) dollars, based a scrubber availability factor of 90%.

A review of economic analyses performed for several proposed resource recovery facilities indicates that the highest cost of adding acid gas control was $4.37 (1984 dollars) per ton of MSW incinerated. This cost included amortized capital cost and annual operating cost. Equating this value to operating the proposed facility (2,250 tons per day) results in an annualized cost of approximately 3.6 million dollars. It should be noted that an accurate comparison of projected costs can only be determined by equating the amortization periods and including site specific costs for the various facilities. In any case the figures supplied by the applicant appear to the questionable and additional study is required to clearly define and support the applicant's cost analysis.

Assuming that the applicant's upper range figure of 6.5 million dollars of control is justified, an analysis of the costs required to control tonnage of pollutants removed is required.

A scrubber with a SO_2 removal efficiency of 70% would most likely be capable of controlling acid gas emissions with an efficiency of 90%. The applicant has indicated that approximately 730,000 tons per year of MSW will actually be processed by the 2,250 TPD facility. Based on the cost of per ton of controlling SO_2 and HCl* (assuming a conservatively low estimate of 6.0 pounds of HCl emitted per ton of refuse charged) the installation and operation of a scrubber unit would be $2,015 which is consistent when compared to costs of up to $2,000 per ton which are considered reasonable in developing EPA New Source Performance Standards. Again, it should be noted that this estimated was based on the cost provided by the applicant which attributed a cost increase of using acid gas control due to a scrubber availability factor of 90%. In accordance with other information (see testimony of Waler R. Niessen, page 13; Babylon Resource Recovery Facility) the use of a dry scrubber does not significantly reduce plant availibility. This would imply that the applicant's projection of 6.5 million ($8.9 per ton of MSW processed) to control acid gases on an annualized basis is unreasonably high and the actual cost should be closer to the other cost estimates provided by this discussion. In addition, to the high cost estimate supplied by the applicant, the amount of HCl emissions per ton of MSW charged is expected to be much greater than 6 pound per ton when the facility goes into operation thus further decreasing the cost per ton of acid gases controlled. The costs projected for adding acid gas scrubbers for other projected resource recovery facilities and the South Broward facility are given in the following paragraphs.

Previous analyses completed for similar facilities have indicated that the cost of using the scrubber-baghouse combination was not unreasonable compared to using an electrostatic precipitator alone. At rated capacity, a unit proposed for installation in the state of Connecticut showed that the cost of using the scrubber-baghouse combination and the precipitator alone were $3.36 and $1.83 respectively per ton of refuse charged. This comparison indicates the costs per ton of pollutant removed using the scrubber-baghouse combination are indeed reasonable when compared to the costs of using an an electrostatic precipitator alone. This slight differential in cost can be attributed to the following:

1) a scrubber cools the gases and reduces their volume which reduces the size requirement (cost) of the particulate control

device, and 2) a dry scrubber is mechanically a simple device and capable of off-site fabrication.

Based on the scrubber's ability to control SO_2, HCl*, and other acid gas emissions, and the size of the projected resource recovery facility (the cost to control emissions on a per ton of MSW charged decreases as the size of the facility increases), the department feels that the cost of adding a flue gas scrubber to the precipitator or using the dry scrubber-baghouse combination is not unreasonable for this facility. The added cost of purchasing scrubbers according to general equipment vendors, designers and contractors is typically in the range of 2 to 5 percent of the total cost for the project, and would be offset by the immediate economic and environmental benefits realized by the installation. The actual cost of using the dry scrubber-baghouse combination was well presented in the recent hearing of the South Broward County Solid Waste Energy Resource Facility.

During testimony at the South Broward hearing, Dr. Aaron Teller, President of Teller Environmental Systems, guaranteed that his company could provide acid gas and particulate control using dry scrubbing and fabric filter technology for $6.00 per ton of municipal solid waste incinerated. This cost would utilize equipment that is capable of reducing, SO_2 emissions by 70%, HCl by 90%, HF by 95%, heavy metals by 99%, and controlling particulate emissions to 0.01 grains/dscf, corrected to 12% CO_2. These control efficiencies are much more stringent than those proposed by the applicant, yet the guaranteed cost of providing the high efficiency control for <u>both particulates and acid gases</u> is equal to the cost provided by the applicant for acid gas control alone. In addition, other states such as Connecticut are seeing that actual tipping fees have increased much less than expected when the dry scrubber-baghouse combination was imposed instead of using an ESP only for controlling emissions from resource recovery facilities.

At a recent conference held in Washington D.C., entitled "Acid Gas and Dioxin Control For Waste-to-Energy Facilities", a topic of great concern was the methods in which emissions from resource recovery facilities should be controlled. The general consensus of the conference speakers (including EPA) is that resource recovery facilities are best controlled with a dry scrubber-baghouse combination.

Based on the scrubber's ability to control SO_2, HCl*, and other acid gas emissions, and the size of the projected resource recovery facility (the cost to control emissions on a per ton of refuse charged decreases as the size of the facility increases), the department feels that the cost of adding a flue gas scrubber to the precipitator or using the dry scrubber-baghouse combination is not unreasonable for this facility. Assuming a realistic figure of 290,000 households being served by the facility when construction begins and Dr. Teller's cost estimate, the cost of total particulate and acid gas control would amount to $1.36 per month per household with approximately half of the cost going to acid gas control and the other half to particulate control. In view that the actual number of households will be greater when the facility actually goes on line and it is known that businesses and industry will also generate refuse and share the cost, the actual cost per household is expected to be even less.

(* Hydrochloric acid [HCl], though not listed as a regulated pollutant for MSW incinerators, is intensely corrosive and should be included in the economic analysis when justifying the addition of flue gas scrubbing equipment. The EPA is currently requiring hazardous waste incinerators emitting more than four (4) pounds of HCl per hour achieve removal efficiency of up to 99%. A minimum of 99% removal efficiency is required when removal at this efficiency will not reduce emissions to four pounds per hour.)

b. NSPS and Florida SIP Limit Analysis

These two regulations dictate similar emission limits using slightly different units. The proposed particulate emission limit of 0.015 gr/dscf is far below either of these limits.

V. Air Quality Analysis

The air quality impact of the proposed emissions has been analyzed. Atmospheric dispersion modeling has been completed and used in conjuction with an analysis of existing air quality data to determine maximum ground-level ambient concentrations of the pollutants subject to BACT. Based on these anlayses, the department has reasonable assurance that the proposed solid waste recovery facility in South Broward County, subject to these BACT emission limitations, will not cause or contribute to a violation of any PSD increment or ambient air quality standard.

a. Modeling Methodology

The EPA-approved Industrial Source Complex Short-Term (ISCST) dispersion model was used in the air quality impact analysis. This model determines ground-level concentrations of inert gases or small particules emitted into the atmosphere by point, area, and volume sources. The model incorporates elements for plume rise, transport by the mean wind, gaussian dispersion, and pollutant removal mechanisms such as deposition or transformation. The ISCST model also allows for the separation of sources, building wake downwash, and various other input and output features. Both screening and refined analyses were completed using this model.

The applicant completed the dispersion modeling for two scenarios. The first scenario dealt with the initial capacity of the proposed facility and the second scenario with a predicted ultimate capacity. The initial capacity of the facility was estimated at 2705 tons per day (TPD) of municipal solid waste (MSW). This capacity was estimated because the actual incinerator size had not been determined. The ultimate capacity of the facility was estimated at 3795 TPD of MSW; however, there are currently no plans for the construction of additional incinerators to bring the capacity up to this level. Since the submission of the modeling results, the applicant has decided to initially construct three 750 TPD incinerators. Allowing for these units to run at up to 15% above nameplate capacity (this same allowance was made in the original estimate of 2705 TPD), the initial capacity is now estimated as 2588 TPD.

In addition to estimating the capacity of the facility, the applicant also estimated the emission rates of the regulated pollutants. These estimates were based on test results from other facilities and from their proposed best available control technology (BACT) analysis. The department has reviewed the applicant's BACT analysis and has in some cases determined a different emission limitation for a pollutant. For the purpose of this review the initial capacity, as currently anticipated (2588 TPD), and the emission limitations as determined by the department will be used to develop the ambient impacts. It is assumed that the emission characteristics, i.e., the stack height, stack gas temperatures, exit velocity, and stack diameter, are the same for the new capacity and BACT emision rates, although these could change if a different control device is required to meet these limitations.

Five years of sequential hourly meteorological data were used in the modeling analyses. Both the surface and the upper air data used were National Weather Service data collected at Miami, Florida, during the period 1970-1974. Since five years of data were used, the highest, second-high, short-term predicted concentrations are compared with the appropriate ambient standard or PSD increment.

The initial set of screening model runs determined the highest, second-high concentrations, over a polar coordinate receptor grid with 36 radials, 10 degrees apart, and 10 downwind distances from 0.3 km to 4.3 km. Concentrations were predicted for the initial capacity fo the facility. Additional refined modeling was completed for those days having the highest, second-high concentrations using a refined receptor grid of sevel radials, 2 degrees apart and seven distances, 100 m apart, centered on the location of the previously determined high, second-high value. In all of these runs only the proposed RRF was modeled. Other major sources in the area, namely Florida

Power and Light's Port Everglades and Ft. Lauderdale facilities, were additionally modeled by the applicant.

The impact of the proposed facility on the Everglades National Park Class I area was also evaluated. Modeling was completed placing receptors along the edge of the Class I area using five years of meteorological data. The 17 receptor locations were spaced two kilometers apart along the northeast boundary of the park.

All of the modeling was completed using the SO_2 emission rate of the proposed facility. The impacts of the other emitted pollutants were determined by ratioing the emission rates to the SO_2 emission rate and multiplying by the SO_2 impact. Total ambient air quality impacts were based on the modeled impacts plus the monitored "background" concentrations.

The stack parameters and emission rates used in evaluating the ambient impacts are listed in Table V-1 and Table V-2, respectively.

b. Analysis of Existing Air Quality

Preconstruction ambient air quality monitoring is required for all pollutants subject to PSD review. In general, one year of quality assured data using an EPA reference, or the equivalent monitor must be submitted. Sometimes less than one year of data, but not less than four months, may be accepted when department approval is given.

An exemption to the monitoring requirement can be obtained if the maximum air quality impact, as determined through air quality modeling, is less than a pollutant-specific deminimus concentration. In addition, if current monitoring data already exist and these data are representative of the proposed source area, then at the discretion of the department these data may be used.

The predicted maximum air quality impacts of the proposed facility for those pollutants subject to PSD review are given in Table V-3. The monitoring demininus level for each pollutant is also listed. Sulfuric acid mist and arsenic are not listed because there is no deminimus level for either of these pollutants. All pollutants have maximum predicted impacts below their respective deminimus values. Therefore, specific preconstruction monitoring is not required for any pollutant.

Table V-4 lists the measured ambient concentrations of all pollutants being currently monitored within 10 kilometers of the proposed facility. These values are used to estimate current background levels.

Table V-1

Broward County Resource Recovery Facility
Source Parameters

Source (1)	UTM - E (km)	UTM - N (km)	Stack Height (M)	Exit Temp. (K)	Exit Velocity (M)	Stack Diameter (M)
Unit 1	579.6	2883.3	59.4	505	26.4 (2)	2.29
Unit 2	579.6	2883.3	59.4	505	26.4 (2)	2.29
Unit 3	579.6	2883.3	59.4	505	26.4 (2)	2.29

(1) Three 750 TPD incinerators, each with a flue to a common stack. For modeling purposes the common stack was given a stack diameter of 5.03 m and an exit velocity of 14.1 m/s, providing for a minimum flow rate.

(2) Estimated by dividing flow rate (ACFM) in application by 3 and calculating with given diameters.

Table V-2
Broward County Resource Recovery Facility
Maximum Emission Rates (1)

Polluatant	(lb/ton)	(lb/hr)	(ton/yr)
PM	0.34	37.5	164
SO_2	2.8/5.6(2)	603.9	1322
NOx	5.0	539.2	2361
CO	0.8	86.3	378
VOC	0.12	12.9	57
Pb	0.014	1.5	6
F^-	0.023	2.5	11
H_2SO_4 Mist	0.042	4.6	20
Be	8.4×10^{-6}	0.00091	0.0040
Hg	0.0027	0.29	1.3
As	0.00028	0.030	0.13
HCl	1.11	120	525

(1) Based on facility capacity of 2588 TPD of MSW and department emission limitations.

(2) The emission limitation is 2.8 lb/ton 30 day average, not to exceed 5.6 lb/ton.

Table V-3
Broward County Resource Recovery Facility
Maximum Air Quality Impacts of the RRF
For Comparsion to the Deminumus Ambient Levels

Polluatant and Averaging Time	Predicted Impact (ug/m^3)	Deminimus Ambient Impact Level(ug/m^3)
SO_2 (24-hour)	7.4	13
PM (24-hour)	0.5	10
NO_2 (Annual)	0.7	14
CO (8-hour)	2.1	575
Pb (24-hour)	0.02	0.1
F^- (24-hour)	0.030	0.25
Be (24-hour)	0.00001	0.0005
Hg (24-hour)	0.004	0.025

Table V-4
Broward County Resource Recovery Facility
Monitoring Data Within 10 km of the RRF

Site	(Location with Respect to the Proposed Facility) Direction (degrees)	Distance (km)	Pollutant	Concentration 1984 Annual (ug/m^3)	24-hour (ug/m^3)	8-hour (mg/m^3)	1-hour (mg/m^3)
0420002	3°	2.0	CO			10	17
0910002	296°	3.8	PM	33	64		
			NO$_2$	28			
			SO$_2$	3	4		
1260004	55°	6.8	PM	41	72		
			NO$_2$	29			
			SO$_2$	4	28		
1840001	158°	6.9	PM	39	70		
			Pb (quarterly)	0.2			
3530001	216°	7.3	NO$_2$	30			
			SO$_2$	3	6		
1260003	27°	7.6	PM	59	93		
			NO$_2$	42			
			SO$_2$	3	4		
			CO			7	11
			Pb (quarterly)	0.9			
1840002	150°	8.6	CO			6	10
3640002	334°	9.4	PM	31	59		

The PSD increments represent the amount that new sources may increase ambient ground-level concentrations of SO_2 and PM. At no time, however, can the increased emissions of these pollutants cause or contribute to a violation of the ambient air quality standards.

c. PSD Increment Analysis

The proposed Broward County RRF is to be located in a Class II area. This area is also designated as an attainment area for both SO_2 and PM. A PSD increment analysis is therefore required to show compliance with the Class II increments.

The PSD increments represent the amount that new sources in the area may increase ambient ground-level concentrations of SO_2 and PM. At no time, however, can the increased loading of these pollutants cause or contribute to a violation of the ambient air quality standards.

All SO_2 and PM emission increases from sources constructed or modified after the baseline date (December 1977) will consume PSD increment. In addition, all SO_2 and PM emission increases associated with construction or modification of major sources which occurred after January 6, 1975, will consume increment. The proposed Broward County RRF is the only significant source in the area which will consume PSD increment for either SO_2 or PM.

Atmospheric dispersion modeling, as previously described, was performed to quantify the amount of PSD increment consumed. The results of this modeling are summarized in Table V-5. The results indicate that the concentration increases are within the allowable amounts.

A Class I area increment analysis is required because the proposed facility is located within 100 kilometers (57 km) of the Everglades National Park, a designated Class I area. Although the distance to the Class I area is greater than 50 kilometers (the distance to which the models are generally considered valid), the applicant used the model to estimate the impact on this area. The results indicate a less than significant impact.

d. AAQS Analysis

Given existing air quality in the area of the proposed facility, emissions from the new facility are not expected to cause or contribute to a violation of an AAQS. Table V-6 shows the results of the AAQS analysis.

The results showed that, with the exception of SO_2 and lead, the maximum impacts of the other criteria pollutants were less than the significant impact levels defined in Rule 17-2.100(150), FAC. As such, no further modeling analysis was completed for PM,

Table V-5
Broward County Resource Recovery Facility
Comparison of New Source Impacts with PSD Increments

Pollutant and Averaging Time	PSD Class II Increment (ug/m^3)	Predicted Increased Concentration (ug/m^3)	Percent Increment Consumed	PSD Class I Increment (ug/m^3)	Predicted Increased Concentration (ug/m
SO_2					
3-hour	512	26	5	25	4
24-hour	91	7	8	5	1
Annual	20	<1	<5	2	<1
PM					
24-hour	37	<1	<3	10	<1
Annual	19	<<1	<<5	5	<<1

Table V-6
Broward County Resource Recovery Facility
Comparsion of Total Impact with the AAQS

Pollutant and Averaging Time	Maximum Impact Project (ug/m^3)	Maximum Impact (1) All Sources (ug/m^3)	Existing Background (2) (ug/m^3)	Maximum Total Impact (ug/m^3)	Florida AAQS (ug/m^3)
SO$_2$					
3-hour	26	625	63 (3)	688	1300
24-hour	7	216	28	244	260
Annual	<1 (4)	-	4	-	60
PM					
24-hour	<1 (4)	-	93	-	150
Annual	<<1 (4)	-	59	-	60
NO$_2$					
Annual	<1 (4)	-	42	-	60
CO					
1-hour	4 (4)	-	17,000	-	40,000
8-hour	2 (4)	-	10,000	-	10,000
Pb					
3-months	<0.1	-	0.9	1	1.5

(1) Maximum impact includes the FPL Port Everglades and Fort Lauderdale power plants.

(2) Existing background is estimated using the highest monitored concentrations in the area near the proposed

(3) The 3-hour background is estimated by multiplying the 24-hour background by 2.25.

(4) Less than significant, no further analysis completed.

NOx, and CO. For SO_2, additional modeling was performed which included the interaction of surrounding sources of SO_2. For lead, there is no significant impact level defined in the Rule. No further modeling of lead was completed because the predeominate source of ambient lead in the area is mobile sources.

The total impact on ambient air is obtained by adding a "background" concentration to the maximum modeled concentration. This "background" concentration takes in to account all sources of the particular pollutant in question that were not explicitly modeled. A conservative estimate of these "background" concentrations is given by the second highest monitored concentration for each pollutant as listed in Table V-4. This is a conservative estimate because sources used in the modeling may have contributed to the monitored value and contribute doubly to the total impact.

Based on this analysis, the department has reasonable assurance that no AAQS will be exceeded as a result of the operation of the proposed new resource recovery facility.

VI. Additional Impacts Analysis

a. Impacts on Soils and Vegetation

The maximum ground-level concentrations predicted to occur as a result of emissions from the proposed project in conjunction with all other sources, including a background concentrations, will be at or below all applicable AAQS including the secondary standards designed to protect public welfare-related values. As such, these pollutants are not expected to have a harmful impact on soils and vegetation.

A summary of the types and quantities of soils and vegetation in and around the proposed RRF site area and in the Everglades National Park can be found in the Site Certification Application. The applicant has also compared predicted maximum impacts with known adverse impact levels for both criteria and noncriteria pollutants. No adverse impacts are expected.

b. Impact on Visibility

A level I visibility screening analysis was performed to determine if any impact may occur in the Class I area. The analysis showed that there was no potential for an adverse impact on visibility in this area.

c. Growth-Related Air Quality Impacts

The proposed facility is not expected to significantly change employment, population, housing, or commercial/industrial development in the area to the extent that a significant air quality impact will result.

d. GEP Stack Height Determination

Good Engineering Practice (GEP) Stack height is defined as the greater of: (1) 65 meters or (2) the maximum nearby building height plus 1.5 times the building height or width, which ever is less. For the proposed project, a single common stack, housing the individual flues for each incinerator, will be 61.0 meters high. This is below the allowed GEP stack height of 65 meters.

e. Noncriteria Pollutants

The proposed facility emits in significant amounts (as defined in the PSD regulations): fluorides, sulfuric acid mist, beryllium, mercury, and arsenic. All of these pollutants are regulated, but, there is no ambient air quality standards or PSD increments set for any of them. For three of these polluants, fluorides, beryllium, and mercury, a deminimus ambient impact level has been defined. Exceedance of these levels, usually determined by dispersion modeling, is used to determine if ambient monitoring is necessary. The results of this modeling for these pollutants is listed in Table V-3. For each of these three pollutants, the predicted impact is less than their respective deminimus impact level.

f. Unregulated Pollutants

Two additional pollutants are often brought up in the context of resource recovery facilities. These are hydrogen chloride (HCl) and dioxins (2, 3, 7, 8-TCDD). Neither is currently regulated within the PSD regulations. Hydrogen chloride is regulated nationally for other type sources but not specifically for resource recovery facilities. Some states do regulate both of these substances. Both of these substances may become regulated either nationally or by the state in the future. The recommended control equipment necessary for the facility to meet the BACT emissions limitations for the regulated pollutants will also control HCl and dioxins.

Hydrogen chloride is not a regulated pollutant. However, because emissions of this pollutant are known to be relatively high, the applicant was asked to estimate these emissions. Uncontrolled, the emissions of hydrogen chlorides are on the same order as sulfur dioxide and nitrogen oxides. Emissions will likely be reduced due to controls being required for fluroides and sulfuric acid mist.

VII. Nonattainment Review

EPA announced approval of Florida's new source review program for major sources in designated nonattainment areas on March 18, 1980 (45 FR 17140). Subsequently, in 1985, EPA discovered that the Florida Power Plant Siting Act supercedes in part the nonattainment new source review regulations under Florida law. Consequently, the Florida SIP is deficient with respect to electrical power plants. EPA plans to issue, in the near future, a federal register notice clarifying that two sets of nonattainment regulations will apply:

(1) For sources located in designated nonattainment areas, EPA's construction ban (40 CFR 52.24) applies to major sources and major modifications, and

(2) For sources locating in designated attainment or unclassifiable areas, EPA's Interpretative Ruling (40 CFR 51.18 Appendix S) will apply to major sources and major modifications.

The proposed source will be located in an area designated nonattainment for ozone, but is not a major source of VOC and, thus, will not subject to the construction ban.

PERMIT TO CONSTRUCT UNDER THE RULES FOR THE PREVENTION OF SIGNIFICANT DETERIORATION OF AIR QUALITY

Pursuant to and in accordance with the provisions of Part C, Subpart 1 of the Clean Air Act, as amended, 42 U.S.C. ¶7470 et. seq., and the regulations promulgated thereunder at 40 CFR ¶52.21, as amended at 45 Fed. Reg. 52676, 52735-41 (August 7, 1980),

South Broward County Resource Recovery Facility

is, as of the effective date of this permit (PSD-FL-108) authorized to construct a stationary source at the following location:

On a 248 acre tract at the southeast
intersection of State Road 84 and US
Route 441 in Broward County, Florida.

Upon completion of authorized construction and commencement of operation/production, this stationary source shall be operated in accordance with the emission limitations, sampling requirements, monitoring requirements and other conditions set forth in the attached Specific Conditions (Part I) and General Conditions (Part II)

This permit is hereby issued on _________ and shall become effective thirty (30) days after receipt hereof unless a petition for administrative review is filed with the Administrator during that time. If a petition is filed any applicable effective date shall be determined in accordance with 40 CFR ¶124.19(f)(1).

If construction does not commence within 18 months after the effective date of this permit, or if construction is discontinued for a period of 18 months or more, or if construction is not completed within a reasonable time, this permit shall expire and authorization to construct shall become invalid.

This authorization to construct/modify shall not relieve the owner or operator of the responsibility to comply fully with all applicable provisions of Federal, State, and local law.

_____________ _____________________

Date Signed Regional Administrator

PART I

Specific Conditions

1. Emission Limitations

   a. Stack emissions from each unit shall not exceed the following:

      (1) Particulate matter: 0.015 grains per dry standard cubic foot corrected to 12% CO_2 (gr/dscf-12%).

      (2) Visible Emissions: Opacity of stack emissions shall not be greater than 15% opacity. Excess opacity resulting from startup or shutdown shall be permitted providing (1) best operational practices to minimize emissions are adhered to and (2) the duration of excess opacity shall be minimized but in no case exceed two hours in any 24-hour period unless specifically authorized by EPA for longer duration.

      Excess emissions which are caused entirely or in part by poor maintenance, poor operation, or any other equipment or process failure which may reasonably be prevented during start-up or shutdown shall be prohibited.

      (3) SO_2: 0.31 lb/MBtu heat input

      (4) Nitrogen Oxides: 0.56 lb/MMBtu heat input

      (5) Carbon Monoxide: 0.09 lb/MMBtu heat input

      (6) Lead: 0.001 lb/MMBtu heat input

      (7) Fluorides: 0.0018 lb/MMBtu heat input

      (8) Beryllium: 9.3×10^{-7} lb/MMBtu heat input

      (9) Each of the emission limits in conditions (1) and (3) through (8) is to be expressed as a 3-hour average based on the expected length of time for a particulate compliance test.

(10) Mercury: 2300 grams/day*

(11) Sulfuric Acid Mist: 8.5×10^{-4} lb/MBtu heat input

(12) The units are subject to 40 CFR Part 60, Subpart Db New Source Performance Standards (NSPS), except that where requirements in this permit are more restrictive, the requirements in this permit shall apply.

(13) There shall be no fugitive emissions from the refuse bunker and the ash handling and loadout. The potential for dust generation by ash handling activities will be mitigated by quenching the ash prior to loading in ash transport trucks. Additionally, all portions of the proposed facility including the ash handling facility which have the potential for fugitive emissions will be enclosed. Also those areas which have to be open for operational purposes, e.g., tipping floor of the refuse bunker while trunks are entering and leaving, will be under negative air pressure.

Only distillate fuel oil or natural gas will be used in start-up burners. The annual capacity factor for use of natural gas, as determined by 40 CFR 60.43b(d), shall be less than 10%.

*Total emissions from each unit shall not exceed this value.

b. Compliance Tests

(1) Compliance tests for particulate matter, SO_2, nitrogen oxides, CO, fluorides, mercury and beryllium shall be conducted in accordance with 40 CFR 60.8 (a), (b), (d), (e), and (f), except that an annual test will be conducted for particulate matter. Compliance tests for opacity will be conducted simultaneously during each compliance test run for particulate matter.

Compliance tests shall be conducted as specified herein by EPA and as required by 40 CFR §60.8. The permittee shall make available to EPA such records as may be necessary to determine the conditions of the performance tests and the methods to be used in obtaining representative RDF samples for ultimate analyses required in Method 19, Appendix A.

(2) The following test methods and procedures from 40 CFR Parts 60 and 61 shall be used for compliance testing:

a. Method 1 for selection of sample site and sample traverses

b. Method 2 for determining stack gas flow rate when converting concentrations to or from mass emission limits.

c. Method 3 for gas analysis when needed for calculation of molecular weight or percent CO_2.

d. Method 4 for determining moisture content when converting stack velocity to dry volumetric flow rate for use in converting concentrations in dry gases to or from mass emission limits.

e. Method 5 for concentration of particulate matter and associated moisture content. One sample shall constitute one test run.

f. Method 9 for visible determination of the opacity of emissions.

g. Method 6 for concentration of SO_2. Two samples, taken at approximately 30 minute intervals, shall constitute one test run.

h. Method 7 for concentration of nitrogen oxides. Four samples, taken at approximately 15 minute intervals, shall constitute one test run.

i. Method 8 for determination of sulfuric acid mist concentration and associated moisture content. Ons sample shall constitute one test run.

j. Method 10 (continuous) for determination of CO concentrations. One sample constitutes one test run.

k. Method 12 for determination of lead concentration and associated moisture content. One sample constitutes one test run.

l. Method 13A or 13B for determination of fluoride concentrations and associated moisture content. One sample shall constitute one test run.

m. Method 19 for determination of "F" factors in determining compliance with heat input emission rates and sulfur dioxide removal in Special Condition 1.a.(4).

n. Method 101A for determination of mercury emission rate and associated moisture content. One sample shall constitute one test run.

o. Method 104 for determination of beryllium emission rate and associated moisture content. One sample shall constitute one test run.

p. Method 25 or 25A for determination of volatile organic compounds. One sample shall constitute one test run.

2. The height of the boiler exhaust stack shall not be less than 200 feet above ground level at the base of the stack.

3. The incinerator boiler shall not be loaded in excess of their rated capacity of 71,875 pounds of RDF per hour each or 281.0 x 10^6 Btu per hour each.

4. The incinerator boilers shall have a metal name plate affixed in a conspicuous place on the shell showing manufacturer, model number, type waste, rated capacity and certification number.

5. The permittee must submit to EPA and DER within fifteen (15) days after it becomes available to the County, copies of technical data pertaining to the incinerator boiler design, scrubber designing electrostatic precipitator design, and the fuel mix that can be used to evaluate compliance of the facility with the preceeding emission limitations.

6. Grease, scum, grit screenings or sewage sludge shall not be charged into the solid waste to energy facility boilers.

7. Air Pollution Control Equipment

   The permittee shall install, continuously operate, and maintain the following air pollution controls to minimize emissions. Controls listed shall be fully operational upon start-up of the proposed equipment.

   a. Each boiler shall be equipped with a particulate emission control device for the control of particulates.

   b. Each boiler shall be equipped with an acid gas control device designed to remove at least 90% of the acid gases.

8. Stack Monitoring Program

   The permittee shall install and operate continuous monitoring devices for oxygen and stack opacity. The monitoring devices shall meet the applicable requirements of Rule 17-2.710, FAC, 40 CFR Part 60, Subparts A and Db, Sections 60.13 and 60.48b respectively, except that emission rates shall be calculated in units consistent with emission limits in this permit. The conversion procedure shall be approved by EPA.

9. Reporting

   a. A copy of the results of the stack tests shall be submitted within forty-five days of testing to the DER Bureau of Air Quality Management, the DER Southeast Florida District Office, Broward County and EPA Region IV.

   b. Stack monitoring shall be reported to the DER Southeast District Office and EPA Region IV on a quarterly basis in accordance with Section 17-2.710, FAC, and 40 CFR, Part 60, Subsections 60.7 and 60.49b.

10. Fuel

   The Resource Recovery Facility shall utilize refuse such as garbage and trash (as defined in Chapter 17-7, FAC) but not sludge from sewage treatment plants as its fuel. Use of alternate fuels would necessitate application for a modification to this permit.

11. Addresses for submitting reports are:

a. EPA - Region IV

Chief, Air Compliance Branch
U.S. Environmental Protection Agency
345 Courtland St.
Atlanta, GA 30365

b. DER

Chief, Compliance and Ambient Monitoring
Bureau of Air Quality Management
Florida Department of Environmental Regulation
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, FL 32301

c. Southeast District Office of DER

District Manager
Department of Environmental Regulation
3301 Gun Club Road
P. O. Box 3858
West Palm Beach, FL 33402

d. Broward County

Broward County Environmental Quality Control Board
500 Southwest 14th Court
Ft. Lauderdale, Florida 33315

PART II

General Conditions

1. The permittee shall comply with the notification and recordkeeping requirements codified at 40 CFR Part 60, Subpart A, ¶ 60.7.

2. The permittee shall retain records of all information resulting from monitoring activities and information indicating operating parameters as specified in the specific conditions of this permit for a minimum of two (2) years from the date of recording.

3. If, for any reason, the permittee does not comply with or will not be able to comply with the emission limitations specified in this permit, the permittee shall provide EPA with the following information in writing within five (5) days of such conditions:

   (a) description of noncomplying emission(s),
   (b) cause of noncompliance,
   (c) anticipated time the noncompliance is expected to continue or, if corrected, the duration of the period of noncompliance,
   (d) steps taken by the permittee to reduce and eliminate the noncomplying emission, and
   (e) steps taken by the permittee to prevent recurrence of the noncomplying emission.

   Failure to provide the above information when appropriate shall constitute a violation of the terms and conditions of this permit. Submittal of the aforementioned information does not constitute a waiver of the emission limitations contained within this permit.

4. Any proposed change in the information submitted in the application regarding facility emissions or changes in the quantity or quality of materials processed that would result in new or increased emissions or ambient air quality impact must be reported to EPA. If appropriate, modifications to the permit may then be made by EPA to reflect any necessary changes in the permit conditions. In no case are any new or increased emissions allowed that will cause violation of the emission limitations specified herein. Any construction or operation of the source in material variance with the application shall be considered a violation of this permit.

5. In the event of any change in control or ownership of the source described in the permit, the permittee shall notify the succeeding owner of the existence of this permit and EPA of the change in control of ownership within 30 days.

6. The permittee shall allow representatives of the state and local environmental control agency or representatives of the EPA upon the presentation of credentials:

   (a) to enter upon the permittee's premises, or other premises under the control of the permittee, where an air pollutant source is located or in which any records are required to be kept under the terms and conditions of the permit;

   (b) to have access to and copy at reasonable times any records required to be kept under the terms and conditions of this permit, or the Clean Air Act;

   (c) to inspect at reasonable times any monitoring equipment or monitoring method required in this permit;

   (d) to sample at reasonable times any emissions of pollutants; and

   (e) to perform at reasonable times an operation and maintenance inspection of the permitted source.

7. The conditions of this permit are severable, and if any provision of this permit or the application of any provision of this permit to any circumstance is held invalid, the application of such provision to other circumstances and the remainder of this permit shall not be affected thereby.

PM
4-20-87
Atlanta, Ga.

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

APR 17 1987

4APT/APB-eaw

Mr. Thomas M. Henderson
Project Director
Broward County Resource Recovery Office
Room 521
115 South Andrews Avenue
Fort Lauderdale, Florida 33301

Re: South Broward Resource Recovery Facility (PSD-FL-105)

Dear Mr. Henderson:

Please find enclosed the draft final determination and permit for the above-referenced facility. As you will note, we have made changes in the final determination and permit in accordance with our review of your requests in your April 2, 1987 letter. We have also revised Tables V-1, V-2, V-3, V-5, and V-6 in accordance with the revised modeling data submitted in your letter of April 9, 1987.

In reference to your letter of April 2, 1987, we have agreed to change our reference to percent oxygen to percent carbon dioxide, and modify the carbon monoxide 8-hour continuous emissions limit. The change in the reference for demonstrating compliance of emissions limits from oxygen to carbon dioxide is assumed to have a minimal affect on the emissions limits used in analyses. Therefore, the change was made. We also concur with your determination that the statistical analysis yields a value for the 8-hour standard much too high to be used in determining compliance with the BACT emissions rate for carbon monoxide of 88 ppm (0.09 lb/mmBtu). Therefore, we have changed the permit to stipulate that this emissions limit demonstrates compliance based upon a 4-day rolling average. Employing the twelve highest 8-hour averages in the Westchester data would yield a 4-day rolling average of approximately 80 ppm, thus we believe the proposed standard is reasonable.

In regard to your request that CEM data be used to indicate compliance rather than demonstrate it, we posed this question to our Compliance support staff upon which they stated that CEM equipment should be afforded a much higher degree of reliability than your letter indicates. It is believed that CEMS will be capable of providing data of sufficient reliability to be used for compliance determinations provided the quality

DER
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assurance procedures outlined in the permit are followed. In addition, we have decided to leave the emission limit for sulfuric acid mist in the permit as a reference test for resource recovery facilities may become available in the future for demonstration of compliance with the limit.

If you have any questions or comments regarding this letter or the final determination and permit, please do not hesitate to contact me.

Sincerely yours,

Bruce P. Miller

Bruce P. Miller, Chief
Air Programs Branch
Air, Pesticides, and Toxics
Management Division

Enclosures

cc (Enclosures):
Mr. C. H. Fancy, P.E.
Deputy Chief
Bureau of Air Quality Management
Department of Environmental Regulation

Mr. Ken Kosky
KBN Engineering

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Final Determination
and Permit

South Broward County Resource Recovery Facility

Broward County, Florida

PSD-FL-105

Prevention of Significant Deterioration

(40 CFR 52.21)

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CONTENTS

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I. INTRODUCTION

Pursuant to Section 403.505, Florida Statutes, South Broward Resource Recovery Project, Inc. (County), applied to the Florida Department of Environmental Regulation (DER) in April 1985 for certification of a steam electric generating, solid waste energy recovery facility at a site near the intersection of the U.S. Route 441 and State Road 84 in Broward County, Florida. After a thorough review by DER, including public hearings, the Florida Power Plant Siting Board issued a site certification to the County. At the time, FDER believed that such a site certification constituted a legal prevention of significant deterioration (PSD) permit under Chapter 17-2.500 of the Florida air pollution regulations which had been approved by the U.S. Environmental Protection Agency (EPA) on December 22, 1983. In the summer of 1985, EPA became aware that the Florida Electrical Power Plant Siting Act (PPSA), under which the site certification was issued, restricts the authority of the State of Florida to implement any regulation (i.e., PSD Regulations) pertaining to power plants other than those in the Act. Consequently, EPA determined that the Florida PSD regulations were superseded by the PPSA, and that the PPSA could not legally be approved by EPA as part of the State Implementation Plan (SIP) since it did not comply with EPA PSD regulations both procedurally and substantively. Thus, EPA concluded that the proposed South Broward County Resource Recovery Facility (RRF) did not have a valid PSD permit under the PPSA. EPA subsequently remanded PSD authority for sources subject to the PPSA while delegating responsibility for the technical and administrative portions of the PSD review to the FDER. The following final determination and permit constitute the culmination of those activities delegated to the FDER by EPA.

The applicant plans to construct a 2250 tons per day (TPD) solid waste-to-energy facility to be located near the intersection of the U.S. Route 441 and State Road 84 in Broward County, Florida. Municipal solid waste (MSW) will be combusted to produce steam for power generation. The present plans are to construct three 750 TPD MSW incinerators. An ultimate maximum capacity of 3300 TPD is anticipated in the future which will require the addition of a fourth incinerator. The Broward County Resource Recovery Office will need to submit an application to construct the fourth unit at a future date. The applicant requests that each unit be permitted at 115% of its rated capacity. At 115% capacity, each of the three energy recovery units will have an approximate heat input of 323.6 million Btu per hour based on a heat content of 4500 Btu/lb for MSW. Each incinerator will be scheduled to operate 8760 hours per year. The yearly tonnage of the various air pollutants emitted were calculated on this basis.

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II. RULE APPLICABILITY

The proposed site of the South Broward County RRF is located within a nonattainment area for ozone. This designation requires that all proposed new surces which would emit greater than 100 tons per year (TPY) of volatile organic compound (VOC) be prohibited from constructing under 40 CFR 52.24. As the proposed incineration facility is projected to emit less than 100 TPY of VOC, the proposed source is not subject to the construction ban.

The source is subject to the regulations for PSD of air quality under 40 CFR 52.21 regarding the assessment of source emissions in attainment or unclassified areas. Since this source is within the category of stationary sources listed under the PSD regulations which specifies the threshold of emissions for PSD applicability as 100 TPY or greater of any regulated pollutant, the source must provide a Best Available Control Technology (BACT) determination, an ambient air quality analysis, a source impact analysis and an additional impact analysis (soils, vegetation, visibility) for each pollutant emitted in significant amounts. These include: particulate matter (PM), sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen oxides (NO_x), lead (Pb), mercury (Hg), fluorides (as hydrogen fluoride, HF), and sulfuric acid mist. In addition to the above, a Class I area impact analysis is required because the source is to be located within 100 kilometers of the Everglades National Park.

New Source Performance Standards (NSPS) for incinerators under 40 CFR 60, subpart E, and Standards of Performance for Industrial-Commercial-Institutional Steam Generating under 40 CFR 60, subpart Db, apply to each unit within the proposed facility. These NSPS set emission standards for a broad category of sources and limit the maximum amounts of PM and NO_x which may be emitted from any facility subject to these regulations.

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III. PSD APPLICABILITY DETERMINATION

Title 40 Code of Federal Regulations, Section 52.21 requires that each pollutant subject to PSD review must be controlled by BACT. Nine pollutants are subject to BACT. The BACT emission limits proposed are summarized as follows:

Pollutant	BACT EMISSION LIMITS
Particulate Matter	0.015 gr/dscf, corrected to 12% CO_2
Sulfur Dioxide	0.140 lbs/mmBtu or 65% removal (not to exceed 0.310 lb/mmBtu)
Nitrogen Oxides	0.560 lb/mmBtu
Carbon Monoxide	0.090 lb/mmBtu
Lead	0.00150 lb/mmBtu
Mercury	7.50×10^{-4} lb/mmBtu
Beryllium	9.30×10^{-7} lb/mmBtu
Fluorides	0.0040 lb/mmBtu
Sulfuric Acid Mist	4.70×10^{-3} lb/mmBtu

These emission limitations are based on the determination that BACT is control of acid gas emissions and a high degree of particulate emissions reduction.

Based upon these air pollutant emission limits, the calculated total annual tonnage of regulated air pollutants emitted from the units to the atmosphere is listed as follows:

Pollutant		Maximum Annual Emissions (tons/year)	PSD Significant Emissions Rate (tons/year)
Particulate	(PM)	164	25
Sulfur Dioxide	(SO_2)	1318	40
Nitrogen Dioxide	(NO)	2381	40
Carbon Monoxide	(CO)	383	100
Lead	(Pb)	6.4	0.6
Mercury	(Hg)	3.2	0.1
Beryllium	(Be)	0.0040	0.0004
Fluorides	(F)	17	3
Sulfuric Acid Mist	(H_2SO_4)	20	7

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IV. BEST AVAILABLE CONTROL TECHNOLOGY DETERMINATION (BACT)

A. Particulate Matter

New Source performance standards for incinerators limit particulate emissions from these units to 0.08 grains per dry standard cubic foot (gr/dscf) based on a 12% flue gas concentration of carbon dioxide. NSPS for industrial-commercial-institutional steam generating units limit particulate emissions from these units to 0.10 lb/mmBtu or approximately 0.05 gr/dscf. However, BACT clearinghouse reports incinerators emission limits to be from 0.01 to 0.03 gr/dscf.

In making the BACT determination, an emissions limit was selected to ensure that hazardous yet unregulated pollutants are controlled in accordance with the North County incinerator PSD remand. The control of dioxins, furans, and other condensible organics is hypothesized to occur due to their condensation and adsorption on particulate matter. As the collective surface area of fine particulate matter is greater than that of larger particles per mass unit and fine particulate matter consists of a significant portion of the total particulate matter, control equipment should be selected which ensures the highest degree of control for fine particulates. Baghouses are considered control equipment capable of achieving the maximum degree of fine particulate control and facilities equipped with baghouses have demonstrated emissions on the order of 0.01 gr/dscf. However, the applicant has argued that the use of baghouses is not a tried and true technology on municipal incinerators and proposes the use of an electrostatic precipitator (ESP) with an emission rate of 0.03 gr/dscf. EPA has consented to the use of an ESP provided a lower emissions limit can be met. The limit which was determined to be BACT is 0.015 gr/dscf and represents an approximate increase in ESP anualized costs of $134,000 per year or a cost of $1,035 per ton of additional particulate removed. However, the applicant may install either baghouse or an ESP to meet this limitation.

Energy impacts are considered to be insignificantly affected by the increase in removal efficiency, and environmental benefit due to decreased emissions of unregulated hazardous pollutants is not assessable at this time, although clearly evident.

B. Sulfur Dioxide

The emissions of sulfur dioxide from municipal solid waste incinerators is dependent upon three factors. These factors are: the sulfur content of the waste, the conversion of organic and inorganic sulfur compounds to sulfur dioxide, and the retention of the sulfur dioxide in the ash. This determination assumes that all combined sulfur is converted and none is retained in the ash.

The applicant has reported the sulfur content of the waste to be 0.19 wt% maximum and 0.12 wt% average. This results in SO_2 emission rates of 7.6 to 4.8 lb/ton of MSW fired, or, at 4500 Btu/lb, 0.840 to 0.530 lb/mmBtu, respectively. Taking into account the selection of acid gas control devices (explained under acid gas BACT), the resultant emissions of sulfur dioxide should be reduced by at least 65% and reportedly as high as 96%. EPA and the applicant have agreed that 65% control of sulfur dioxide is BACT and should result in an emissions rate range of 0.290 lb/mmBtu to 0.186 lb/mmBtu. The emissions limit stipulated as BACT in the permit is a 65% reduction of sulfur dioxide emissions, not to exceed 0.310 lb/mmBtu. This limit was based on EPA-Broward County negotiations, the emissions limits at other facilities, and the variability of fuel sulfur content. Economic and environmental considerations are included under the acid gas BACT section.

C. Acid Gases

Acid gases consist primarily of sulfuric acid mist, hydrogen fluoride, and the unregulated pollutant hydrogen chloride. BACT for acid gas control was selected based on the North County remand which allows the consideration of unregulated pollutants in the assessment of BACT for regulated pollutants. The selection of 90% acid gas control includes the reduction of hydrogen chloride emissions in the economic analysis and the reduction of condensible unregulated organic emissions (i.e., dioxins, furans) and heavy metals, due to the gas cooling effects of the acid gas control system proposed, in the environmental benefit analysis.

Sulfuric acid mist is generated as a result of the oxidation of sulfur dioxide to sulfur trioxide in the flue gas. Combination of sulfur trioxide and water results in the formation of sulfuric acid mists. The uncontrolled emissions of this pollutant are estimated to be as high as 200 TPY. BACT of 90% control of these emissions results in an emissions reduction of 180 TPY.

Hydrogen fluoride is created through the combustion of waste materials containing fluorine. Although the reported emissions of hydrogen fluoride vary greatly, the emissions have been reported to be as high as 0.02 lb/mmBtu. However, the applicant predicts an uncontrolled emission rate of 0.04 lb/mmBtu or 170 TPY at this is facility. A 90% control efficiency for this pollutant results in the control of 153 TPY based on the agreed emission rate of 0.004 lb/mmBtu and is considered BACT.

The formation of hydrogen chloride emissions is due primarily to the combustion of plastics containing chlorine. It is projected that by the year 2000 the plastic content of municipal solid waste will be 4.2 wt%, of which 11.2 wt% is PVC resin in plastics. Using the weight percent of chlorine in PVC (45.3 wt%), the expected uncontrolled emissions from this facility are 0.47 lb/mmBtu or 2013 tons per year. Acid gas control will provide control of 90% of these emissions of hydrogen chloride or 1993 TPY.

In assessing the economic impacts, 240 TPY of sulfur dioxide, 180 TPY of sulfuric acid mist, 153 TPY of hydrogen fluoride, and 1994 TPY of hydrogen chloride were used in determining the cost effectiveness of acid gas control. EPA studies have estimated that the cost of acid gas control for this facility to be approximately 3 million dollars in annualized costs. This results in a cost of $1169 per ton of total pollutants (listed above) and is considered reasonable.

The environmental benefits due to application of acid gas control are the reduction of the flue gas temperature for the condensation of dioxins, furans, pyrenes, biphenyls, and mercury which may then be removed by a high efficiency particulate control device. Even though the formation of the toxic organic compounds is due to the design and operation of the combustion device, studies show that the use of acid gas control and high efficiency particulate removal equipment is capable of achieving a 99+% reduction of the compounds formed. No acceptable levels of exposure to these compounds have been published and EPA is thereby obligated to ensure the public a minimal exposure to them.

D. Nitrogen Oxides

During combustion of municipal solid waste, NO_x is formed in high temperature zones in and around the furnace flame by the oxidation of atmospheric nitrogen and nitrogen in the waste. The two primary variables that affect the formation of NO_x are the combustion temperatures and the concentration of oxygen. Techniques such as the method of fuel firing, correct distribution of combustion air between overfire and underfire air, exhaust gas recirculation, and decreased heat release rates have been used to reduce NO_x emission. A few add-on control techniques such as catalytic reduction with ammonia and thermal de-No_x are still experimental and not considered to be demonstrated technology for the proposed project. State-of-the-art control of the combustion variables will be used to limit NO_x emissions at 0.54 lb/mmBtu. This level of control is judged to represent BACT.

NSPS for industrial-commercial-institutional steam generating units regulates nitrogen oxide emissions for this facility if auxiliary fuels exceed 10% of the fuel input. Permit limits have been stipulated to ensure auxiliary fuel input at each of the units will be less than 10%.

E. Carbon Monoxide

Incomplete combustion causes the emissions of solid carbon particles (e.g., smoke or soot) unburned and/or partially oxidized hydrocarbons and carbon monoxide, as well as resulting in the loss of heat energy. The applicant proposes that good equipment design and operation are BACT for carbon monoxide. Based on technical information relating good combustion practices and BACT determinations from other states, a limit of 0.090 lb/mmBtu is judged to represent BACT for carbon monoxide emissions.

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F. Lead

With respect to lead emissions, two conditions are needed to achieve high removal efficiencies of metallic compounds emitted at refuse burning facilities: (1) operation of particulate matter control equipment at temperatures below 500°F, and (2) consistently efficient removal of submicron fly ash particles. The maximum temperature of the incinerator combustion gases at the inlet to the particulate control device is estimated to be below 300°F. At this temperature the particulate control equipment would be capable of removing the lead emissions from the flue gas stream.

The emission limit judged to be reasonable for lead is based on test results at similar facilities and the degree of emission control that will be provided by the control equipment which has been determined to be BACT for this facility. In accordance with data contained in the California Air Resources Board (CARB) report on resource recovery facilities, the highest uncontrolled lead emission rate from refuse-fired incinerators tested is 0.037 lbs/mmBtu. Based on a heating value of 4500 Btu per pound of refuse and the control efficiency reported for lead emissions using the required BACT (scrubber and particulate control of 0.015 gr/dscf, corrected to 12% CO_2), an emission limitation of 0.00150 lb/mmBtu is judged to be BACT.

G. Mercury

BACT is determined to be or 7.50×10^{-4} lb/mmBtu. This level of mercury emissions is judged to be reasonable based on test data from similar facilities and the degree of control that will be provided by the acid gas and particulate control equipment.

H. Beryllium

The uncontrolled emission of beryllium, according to the California report, when firing MSW is estimated to be 6.2×10^{-6} lb/mmBtu. Uncontrolled beryllium emissions would be approximately 11 grams per 24 hours or 0.01 TPY. The operating temperature of the particulate matter emission control device will be below 300°F. Operation at this temperature will promote adsorption/condensation of beryllium oxides, present in the flue gas stream, onto available fly ash particulates for subsequent removal by the particulate control device. The annual beryllium emissions are estimated to be 0.004 TPY. This amount of beryllium emitted is considered to have a negligible impact on the environment. The emission limit of 9.3×10^{-7} lb/mmBtu is judged to be BACT.

V. AIR QUALITY ANALYSIS

The air quality impact of the proposed facility has been analyzed. Atmospheric dispersion modeling has been completed and used in conjunction with an analysis of existing air quality data to determine maximum ground-level ambient concentrations of the criteria pollutants subject to BACT. Based on these analyses, EPA has reasonable assurance that the proposed solid waste recovery facility in South Broward County, subject to the BACT emission limitations, will not cause or contribute to a violation of any PSD increment or ambient air quality standard.

A. Modeling Methodology

The EPA-approved Industrial Source Complex Short-Term (ISCST) dispersion model was used in the air quality impact analysis. This model determines ground-level concentrations of gaseous and solid pollutants emitted into the atmosphere by point, area, and volume sources. The model incorporates elements for plume rise, transport by the wind, gaussian dispersion, and pollutant removal mechanisms such as deposition or transformation. The ISCST model also allows for the separation of sources, building wake downwash, and various other input and output features. Both screening and refined analyses were completed using this model, the source parameters in Table V-1 and emission rates in Table V-2.

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Table V-1

Broward County Resource Recovery Facility
Source Parameters

Source (1)	UTM - E (km)	UTM - N (km)	Stack Height (m)	Exit Temp. (K)	Exit Velocity (m/s)	Stack Diameter (m)
Unit 1	579.6	2883.3	59.4	381	18.0 (2)	2.29
Unit 2	579.6	2883.3	59.4	381	18.0 (2)	2.29
Unit 3	579.6	2883.3	59.4	381	18.0 (2)	2.29

(1) Three 750 TPD incinerators, each with a flue to a common stack. For modeling purposes the common stack was given a stack diameter of 5.03 meters and an exit velocity of 11.2 m/s, providing for a minimum flow rate.

(2) Estimated by using a flow rate of 157,000 ACFM for each unit and calculated using given diameters.

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Table V-2
Broward County Resource Recovery Facility
Maximum Emission Rates (1)

Pollutant	(lb/ton)	(lb/hr)	(ton/yr)
PM	0.34	37.5	164
SO_2	2.8 (2)	302.9	1318
NO_x	5.04	544	2381
CO	0.81	87.4	383
Pb	0.00135	1.46	6.4
F^-	0.023	3.88	17.0
Be	8.4×10^{-6}	0.0009	0.0040
Hg	0.00675	0.73	3.2

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(1) Based on facility capacity of 2588 TPD of MSW and emission limits

(2) Based on a maximum emission rate of 0.31 lb/mmBtu at 65% removal efficiency.

Five years of sequential hourly meteorological data were used in the modeling analyses. Both the surface and the upper air data used were National Weather Service data collected at Miami, Florida, during the period 1970-1974. Since five years of data were used, the highest, second-high, short-term predicted concentrations are compared with the appropriate short-term ambient standard or PSD increment. The highest predicted concentration were used for comparison with long-term standards (annual).

The initial set of screening model runs determined the highest, second-high concentrations, over a polar coordinate receptor grid with 36 radials, 10 degrees apart, and 10 downwind distances from 0.3 km to 4.3 km. Concentrations are predicted for the initial capacity of the facility. Additional refined modeling was completed for those days having the highest, second high concentrations using a refined receptor grid of several radials, two degrees apart and at seven distances, 100 meters apart, centered on the location of the previously determined highest, second-high value. In all of these runs, only the proposed RRF was modeled.

All of the modeling was completed using the SO_2 emission rate of the proposed facility. The impacts of the other emitted pollutants were determined by ratioing the emission rates to the SO_2 emission rate and multiplying by the SO_2 impact. Total ambient air quality impacts were based on the modeled impacts plus the monitored "background" concentrations.

The impact of the proposed facility on the Everglades National Park Class I area was also evaluated. Modeling was completed placing receptors along the edge of the Class I area using five years of meteorological data. The 17 receptor locations were spaced two kilometers apart along the northeast boundary of the park.

B. Analysis of Existing Air Quality

Preconstruction ambient air quality monitoring is required for all pollutants subject to PSD review. In general, one year of quality assured data using EPA reference, or the equivalent monitor, must be submitted. Sometimes less than one year of data, but not less than four months, may be accepted when EPA approval is given. An exemption to the monitoring requirement can be obtained if the maximum air quality impact, as determined through air quality modeling, is less than a pollutant-specific de minimus concentration. In addition, if current monitoring data already exist and these data are representative of the proposed source area, then these data may be used at the discretion of the reviewing authority.

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The predicted maximum air quality impacts of the proposed facility for those pollutants subject to PSD review are given in Table V-3. The monitoring de minimus level for each pollutant is also listed. Sulfuric acid mist and arsenic are not listed because there is no de minimus level for either of these pollutants. All pollutants have maximum predicted impacts below their respective de minimus values. Therfore, specific preconstruction monitoring is not required for any pollutant.

Table V-4 lists the measured ambient concentrations of all pollutants being currently monitored within 10 kilometers of the proposed facility. These values are used to estimate current background levels.

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Table V-3

Broward County Resource Recovery Facility
Maximum Air Quality Impacts of the RRF
For Comparison to the De minimus Ambient Levels

Pollutant and Averaging Time	Predicted Impact (ug/m^3)	De minimus Ambient Impact Level (ug/m^3)
SO_2 (24-hour)	6.2	13
PM (24-hour)	0.8	10
NO_2 (Annual)	1.4	14
CO (8-hour)	11.8	575
Pb (24-hour)	0.03	0.1 (quarterly)
F^- (24-hour)	0.081	0.25
Be (24-hour)	0.00002	0.0005
Hg (24-hour)	0.015	0.025

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Table V-4

Broward County Resource Recovery Facility
Monitoring Data Within 10 km of the RRF

Site	-Location with Respect to the Proposed Facility- Direction (degrees)	Distance (km)	Pollutant	Concentration 1984 Annual (ug/m^3)	24-hour (ug/m^3)	8-hour (mg/m^3)	1-hour (mg/m^3)
0420002	3°	2.0	CO			10	17
0910002	296°	3.8	PM	33	64		
			NO_2	28			
			SO_2	3	4		
1260004	55°	6.8	PM	41	72		
			NO_2	29			
			SO_2	4	28		
1840001	158°	6.9	PM	39	70		
			Pb (quarterly)	0.2			
3530001	216°	7.3	NO_2	30			
			SO_2	3	6		
1260003	27°	7.6	PM	59	93		
			NO_2	42			
			SO_2	3	4		
			CO			7	11
			Pb (quarterly)	0.9			
1840002	150°	8.6	CO			6	10
3640002	334°	9.4	PM	31	59		

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C. PSD Increment Analysis

The proposed Broward County RRF is to be located in a Class II area. This area is designated as an attainment area for both SO_2 and PM. A PSD increment analysis is therefore required to show compliance with the Class II increments.

The PSD increments represent the amount that new sources in the area may increase ambient ground-level concentrations of SO_2 and PM. At no time, however, can the increased loading of these pollutants cause or contribute to a violation of the ambient air quality standards.

All SO_2 and PM emission increases from sources constructed or modified after the baseline date (December 1977) will consume PSD increment. In addition, all SO_2 and PM emission increases associated with construction or modification of major sources which occurred after January 6, 1975, will consume increment. The proposed Broward County RRF is the only significant source in the area which will consume PSD increment for either SO_2 or PM.

Atmospheric dispersion modeling, as previously described, was performed to quantify the amount of PSD increment consumed. The results of this modeling are summarized in Table V-5. The results indicate that the concentration increases are within the allowable amounts.

A Class I area increment analysis is required because of the proposed facility is located within 100 kilometers (57 km) of the Everglades National Park, a designated Class I area. Although the distance to the Class I area is greater than 50 kilometers (the distance to which the models are generally considered valid), the applicant used the model to estimate the impact on this area. The results indicate a less than significant impact.

D. AAQS Analysis

Given existing air quality in the area of the proposed facility, emissions from the new facility are not expected to cause or contribute to a violation of an AAQS. Table V-6 shows the results of the AAQS analysis.

The results showed that, with the exception of SO_2 and lead, the maximum impacts of the other criteria pollutants were less than the significant impact levels defined in 40 CFR 52.21. As such, no further modeling analysis was completed for PM, NO_x, and CO. For SO_2, additional modeling was performed which included the interaction of surrounding sources of SO_2. For lead, there is no significant impact level defined in the regulation. However, no further modeling of lead was completed because the predominate sources of ambient lead in the area are mobile sources.

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Table V-5

Broward County Resource Recovery Facility
Comparison of New Source Impacts with PSD Increments

Pollutant and Averaging Time	PSD Class II Increment (ug/m^3)	Predicted Increased Concentration (ug/m^3)	Percent Increment Consumed	PSD Class I Increment (ug/m^3)	Predicted Increased Concentration (ug/m^3)
SO_2					
3-hour	512	26	5	25	4
24-hour	91	6	7	5	1
Annual	20	<1	<5	2	<1
PM					
24-hour	37	<1	<3	10	<1
Annual	19	<<1	<<5	5	<<1

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Table V-6

Broward County Resource Recovery Facility
Comparison of Total Impact with the AAQS

Pollutant and Averaging Time	Maximum Impact Project (ug/m^3)	Maximum Impact (1) All Sources (ug/m^3)	Existing Background (2) (ug/m^3)	Maximum Total Impact (ug/m^3)	National Ambient Air Quality Standard (ug/m^3)
SO_2					
3-hour	26	625	63 (3)	688	1300
24-hour	6	216	28	244	260
Annual	<1 (4)	-	4	-	60
PM					
24-hour	<1 (4)	-	93	-	150
Annual	<<1 (4)	-	59	-	60
NO_2					
Annual	1.4 (4)	-	42	43	100
CO					
1-hour	64 (4)	-	17,000	-	40,000
8-hour	12 (4)	-	10,000	-	10,000
Pb					
3-months	<0.1	-	0.9	1	1.5

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(1) Maximum impact includes the FPL Port Everglades and Fort Lauderdale power plants.

(2) Existing background is estimated using the highest monitored concentrations in the area near the proposed facility.

(3) The 3-hour background is estimated by multiplying the 24-hour background by 2.25.

(4) Less than significant, no further analysis completed.

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The total impact on ambient air is obtained by adding a "background" concentration to the maximum modeled concentration. This "background" concentration takes into account all sources of the particular pollutant in question that were not explicitly modeled. A conservative estimate of these "background" concentrations was made by using the highest monitored concentration for each pollutant as listed in Table V-4. This is a conservative estimate because sources used in the modeling may have contributed to the monitored value.

Based on this analysis, EPA has resonable assurance that no AAQS will be exceeded as a result of the operation of the proposed new resource recovery facility.

VI. ADDITIONAL IMPACTS ANALYSIS

A. Impacts on Soils and Vegetation

The maximum ground-level concentrations predicted to occur as a result of emissions from the proposed project in conjunction with all other sources, including background concentrations, will be at or below all applicable AAQS including the secondary standards designed to protect public welfare-related values. As such, these pollutants are not expected to have a harmful impact on soils and vegetation.

A summary of the types and quantities of soils and vegetation in and around the proposed RRF site area and in the Everglades National Park can be found in the Site Certification Application. The applicant has also compared predicted maximum impacts with known adverse impact levels for both criteria and noncriteria pollutants. No adverse impacts are expected.

B. Impact on Visibility

A level I visibility screening analysis was performed to determine if any impact may occur in the Class I area. The analysis showed that there was no potential for an adverse impact on visibility in this area.

C. Growth-Related Air Quality Impacts

The proposed facility is not expected to significantly change employment, population, housing, or commercial/industrial development in the area to the extent that a significant air quality impact will result.

D. GEP Stack Height Determination

Good Engineering Practice (GEP) Stack height is defined as the greater of: (1) 65 meters or (2) the maximum nearby building height plus 1.5 times the building height or width, whichever is less. For the proposed project, a single common stack, housing the individual flues for each incinerator, will be 59.4 meters high. This is below the allowed GEP stack height of 65 meters.

E. Noncriteria Pollutants

The proposed facility emits in significant amounts (as defined in the PSD regulations): fluorides, sulfuric acid mist, beryllium, mercury, and arsenic. All of these pollutants are regulated, but there is no ambient air quality standards or PSD increments set for any of them. For three of these pollutants--fluorides, beryllium, and mercury—a de minimus ambient impact level has been defined. Exceedance of these levels, usually determined by dispersion modeling, is used to determine if ambient monitoring is necessary. The results of this modeling for these pollutants is listed in Table V-3. For each of these three pollutants, the predicted impact is less than their respective de minimus impact level.

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F. Unregulated Pollutants

Two additional pollutants are often brought up in the context of resource recovery facilities. These are hydrogen chloride (HCl) and dioxins (2, 3, 7, 8-TCDD). Neither is currently regulated within the PSD regulations. Hydrogen chloride is regulated nationally for other type sources but not specifically for resource recovery facilities. Some states do regulate both of these substances. Both of these substances may become regulated either nationally or by the State in the future. The recommended control equipment necessary for the facility to meet the BACT emissions limitations for the regulated pollutants will also control HCl and dioxins.

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PART I

Specific Conditions

1. Emission Limitations

   a. Stack emissions from each unit shall not exceed the following:

Particulate: 0.0150 gr/dscf dry volume corrected to 12% CO_2.

Sulfur Dioxide: 0.140 lb/mmBtu heat input and 60 ppm (3-hr rolling average, dry volume, corrected to 12% CO_2), or 65% control of total SO_2 emissions.* In no case shall the SO_2 emissions exceed 0.310 lb/mmBtu heat input and 124 ppm (3-hr rolling average, dry volume, corrected to 12% CO_2).

Initial and subsequent compliance tests shall determine the actual emission limit (in ppm) from the control device at 65% control efficiency. The observed average emission rate from compliance testing will be statistically analyzed using a 95% probability level to derive a hypothetical emission rate. The final operating SO_2 emission limit (in ppm) shall be based on this hypothetical emission rate or the 124 ppm (3-hr rolling average, dry volume, corrected to 12% CO_2), whichever is more stringent.

Nitrogen Oxides: .560 lb/mmBtu (350 ppm, 3-hr rolling average, dry volume, corrected to 12% CO_2).

Carbon Monoxide: .090 lb/mmBtu (400 ppm, 1-hr rolling average, dry volume, corrected to 12% CO_2).
(88 ppm, 4-day rolling average, dry volume, corrected to 12% CO_2).

Lead: .00150 lb/mmBtu

Fluorides: .0040 lb/mmBtu

Beryllium: 9.30×10^{-7} lb/mmBtu

Mercury: 7.50×10^{-4} lb/mmBtu

Sulfuric acid mist: 4.70×10^{-3} lb/mmBtu

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* Total SO_2 emissions will be measured at the inlet to the acid gas control device.

Visible Emissions: Opacity of stack emissions shall not be greater than 15% opacity. Excess opacity resulting from startup or shutdown shall be permitted providing (1) best operational practices to minimize emissions are adhered to and (2) the duration of excess opacity shall be minimized but in no case exceed two hours in any 24-hour period unless specifically authorized by EPA for longer duration.

Excess emissions which are caused entirely or in part by poor maintenance, poor operation, or any other equipment or process failure which may reasonably be prevented during start-up or shutdown shall be prohibited.

The units are subject to 40 CFR Part 60, Subpart E and Subpart Db, New Source Performance Standards (NSPS), except that where requirements in this permit are more restrictive, the requirements in this permit shall apply.

There shall be no greater than 10% opacity for emissions from the refuse bunker and the ash handling and loadout. The potential for dust generation by ash handling activities will be mitigated by quenching the ash prior to loading in ash transport trucks. Additionally, all portions of the proposed facility, including the ash handling facility, which have the potential for fugitive emissions will be enclosed. Also, those areas which have to be open for operational purposes, (e.g., tipping floor of the refuse bunker while trucks are entering and leaving) will be under negative air pressure.

b. Only distillate fuel oil or natural gas shall be used in startup burners. The annual capacity factor for use of natural gas and oil, as determined by 40 CFR 60.43b(d), shall be less than 10%. If the annual capacity factor of natural gas is greater than 10%, then the facility shall be subject to 560.44 b.

c. None of the three individual municipal solid waste incinerators shall not be charged in excess of 323.6 mmbtu/hr and 863 tons per day MSW (115% rated capacity).

d. Compliance Tests

(1) a. Annual compliance tests for particulate matter, lead, SO_2, nitrogen oxides, CO, fluorides, mercury, and beryllium shall be conducted in accordance with 40 CFR 60.8 (a), (b), (d), (e), and (f).

b. Compliance with the opacity standard for the incinerator stack emissions in condition 1.a. of this part shall be determined in accordance with 40 CFR 60.11 (b) and (e).

c. Compliance with the emission limitation for 65% control of total sulfur dioxide emissions shall be determined by using the test methods in condition 1.d.(2) and sampling for SO_2 emissions before and after the acid gas control device.

(2) The following test methods and procedures for 40 CFR Parts 60 and 61 shall be used for compliance testing:

a. Method 1 for selection of sample site and sample traverses.

b. Method 2 for determining stack gas flow rate when converting concentrations to or from mass emission limits.

c. Method 3 for gas analysis for calculation of percent O_2 and CO_2.

d. Method 4 for determining stack gas moisture content to convert the flow rate from actual standard cubic feet to dry standard cubic feet for use in converting concentrations in dry gases to or from mass emission limits.

e. Method 5 for concentration of particulate matter and associated moisture content. One sample shall constitute one test run.

f. Method 9 for visible determination of the opacity of emissions.

g. Method 6 for concentration of SO_2. Two samples, taken at approximately 30 minute intervals, shall contitute one test run.

h. Method 7 for concentration of nitrogen oxides. Four samples, taken at approximately 15 minute intervals, shall constitute one test run.

i. Method 10 for determination of CO concentrations. One sample constitutes one test run.

j. Method 12 for determination of lead concentration and associated moisture content. One sample constitutes one test run.

k. Method 13B for determination of fluoride concentrations and associated moisture content. One sample shall constitute one test run.

l. Method 101A for determination of mercury emission rate and associated moisture content. One sample shall constitute one test run.

m. Method 104 for determination of beryllium emission rate and associated moisture content. One sample shall constitute one test run.

2. Compliance with emission limitations specified in lb/mmBtu in conditions 1.a. and 1.c. of this part shall be determined by calculating an "F" factor in dscf/mmbtu corrected to 12% CO_2 using the boilers' efficiency (as determined by the calorimeter method contained in Attachment A during acceptance testing) and the measured steam production and quality. Data obtained from test methods required in condition 1.d. of this part for compliance testing shall be used for the calculation of the "F" factor required by this condition.

3. The height of each boiler exhaust stack shall not be less than 200 feet above ground level at the base of the stack.

4. Each incinerator boiler shall have a metal name plate affixed in a conspicuous place on the shell showing manufacturer, model number, type waste, rated capacity, thermal efficiency, and certification number.

5. The permittee must submit to EPA and DER, within fifteen (15) days after it becomes available to the County, copies of technical data pertaining to the incinerator boiler design, acid gas control equipment design, particulate control equipment design, and the fuel mix that will be used to evaluate compliance of the facility with the preceeding emission limitations.

6. Fuel

   The Resource Recovery Facility shall utilize refuse such as garbage and trash (as defined in Chapter 17-7, FAC) but not grease, scum, grit screenings or sewage sludge.

7. Air Pollution Control Equipment

   The permittee shall install, continuously operate, and maintain the following air pollution controls to minimize emissions. Controls listed shall be fully operational upon startup of the proposed equipment.

   a. Each boiler shall be equipped with a particulate emission control device for the control of particulates.

   b. Each boiler shall be equipped with an acid gas control device designed to remove at least 90% of the acid gases.

8. Continuous Emission Monitoring

   a. Prior to the date of startup and thereafter, the Broward County shall install, maintain, and operate the following continuous monitoring systems for each boiler exhaust stack:

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(1) Continuous emission monitoring (CEM) systems to measure stack gas opacity and SO_2, NO_x, CO, CO_2, and O_2 concentrations for each unit. The systems shall meet the EPA monitoring performance specifications of 40 CFR 60.13 and 40 CFR 60, Appendix B, prior to and during initial compliance testing and annually thereafter. Additionally, CEM's shall meet the quality control requirements of 40 CFR 60, Appendix F (Attachment B).

b. An excess emissions report shall be submitted to EPA for every calendar quarter. The report shall include the following:

(1) The magnitude of excess emissions computed in accordance with 40 CFR 60.13(h), any conversion factors used, and the date and time of commencement and completion of each period of excess emissions (60.7(c)(1)).

(2) Specific identification of each period of excess emissions that occurs during startups, shutdowns, and malfunctions of the furnace/boiler system. The nature and cause of any malfunction (if known) and the corrective action taken or preventive measures adopted shall also be reported (60.7(c)(2)).

(3) The date and time identifying each period during which the continuous monitoring system was inoperative except for zero and span checks, and the nature of the system repairs or adjustments (60.7(c)(3)).

(4) When no excess emissions have occurred or the continuous monitoring system has not been inoperative, repaired, or adjusted, such information shall be stated in the report (60.7(c)(4)).

(5) Broward County shall maintain a file of all measurements, including continuous monitoring systems performance evaluations; all continuous monitoring systems or monitoring device calibrartion checks; adjustments and maintenance performed on these systems or devices; and all other information required by this permit recorded in a permanent form suitable for inspection (60.7(d)).

c. Excess emissions indicated by the CEM systems shall be considered violations of the applicable emissions limits for the purposes of this permit provided the data represents accurate emission levels and the CEM's do not exceed the calibration drift (as specified in the respective performance specification tests) on the day when initial and subsequent compliance is determined. The burden of proof to demonstrate that the data does not reflect accurate emission readings shall be the responsibility of the permittee.

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9. Reporting

a. A copy of the results of the stack tests shall be submitted within forty-five days of testing to the DER Bureau of Air Quality Management, the DER Southeast Florida District Office, Broward County, and EPA Region IV.

b. Stack monitoring shall be reported to the DER Southeast District Office and EPA Region IV on a quarterly basis in accordance with Section 17-2.710, FAC, and 40 CFR 60.7.

c. Addresses for submitting reports are:

EPA Region IV

Chief, Air Compliance Branch
U.S. Environmental Protection Agency
345 Courtland Street, N.E.
Atlanta, Georgia 30365

Florida Department of Environmental Regulation (DER)

Chief, Compliance and Ambient Monitoring
Bureau of Air Quality Management
Florida Department of Environmental
Regulation (DER)
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32301

Southeast District Office of DER

District Manager
Department of Environmental Regulation
3301 Gun Club Road
P.O. Box 3858
West Palm Beach, Florida 33402

Broward County

Broward County Environmental Quality
Control Board
500 Southwest 14th Court
Ft. Lauderdale, Florida 33315

PART II

General Conditions

1. The permittee shall comply with the notification and record-keeping requirements codified at 40 CFR Part 60.7.

2. The permittee shall retain records of all information resulting from monitoring activities and information indicating operation parameters as specified in the specific conditions of this permit for a minimum of two (2) years from the date of recording.

3. If, for any reason, the permittee does not comply with or will not be able to comply with the emission limitations specified in this permit, the permittee shall provide EPA with the following information in writing within five (5) days of such condition:

   (a) description of noncomplying emission(s),
   (b) cause of noncompliance,
   (c) anticipated time the noncompliance is expected to continue or, if corrected, the duration of the period of noncompliance,
   (d) steps taken by the permittee to reduce and eliminate the noncomplying emission.

   Failure to provide the above information when appropriate shall constitute a violation of the terms and conditions of this permit. Submittal of the aforementioned information does not constitute a waiver of the emission limitations contained within this permit.

4. Any proposed change in the information contained in the final determination regarding facility emissions or changes in the quantity or quality of materials processed that would result in new or increased emissions or ambient air quality impact must be reported to EPA. If appropriate, modifications to the permit may then be made by EPA to reflect any necessary changes in the permit conditions. In no case are any new or increased emissions allowed that will cause violation of the emission limitations specified herein. Any contruction or operation of the source in material variance with the final determination shall be considered a violation of this permit.

5. In the event of any change in control of ownership of the source described in the permit, the permittee shall notify the succeeding owner of the existence of this permit and EPA of the change in control of ownership within 30 days.

6. The permittee shall allow representatives of the state and local environmental control agency or representatives of the EPA, upon presentation of credentials:

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(a) to enter upon the permittee's premises, or other premises under the control of the permittee, where an air pollutant source is located or in which any records are required to be kept under the terms and conditions of this permit;

(b) to have access to and copy at reasonable times any records required to be kept under the terms and conditions of this permit, or the Clean Air Act;

(c) to inspect at reasonable times any monitoring equipment or monitoring method required in this permit;

(d) to sample at reasonable times any emissions of pollutants; and

(e) to perform at reasonable times an operation and maintenance inspection of the permitted source.

7. The conditions of this permit are severable, and if any provision of this permit or the application of any provisions of this permit to any circumstances is held invalid, the application of such provision to other circumstances and the remainder of this permit shall not be affected.

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ATTACHMENT A

CALCULATING EFFICIENCY OF MUNICIPAL WASTE MASS BURNING ENERGY RECOVERY SYSTEMS

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FERDNAND DeGEYTER
Seghers Engineering, SA

ABSTRACT

One of the questions on mass burning of municipal waste has been how much heat can be recovered from the waste. The answer must always be conditioned on the heating value of the waste. The problem is to determine that value. Every sample of waste will have different moisture, ash and chemical composition, which will calculate to different heating values. The practice in the U.S. is to use the high heat value in calculating energy production, which further complicates the question. Our suggestion is to use the furnace as the calorimeter to determine the heating value of the waste.

This is accomplished by measuring all the known inputs: waste quantity; combustion air; feedwater and cooling water; and all the known outputs: steam; blowdown; ash; radiation and flue gas. Flue gas O_2, CO_2, H_2O and S are measured and used to calculate a waste Btu content. Efficiency is calculated by dividing the net heat in steam by the calculated heat input.

INTRODUCTION

One system of incineration has been proven by over 30 years of successful operation in Europe and, to a limited extent, in the U.S.: mass burning of unsorted waste on specially designed grate systems.

Specially designed waterwall boilers recover heat energy from the hot flue gases in the form of steam for district heating, process or electrical production. One of the questions on mass burning has been determining exactly how much heat can be recovered from the waste. The main problem is calculating the heating value of municipal waste. If 20 samples are taken, it is likely that 20 different heating values will result. Every sample of waste will have different moisture, ash and chemical composition, which will calculate to different heating values.

The practice in the U.S. is to use the high heat value in calculating energy production, which further complicates the question. Two samples of waste may have similar high heat values (Table 1) but different moisture content and the resultant energy production (steaming rate) will vary significantly.

The steaming rate varies with the Btu content of the waste in a linear relationship over a range of about 3800 to 5200 Btu/lb kcal/kg (2100-29,000) assuming all other factors are equal. Below 4300 and above 5200, the ratio changes as indicated below:

HHV	3000	4300	4500	5200	6000 Btu/lb
	(1667)	(2400)	(2500)	(2900)	(3333 kcal/kg)
LHV	2400		4270		5740
	(1333)			(1318)	(3200 kcal/kg)
Steam Rate	1.25	2.20	2.31	2.67	3.20

Approximately the same amount of heat is lost through radiation of the boiler so lower Btu fuel would have a lower net steaming rate. Steaming rate would likewise vary inversely with the flue gas temperature, all other factors being equal.

Flue Gas Exhaust Temperature:	400°F (205°C)	374°F (190°C)
Steaming Rate (Net lb/lbs):	2.22	2.31

Finally, steaming rate varies with the percent furnace loading. Normally, mass burning furnaces will be run at

90 to 105 percent of rated capacity. Below 66 percent furnace loading, the boiler efficiency falls off rapidly to the point where it is not economically feasible to operate a furnace for energy recovery below 60 percent capacity.

The question is always asked: "What will the manufacturer guarantee as a steaming rate;" The answer must always be conditioned on the composition and heating value of the waste. The problem then is to determine those values. Our suggestion is to use the furnace as the calorimeter to determine the heating value of the waste.

Most furnace/boiler systems are designed for a total heat throughput or a maximum furnace capacity for waste at some specific heating value (Btu/lb or kcal/kg). The throughput may increase to some design overload if the heating value decreases and vice versa, so the maximum total heat throughput is not exceeded (Fig. 1).

PERFORMANCE GUARANTEES

Mass burning waste incinerator plants must meet specific performance guarantees, which are only partly within the dictates of the furnace/boiler and mostly a function of the waste processed.

Common guarantees are:

(a) waste throughput, hourly, daily or yearly (should be based on some assumed heating value of the waste);

(b) energy production (usually expressed as a factor of waste input (lb steam/lb waste) and contingent on an assumed composition and heat value of the waste);

(c) maximum putrescibles and combustible material in residue (a better indication of furnace performance than total amount of residue, which is more a function of the waste);

(d) maximum particulate emissions and other environmental factors.

We are concerned here with (a) and (b) and suggest a method for helping the supplier and customer to agree on how to determine if a system meets its guarantees.

ADJUSTMENTS TO OBSERVED THROUGHPUT CAPACITY AND ENERGY RECOVERY RATES

It is recognized that the refuse delivered to a mass burning facility for acceptance test purposes may not have the same composition as the reference processible waste and that throughput capacity and energy recovery are dependent upon the refuse composition, particularly its moisture content and heating value.

For example, the processing of lower Btu content than that of the reference waste will allow higher throughput rates but result in lower energy yield and may, therefore, appear to demonstrate higher throughput but lower per ton energy yields than that which would have been obtained had the plant been tested with reference processible waste. Similarly, if the waste furnished for acceptance testing purposes has a higher Btu content than that of the reference waste, the demonstrated throughput capacity may be less than that which would have been obtained with reference processible waste but the per ton energy yield would be higher.

It is further recognized that it is difficult and economically unfeasible to obtain an accurate measurement of the heating value of the waste through sampling of the waste being processed during the acceptance test and impossible after it has been incinerated. It is therefore proposed that the combustion system be used as a calorimeter, following in general the principles for determining efficiency and capacity described in the ASME Power Test Code 4.1 for steam generating units (1964, reaffirmed 1979) and the ASME Performance Test Code 33 for large incinerators (1978). The abbreviated effciency test (PTC 33a-1980, Appendix to ASME PTC 33) may be used to determine efficiency by the heat balance method.

The concept is to measure all the known inputs: fuel (waste) in pounds, combustion air flow and temperature, feedwater temperature and flow, and cooling water (to ash extractor) flow and temperature; and to measure all the outputs: steam flow, temperature and pressure, blowdown flow and temperature, ash quantity, temperature and carbon contents, and skin temperature (to calculate radiation).

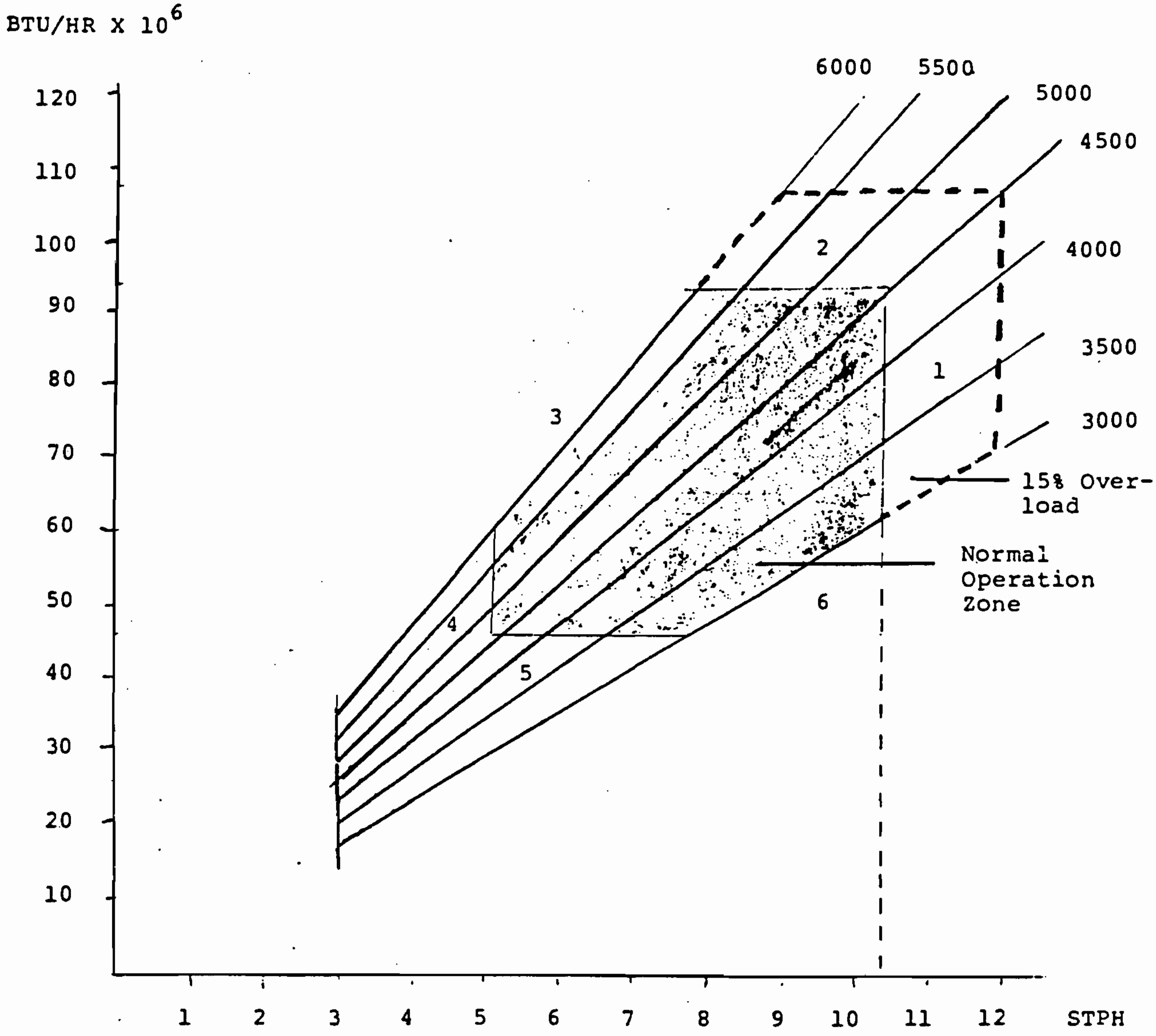
We also measure flue gas temperature and flow so we know everything going in and coming out.

The flue gas is further analyzed to measure oxygen, carbon dioxide, water and sulphur and these figures are used to back into a waste analysis. Btu content is calculated from this analysis and compared with output to figure furnace/boiler efficiency. Given this calculated efficiency and, assuming that the efficiency obtained during the test, after appropriate corrections, would be the same as that which would have been obtained using reference processible waste, the throughput capacity and energy outputs observed in the test will be adjusted to reflect the difference between the calculated heating value of the test fuel and the assumed heating value of the reference processible waste.

SPECIFIC TEST PROCEDURES

INCINERATOR CAPACITY TEST

The purpose of this test is to demonstrate the ability of the boiler plant to handle and burn the guaranteed throughput of specified solid waste while staying within the limits of the specified normal operating grate temperatures and while meeting the guaranteed degree of burnout. This test should also give an indication regarding the reliability of



1 Maximum MSW throughput (10.41 STPH)
2 Maximum heat release rate (94 X 10^6 BTU/HR)
3 Maximum expected caloric value (6000 BTU/LB)
4 Minimum MSW through (50% Max)
5 Minimum heat release rate (50% Max)
6 Minimum expected caloric value (3000 BTU/LB)

FIG. 1 TYPICAL FURNACE OPERATION DIAGRAM the equipment and, therefore, each line should be run at full load for at least 7 days, after stabilization, without interruption. In the event of a breakdown, the test should be repeated. All equipment should operate during the test at its normal mode and capacity, and the maintenance force and supplies should be those proposed to be available during normal operation of the plant – all to demonstrate the availability of the plant under normal operating conditions.

The facility should be operated for a 7 day period, at the maximum rated capacity and process at least six times (85 percent) the rated daily tons of processible waste.

During the 7 day test period, the total residue from the combustion process should be measured and sampled. The composition of the residue should be determined by hourly samples taken during the 72 hr period when the Facility is processing a total of three times the daily rated tons of processible waste.

The residue sampling should be submitted to the independent engineer for analysis by an independent laboratory prior to the conclusion of the acceptance tests. As a minimum, the residue should be analyzed for moisture content, combustible matter and putrescible matter in accordance with PTC 33.

The facility shall not have been deemed to have passed the throughput capacity test, even though the tonnage processed meets the capacity requirements stated above, if the percentage of combustible and putrescible matter in the total residue exceeds the guaranteed percentages of combustible and putrescible matter.

If the results are not as guaranteed, the Contractor and Customer will likely not be able to agree that the waste processed was identical to the "standard" waste used for contract purposes. Twenty samples will likely result in twenty different results. And, of course, there is no way to sample the waste after it has been incinerated, which would normally be when a controversy would arise. A reasonable alternative is what we are proposing.

The heat balance method of determining efficiency as described herein may be used to calculate the heat value of the waste fired during the test period. If the facility does not meet the throughput capacity test, the demonstrated throughput capacity will be adjusted by the inverse ratio of the heat value of the waste actually processed to the heat value of the reference waste usually assumed to be 4500 Btu/lb HHV.

If this adjustment results in a throughput capacity meeting the guarantee, the facility will have been deemed to have passed the throughput capacity test. If the heat value of the waste fired is determined to have been below 3800 Btu/lb HHV, the waste supplied shall be considered as not representative of processible waste and the test will then be repeated at the customer's expense.

ENERGY RECOVERY TEST

The energy recovery test will consist of a test of the steam raising rate and a test of the electric generation rate, if applicable. The test of the steam raising rate will establish whether the combustion process produces the guaranteed quantity of steam. The test of the electric generation rate will then determine whether the overall performance of the facility meets the guarantees as to energy recovery.

Steam Raising Rate

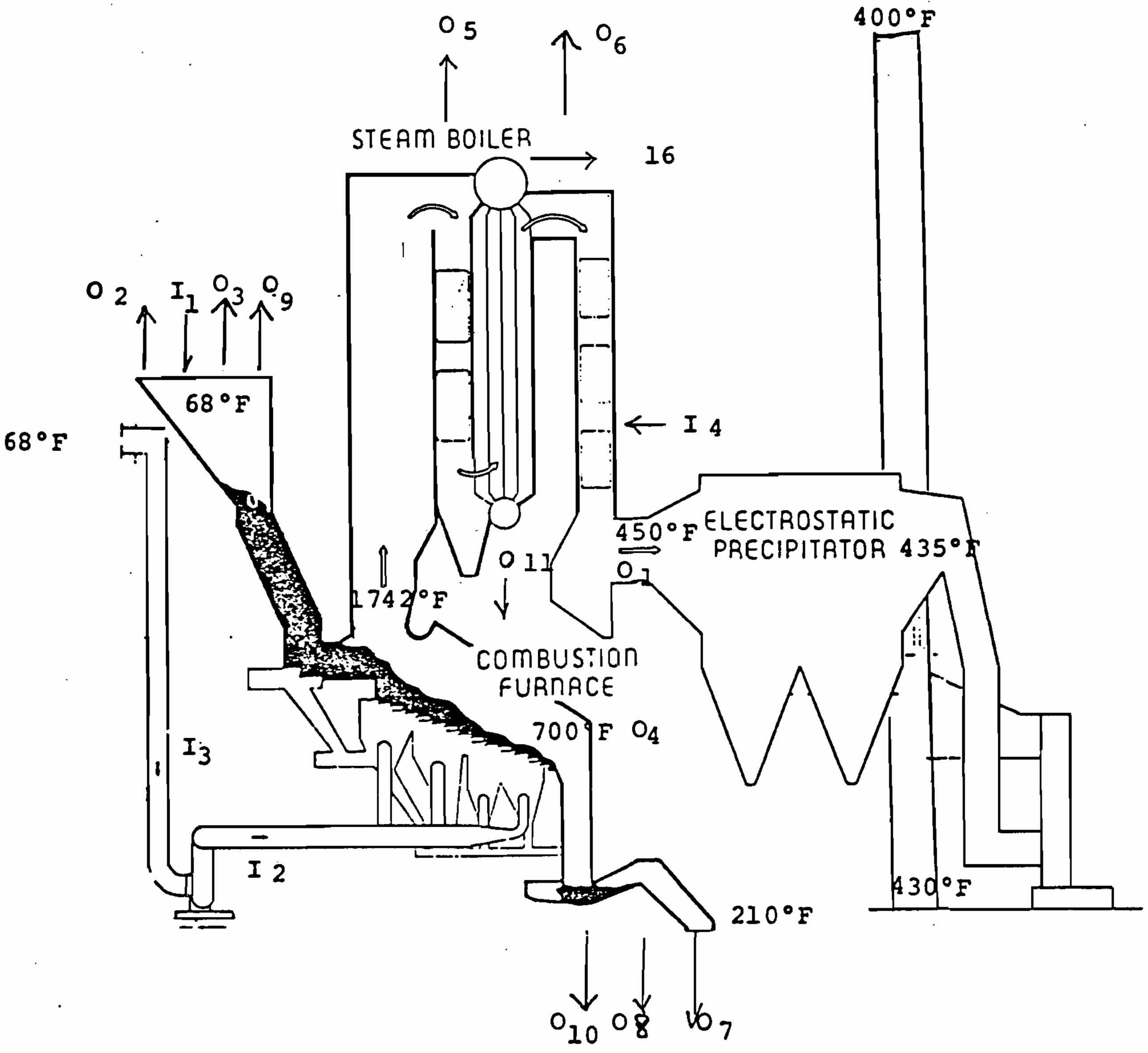
The purpose of this portion of the energy recovery test is to determine whether the facility meets the guaranteed steam raising rate, when processing solid waste, having the heating value of the reference solid waste, at a rate equal to the guaranteed daily throughput capacity under normal operating conditions as to boiler blowdown, exit gas temperatures and excess air ratio.

The test shall be conducted in accordance with the test codes referenced above, as modified herein, for the determination of heat outputs, credits and losses and the calculation of efficiency and fuel heating value by the heat balance method. For the purpose of determining the efficiency, steam output shall be measured at the superheater outlet and hot flue gases shall be measured at the inlet to the stack.

The test shall extend over an 8 hr test period. Pertinent test data shall be recorded at appropriate intervals, in accordance with the test code and shall include the following – all of which are relatively easy to measure with a high degree of accuracy:

- Processible waste feed rate (weight) and moisture
- Boiler outlet steam rate, temperature and pressure
- Feedwater rate and temperatures
- Desuperheater water rate, temperature and pressure (as applicable)
- Boiler drum pressure
- Flue gas rate and temperature at the stack inlet
- CO_2, O_2, SO_2 and H_2O in the flue gas at the stack inlet by various EPA methods
- Residue and fly ash quantities, temperature and unburned carbon and sulfur content
- Barometric pressure
- Combustion air flow and temperatures
- Ambient wet/dry bulb temperatures
- Residue quench water quantity and temperature
- Moisture in residue (after quench)
- In-house steam consumption
- Steam quality – percent moisture or PPM
- Boiler blowdown rate and temperature
- Furnace boiler skin temperature and area

Test measurements should be taken from installed plant instruments which have been previously calibrated



$$\text{Efficiency} = \frac{\text{Net Heat in Steam}}{\text{Net Avail. Heat Input}} \times 100$$

FIG. 2 ENERGY BALANCE FURNACE BOILER SYSTEM

TABLE 1 STEAMING RATE

Assumed Waste Composition	% Moisture	
	20%	25%
Carbon	26.6	22.7
Hydrogen	3.4	4.3
Sulphur	0.2	0.2
Oxygen	25.4	22.6
Nitrogen	0.2	0.2
Moisture	20.0	25.0
Ash	24.2	25.0
High Heat Value	4502	4494 BTU/lb.(2500 KCAL/KG
Gas Temperature	1742	1742° F. (950° C.)
Excess Air	1.3882	1.2503
O_2-Stoichiometric	0.6925	0.6870 lb./lb.
Total Air	7.1445	6.6775 lb./lb.
O_2	0.9614	0.8589 lb./lb.
CO_2	0.9320	0.7875 lb./lb.
H_2O	0.5273	0.6585 lb./lb.
N_2	5.4925	5.1337 lb./lb.
Flue Gas	7.9132	7.4386 lb./lb.
Exhaust Temperature	374° F.	374° F. (190° C.)
Steam Temperature	750° F.	750° F. (400° C.)
Steam Pressure	600 psi	600 psi (41 ATA)
Make-Up Water Temperature	250° F.	250° F. (121° C.)
Steaming Rate, lb.steam/ lb.waste	2.31	2.22

and agreed accurate by the independent engineer. Special portable instrumentation may also be used where required and agreed upon.

Utilizing the test data and measurements from the test, calculations will be made in accordance with the ASME test codes as modified herein, for the determination of boiler heat losses, heat outputs and heat credits (Fig. 2 and Table 2).

METHOD OF DETERMINING SOLID WASTE HIGH HEATING VALUE

With the information accurately obtained during the performance test, the high heating value of the solid waste can be calculated. In order to simplify the method of calculation and the test procedure, the ultimate analysis of the waste will be assumed to consist of only the major components:

- Carbon – Carbon content of the waste is calculated from the percentage of carbon dioxide in the flue gas and the percentage of carbon in the residue.
- Sulfur – Sulfur content of the waste is calculated from the percentage of sulfur dioxide in the flue gas and the percentage of sulfur in the ash.
- Hydrogen – Hydrogen is determined from the amount of moisture in the flue gas taking into account the moisture in the waste, combustion air and ash quench vapor.
- Nitrogen – Nitrogen is an assumed value agreed upon before the test. The nitrogen content of the refuse is very small and will have very little effect on the high heating value of the waste.
- Moisture – Moisture content is determined from samples taken during the performance tests.
- Ash – Ash content is determined from the total residue produced during the test less the moisture, sulfur and carbon contained in the ash.

TABLE 2 REFUSE-FIRED BOILER ENERGY BALANCE

Item	Heat Loss	BTU/LB$_R$	BTUX10^6/DAY
01.	Heat loss due to dry gas. Dry flue gas LB/LB$_R$ x specific heat x (exit gas temp. - ambient air temp.) 6.791 LB/LB$_R$ x .254 Btu/Lb.°F. (400°F-70°F.).	569.2	170.8
02.	Heat loss due to moisture in fuel = (Enthalpy of vapor at 1.0 PSIA @ exit gas temp. - enthalpy of liquid @ ambient air temp.) x moisture in the fuel LB/LB$_R$ (.2119 LB/LB$_R$ x (1240 Btu/LB-48 Btu/LB).	252.6	75.8
03.	Heat loss due to H_2O from comb. of H_2 = 9 x hydrogen in fuel LB/LBL (Enthalpy of vapor - enthalpy of liquid) 9 x .0338 x (1240-48).	362.6	108.8
04.	Heat loss due to combustibles in residue Carbon in residue x 14.500 Btu/LB .0136 x 14.500 Btu/LB.	197.2	59.2
05.	Heat loss due to radiation (ABMA Chart).	45.0	13.5
06.	Unaccounted for losses.	55.0	16.5
07.	Heat loss in residue. Dry residue including unburned carbon x (specific heat of residue) x (residue temp. leaving furnace - residue temp. after quench) .2730 LB/LB$_R$ x .25 Btu/LB°F. x (700°F-210°F.).	33.4	10.0
08.	Heat loss due to moisture in residue. Moisture content of residue x (temp. @ residue leaving quench - temp. of water entering quench) 15/100 (.2730 LB/LB$_R$)(210°F.-70°F.) x 1 Btu/LB°F.	5.7	1.7
09.	Heat loss due to moisture in air. Total dry air required based on fuel rate x moisture in air x specific heat of air x exit gas temp.-inlet air temp.)(0.5583 LB/LB$_R$ x .013 LB$_{water}$/LB$_{air}$ x 0.429 BTU/LB°F. (400° F-70°F).	12.1	3.6
010.	Heat loss due to quench vapor. (Heat loss in dry residue ÷ latent heat of vapor @ atmospheric pressure) x (enthalpy of vapor entering boiler-enthalpy of vapor entering furnace. (33.44 Btu/LB ÷ 970.4 Btu/LB) x (1240 Btu/LB-970.4 Btu/LB).	9.3	2.8

TABLE 2 REFUSE-FIRED BOILER ENERGY BALANCE (CONT'D.)

Item	Heat Loss	BTU/LB_R	$BTUX10^6/DAY$
011.	Heat loss due to blowdown. Estimated steam production x specific heat of steam @ 150 PSIG sat. x blowdown rate. 2.8 LB/LB_R x ~~1196~~ Btu/LBS x 3%	106.5	32
		1648.6	494.6
	Heat Input		
I1.	Fuel heat input. HHV of refuse.	4500	1350
I2.	Dry air heat input. Total dry air required based on fuel rate x specific heat of air x (ambient air temp. - 32°F.) 6.5583 LB/LB_R x .24 Btu/LB$^{\circ}$F. x (70°F.-32°F.).	59.81	17.9
I3	Heat input due to moisture in air. Moisture in air x specific heat of water vapor (ambient air temp. - 32°F.). 6.5583 LB/LB_R x .013 LB_w/LB_{air} x .489 Btu/LB$^{\circ}$ F. (70°F. - 32°F.).	1.6	.5
I4.	Enthalpy of feedwater entering boiler (Feedwater temp.-32°F.) x specific heat of water x lbs. of water/lb. of refuse. (250°F.-32°F.) x 1 Btu/LB$^{\circ}$F x 2.884 LB_w/LB_R	628.7	188.6
		5190.1	1557.0
	Steam Production		
S1.	Heat absorbed in steam. (Items I1 + I2 + I3 +I4)-(Items 1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 + 10 + 11) (4500 + 59.81 + 1.6 + 628.7) - (569.2 + 252.6 + 362.6 + 197.2 + 45.0 + 55.0 + 33.4 + 5.7 + 12.1 + 9.3 + 106.5). 5190.11 - 1648.6.	3541.5	1062.4
		LB_S/LB_R	
	Steaming Rate. Item S1. ÷ enthalpy of lbs. Steam @ 150 PSIG 465° F. 3529.4 ÷ 1254.	2.82	

TABLE 3 SAMPLE FUEL HEATING VALUE DETERMINATION

DATA FROM PERFORMANCE TEST

Flue Gas

CO_2 - 11.19% by wt.
H_2O - 8.90% " "
O_2 - 11.55% " "
SO_2 - 0.20% " "
Flow - 155,675 lbs./hr.
Temp. - 400° F.

Ash

Weight - 5,515 lbs./hr.
C - 5.0% by wt.
S - .1% " "
Temp. - 210° F.
Mois. - 15% by wt.

Combustion Air

Flow - 140,067 lbs.
Temp. - 70° F.

Refuse

Weight - 20,200 lbs.
Moisture - 27,74% by wt.

Ash Cooling Water

Temp. - 70° F.
Flow - 957 lbs./hr.

TABLE 3 SAMPLE FUEL HEATING VALUE DETERMINATION (CONTINUED)

DETERMINATION OF ULTIMATE ANALYSIS OF REFUSE

Item		Lbs./Lb. Refuse
1	Carbon Content	
	$\dfrac{\%\ CO_2\ \text{Flue Gas X Lb./Hr. Flue Gas X}\ Lb._C/CO_2}{\text{Lbs. Refuse}}$	
	$+\ \dfrac{\%\ C_{Ash}\ X\ Lb._{Ash\ Dry}}{\text{Lbs. Refuse}}$	
	$\dfrac{.1179\ X\ 155{,}675\ X\ .2732}{20{,}200} + \dfrac{.08\ X\ 4687}{20{,}200}$	.2472
2	Hydrogen Content	
	H_2O from H_2 Comb. = $H_2O_{Flue\ Gas}$ − H_2O_{Refuse} − H_2O Ash Vapor − H_2O Comb.Air	
	$H_2O_{Flue\ Gas} = \dfrac{\%\ H_2O_{FG}\ X\ Lb._{FG}}{Lbs._{Refuse}}$	
	$= \dfrac{.0890\ X\ 155.675}{20{,}200} = .6859$	
	$H_2O_{Comb.Air.} = \dfrac{Lb._{Comb.Air}\ X\ Lb._{H_2O}/Lb._{Ash}}{Lb._{Refuse}}$	
	$= \dfrac{140{,}067\ X\ .013}{20{,}200} = .090$	
	$H_2O_{Ash\ Vap.} = \dfrac{\text{Cooling Water Flow}}{Lb._{\ Refuse}} - \dfrac{\%\ \text{Mois.in Ash X}\ Lb._{Ash}}{Lb._{\ Refuse}}$	
	$= \dfrac{957}{20{,}200} - \dfrac{.15\ X\ 5155}{20{,}200} = .007$	
	$H_2O_{Refuse} = Lb._{H_2O}/Lb._{Refuse}$ $= .2774$	

TABLE 3 SAMPLE FUEL HEATING VALUE DETERMINATION (CONTINUED)

DETERMINATION OF ULTIMATE ANALYSIS OF REFUSE CONT'D.

Item — Lbs./Lb. Refuse

2 H_2O from H_2 Comb. $= .6859 - .090 - .007 - .2774$
$= .3115$

Convert to Lb. H per $\text{Lb.}_{\text{Refuse}}$

$H = \text{Lb.}_{H_2O} \text{ X } \text{Lb.}_H/\text{Lb.}_{H_2O}$

$= .3115 \text{ X } .1188$ — .03484

3 Sulfur Content

$$\frac{\%\ SO_2 \text{ X } \text{Lb.}_{FG} \text{ X } \text{Lb.}_S/\text{Lb.}_{SO_2}}{\text{Lb.}_{\text{Refuse}}} + \frac{\%\ S_{Ash} \text{ X } \text{Lb.}_{Ash}}{\text{Lb.}_{\text{Refuse}}}$$

$$\frac{.002 \text{ X } 155{,}675 \text{ X } .5}{20{,}200} + \frac{.0024 \text{ X } 4682}{20{,}200}$$ — .0011

4 Moisture Content — .2774

5 Nitrogen Content (Est. Value) — .0060

6 Ash Content

$= \text{Residue} - H_2O_{\text{Refuse}} - C_{Ash} - S_{Ash}$

$$= \frac{5515}{20{,}200} - \frac{.15 \text{ X } 5515}{20{,}200} - \frac{.05 \text{ X } 5515}{20{,}200} - \frac{.001 \text{ X } 5515}{20{,}200}$$ — .21817

7 Oxygen Content

1.00 - (Items) + 2 + 3 + 4 + 5 + 6) =

1.00 - (.2472 + .03483 + .0011 + .2774 +
.0060 + .2183) = .21529

1.000

TABLE 3 SAMPLE FUEL HEATING VALUE DETERMINATION (CONTINUED)

DETERMINATION OF HIGH HEATING VALUE OF SOLID WASTE BY BOJE FORMULA

		Weight Fraction	Btu/Lb.	HHV
1	C	.2472	14,976	3702
2	H	.03484	49,374	1720
3	S	.0011	4,500	5
4	Moisture	.2774	-	
5	N	.0060	2,700	16
6	Ash	.21817	-	-
7	O	.21529	- 4,644	- 1000
				4443 Btu/Lb.

- Oxygen – Oxygen content is taken as the remaining component of the refuse after all values have been calculated.

Neglecting the other minor components in the waste will result in a relatively small error in the high heating value calculation.

After the calculated analysis of the solid waste is determined, the heating value can be calculated using the BOJE formula.

This method of determination of heating values makes a number of assumptions and the results are contingent upon good testing methods.

The results reflect an accurate representation of the solid waste during the test period without the elaborate sampling and testing methods needed to do an accurate and representative chemical analysis of this waste.

SUMMARY

Calculating efficiency of municipal waste mass burning energy recovery systems by measuring the output of the system and basically using the furnace as a calorimeter seems to be reasonable and more accurate than trying to determine the precise composition of refuse by sorting and analysis.

All measurements are practical, timely and appropriate to the fuel actually used. Calculations are mathematically accurate and scientifically correct. This method actually answers more questions and leaves less to chance than any previously suggested procedure. More improvements will likely be found, but this seems to be a good place to start.

ACKNOWLEDGMENTS

1982 National Waste Processing Conference Proceedings, various papers.

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Key Words: Calorific value • Efficiency • Energy • Furnace • Performance • Steam • Testing

Attachment B

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Appendix F. Quality Assurance Procedures

Procedure 1. Quality Assurance Requirements for Gas Continuous Emission Monitoring Systems Used for Compliance Determination

1. Applicability and Principle

1.1 Applicability. Procedure 1 is used to evaluate the effectiveness of quality control (QC) and quality assurance QA) procedures and the quality of data produced by any continuous emission monitoring system (CEMS) that is used for determining compliance with the emission standards on a continuous basis as specified in the applicable regulation. The CEMS may include pollutant (e.g., SO_2 and NO_x) and diluent (e.g., O_2 or CO_2) monitors.

This procedure specifies the minimum QA requirements necessary for the control and assessment of the quality of CEMS data submitted to the Environmental Protection Agency (EPA). Source owners and operators responsible for one or more CEMS's used for compliance monitoring must meet these minimum requirements and are encouraged to develop and implement a more extensive QA program or to continue such programs where they already exist.

Data collected as a result of QA and QC measures required in this procedure are to be submitted to the Agency. These data are to be used by both the Agency and the CEMS operator in assessing the effectiveness of the CEMS QC and QA procedures in the maintenance of acceptable CEMS operation and valid emission data.

Appendix F, Procedure 1 is applicable ____________________(6 months after the promulgation date). The first CEMS accuracy assessment shall be _ a relative accuracy test audit (RATA) (see Section 5) and shall be completed by________________(9 months after the promulgation date) or the date of the initial performance test required by the applicable regulation, whichever is later.

1.2 Principle. The QA procedures consist of two distinct and equally important functions. One function is the assessment of the quality of the CEMS data by estimating precision and accuracy. The other function is the control and improvement of the quality of the CEMS data by implementing QC policies and corrective actions. These two functions form a control loop: When the assessment function indicates that the data quality is inadequate, the control effort must be increased until the data quality is acceptable. In order to provide uniformity in the assessment and reporting of data quality, this procedure explicitly specifies the assessment methods for response drift and accuracy. The methods are based on procedures included in the applicable performance specifications (PS's) in Appendix B of 40 CFR Part 60. Procedure 1 also requires the analysis of the EPA audit samples concurrent with certain reference method (RM) analyses as specified in the applicable RM's.

Because the control and corrective action function encompasses a variety of policies, specifications, standards, and corrective measures, this procedure treats QC requirements in general terms to allow each source owner or operator to develop a QC system that is most effective and efficient for the circumstances.

2. Definitions.

2.1 Continuous Emission Monitoring System. The total equipment required for the determination of a gas concentration or emission rate.

2.2 Diluent Gas. A major gaseous constituent in a gaseous pollutant mixture. For combustion sources, CO_2 and O_2 are the major gaseous constituents of interest.

2.3 Span Value. The upper limit of a gas concentration measurement range that is specified for affected source categories in the applicable subpart of the regulation.

2.4 Zero, Low-Level, and High-Level Values. The CEMS response values related to the source specific span value. Determination of zero, low-level, and high-level values is defined in the appropriate PS in Appendix B of this part.

2.5 Calibration Drift (CD). The difference in the CEMS output reading from a reference value after a period of operation during which no unscheduled maintenance, repair or adjustment took place. The reference value may be supplied by a cylinder gas, gas cell, or optical filter and need not be certified.

2.6 Relative Accuracy (RA). The absolute mean difference between the gas concentration or emission rate determined by the CEMS and the value determined by the RM's plus the 2.5 percent error confidence coefficient of a series of tests divided by the mean of the RM tests or the applicable emission limit.

3. QC Requirements.

Each source owner or operator must develop and implement a QC program. As a minimum, each QC program must include written procedures which should describe in detail, complete, step-by-step procedures and operations for each of the following activities:

1. Calibration of CEMS.
2. CD determination and adjustment of CEMS.
3. Preventive maintenance of CEMS (including spare parts inventory).
4. Data recording, calculations, and reporting.
5. Accuracy audit procedures including sampling and analysis methods.
6. Program of corrective action for malfunctioning CEMS.

As described in Section 5.2, whenever excessive inaccuracies occur for two consecutive quarters, the source owner or operator must revise the current written procedures or modify or replace the CEMS to correct the deficiency causing the excessive inaccuracies.

These written procedures must be kept on record and available for inspection by the enforcement agency.

4. CD Assessment.

4.1 CD Requirement. As described in 40 CFR Part 60.13(d), source owners and operators of CEMS must check, record, and quantify the CD at two concentration values at least once daily in accordance with the method prescribed by the manufacturer. The CEMS calibration must, as a minimum, be adjusted whenever the daily zero (or low-level) CD or the daily high-level CD exceeds two times the limits of the applicable PS's in Appendix B of this regulation.

4.2 Recording Requirement for Automatic CD Adjusting Monitors. Monitors that automatically adjust the data to the corrected calibration values, e.g., microprocessor control, must be programmed to record the unadjusted concentration measured in the CD prior to resetting the calibration or record the amount of adjustment.

4.3 Criteria for Excessive CD. If either the zero (or low-level) or high-level CD result exceeds twice the applicable drift specification in Appendix B for five, consecutive, 24-hour periods, the CEMS is out-of-control. If either the zero (or low-level) or high-level CD result exceeds four times the applicable drift specification in Appendix B during any CD check, the CEMS is out-of-control. If the CEMS is out-of-control, take necessary corrective action. Following corrective action, repeat the CD checks.

4.3.1 Out-Of-Control Period Definition. The beginning of the out-of-control period is the time corresponding to the completion of the daily CD check immediately preceding the completion of the daily CD check that results in the excessive CD (e.g., the end of the fifth consecutive, 24-hour period with a CD in excess of two times the allowable limit when the sixth, consecutive daily CD is also in excess of two times the allowable limit; or the time corresponding to the daily CD check preceding the daily CD check with a CD in excess of four times the allowable limit). The end of the out-of-control period is the time corresponding to the completion of the daily CD check immediately preceding the daily CD check that results in the CD's at both the zero (or low-level) and high-level measurement points are within the corresponding allowable CD limit (i.e., either two times or four times the allowable limit in Appendix B).

4.3.2 CEMS Data Status During Out-Of-Control Period. During the period the CEMS is out-of-control, the CEMS data may not be used in calculating emission compliance nor be counted towards meeting minimum data availability as required and described in the applicable subpart [e.g., §60.47a(f)].

4.4 Data Recording and Reporting. As required in Section 60.7(d) of this regulation, all measurements from the CEMS must be retained on file by the source owner for at least 2 years. However, emission data obtained on each successive day while the CEMS is out-of-control may not be included as part of the minimum daily data requirement of the applicable subpart [e.g., §60.47a(f)] nor be used in the calculation of reported emissions for that period.

5. Data Accuracy Assessment.

5.1 Auditing Requirements. Each CEMS must be audited at least once each calendar quarter. Successive quarterly audits shall occur no closer than 2 months. The audits shall be conducted as follows:

5.1.1 Relative Accuracy Test Audit. The RATA must be conducted at least once every four calendar quarters. Conduct the RATA as described for the RA test procedure in the applicable PS in Appendix B (e.g., PS 2 for SO_2 and NO_x). In addition, analyze the appropriate performance audit samples received from EPA as described in the applicable sampling methods (e.g., Methods 6 and 7).

5.1.2 Cylinder Gas Audit (CGA). If applicable, a CGA may be conducted in three of four calendar quarters, but in no more than three quarters in succession.

To conduct a CGA: (1) Challenge the CEMS (both pollutant and diluent portions of the CEMS, if applicable) with an audit gas of known concentration at two points within the following ranges:

Audit point	Audit range		
	Pollutant monitors	Diluent monitors for --	
		CO_2	O_2
1	20 to 30% of span value	5 to 8% by volume.	4 to 6% by volume.
2	50 to 60% of span value	10 to 14% by volume.	8 to 12% by volume.

Challenge the CEMS three times at each audit point, and use the average of the three responses in determining accuracy.

Use a separate audit gas cylinder for audit points 1 and 2. Do not dilute gas from the audit cylinder when challenging the CEMS.

The monitor should be challenged at each audit point for a sufficient period of time to assure adsorption-desorption of the CEMS sample transport surfaces has stabilized.

(2) Operate each monitor in its normal sampling mode, i.e., pass the audit gas through all filters, scrubbers, conditioners, and other monitor components used during normal sampling, and as much of the sampling probe as is practical. At a minimum, the audit gas should be introduced at the connection between the probe and the sample line.

(3) Use audit gases that have been certified by comparison to National Bureau of Standards (NBS) gaseous Standard Reference Materials (SRM's) or NBS/EPA approved gas manufacturer's Certified Reference Materials (CRM's) (See Citation 1) following EPA Traceability Protocol No. 1 (See Citation 2). As an alternative to Protocol No. 1 audit gases, CRM's may be used directly as audit gases. A list of gas manufacturers that have prepared approved CRM's is available from EPA at the address shown

in Citation 1. Procedures for preparation of CRM's are described in Citation 1. Procedures for preparation of EPA Traceability Protocol 1 materials are described in Citation 2.

The difference between the actual concentration of the audit gas and the concentration indicated by the monitor is used to assess the accuracy of the CEMS.

5.1.3 Relative Accuracy Audit. The RAA may be conducted three of four calendar quarters, but in no more than three quarters in succession. To conduct a RAA, follow the procedure described in the applicable PS in Appendix B for the relative accuracy test, except that only three sets of measurement data are required. Analyses of EPA performance audit samples are also required.

The relative difference between the mean of the RM values and the mean of the CEMS responses will be used to assess the accuracy of the CEMS data.

5.1.4 Other Alternative Audits. Other alternative audit procedures may be used as approved by the Administrator for three of four calendar quarters. One RATA is required at least once every four calendar quarters.

5.2 Criteria for Excessive Inaccuracy. If the RA, using the RATA, exceeds 20 percent or 10 percent of the applicable standard, whichever is greater, the CEMS is out-of-control. For SO_2 emission standards between 130 and 86 ng/J (0.30 and 0.20 lb/million Btu), use 15 percent of the applicable standard; below 86 ng/J (0.20 lb/million Btu), use 20 percent of emission standard. If the inaccuracy exceeds ±15 percent using the CGA or the RAA, or, for the RAA, 7.5 percent of the applicable standard, whichever is greater, the CEMS is out-of-control. If the CEMS is out-of-control, take necessary corrective action to eliminate the problem. Following corrective action, the source owner or operator must audit the CEMS accuracy with a RATA, CGA, or RAA to determine whether the CEMS is operating properly. A RATA must always be used following an out-of-control period resulting from a RATA. The audit following corrective action does not require analysis of EPA performance audit samples. If accuracy audit results show the CEMS to be out-of-control, the CEMS operator shall report both the audit results showing the CEMS to be out-of-control and the results of the audit following corrective action showing the CEMS to be operating within specifications.

5.2.1 Out-Of-Control Period Definition. The beginning of the out-of-control period is the time corresponding to the completion of the sampling for the RATA, RAA, or CGA. The end of the out-of-control period is the time corresponding to the completion of the sampling of the subsequent successful audit.

5.2.2 CEMS Data Status During Out-Of-Control Period. During the period the monitor is out-of-control, the CEMS data may not be used in calculating emission compliance nor be counted towards meeting minimum data availability as required and described in the applicable subpart [e.g., §60.47a(f)].

5.3 Criteria for Acceptable QC Procedure. Repeated excessive inaccuracies indicates the QC procedures are inadequate or that the CEMS is incapable of providing quality data. Therefore, whenever excessive inaccuracies occur for two consecutive quarters, the source owner or operator must revise the QC procedures (see Section 3) or modify or replace the CEMS.

6. Calculations for CEMS Data Accuracy

6.1 RATA RA Calculation. Follow the equations described in Section 8 of Appendix B, PS 2 to calculate the RA for the RATA. The RATA must be calculated in units of the applicable emission standard; e.g., ng/J.

6.2 RAA Accuracy Calculation. Use Equation 1-1 to calculate the accuracy for the RAA. The RAA is calculated in units of the applicable standard.

6.3 CGA Accuracy Calculation. Use Equation 1-1 to calculate the accuracy for the CGA. Each component of the CEMS must meet the acceptable accuracy requirement.

$$A = \frac{C_m - C_a}{C_a} \times 100 \qquad \text{Eq. 1-1}$$

where:

A = Accuracy of the CEMS percent.

C_m = Average CEMS response during audit in units of applicable standard or appropriate concentration.

C_a = Average audit value (CGA certified value or three-run average for RAA) in units of applicable standard or appropriate concentration.

6.4 Example Accuracy Calculations. Example calculations for the RATA, RAA, and CGA are available in Citation Number 3.

7. Reporting Requirements.

At the reporting interval specified in the applicable regulation, report for each CEMS the accuracy results from Section 6 and the CD assessment results from Section 4. Report the drift and accuracy information as a Data Assessment Report (DAR), and include one copy of this DAR for each quarterly audit with the report of emissions required under the applicable subparts of this part.

As a minimum, the DAR must contain the following information:

1. Source owner or operator name and address.

2. Identification and location of monitors in the CEMS.

3. Manufacturer and model number of each monitor in the CEMS.

4. Assessment of CEMS data accuracy and date of assessment as determined by a RATA, RAA, or CGA described in Section 5 including the RA for the RATA, the A for the RAA or CGA, the RM results, the cylinder gases certified values, the CEMS responses, and the calculations results as defined in Section 6. If the accuracy audit results show the CEMS to be out-of-control, the CEMS operator shall report both the audit results showing the CEMS to be out-of-control and the results of the audit following corrective action showing the CEMS to be operating within specifications.

5. Results from EPA performance audit samples described in Section 5 and the applicable RM's.

6. Summary of all corrective actions taken when CEMS was determined out-of-control, as described in Sections 4 and 5.

An example of a DAR format is shown in Figure 1.

8. Bibliography

1. "A Procedure for Establishing Traceability of Gas Mixtures to Certain National Bureau of Standards Standard Reference Materials." Joint publication by NBS and EPA, EPA-600/7-81-010. Available from the U.S.

Environmental Protection Agency. Quality Assurance Division (MD-77). Research Triangle Park, North Carolina 27711.

2. "Traceability Protocol for Establishing True Concentrations of Gases Used for Calibration and Audits of Continuous Source Emission Monitors (Protocol Number 1)." June 1978. Section 3.0.4 of the Quality Assurance Handbook for Air Pollution Measurement Systems. Volume III. Stationary Source Specific Methods. EPA-600/4-77-027b. August 1977. U.S. Environmental Protection Agency. Office of Research and Development Publications, 26 West St. Clair Street, Cincinnati, Ohio 45268.

3. Calculation and Interpretation of Accuracy for Continuous Emission Monitoring Systems (CEMS). Section 3.0.7 of the Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, Stationary Source Specific Methods. EPA-600/4-77-027b. August 1977. U.S. Environmental Protection Agency. Office of Research and Development Publications, 26 West St. Clair Street, Cincinnati, Ohio 45268.

[illegible]

(NOTE TO FEDERAL REGISTER PRINTING OFFICE: PLACE FIGURE 1 AT END OF TEXT.)

Figure 1. EXAMPLE FORMAT FOR DATA ASSESSMENT REPORT

Period ending date ____________________ Year __________

Company name ______________________________

Plant name ____________________ Source unit no. __________

CEMS manufacturer ____________________ Model no. __________

CEMS serial no. __________ CEMS type (e.g., in situ) __________

CEMS sampling location (e.g., control device outlet) __________

CEMS span values as per the applicable regulation, SO_2 __________ ppm,

O_2 __________ percent, NO_x __________ ppm, CO_2 __________ percent

I. Accuracy assessment results (Complete A, B, or C below for each CEMS or for each pollutant and diluent analyzer, as applicable.) If the quarterly audit results show the CEMS to be out-of-control, report the results of both the quarterly audit and the audit following corrective action showing the CEMS to be operating properly.

A. Relative accuracy test audit (RATA) for __________ (e.g., SO_2 in ng/J).

1. Date of audit __________.
2. Reference methods (RM's) used __________ (e.g., Methods 3 and 6).
3. Average RM value __________ (e.g., ng/J, mg/dsm^3, or percent volume).
4. Average CEMS value __________.
5. Absolute value of mean difference $|\bar{d}|$ __________.
6. Confidence coefficient $|CC|$ __________.
7. Percent relative accuracy (RA) __________ percent.

Figure 1. EXAMPLE FORMAT FOR DATA ASSESSMENT REPORT
(Continued)

8. EPA performance audit results:

a. Audit lot number (1) ____________ (2) ____________

b. Audit sample number (1) ____________ (2) ____________

c. Results (mg/dsm^3) (1) ____________ (2) ____________

d. Actual value (mg/dsm^3)* (1) ____________ (2) ____________

e. Percentage difference* (1) ____________ (2) ____________

B. Cylinder gas audit (CGA) for ____________________ (e.g., SO_2 in ppm).

1. Date of audit ________________.

	Audit point 1	Audit point 2	
2. Cylinder DOT/ID number	__________	__________	
3. Date of certification	__________	__________	
4. Type of certification	__________	__________	(e.g., EPA protocol 1 or CRM).
5. Certified audit value	__________	__________	(e.g., ppm).
6. CEMS response value	__________	__________	(e.g., ppm).
7. Percentage difference	__________	__________	percent.

C. Relative accuracy audit (RAA) for ________________ (e.g., SO_2 in ng/J).

1. Date of audit ________________________.

2. Reference methods (RM's) used ____________ (e.g., Methods 3 and 6).

3. Average RM value ____________ (e.g., ng/J).

4. Average CEMS value ________________.

5. Percentage difference ________________ percent.

---

* To be completed by the Agency.

Figure 1. EXAMPLE FORMAT FOR DATA ASSESSMENT REPORT (Continued)

6. EPA performance audit results:

    a. Audit lot number (1)____________ (2)____________

    b. Audit sample number (1)____________ (2)____________

    c. Results (mg/dsm^3)* (1)____________ (2)____________

    d. Actual value (mg/dsm^3)* (1)____________ (2)____________

    e. Percentage difference* (1)____________ (2)____________

D. Corrective action for excessive inaccuracy.

1. Out-of-control periods.

    a. Date(s) ______________________.

    b. Number of days ____________________.

2. Corrective action taken ____

____

____

____.

3. Results of audit following corrective action. (Use format of A, B, or C above, as applicable.)

II. Calibration drift assessment.

A. Out-of-control periods.

1. Date(s) __________________.

2. Number of days __________________.

B. Corrective action taken ____

____

____

____

Final Determination
and Permit Conditions

South Broward County Resource Recovery Facility

Broward County, Florida

PSD-FL-105

Prevention of Significant Deterioration

(40 CFR 52.21)

May 1, 1987

CONTENTS

I. INTRODUCTION

Pursuant to Section 403.505, Florida Statutes, South Broward Resource Recovery Project, Inc. (County), applied to the Florida Department of Environmental Regulation (DER) in April 1985 for certification of a steam electric generating, solid waste energy recovery facility at a site near the intersection of the U.S. Route 441 and State Road 84 in Broward County, Florida. After a thorough review by DER, including public hearings, the Florida Power Plant Siting Board issued a site certification to the County. At the time of the county's application, , FDER believed that such a site certification constituted a legal prevention of significant deterioration (PSD) permit under Chapter 17-2.500 of the Florida air pollution regulations which had been approved by the U.S. Environmental Protection Agency (EPA) on December 22, 1983. In the summer of 1985, EPA became aware that the Florida Electrical Power Plant Siting Act (PPSA), under which the site certification was issued, restricts the authority of the State of Florida to implement any regulation (i.e., PSD Regulations) pertaining to power plants other than those in the Act. Consequently, EPA determined that the Florida PSD regulations were superseded by the PPSA, and that the PPSA could not legally be approved by EPA as part of the State Implementation Plan (SIP) since it did not comply with EPA PSD regulations both procedurally and substantively. Thus, EPA concluded that the proposed South Broward County Resource Recovery Facility (RRF) could not be issued a valid PSD permit by FDER. Nor could the PPSA certification substitute for a valid PSD permit. EPA subsequently remanded PSD authority for sources subject to the PPSA while delegating responsibility for the technical and administrative portions of the PSD review to the FDER. The following final determination and permit constitute EPA's final action as well as the culmination of those activities delegated to the FDER by EPA.

The applicant plans to construct a 2250 tons per day (TPD) solid waste-to-energy facility to be located near the intersection of the U.S. Route 441 and State Road 84 in Broward County, Florida. Municipal solid waste (MSW) will be combusted to produce steam for power generation. The present plans are to construct three 750 TPD MSW incinerators. An ultimate maximum capacity of 3300 TPD is anticipated in the future which will require the addition of a fourth incinerator. The Broward County Resource Recovery Office will need to submit an application to construct the fourth unit at a future date. The applicant requests that each unit be permitted at 115% of its rated capacity. At 115% capacity, each of the three energy recovery units will have an approximate heat input of 323.6 million Btu per hour based on a heat content of 4500 Btu/lb for MSW. Each incinerator will be allowed to operate 8760 hours per year. The yearly tonnage of the various air pollutants emitted were calculated on this basis.

II. RULE APPLICABILITY

The proposed site of the South Broward County RRF is located within a nonattainment area for ozone. This designation requires that all proposed new sources which would emit greater than 100 tons per year (TPY) of volatile organic compound (VOC) be subject to nonattainment review. As the proposed incineration facility is projected to emit less than 100 TPY of VOC, the proposed source is not subject to a nonattainment review.

The source is subject to the regulations for PSD of air quality under 40 CFR 52.21 regarding the assessment of source emissions in attainment or unclassified areas. Since this source is within the category of stationary sources listed under the PSD regulations which specifies the threshold of emissions for PSD applicability as 100 TPY or greater of any regulated pollutant, the source must provide a Best Available Control Technology (BACT) determination, an ambient air quality analysis, a source impact analysis and an additional impact analysis (soils, vegetation, visibility) for each pollutant emitted in significant amounts. These include: particulate matter (PM), sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen oxides (NO_x), lead (Pb), mercury (Hg), fluorides (as hydrogen fluoride, HF), and sulfuric acid mist. In addition to the above, a Class I area impact analysis is required because the source is to be located within 100 kilometers of the Everglades National Park.

New Source Performance Standards (NSPS) for incinerators under 40 CFR 60, subpart E, and Standards of Performance for Industrial-Commercial-Institutional Steam Generating under 40 CFR 60, subpart Db, apply to each unit within the proposed facility. These NSPS set emission standards for a broad category of sources and limit the maximum amounts of PM and NO_x which may be emitted from any facility subject to these regulations.

III. PSD APPLICABILITY DETERMINATION

Title 40 Code of Federal Regulations, Section 52.21 requires that each pollutant subject to PSD review must be controlled by BACT. Nine pollutants are subject to BACT. The BACT emission limits proposed are summarized as follows:

Pollutant	BACT EMISSION LIMITS
Particulate Matter	0.015 gr/dscf, corrected to 12% CO_2
Sulfur Dioxide	0.140 lbs/mmBtu or 65% removal (not to exceed 0.310 lb/mmBtu)
Nitrogen Oxides	0.560 lb/mmBtu
Carbon Monoxide	0.090 lb/mmBtu
Lead	0.00150 lb/mmBtu
Mercury	7.50×10^{-4} lb/mmBtu
Beryllium	9.30×10^{-7} lb/mmBtu
Fluorides	0.0040 lb/mmBtu
Sulfuric Acid Mist	90% removal (not to exceed 4.70×10^{-3} lb/mmBtu)

These emission limitations are based on the determination that BACT is control of acid gas emissions and a high degree of particulate emissions reduction.

Based upon these air pollutant emission limits, the calculated total annual tonnage of regulated air pollutants emitted from the units to the atmosphere is listed as follows:

Pollutant		Maximum Annual Emissions (tons/year)	PSD Significant Emissions Rate (tons/year)
Particulate	(PM)	164	25
Sulfur Dioxide	(SO_2)	1318	40
Nitrogen Dioxide	(NO)	2381	40
Carbon Monoxide	(CO)	383	100
Lead	(Pb)	6.4	0.6
Mercury	(Hg)	3.2	0.1
Beryllium	(Be)	0.0040	0.0004
Fluorides	(F)	17	3
Sulfuric Acid Mist	(H_2SO_4)	20	7

IV. BEST AVAILABLE CONTROL TECHNOLOGY DETERMINATION (BACT)

A. Particulate Matter

New Source performance standards for incinerators limit particulate emissions from these units to 0.08 grains per dry standard cubic foot (gr/dscf) based on a 12% flue gas concentration of carbon dioxide. NSPS for industrial-commercial-institutional steam generating units limit particulate emissions from these units to 0.10 lb/mmBtu or approximately 0.05 gr/dscf. However, BACT clearinghouse reports incinerators emission limits to be from 0.01 to 0.03 gr/dscf.

In making the BACT determination, an emissions limit was selected to ensure that hazardous yet unregulated pollutants are controlled in accordance with the North County, California, incinerator PSD remand. The control of dioxins, furans, and other condensible organics is hypothesized to occur due to their condensation and adsorption on particulate matter. As the collective surface area of fine particulate matter is greater than that of larger particles per mass unit and fine particulate matter consists of a significant portion of the total particulate matter, control equipment should be selected which ensures a high degree of control for fine particulates. EPA has agreed that the use of an electrostatic precipitator (ESP) can provide this high degree of control and the limit which was determined to be BACT is 0.015 gr/dscf. This results in an approximate increase in ESP annualized costs of $134,000 per year over the originally proposed emission limit of 0.03 gr/dscf, or a cost of $1,035 per ton of additional particulate removed. However, the applicant may install either an ESP or baghouse to meet this limitation.

Energy impacts are considered to be insignificantly affected by the increase in removal efficiency, and environmental benefit due to decreased emissions of unregulated hazardous pollutants is not assessable at this time.

B. Sulfur Dioxide

The emissions of sulfur dioxide from municipal solid waste incinerators depend on three factors. These factors are: the sulfur content of the waste, the conversion of organic and inorganic sulfur compounds to sulfur dioxide, and the retention of the sulfur dioxide in the ash. This final determination assumes that all combined sulfur is converted and none is retained in the ash.

The applicant has reported the sulfur content of the waste to be 0.19 wt% maximum and 0.12 wt% average. This results in SO_2 emission rates of 7.6 to 4.8 lb/ton of MSW fired, or, at 4500 Btu/lb, 0.840 to 0.530 lb/mmBtu, respectively. Taking into account the selection of acid gas control devices (explained under acid gas BACT), the resultant emissions of sulfur dioxide should be reduced by at least 65%. The emissions limit stipulated as BACT in the permit is 0.140 lb/mmBtu or a 65% reduction of sulfur dioxide emissions, not to exceed 0.310 lb/mmBtu. This limit was based on the emissions limits at other facilities and the variability of fuel sulfur content. Economic and environmental considerations are included under the acid gas BACT section.

C. Acid Gases

Acid gases consist primarily of sulfuric acid mist, hydrogen fluoride, and the unregulated pollutant hydrogen chloride. BACT for acid gas control was selected based on the North County remand which allows the consideration of unregulated pollutants in the assessment of BACT for regulated pollutants. The selection of 90% acid gas control includes the reduction of hydrogen chloride emissions in the economic analysis and the apparent reduction of condensible unregulated organic emissions (i.e., dioxins, furans) and heavy metals, due to the gas cooling effects of the acid gas control system proposed, in the environmental benefit analysis.

Sulfuric acid mist is generated as a result of the oxidation of sulfur dioxide to sulfur trioxide in the flue gas. Combination of sulfur trioxide and water results in the formation of sulfuric acid mists. The uncontrolled emissions of this pollutant are estimated to be as high as 200 TPY. BACT of 90% control of these emissions results in an emissions reduction of 180 TPY.

Hydrogen fluoride is created through the combustion of waste materials containing fluorine. Although the reported emissions of hydrogen fluoride vary greatly at existing facilities, the emissions have been reported to be as high as 0.02 lb/mmBtu. However, the applicant predicts an uncontrolled emission rate of 0.04 lb/mmBtu or 170 TPY at this facility. A 90% control efficiency for this pollutant results in the control of 153 TPY based on the agreed emission rate of 0.004 lb/mmBtu and is considered BACT.

The formation of hydrogen chloride emissions is due primarily to the combustion of plastics containing chlorine. It is assumed that the plastic content of municipal solid waste is 4.2 wt%, of which 11.2 wt% is PVC resin in plastics. Using the weight percent of chlorine in PVC (45.3 wt%), the expected uncontrolled emissions from this facility are 0.47 lb/mmBtu or 2013 tons per year. Acid gas control will provide control of 90% of these emissions of hydrogen chloride or 1993 TPY.

In assessing the economic impacts, 240 TPY of sulfur dioxide, 180 TPY of sulfuric acid mist, 153 TPY of hydrogen fluoride, and 1994 TPY of hydrogen chloride were used in determining the cost effectiveness of acid gas control. EPA studies have estimated that the cost of acid gas control for this facility to be approximately 3 million dollars in annualized costs. This results in a cost of $1169 per ton of total pollutants (listed above) and is considered reasonable.

The environmental benefits due to application of acid gas control are the reduction of the flue gas temperature for the condensation of dioxins, furans, pyrenes, biphenyls, and mercury which may then be removed by a high efficiency particulate control device. Even though the formation of the toxic organic compounds may be primarily due to the design and operation of the combustion device, studies show that the use of acid gas control and high efficiency particulate removal equipment is capable of achieving a 99+% reduction of the compounds formed. No acceptable levels of exposure to these compounds have been established by EPA and EPA is therefore obligated to ensure the public a minimal exposure to them.

D. Nitrogen Oxides

During combustion of municipal solid waste, NO_x is formed in high temperature zones in and around the furnace flame by the oxidation of atmospheric nitrogen and nitrogen in the waste. The two primary variables that affect the formation of NO_x are the combustion temperatures and the concentration of oxygen. Techniques such as the method of fuel firing, correct distribution of combustion air between overfire and underfire air, exhaust gas recirculation, and decreased heat release rates have been used to reduce NO_x emission. A few add-on control techniques such as catalytic reduction with ammonia and thermal de-No_x are still experimental and not considered to be demonstrated technology for the proposed project. State-of-the-art control of the combustion variables will be used to limit NO_x emissions at 0.54 lb/mmBtu. This level of control is judged to represent BACT.

NSPS for industrial-commercial-institutional steam generating units regulates nitrogen oxide emissions for this facility if auxiliary fuels exceed 10% of the fuel input. Permit limits have been stipulated to ensure that auxiliary fuel input at each of the units will be less than 10%.

E. Carbon Monoxide

Incomplete combustion causes the emissions of solid carbon particles (e.g., smoke or soot) unburned and/or partially oxidized hydrocarbons and carbon monoxide, as well as resulting in the loss of heat energy. The applicant proposes that good equipment design and operation are BACT for carbon monoxide. Based on technical information relating good combustion practices and BACT determinations from other states, a limit of 0.090 lb/mmBtu is judged to represent BACT for carbon monoxide emissions.

F. Lead

With respect to lead emissions, two conditions are needed to achieve high removal efficiencies of metallic compounds emitted at refuse burning facilities: (1) operation of particulate matter control equipment at temperatures below 500°F, and (2) consistently efficient removal of submicron fly ash particles. The maximum temperature of the incinerator combustion gases at the inlet to the particulate control device is estimated to be below 300°F. At this temperature the particulate control equipment would be capable of removing the lead emissions from the flue gas stream.

The emission limit judged to be reasonable for lead is based on test results at similar facilities and the degree of emission control that will be provided by the control equipment which has been determined to be BACT for this facility. In accordance with data contained in the California Air Resources Board (CARB) report on resource recovery facilities, the highest uncontrolled lead emission rate from refuse-fired incinerators tested is 0.037 lbs/mmBtu. Based on a heating value of 4500 Btu per pound of refuse and the control efficiency reported for lead emissions using the required BACT (scrubber and particulate control of 0.015 gr/dscf, corrected to 12% CO_2), an emission limitation of 0.00150 lb/mmBtu is judged to be BACT.

G. Mercury

BACT is determined to be or 7.50×10^{-4} lb/mmBtu. This level of mercury emissions is judged to be reasonable based on test data from similar facilities and the degree of control that will be provided by the acid gas and particulate control equipment.

H. Beryllium

The uncontrolled emission of beryllium, according to the California report, when firing MSW is estimated to be 6.2×10^{-6} lb/mmBtu. Uncontrolled beryllium emissions would be approximately 11 grams per 24 hours or 0.01 TPY. The operating temperature of the particulate matter emission control device will be below 300°F. Operation at this temperature will promote adsorption/condensation of beryllium oxides, present in the flue gas stream, onto available fly ash particulates for subsequent removal by the particulate control device. The annual beryllium emissions are estimated to be 0.004 TPY. This amount of beryllium emitted is considered to have a negligible impact on the environment. The emission limit of 9.3×10^{-7} lb/mmBtu is judged to be BACT.

V. AIR QUALITY ANALYSIS

The air quality impact of the proposed facility has been analyzed. Atmospheric dispersion modeling has been completed and used in conjunction with an analysis of existing air quality data to determine maximum ground-level ambient concentrations of the criteria pollutants subject to BACT. Based on these analyses, EPA has reasonable assurance that the proposed solid waste recovery facility in South Broward County, subject to the BACT emission limitations, will not cause or contribute to a violation of any PSD increment or ambient air quality standard.

A. Modeling Methodology

The EPA-approved Industrial Source Complex Short-Term (ISCST) dispersion model was used in the air quality impact analysis. This model determines ground-level concentrations of gaseous and solid pollutants emitted into the atmosphere by point, area, and volume sources. The model incorporates elements for plume rise, transport by the wind, gaussian dispersion, and pollutant removal mechanisms such as deposition or transformation. The ISCST model also allows for the separation of sources, building wake downwash, and various other input and output features. Both screening and refined analyses were completed using this model, the source parameters in Table V-1 and emission rates in Table V-2.

Table V-1

Broward County Resource Recovery Facility
Source Parameters

Source (1)	UTM - E (km)	UTM - N (km)	Stack Height (m)	Exit Temp. (K)	Exit Velocity (m/s)	Stack Diameter (m)
Unit 1	579.6	2883.3	59.4	381	18.0 (2)	2.29
Unit 2	579.6	2883.3	59.4	381	18.0 (2)	2.29
Unit 3	579.6	2883.3	59.4	381	18.0 (2)	2.29

---

(1) Three 750 TPD incinerators, each with a flue to a common stack. For modeling purposes the common stack was given a stack diameter of 5.03 meters and an exit velocity of 11.2 m/s, providing for a minimum flow rate.

(2) Estimated by using a flow rate of 157,000 ACFM for each unit and calculated using given diameters.

Table V-2
Broward County Resource Recovery Facility
Maximum Emission Rates (1)

Pollutant	(lb/ton)	(lb/hr)	(ton/yr)
PM	0.34	37.5	164
SO_2	2.8 (2)	302.9	1318
NO_x	5.04	544	2381
CO	0.81	87.4	383
Pb	0.00135	1.46	6.4
F^-	0.023	3.88	17.0
Be	8.4×10^{-6}	0.0009	0.0040
Hg	0.00675	0.73	3.2
H_2SO_4 (3)	-	-	20

---

(1) Based on facility capacity of 2588 TPD of MSW and emission limits.

(2) Based on a maximum emission rate of 0.31 lb/mmBtu at 65% removal efficiency.

(3) 90% removal (not to exceed 4.7×10^{-3} lbs/mmBtu).

Five years of sequential hourly meteorological data were used in the modeling analyses. Both the surface and the upper air data used were National Weather Service data collected at Miami, Florida, during the period 1970-1974. Since five years of data were used, the highest, second-high, short-term predicted concentrations are compared with the appropriate short-term ambient standard or PSD increment. The highest predicted concentration were used for comparison with long-term standards (annual).

The initial set of screening model runs determined the highest, second-high concentrations, over a polar coordinate receptor grid with 36 radials, 10 degrees apart, and 10 downwind distances from 0.3 km to 4.3 km. Concentrations are predicted for the initial capacity of the facility. Additional refined modeling was completed for those days having the highest, second high concentrations using a refined receptor grid of several radials, two degrees apart and at seven distances, 100 meters apart, centered on the location of the previously determined highest, second-high value. In all of these runs, only the proposed RRF was modeled.

All of the modeling was completed using the SO_2 emission rate of the proposed facility. The impacts of the other emitted pollutants were determined by ratioing the emission rates to the SO_2 emission rate and multiplying by the SO_2 impact. Total ambient air quality impacts were based on the modeled impacts plus the monitored "background" concentrations.

The impact of the proposed facility on the Everglades National Park Class I area was also evaluated. Modeling was completed placing receptors along the edge of the Class I area using five years of meteorological data. The 17 receptor locations were spaced two kilometers apart along the northeast boundary of the park.

B. Analysis of Existing Air Quality

Preconstruction ambient air quality monitoring is required for all pollutants subject to PSD review. In general, one year of quality assured data using EPA reference, or the equivalent monitor, must be submitted. Sometimes less than one year of data, but not less than four months, may be accepted when EPA approval is given. An exemption to the monitoring requirement can be obtained if the maximum air quality impact, as determined through air quality modeling, is less than a pollutant-specific de minimus concentration. In addition, if current monitoring data already exist and these data are representative of the proposed source area, then these data may be used at the discretion of the reviewing authority.

The predicted maximum air quality impacts of the proposed facility for those pollutants subject to PSD review are given in Table V-3. The monitoring de minimus level for each pollutant is also listed. Sulfuric acid mist and arsenic are not listed because there is no de minimus level for either of these pollutants. All pollutants have maximum predicted impacts below their respective de minimus values. Therfore, specific preconstruction monitoring is not required for any pollutant.

Table V-4 lists the measured ambient concentrations of all pollutants being currently monitored within 10 kilometers of the proposed facility. These values are used to estimate current background levels.

Table V-3

Broward County Resource Recovery Facility
Maximum Air Quality Impacts of the RRF
For Comparison to the De minimus Ambient Levels

Pollutant and Averaging Time	Predicted Impact (ug/m^3)	De minimus Ambient Impact Level (ug/m^3)
SO_2 (24-hour)	6.2	13
PM (24-hour)	0.8	10
NO_2 (Annual)	1.4	14
CO (8-hour) (1)	11.8	575
Pb (24-hour)	0.03	0.1 (quarterly)
F^- (24-hour)	0.081	0.25
Be (24-hour)	0.00002	0.0005
Hg (24-hour)	0.015	0.25

---

(1) Based on an assumed maximum of 200 ppm, 8-hour average emissions rate.

Table V-4

Broward County Resource Recovery Facility Monitoring Data Within 10 km of the RRF

	-Location with Respect to the Proposed Facility-			Concentration 1984			
Site	Direction (degrees)	Distance (km)	Pollutant	Annual (ug/m3)	24-hour (ug/m3)	8-hour (mg/m3)	1-hour (mg/m3)
0420002	3°	2.0	CO			10	17
0910002	296°	3.8	PM	33	64		
			NO_2	28			
			SO_2	3	4		
1260004	55°	6.8	PM	41	72		
			NO_2	29			
			SO_2	4	28		
1840001	158°	6.9	PM	39	70		
			Pb (quarterly)	0.2			
3530001	216°	7.3	NO_2	30			
			SO_2	3	6		
1260003	27°	7.6	PM	59	93		
			NO_2	42			
			SO_2	3	4		
			CO			7	11
			Pb (quarterly)	0.9			
1840002	150°	8.6	CO			6	10
3640002	334°	9.4	PM	31	59		

C. PSD Increment Analysis

The proposed Broward County RRF is to be located in a Class II area. This area is designated as an attainment area for both SO_2 and PM. A PSD increment analysis is therefore required to show compliance with the Class II increments.

The PSD increments represent the amount that new sources in the area may increase ambient ground-level concentrations of SO_2 and PM. At no time, however, can the increased loading of these pollutants cause or contribute to a violation of the ambient air quality standards.

All SO_2 and PM emission increases from sources constructed or modified after the baseline date (December 1977) will consume PSD increment. In addition, all SO_2 and PM emission increases associated with construction or modification of major sources which occurred after January 6, 1975, will consume increment. The proposed Broward County RRF is the only significant source in the area which will consume PSD increment for either SO_2 or PM.

Atmospheric dispersion modeling, as previously described, was performed to quantify the amount of PSD increment consumed. The results of this modeling are summarized in Table V-5. The results indicate that the concentration increases are within the allowable amounts.

A Class I area increment analysis is required because of the proposed facility is located within 100 kilometers (57 km) of the Everglades National Park, a designated Class I area. Although the distance to the Class I area is greater than 50 kilometers (the distance to which the models are generally considered valid), the applicant used the model to estimate the impact on this area. The results indicate a less than significant impact.

D. AAQS Analysis

Given existing air quality in the area of the proposed facility, emissions from the new facility are not expected to cause or contribute to a violation of an AAQS. Table V-6 shows the results of the AAQS analysis.

The results showed that, with the exception of SO_2 and lead, the maximum impacts of the other criteria pollutants were less than the significant impact levels defined in 40 CFR 52.21. As such, no further modeling analysis was completed for PM, NO_x, and CO. For SO_2, additional modeling was performed which included the interaction of surrounding sources of SO_2. For lead, there is no significant impact level defined in the regulation. However, no further modeling of lead was completed because the predominate sources of ambient lead in the area are mobile sources.

Table V-5

Broward County Resource Recovery Facility
Comparison of New Source Impacts with PSD Increments

Pollutant and Averaging Time	PSD Class II Increment (ug/m^3)	Predicted Increased Concentration (ug/m^3)	Percent Increment Consumed	PSD Class I Increment (ug/m^3)	Predicted Increased Concentration (ug/m^3)
SO_2					
3-hour	512	26	5	25	4
24-hour	91	6	7	5	1
Annual	20	<1	<5	2	<1
PM					
24-hour	37	<1	<3	10	<1
Annual	19	<<1	<<5	5	<<1

Table V-6

Broward County Resource Recovery Facility Comparison of Total Impact with the AAQS

Pollutant and Averaging Time	Maximum Impact Project (ug/m^3)	Maximum Impact (1) All Sources (ug/m^3)	Existing Background (2) (ug/m^3)	Maximum Total Impact (ug/m^3)	National Ambient Air Quality Standard (ug/m^3)
SO_2					
3-hour	26	625	63 (3)	688	1300
24-hour	6	216	28	244	260
Annual	<1 (4)	-	4	-	60
PM					
24-hour	<1 (4)	-	93	-	150
Annual	<<1 (4)	-	59	-	60
NO_2					
Annual	1.4 (4)	-	42	43	100
CO					
1-hour	64 (4)	-	17,000	-	40,000
8-hour	12 (4)	-	10,000	-	10,000
Pb					
3-months	<0.1	-	0.9	1	1.5

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(1) Maximum impact includes the FPL Port Everglades and Fort Lauderdale power plants.

(2) Existing background is estimated using the highest monitored concentrations in the area near the proposed facility.

(3) The 3-hour background is estimated by multiplying the 24-hour background by 2.25.

(4) Less than significant, no further analysis completed. For CO, analysis based on 400 ppm, maximum, 1-hour and assumed 200 ppm, maximum, 8-hour average emissions rate.

The total impact on ambient air is obtained by adding a "background" concentration to the maximum modeled concentration. This "background" concentration takes into account all sources of the particular pollutant in question that were not explicitly modeled. A conservative estimate of these "background" concentrations was made by using the highest monitored concentration for each pollutant as listed in Table V-4. This is a conservative estimate because sources used in the modeling may have contributed to the monitored value.

Based on this analysis, EPA has resonable assurance that no AAQS will be exceeded as a result of the operation of the proposed new resource recovery facility.

VI. ADDITIONAL IMPACTS ANALYSIS

A. Impacts on Soils and Vegetation

The maximum ground-level concentrations predicted to occur as a result of emissions from the proposed project in conjunction with all other sources, including background concentrations, will be at or below all applicable AAQS including the secondary standards designed to protect public welfare-related values. As such, these pollutants are not expected to have a harmful impact on soils and vegetation.

A summary of the types and quantities of soils and vegetation in and around the proposed RRF site area and in the Everglades National Park can be found in the Site Certification Application. The applicant has also compared predicted maximum impacts with known adverse impact levels for both criteria and noncriteria pollutants. No adverse impacts are expected.

B. Impact on Visibility

A level I visibility screening analysis was performed to determine if any impact may occur in the Class I area. The analysis showed that there was no potential for an adverse impact on visibility in this area.

C. Growth-Related Air Quality Impacts

The proposed facility is not expected to significantly change employment, population, housing, or commercial/industrial development in the area to the extent that a significant air quality impact will result.

D. GEP Stack Height Determination

Good Engineering Practice (GEP) Stack height is defined as the greater of: (1) 65 meters or (2) the maximum nearby building height plus 1.5 times the building height or width, whichever is less. For the proposed project, a single common stack, housing the individual flues for each incinerator, will be 59.4 meters high. This is below the allowed GEP stack height of 65 meters.

E. Noncriteria Pollutants

The proposed facility emits in significant amounts (as defined in the PSD regulations): fluorides, sulfuric acid mist, beryllium, mercury, and arsenic. All of these pollutants are regulated, but there is no ambient air quality standards or PSD increments set for any of them. For three of these pollutants--fluorides, beryllium, and mercury--a de minimus ambient impact level has been defined. Exceedance of these levels, usually determined by dispersion modeling, is used to determine if ambient monitoring is necessary. The results of this modeling for these pollutants is listed in Table V-3. For each of these three pollutants, the predicted impact is less than their respective de minimus impact level.

F. Unregulated Pollutants

Two additional pollutants are often brought up in the context of resource recovery facilities. These are hydrogen chloride (HCl) and dioxins (2, 3, 7, 8-TCDD). Neither is currently regulated within the PSD regulations. Hydrogen chloride is regulated nationally for other type sources but not specifically for resource recovery facilities. Some states do regulate both of these substances. Both of these substances may become regulated either nationally or by the State in the future. The recommended control equipment necessary for the facility to meet the BACT emissions limitations for the regulated pollutants will also control HCl and dioxins.

VII. FINAL PERMIT

PART I. - Specific Conditions

1. Emission Limitations

a. Stack emissions from each unit shall not exceed the following:

Particulate: 0.0150 gr/dscf dry volume corrected to 12% CO_2.

Sulfur Dioxide: (1) 0.140 lb/mmBtu heat input and 60 ppm (3-hr rolling average, dry volume, corrected to 12% CO_2); or

(2) 65% reduction of uncontrolled SO_2 emissions.* In no case shall the SO_2 emissions exceed 0.310 lb/mmBtu heat input and 124 ppm (3-hr rolling average, dry volume, corrected to 12% CO_2).

The 124 ppm limit above shall be modified to reflect a new emission limit (in ppm) from the control device at 65% control efficiency. Within 18 months of start-up of operation, the County shall submit compliance tests that will be used to determine the new SO_2 emission limit (in ppm). The limit will be determined by observed average emission rate ($\bar{x}$) from the submitted compliance tests and will be statistically analyzed using the one tailed student T test ($t_{.05} = (\bar{x} - u)/\sqrt{n}/s$) at the 95% confidence level to derive a mean emission rate (u), where s is the standard deviation of observed values n. The final operating SO_2 emission limit (in ppm) shall be this mean emission rate (u). This value shall be restricted to no more than 124 ppm or less than 60 ppm (3-hr rolling average, dry volume, corrected to 12% CO_2).

Nitrogen Oxides: .560 lb/mmBtu heat input and 350 ppm (3-hr rolling average, dry volume, corrected to 12% CO_2).

Carbon Monoxide: .090 lb/mmBtu heat input; 400 ppm (1-hr rolling average, dry volume, corrected to 12% CO_2); and 88 ppm (4-day rolling average, dry volume, corrected to 12% CO_2).

Lead: .00150 lb/mmBtu

Fluorides: .0040 lb/mmBtu

Beryllium: 9.30×10^{-7} lb/mmBtu

Mercury: 7.50×10^{-4} lb/mmBtu

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* Uncontrolled SO_2 emissions will be measured at the inlet to the acid gas control device.

Visible Emissions: Opacity of stack emissions shall not be greater than 15% opacity. Excess opacity resulting from startup or shutdown shall be permitted providing (1) best operational practices to minimize emissions are adhered to and (2) the duration of excess opacity shall be minimized but in no case exceed two hours in any 24-hour period unless specifically authorized by EPA for longer duration.

Excess emissions which are caused entirely or in part by poor maintenance, poor operation, or any other equipment or process failure which may reasonably be prevented during start-up or shutdown shall be prohibited.

The units are subject to 40 CFR Part 60, Subpart E and Subpart Db, New Source Performance Standards (NSPS), except that where requirements in this permit are more restrictive, the requirements in this permit shall apply.

There shall be no greater than 10% opacity for emissions from the refuse bunker and the ash handling and loadout. The potential for dust generation by ash handling activities will be mitigated by quenching the ash prior to loading in ash transport trucks. Additionally, all portions of the proposed facility, including the ash handling facility, which have the potential for fugitive emissions will be enclosed. Also, those areas which have to be open for operational purposes, (e.g., tipping floor of the refuse bunker while trucks are entering and leaving) will be under negative air pressure.

b. Only distillate fuel oil or natural gas shall be used in startup burners. The annual capacity factor for use of natural gas and oil, as determined by 40 CFR 60.43b(d), shall be less than 10%. If the annual capacity factor of natural gas is greater than 10%, then the facility shall be subject to §60.44b.

c. None of the three individual municipal solid waste incinerators shall be charged in excess of 323.6 mmBtu/hr and 863 tons per day MSW (115% rated capacity) nor produce in excess of 192,000 lbs/hr of steam (3-hr rolling average).

d. Compliance Tests

(1) a. Annual compliance tests for particulate matter, lead, SO_2, nitrogen oxides, CO, fluorides, mercury, and beryllium shall be conducted in accordance with 40 CFR 60.8 (a), (b), (d), (e), and (f).

b. Compliance with the opacity standard for the incinerator stack emissions in condition 1.a. of this part shall be determined in accordance with 40 CFR 60.11 (b) and (e).

c. Compliance with the emission limitation for 65% control of total sulfur dioxide emissions shall be determined by using the test methods in condition 1.d.(2) and sampling for SO_2 emissions before and after the acid gas control device. Continuous emissions data shall also be used to demonstrate compliance with the SO_2 concentration limits in condition 1.a. above.

(2) The following test methods and procedures for 40 CFR Parts 60 and 61 shall be used for compliance testing:

a. Method 1 for selection of sample site and sample traverses.

b. Method 2 for determining stack gas flow rate when converting concentrations to or from mass emission limits.

c. Method 3 for gas analysis for calculation of percent O_2 and CO_2.

d. Method 4 for determining stack gas moisture content to convert the flow rate from actual standard cubic feet to dry standard cubic feet for use in converting concentrations in dry gases to or from mass emission limits.

e. Method 5 for concentration of particulate matter and associated moisture content. One sample shall constitute one test run.

f. Method 9 for visible determination of the opacity of emissions.

g. Method 6 for concentration of SO_2. Two samples, taken at approximately 30 minute intervals, shall contitute one test run.

h. Method 7 for concentration of nitrogen oxides. Four samples, taken at approximately 15 minute intervals, shall constitute one test run.

i. Method 10 for determination of CO concentrations. One sample constitutes one test run.

j. Method 12 for determination of lead concentration and associated moisture content. One sample constitutes one test run.

k. Method 13B for determination of fluoride concentrations and associated moisture content. One sample shall constitute one test run.

l. Method 101A for determination of mercury emission rate and associated moisture content. One sample shall constitute one test run.

m. Method 104 for determination of beryllium emission rate and associated moisture content. One sample shall constitute one test run.

2. Compliance with emission limitations specified in lb/mmBtu in conditions 1.a. and 1.c. of this part shall be determined by calculating an "F" factor in dscf/mmBtu corrected to 12% CO_2 using the boilers' efficiency (as determined by the calorimeter method contained in Attachment A during acceptance testing) and the measured steam production. Data obtained from test methods required in condition 1.d. of this part for compliance testing shall be used for the calculation of the "F" factor required by this condition.

3. Devices shall be installed to continuously monitor and record steam production. These devices shall be adequately maintained and operating during all periods of steam production.

4. The height of each boiler exhaust stack shall not be less than 59.4 meters above ground level at the base of the stack.

5. Each incinerator boiler shall have a metal name plate affixed in a conspicuous place on the shell showing manufacturer, model number, type waste, rated capacity, and certification number.

6. The permittee must submit to EPA and DER, within fifteen (15) days after it becomes available to the County, copies of technical data pertaining to the incinerator boiler design, acid gas control equipment design, particulate control equipment design, and the fuel mix that will be used to evaluate compliance of the facility with the preceeding emission limitations.

7. Fuel

The Resource Recovery Facility shall utilize refuse such as garbage and trash (as defined in Chapter 17-7, FAC) but not grease, scum, grit screenings or sewage sludge.

8. Air Pollution Control Equipment

The permittee shall install, continuously operate, and maintain the following air pollution controls to minimize emissions. Controls listed shall be fully operational upon startup of the proposed equipment.

a. Each boiler shall be equipped with a particulate emission control device for the control of particulates.

b. Each boiler shall be equipped with an acid gas control device designed to remove at least 90% of the acid gases.

9. Continuous Emission Monitoring

a. Prior to the date of startup and thereafter, the County shall install, maintain, and operate the following continuous monitoring systems for each boiler exhaust stack:

(1) Continuous emission monitoring (CEM) systems to measure stack gas opacity and SO_2, NO_x, CO, CO_2, and O_2 concentrations for each unit. Continuous monitors for SO_2 shall be installed after the acid gas control device for each unit. The systems shall meet the EPA monitoring performance specifications of 40 CFR 60.13 and 40 CFR 60, Appendix B, during initial compliance testing and annually thereafter. Additionally, CEM's shall meet the quality control requirements of 40 CFR 60, Appendix F (Attachment B).

(2) CEM data recorded during periods of startup, shutdown, and malfunction shall be reported but excluded from compliance averaging periods for CO, NO_x, and opacity.

(3) a. CEM data recorded during periods of startup and shutdown shall be excluded from compliance averaging periods for SO_2.

b. CEM data recorded during periods of acid gas control device malfunctions shall be excluded from compliance averaging periods for SO_2 provided that the preceeding thirty day period which ends on the last day of the malfunction period meets an average SO_2 emission limit equal to the SO_2 limit specified in condition 1.a. CEM data must be available for 90% of the operating time for this exemption to apply. A malfunction as used in this permit means any sudden and unavoidable failure of air pollution control equipment or process equipment or of a process to operate in a normal or usual manner. Failures that are caused entirely or in part by poor maintenance, careless operation, or any other preventable upset condition or preventable equipment breakdown shall not be considered malfunctions.

b. An excess emissions report shall be submitted to EPA for every calendar quarter. The report shall include the following:

(1) The magnitude of excess emissions computed in accordance with 40 CFR 60.13(h), any conversion factors used, and the date and time of commencement and completion of each period of excess emissions (60.7(c)(1)).

(2) Specific identification of each period of excess emissions that occurs during startups, shutdowns, and malfunctions of the furnace/boiler system. The nature and cause of any malfunction (if known) and the corrective action taken or preventive measures adopted shall also be reported (60.7(c)(2)).

(3) The date and time identifying each period during which the continuous monitoring system was inoperative except for zero and span checks, and the nature of the system repairs or adjustments (60.7(c)(3)).

(4) When no excess emissions have occurred or the continuous monitoring system has not been inoperative, repaired, or adjusted, such information shall be stated in the report (60.7(c)(4)).

(5) County shall maintain a file of all measurements, including continuous monitoring systems performance evaluations; all continuous monitoring systems or monitoring device calibrartion checks; adjustments and maintenance performed on these systems or devices; and all other information required by this permit recorded in a permanent form suitable for inspection (60.7(d)).

(6) Excess emissions shall be defined as any applicable period during which the average emissions of CO, NO_x, and/or SO_2, as measured by the continuous monitoring system, exceeds the CO, NO_x, and/or SO_2 maximum emission limit (in ppm) set for each pollutant in condition 1.a. above.

c. Excess emissions indicated by the CEM systems shall be considered violations of the applicable opacity limit or operating emission limits (in ppm) for the purposes of this permit provided the data represents accurate emission levels and the CEM's do not exceed the calibration drift (as specified in the respective performance specification tests) on the day when initial and subsequent compliance is determined. The burden of proof to demonstrate that the data does not reflect accurate emission readings shall be the responsibility of the permittee.

10. Reporting

a. A copy of the results of the compliance tests shall be submitted within forty-five days of testing to the DER Bureau of Air Quality Management, the DER Southeast Florida District Office, Broward County, and EPA Region IV.

b. Continuous emissions monitoring data shall be reported to the DER Southeast District Office and EPA Region IV on a quarterly basis in accordance with Section 17-2.710, FAC, and 40 CFR 60.7.

c. Addresses for submitting reports are:

EPA Region IV

Chief, Air Compliance Branch
U.S. Environmental Protection Agency
345 Courtland Street, N.E.
Atlanta, Georgia 30365

Florida Department of Environmental Regulation (DER)

Deputy Chief, Compliance and Ambient Monitoring
Bureau of Air Quality Management
Florida Department of Environmental
Regulation (DER)
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32301

Southeast District Office of DER

District Manager
Department of Environmental Regulation
3301 Gun Club Road
P.O. Box 3858
West Palm Beach, Florida 33402

Broward County

Broward County Environmental Quality
Control Board
500 Southwest 14th Court
Ft. Lauderdale, Florida 33315

PART II. - General Conditions

1. The permittee shall comply with the notification and record-keeping requirements codified at 40 CFR Part 60.7. In addition, the permittee shall provide EPA with 30 days notice prior to conducting any compliance testing required under condition 1.a.

2. The permittee shall retain records of all information resulting from monitoring activities and information indicating operation parameters as specified in the specific conditions of this permit for a minimum of two (2) years from the date of recording.

3. If, for any reason, the permittee does not comply with or will not be able to comply with the emission limitations specified in this permit, the permittee shall provide EPA with the following information in writing within five (5) days of such condition:

   (a) description of noncomplying emission(s),
   (b) cause of noncompliance,
   (c) anticipated time the noncompliance is expected to continue or, if corrected, the duration of the period of noncompliance,
   (d) steps taken by the permittee to reduce and eliminate the noncomplying emission.

   Failure to provide the above information when appropriate shall constitute a violation of the terms and conditions of this permit. Submittal of the aforementioned information does not constitute a waiver of the emission limitations contained within this permit.

4. Any proposed change in the information contained in the final determination regarding facility emissions or changes in the quantity or quality of materials processed that would result in new or increased emissions or ambient air quality impact must be reported to EPA. If appropriate, modifications to the permit may then be made by EPA to reflect any necessary changes in the permit conditions. In no case are any new or increased emissions allowed that will cause violation of the emission limitations specified herein. Any contruction or operation of the source in material variance with the final determination shall be considered a violation of this permit.

5. In the event of any change in control of ownership of the source described in the permit, the permittee shall notify the succeeding owner of the existence of this permit and EPA of the change in control of ownership within 30 days.

6. The permittee shall allow representatives of the state and local environmental control agency or representatives of the EPA, upon presentation of credentials:

(a) to enter upon the permittee's premises, or other premises under the control of the permittee, where an air pollutant source is located or in which any records are required to be kept under the terms and conditions of this permit;

(b) to have access to and copy at reasonable times any records required to be kept under the terms and conditions of this permit, or the Clean Air Act;

(c) to inspect at reasonable times any monitoring equipment or monitoring method required in this permit;

(d) to sample at reasonable times any emissions of pollutants; and

(e) to perform at reasonable times an operation and maintenance inspection of the permitted source.

7. The conditions of this permit are severable, and if any provision of this permit or the application of any provisions of this permit to any circumstances is held invalid, the application of such provision to other circumstances and the remainder of this permit shall not be affected.

VIII. PUBLIC COMMENTS/NOTICE

No public comments were received by the Florida DER during the public comment period, except for EPA-Region IV concerns regarding acid gas and particulate control. These concerns are incorporated in the final determination and permit as changes to the preliminary determination and final permit.

BEST AVAILABLE COPY

FORT LAUDERDALE NEWS/SUN-SENTINEL

Published Daily

Fort Lauderdale, Broward County, Florida
Boca Raton, Palm Beach County, Florida

STATE OF FLORIDA
COUNTY OF BROWARD/PALM BEACH

Before the undersigned authority personally appeared Nancy Watt who on oath says that he is Classified Supervisor of the Fort Lauderdale News/Sun-Sentinel, Daily newspapers published in Broward/Palm Beach County, Florida that the attached copy of advertisement, being a Notice of Prevention in the matter of of Significant Deterioration (PSD) Draft Permit in the Court, was published in said newspaper in the issues of Feb. 12, 1987

Affiant further says that the said Fort Lauderdale News/Sun-Sentinel are newspapers published in said Broward/Palm Beach County, Florida, and that the said newspapers have heretofore been continuously published in said Broward/Palm Beach County, Florida, each day, and have been entered as second class matter at the post office in Fort Lauderdale, in said Broward County, Florida, for a period of one year next preceding the first publication of the attached copy of advertisement; and affiant says that he has neither paid nor promised any person, firm or corporation any discount, rebate, commission or refund for the purpose of securing this advertisement for publication in said newspapers.

Nancy Watt

Sworn to and subscribed before me this 12th day of February A.D. 19 87

(SEAL) Notary Public

Notary Public, State of Florida
My Commission Expires July 20, 1989
Bonded Thru Troy Fain - Insurance, Inc.

PAS

Notice of Prevention of Significant Deterioration (PSD) Draft Permit

Name and address of applicant:

Broward County
South Broward Resource Recovery Project, Inc.
Room 521, 115 S. Andrews Avenue, Ft. Lauderdale, Florida 33301

Name of address of office processing application:

Department of Environmental Regulation
Bureau of Air Quality Management
2600 Blair Stone Road, Tallahassee, Florida 32301

Broward County applied to the Florida Department of Environmental Regulation (DER) to construct an energy recovery facility near the intersection of U.S. Route 441 and State Road 84 in Broward County. The application is subject to U.S. Environmental Protection Agency (EPA) regulations for Protection of Significant Deterioration of Air Quality (PSD), codified at 40 CFR 52.21. These regulations require that, before construction on a source of air pollution subject to PSD may begin, a permit must be obtained from EPA. Such permit can only be issued if the new construction has been determined by EPA to comply with the requirements of the PSD regulations which are described in 40 CFR 52.21. These requirements include a restriction on the incremental increases in air quality due to the new source, and application of best available control technology (BACT).

The DER has been granted delegation by EPA to carry out the PSD review of this source, except for final signature of the PSD permit. Acting under that delegation, the DER has prepared a draft permit and made a preliminary determination that the construction will comply with all applicable provisions of the PSD regulations. The degree of increment consumption that will result from the construction is:

Class I Area

Pollutant	Annual Average	24-hr. Avg.	3-hr. Avg.
Sulfur Dioxide	50%	20%	16%
Particulate Matter	20%	10%	

Class II Area

Pollutant	Annual Average	24-hr. Avg.	3-hr. Avg.
Sulfur Dioxide	5%	8%	5%
Particulate	5%	3%	

A copy of the administrative record of the application, including the draft PSD permit, the preliminary determination, and all materials submitted by the applicant, will be available for review for 30 days during normal business hours, 8:00 a.m. to 5:00 p.m., Monday through Friday, except legal holidays, at the following locations:

Department of Environmental Regulation
Bureau of Air Quality Management
2600 Blair Stone Road
Tallahassee, Florida 32301

Southeast Florida District
3301 Gun Club Road
West Palm Beach, Florida 33402

Broward County Environmental
Quality Control Board
821 South Andrews Avenue
Ft. Lauderdale, Florida 33316

Written comments on the preliminary determination may be submitted to:

C. H. Fancy, P.E.
Bureau of Air Quality Management
Department of Environmental Regulation
2600 Blair Stone Road
Tallahassee, Florida 32301
Telephone (904) 488-1344

Further information on the application, including copies of the application, the draft permit, and a fact sheet, may be obtained from the person named above.

All comments postmarked within 30 days of the date of this notice will be considered by DER in preparing the final determination. The final determination will be sent to EPA for issuance or denial of the PSD application.

Any person may request a public hearing on the draft permit. Request must be in writing, and shall state the issues to be raised in the hearing.

Requests for a hearing must be postmarked not later than 30 days from the date of this notice and sent to:

C. H. Fancy, P.E.
Bureau of Air Quality Management
Department of Environmental Regulation
2600 Blair Stone Road
Tallahassee, Florida 32301
Telephone (904) 488-1344

A special set of circumstances is applicable to this PSD permit application. A certification to construct the source was issued by the Power Plant Sitting Board on June 3, 1986, under the Florida Power Plant Sitting Act. At the time Broward County filed this application, DER considered such a certification to constitute a PSD permit issued under Florida's PSD regulations, which had been approved by EPA. Such approval by EPA transferred permit signature authority for PSD sources from EPA to DER. While this application was pending and before the issuance of the Power Plant Site Certification for this source, EPA determined that Power Plant Site Certifications, because of certain procedural differences did not constitute PSD permits under the DER regulations, and thus do not satisfy the requirements of the Federal Clean Air Act. In order to rectify this situation, EPA withdrew authority from DER to issue PSD permits to such sources, but delegated to DER the authority to process the PSD applications in preparation for issuance of a permit by EPA.

Wayn

AIR PROGRAMS BRANCH
RECEIVED
APR 30 1987
EPA-REGION IV
ATLANTA

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION

TWIN TOWERS OFFICE BUILDING
2600 BLAIR STONE ROAD
TALLAHASSEE, FLORIDA 32399-2400

BOB MARTINEZ
GOVERNOR

DALE TWACHTMANN
SECRETARY

April 28, 1987

Mr. Bruce P. Miller
Chief
Air Programs Branch
Air Pesticides and Toxics
Management Division
345 Courtland Street
Atlanta, Georgia 30365

Dear Mr. Miller:

The Bureau of Air Quality Management has reviewed the draft PSD permit sent by your office on April 17, 1987 for the South Broward Resource Recovery Facility (PSD-FL-105). The Bureau does not have any substantive comments but has noted the following:

1. In Section II (Rule Applicability) - on the third line of the first paragraph, change "surces" to sources.
2. On page 6 of Specific Conditions - reports should be submitted to the Deputy Chief, Compliance and Ambient Monitoring.

In addition, no comments were received by the Department during the second public noticing period other than the one sent by EPA, Region IV.

If you have any questions regarding this letter, please contact me at (904) 488-1344.

Sincerely,

C. H. Fancy, P.E.
Deputy Chief
Bureau of Air Quality
Management

CHF:BA:jw

APPENDICES

ASME
1986 NATIONAL WASTE
PROCESSING CONFERENCE

ATTACHMENT A

AN EXAMINATION OF PROPOSED ACCEPTANCE TESTING METHODS

K. E. GRIGGS
Department of the Army
U.S. Army Construction Engineering Research Laboratory
Champaign, Illinois

ABSTRACT

This paper describes test procedures proposed to be used to determine the acceptance or operational performance of solid waste incinerators with heat recovery. The throughput capacity of the heat recovery incinerator, volume and mass reduction, environmental emissions, and overall thermal efficiency are used as performance indicators.

To develop the performance test, the manufacturers of heat recovery incinerators (HRI's) were contacted to obtain literature describing their products. The literature was reviewed to determine the characteristics that manufacturers use to describe their HRI's, and to learn general operating procedures and conditions. The Power Test Codes of the American Society of Mechanical Engineers (ASME) were reviewed to see whether they could be used for testing HRI's. In addition, the proposals presented at the last three National Waste Processing Conferences were also reviewed. Four efficiency test procedures—the input-output, heat-loss, modified heat-loss, and calorimeter methods—were identified from this information, along with an alternate concept of separate combustion efficiency and thermal energy recovery testing. Recommendations are made as to what should be considered as the "standard" for acceptance testing, based upon a user's perspective.

INTRODUCTION

The Resource Conservation and Recovery Act of 1976 recommended the use of recovered-material derived fuels to the maximum extent practical in Federally owned fossil fuel fired energy systems. To fulfill the intent of this Act and to take advantage of possible energy cost savings, the Army has undertaken the task of installing heat recovery incinerators (HRI's) at various installations throughout the continental United States. To provide planning guidance for such HRI installations, the U.S. Army Construction Engineering Research Laboratory (USA-CERL) has developed several publications [1-3]. Currently, HRI's are operational at Fort Eustis, Virginia, Fort Leonard Wood, Missouri, Fort Rucker, Alabama, and Redstone Arsenal, Alabama. By 1990, it is expected that waste may be burned at over 15 Army installations.

Unlike other large-scale equipment, such as coal- or oil-fired boilers, no standard performance test is currently available to assess field performance or to use as an acceptance test specifically for HRI plants. Within the Army, Directorates of Engineering and Housing (DEH's) and District Engineers need standard performance test procedures to trouble-shoot HRI systems and to ensure that new HRI's meet waste throughput and efficiency specifications before the systems are accepted and turned over to the DEH for operation.

Manufacturers of HRI's were contacted to obtain literature describing their incinerators. The literature was reviewed to determine the characteristics that manufacturers use to describe their products, and to learn general operating procedures and conditions. The American Society of Mechanical Engineers (ASME) Power Test Codes (PTC 4.1 and PTC 33) were reviewed to see whether they could be used for testing HRI's. The Naval Civil Engineering Laboratory procedures in HRI testing were reviewed for applicable testing information. It was determined that the basis, or core, of the acceptance test should be the repeated ability to demonstrate that the unit will operate at the specified thermal efficiency while simultaneously achieving the rated throughput capacity, weight and volume reduction, steam (or other thermal) output, and environmental emissions. While thermal efficiency (the ability to release the theoretical heat energy available in a useful form) can not be the sole criteria for acceptance, it is the best single indicator of the correctness of design and quality of manufacture.

The Army's requirement is for an acceptance test developed for HRI's in the range of 20–100 TPD (18–91 tpd) of solid waste. Tests for compliance with clean air requirements are defined by local, State, and Federal agencies. It is intended that new HRI's meet stipulated capacity, volume and weight reduction and efficiency guarantees while operating in compliance with clean air requirements. Therefore, the test procedures must be conducted concurrently with environmental testing, assuring compliance with air emission standards during normal operation.

Unfortunately, no matter how rigorous an acceptance test is, the performance standards that the HRI is required to meet must be clearly and completely defined in the project specifications. The test itself will not prevent or correct problems that previous HRI projects have encountered. However, the test procedures described in this paper will reveal the existence of these problems.

ELEMENTS OF A GOOD ACCEPTANCE TEST

The question of an appropriate and accurate HRI acceptance test is a matter that has been discussed in technical papers at the three ASME National Waste Processing Conferences in 1980, 1982, and 1984 [4–7]. The acceptance testing of an HRI is a very complex issue due to both the variability of the quality (heat content versus moisture and noncombustibles) of the refuse and the variety of technologies used to burn it, some of which are still developing. The simplest acceptance test would be to see if the HRI could produce the rated amount of steam when firing the rated amount of refuse and supplementary fuel (if required). Unfortunately, this does not take into consideration possible variations in the heat content (Btu/lb) of the waste which may allow a poorly operating unit to still make its rated steam output (high Btu waste) or may prohibit a well operating unit from making its rated steam output (low Btu waste) at the rated mass firing rate. There seems to be a general consensus by most investigators, in this area, that thermal efficiency is the best indicator of quality of performance, since it takes into consideration the heat content of the waste stream.

However, none of the investigators that have reported at the conferences referenced above, has directly addressed the problem of how much the thermal efficiency of the various HRI technologies may change due to "off design" operation as a result of burning waste of a quality other than that specified. The main controversy seems to be the method (and the degree of effort) that should be the standard in determining that thermal efficiency. Much of this controversy is prompted by the difficulty in determining the Higher Heating Value (HHV) of the waste. The various proposals that were made, have had the implied aim of minimizing the effect of this uncertainty. Very little effort has been made to develop automated equipment for more economic and accurate determination of the waste HHV. The National Bureau of Standards (NBS) has developed a calorimeter for "large", kilogram size RDF pellets. However, the methods for making this determination are still very labor intensive and involve the collection and processing of large amounts of waste in order to achieve a reasonable accuracy.

In addition to the above, it must not be forgotten that thermal efficiency can not be the sole criterion for acceptance, although it may be the central part or core of testing. The plant must also have the capability of processing the design amount of waste, produce acceptable environmental emissions, discharge ash that exhibits the desired volume and mass reductions, and do all of this reliably. The plant must be able to do all of these things, including demonstrating an acceptable thermal efficiency, at the same time. USA-CERL is currently recommending that acceptance testing consist of three 24 hr runs conducted within 5 days in order to demonstrate reliability. With the exception of thermal efficiency testing, all of the above criteria have very specific and well defined methods of being measured.

THERMAL EFFICIENCY TESTING PROCEDURES

The efficiency testing procedures described in this paper can serve two purposes. First, they may be used as the basis of an acceptance test to establish whether a specific system has complied with the capacity, volume and mass reduction, and efficiency criteria in the specification under which it was purchased. Second, these tests can be used as a periodic performance evaluation indicating when abnormally high inefficiencies are occurring. In this instance, the test is conducted regularly and the information is compared with that from previous tests. Reduced thermal efficiency may also indirectly indicate the possibility of environmental emission problems. This comparison may be made because of the common procedure and data base.

To accomplish these tasks, four thermal efficiency testing procedures have been identified, along with an alternate concept of separate combustion efficiency and thermal energy recovery testing. The primary procedures are the input–output, the heat-loss, the modified heat-loss, and the calorimeter methods. Figure 1 provides a very simplified illustration of most of the factors that must be considered in utilizing these methods. They are discussed in detail in the previously referenced papers [4–7] and are described by the following equations:

Input–output method:

Thermal efficiency (%)

$$= \frac{\text{Useful Heat Output}}{\text{Heat Input}} \times 100 \quad (1)$$

Heat-loss method:

Thermal efficiency (%)

$$= \left(1 - \frac{\text{Losses}}{\text{Heat Input}}\right) \times 100 \quad (2)$$

Modified heat-loss method:

Thermal efficiency (%)

$$= \left(1 - \frac{\text{Major Losses}}{\text{Heat Input}}\right) \times 100 \quad (3)$$

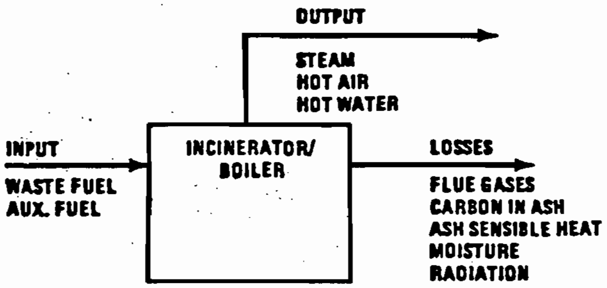

FIG. 1 ENERGY FLOW

Calorimeter method:

Thermal efficiency (%)

$$= \left(\frac{\text{Useful Heat Output}}{\text{Useful Heat Output} + \text{Losses}}\right) \times 100 \quad (4)$$

INPUT-OUTPUT

As the name input–output implies, only the energy inputs and the useful energy outputs are measured. The main disadvantage with this method is the accurate determination of the heat content of the waste. This normally involves the collection of large amounts of waste and making the determination based upon many laboratory analyses, sorting the waste into its components, or making a visual estimation. This method of efficiency determination is essentially based upon the very definition of thermal efficiency. However, it will only indicate that a problem exists and does nothing to define the problem.

The main advantage of the input–output method is that it is the simplest of the four. Much of the required instrumentation should already exist as a part of the system's normal operating controls. Moreover, there is a requirement for less data and laboratory analysis than with the other methods; except for the modified heat loss method, which is also the least accurate. The only method that has the potential for more accuracy than the input–output method is the calorimeter method, which is also very complex.

HEAT LOSS

The heat-loss method, which is also sometimes (erroneously) referred to as the heat-balance method, is less accurate than the input–output method. This method involves the measurement of heat losses from the system, such as sensible and latent heat in the flue gas, sensible heat in the ash, combustible material in the ash, radiation and convection from the incinerator and boiler surfaces, latent heat from evaporation of ash quench water, and heat contained in boiler blowdown. This method varies from the calorimeter and input–output methods in that the useful energy output is not measured, but the total heat input is measured and some smaller heat losses may be partially estimated. The accuracy of this method is variable, based upon the number of the losses estimated and the accuracy of that estimation. In addition, this method is also affected by the accuracy of the determination of the heat content of the waste, as noted above; and the accuracy of the determination of the moisture in the flue gas, which will have a large impact upon the gas latent heat losses. The results of a heat-loss determination will never agree (in practice) with the results of the input–output method (based upon coal fired boiler experience), although the difference may be as little as 2%.

While the heat-loss method is more difficult and potentially less accurate than the input–output method, its advantage is that it does provide more useful information. For example, if an incinerator system is not operating efficiently, this method should show where the excessive losses are (e.g., unburned carbon in the residue, high exit gas temperature, etc.). Hence, this method is most valuable in identifying operating and maintenance problems, and preferred by many engineers for all types of fossil fuel fired facilities.

SHORT FORM (MODIFIED) HEAT LOSS

The least accurate method is the modified or "short form" of the heat-loss determination. This method was proposed by Hecklinger and Grillo in 1982 [5] and based upon earlier recommendations by Stabenow in 1980 [4]. Although it is the least accurate, it is also extremely simple and quick. It is based upon the assumption that the major heat loss in the system is up the stack and normally involves taking only O_2 and temperature measurements on the stack gases in addition to measuring the fuel firing rate. This is a good assumption for oil/gas fired boilers and is reasonable for most of the larger coal fired boilers where efficient combustion of the fuel is very certain and the amount of moisture in these gases is low and well defined. With the thermal efficiency calculation depending so heavily on so few measurements, the highly variable and generally larger amounts of moisture in the stack gases from an HRI can have a large impact on the results, as noted above in the discussion of the heat loss method. Additionally, incomplete combustion of the waste can result in losses as significant as the stack losses as demonstrated by some of the operating instances at Fort Knox and Fort Eustis where labels and other paper goods were readable after going through the incinerator. This can be compensated for by measuring the ash production rate and the carbon content of the ash. Unfortunately, that would make this method almost as complex, but still less accurate than the input–output method. However, this method could be used for day-to-day comparative indications of changes in thermal efficiency that may require more detailed investigation. It could also be used to monitor the results of changes associated with the operating crew and/or maintenance procedures.

CALORIMETER

The most rigorous method (which is used in Europe) is to use the HRI as a continuous calorimeter. The calorimeter method is much more complex than any of the other methods. It involves doing a complete mass and energy balance around the HRI, with the only unknown being the heat content of the waste stream. This involves a very large number of measurements (some of which can be quite tedious, such as heat loss to ash quench water including evaporation) and much more instrumentation than normally found on all but the largest HRI's. Essentially, all of the losses associated with the heat-loss method, and the energy output measurements associated with the input–output method, must be actually made, and not estimated. If these measurements are made carefully with accurate instrumentation, this method would produce the most accurate results, and avoid the problem of determining the heat content of the waste. However, the measurement of the total moisture of the flue gas is still a major problem at this time, since the traditional EPA Method 5 only involves grab samples. The amount of this moisture can be quite significant if internal sprays are used to cool the combustion zone, the waste is very wet, and/or a quench, ash cooling system is used that is not isolated from the combustion zone. In addition, the potential improvement in accuracy over the input–output method is not significant (0.73% [7]) based upon the size range and lack of sophistication of typical Army HRI plants.

Due to the complexity involved, the not yet totally resolved question of measuring the moisture in the flue gas, and a relatively small increase in accuracy, this method is not considered appropriate for the size and type of HRI plants the Army would typically build. Starved air technology (the most common type of plant), specifically, is not sufficiently developed to warrant this level of accuracy, and additional instrumentation would have to be supplied (at a significant additional cost), especially for the testing. However, this method would be appropriate to very large (greater than 75 TPD/unit) excess air/water wall plants that also might include electrical cogeneration, and would most likely already have all of the instrumentation necessary, and represent both a state of the art and a magnitude of investment that *would* warrant this level of accuracy and effort. This type of plant would be typical of what the Army would be involved with on a joint basis with a local municipality.

AN ALTERNATE CONCEPT

The basis of this alternate concept is to consider that an HRI facility has two basic purposes: thermal reduction of the waste and energy recovery. These two functions could be examined separately and tested independently of each other. This would involve testing the boiler (separate or integral) by delivering to it the rated amount of hot gases at the temperature specified, and measuring its thermal efficiency by conventional methods. These hot gases would be produced by conventional firing of gas or oil. The efficiency of the incinerator itself would be measured only by determining the amount of carbon in the ash as an indicator of completeness of combustion at the design firing rate. The functioning of the incinerator and the heat content of the waste would not be directly involved in the determination of the efficiency of producing useful thermal output. Unfortunately, incinerators are not normally supplied with start-up and auxiliary (secondary zone) burners of sufficient size to produce the boiler's rated steam output with out burning any waste. However, some manufacturers of modular starved air systems do offer an option of a burner installed in the heat recovery boiler, capable of full steam production, as a back-up, in the event the incinerator ceases to function and steam output must be maintained. In those cases, this separate testing concept could be applicable.

CONCLUSIONS AND RECOMMENDATIONS

This paper has documented the investigation of a standard performance test for Army HRI's. The proposed test methods are based on existing ASME boiler and incinerator test procedures. A summary comparison of them may be found in Table 1. Unfortunately, there has not yet been any field comparison of these methods, and they have only been examined on a theoretical basis. It is recommended that the input–output method be used by the Army as the basis for the thermal efficiency portion of acceptance testing. The heat-loss method should be used to isolate the areas of inefficiencies should losses be excessive. The modified heat-loss method could be used for routine monitoring of the system. It is also recommended that the Army encourage the use of the calorimeter method for commercial HRI installations of unit sizes larger than 75 TPD (generally beyond starved air size), since that method seems most appropriate for plants of that size and expected sophistication. The alternate concept of separate combustion efficiency and thermal recovery testing should be allowed as an alternative where appropriate.

The procedure recommended above has been field tested for applicability at the Redstone Arsenal, Alabama, HRI. Revisions were made to the test procedure details to maximize the use of field available equipment. In addition, contractor-supplied data from performance and emissions tests at the Fort Leonard Wood, Missouri, HRI have been reviewed to evaluate the results of the procedure.

This paper is a condensation of a technical report currently being prepared by the US Army Construction Engineering Research Laboratory. The final report will discuss in much greater detail, the above testing methods, data requirements, and the procedure for conducting an acceptance test with consideration of field experience. When published, this report will be available through NTIS.

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TABLE 1 COMPARISON OF METHODS

Method	Heat Input	Heat Output	Heat Losses	Complexity	Advantages	Disadvantages	Recommendation
Input-Output	Yes	Yes	No	Simple	Direct Indication	No Indication of Problem Area Waste Quality	Use for Small Units (<75 TPD)
Heat-Loss	Yes	No	Most	Moderate	Indicates Problems	Some Losses Estimated Waste Quality	Use as Diagnostic
Modified Heat-Loss (Short Form)	Yes	No	Some	Very Simple	Simplicity	Most Losses Estimated Waste Quality	Use only to Monitor Operation
Calorimeter Method	Aux. Fuel Waste Feed	Yes	All	Very Complex	Most Accurate Avoids Waste Quality	Complexity	Use for Large Units (>75 TPD)
Alternate Concept	Fossil Fuel Only	Optional	Optional	Moderate	Avoids Waste Quality	Special Provision for Aux. Burners	Allow for Special Cases

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CALCULATING EFFICIENCY OF MUNICIPAL WASTE MASS BURNING ENERGY RECOVERY SYSTEMS

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ABSTRACT

One of the questions on mass burning of municipal waste has been how much heat can be recovered from the waste. The answer must always be conditioned on the heating value of the waste. The problem is to determine that value. Every sample of waste will have different moisture, ash and chemical composition, which will calculate to different heating values. The practice in the U.S. is to use the high heat value in calculating energy production, which further complicates the question. Our suggestion is to use the furnace as the calorimeter to determine the heating value of the waste.

This is accomplished by measuring all the known inputs: waste quantity; combustion air; feedwater and cooling water; and all the known outputs: steam; blowdown; ash; radiation and flue gas. Flue gas O_2, CO_2, H_2O and S are measured and used to calculate a waste Btu content. Efficiency is calculated by dividing the net heat in steam by the calculated heat input.

INTRODUCTION

One system of incineration has been proven by over 30 years of successful operation in Europe and, to a limited extent, in the U.S.: mass burning of unsorted waste on specially designed grate systems.

Specially designed waterwall boilers recover heat energy from the hot flue gases in the form of steam for district heating, process or electrical production. One of the questions on mass burning has been determining exactly how much heat can be recovered from the waste. The main problem is calculating the heating value of municipal waste. If 20 samples are taken, it is likely that 20 different heating values will result. Every sample of waste will have different moisture, ash and chemical composition, which will calculate to different heating values.

The practice in the U.S. is to use the high heat value in calculating energy production, which further complicates the question. Two samples of waste may have similar high heat values (Table 1) but different moisture content and the resultant energy production (steaming rate) will vary significantly.

The steaming rate varies with the Btu content of the waste in a linear relationship over a range of about 3800 to 5200 Btu/lb kcal/kg (2100-29,000) assuming all other factors are equal. Below 4300 and above 5200, the ratio changes as indicated below:

HHV	3000	4300	4500	5200	6000 Btu/lb
	(1667)	(2400)	(2500)	(2900)	(3333 kcal/kg)
LHV	2400		4270		5740
	(1333)			(1318)	(3200 kcal/kg)
Steam Rate	1.25	2.20	2.31	2.67	3.20

Approximately the same amount of heat is lost through radiation of the boiler so lower Btu fuel would have a lower net steaming rate. Steaming rate would likewise vary inversely with the flue gas temperature, all other factors being equal.

Flue Gas Exhaust Temperature:	400°F (205°C)	374°F (190°C)
Steaming Rate (Net lb/lbs):	2.22	2.31

Finally, steaming rate varies with the percent furnace loading. Normally, mass burning furnaces will be run at

90 to 105 percent of rated capacity. Below 66 percent furnace loading, the boiler efficiency falls off rapidly to the point where it is not economically feasible to operate a furnace for energy recovery below 60 percent capacity.

The question is always asked: "What will the manufacturer guarantee as a steaming rate;" The answer must always be conditioned on the composition and heating value of the waste. The problem then is to determine those values. Our suggestion is to use the furnace as the calorimeter to determine the heating value of the waste.

Most furnace/boiler systems are designed for a total heat throughput or a maximum furnace capacity for waste at some specific heating value (Btu/lb or kcal/kg). The throughput may increase to some design overload if the heating value decreases and vice versa, so the maximum total heat throughput is not exceeded (Fig. 1).

PERFORMANCE GUARANTEES

Mass burning waste incinerator plants must meet specific performance guarantees, which are only partly within the dictates of the furnace/boiler and mostly a function of the waste processed.

Common guarantees are:

(a) waste throughput, hourly, daily or yearly (should be based on some assumed heating value of the waste);

(b) energy production (usually expressed as a factor of waste input (lb steam/lb waste) and contingent on an assumed composition and heat value of the waste);

(c) maximum putrescibles and combustible material in residue (a better indication of furnace performance than total amount of residue, which is more a function of the waste);

(d) maximum particulate emissions and other environmental factors.

We are concerned here with (a) and (b) and suggest a method for helping the supplier and customer to agree on how to determine if a system meets its guarantees.

ADJUSTMENTS TO OBSERVED THROUGHPUT CAPACITY AND ENERGY RECOVERY RATES

It is recognized that the refuse delivered to a mass burning facility for acceptance test purposes may not have the same composition as the reference processible waste and that throughput capacity and energy recovery are dependent upon the refuse composition, particularly its moisture content and heating value.

For example, the processing of lower Btu content than that of the reference waste will allow higher throughput rates but result in lower energy yield and may, therefore, appear to demonstrate higher throughput but lower per ton energy yields than that which would have been obtained had the plant been tested with reference processible waste. Similarly, if the waste furnished for acceptance testing purposes has a higher Btu content than that of the reference waste, the demonstrated throughput capacity may be less than that which would have been obtained with reference processible waste but the per ton energy yield would be higher.

It is further recognized that it is difficult and economically unfeasible to obtain an accurate measurement of the heating value of the waste through sampling of the waste being processed during the acceptance test and impossible after it has been incinerated. It is therefore proposed that the combustion system be used as a calorimeter, following in general the principles for determining efficiency and capacity described in the ASME Power Test Code 4.1 for steam generating units (1964, reaffirmed 1979) and the ASME Performance Test Code 33 for large incinerators (1978). The abbreviated effciency test (PTC 33a-1980, Appendix to ASME PTC 33) may be used to determine efficiency by the heat balance method.

The concept is to measure all the known inputs: fuel (waste) in pounds, combustion air flow and temperature, feedwater temperature and flow, and cooling water (to ash extractor) flow and temperature; and to measure all the outputs: steam flow, temperature and pressure, blowdown flow and temperature, ash quantity, temperature and carbon contents, and skin temperature (to calculate radiation).

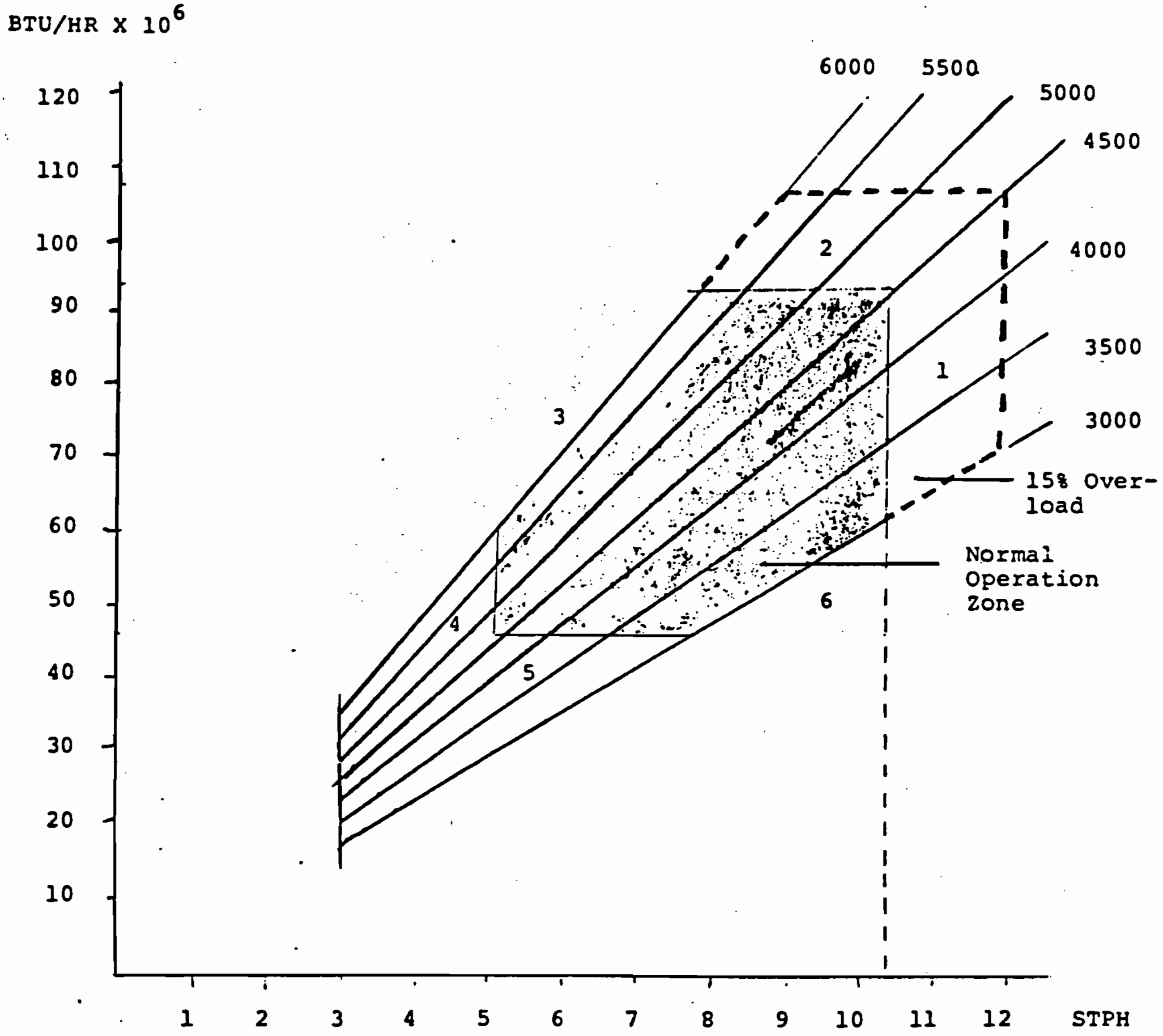
We also measure flue gas temperature and flow so we know everything going in and coming out.

The flue gas is further analyzed to measure oxygen, carbon dioxide, water and sulphur and these figures are used to back into a waste analysis. Btu content is calculated from this analysis and compared with output to figure furnace/boiler efficiency. Given this calculated efficiency and, assuming that the efficiency obtained during the test, after appropriate corrections, would be the same as that which would have been obtained using reference processible waste, the throughput capacity and energy outputs observed in the test will be adjusted to reflect the difference between the calculated heating value of the test fuel and the assumed heating value of the reference processible waste.

SPECIFIC TEST PROCEDURES

INCINERATOR CAPACITY TEST

The purpose of this test is to demonstrate the ability of the boiler plant to handle and burn the guaranteed throughput of specified solid waste while staying within the limits of the specified normal operating grate temperatures and while meeting the guaranteed degree of burnout. This test should also give an indication regarding the reliability of



1 Maximum MSW throughput (10.41 STPH)
2 Maximum heat release rate (94 X 10^6 BTU/HR)
3 Maximum expected caloric value (6000 BTU/LB)
4 Minimum MSW through (50% Max)
5 Minimum heat release rate (50% Max)
6 Minimum expected caloric value (3000 BTU/LB)

FIG. 1 TYPICAL FURNACE OPERATION DIAGRAM the equipment and, therefore, each line should be run at full load for at least 7 days, after stabilization, without interruption. In the event of a breakdown, the test should be repeated. All equipment should operate during the test at its normal mode and capacity, and the maintenance force and supplies should be those proposed to be available during normal operation of the plant — all to demonstrate the availability of the plant under normal operating conditions.

The facility should be operated for a 7 day period, at the maximum rated capacity and process at least six times (85 percent) the rated daily tons of processible waste. During the 7 day test period, the total residue from the combustion process should be measured and sampled. The composition of the residue should be determined by hourly samples taken during the 72 hr period when the Facility is processing a total of three times the daily rated tons of processible waste.

The residue sampling should be submitted to the independent engineer for analysis by an independent laboratory prior to the conclusion of the acceptance tests. As a minimum, the residue should be analyzed for moisture content, combustible matter and putrescible matter in accordance with PTC 33.

The facility shall not have been deemed to have passed the throughput capacity test, even though the tonnage processed meets the capacity requirements stated above, if the percentage of combustible and putrescible matter in the total residue exceeds the guaranteed percentages of combustible and putrescible matter.

If the results are not as guaranteed, the Contractor and Customer will likely not be able to agree that the waste processed was identical to the "standard" waste used for contract purposes. Twenty samples will likely result in twenty different results. And, of course, there is no way to sample the waste after it has been incinerated, which would normally be when a controversy would arise. A reasonable alternative is what we are proposing.

The heat balance method of determining efficiency as described herein may be used to calculate the heat value of the waste fired during the test period. If the facility does not meet the throughput capacity test, the demonstrated throughput capacity will be adjusted by the inverse ratio of the heat value of the waste actually processed to the heat value of the reference waste usually assumed to be 4500 Btu/lb HHV.

If this adjustment results in a throughput capacity meeting the guarantee, the facility will have been deemed to have passed the throughput capacity test. If the heat value of the waste fired is determined to have been below 3800 Btu/lb HHV, the waste supplied shall be considered as not representative of processible waste and the test will then be repeated at the customer's expense.

ENERGY RECOVERY TEST

The energy recovery test will consist of a test of the steam raising rate and a test of the electric generation rate, if applicable. The test of the steam raising rate will establish whether the combustion process produces the guaranteed quantity of steam. The test of the electric generation rate will then determine whether the overall performance of the facility meets the guarantees as to energy recovery.

Steam Raising Rate

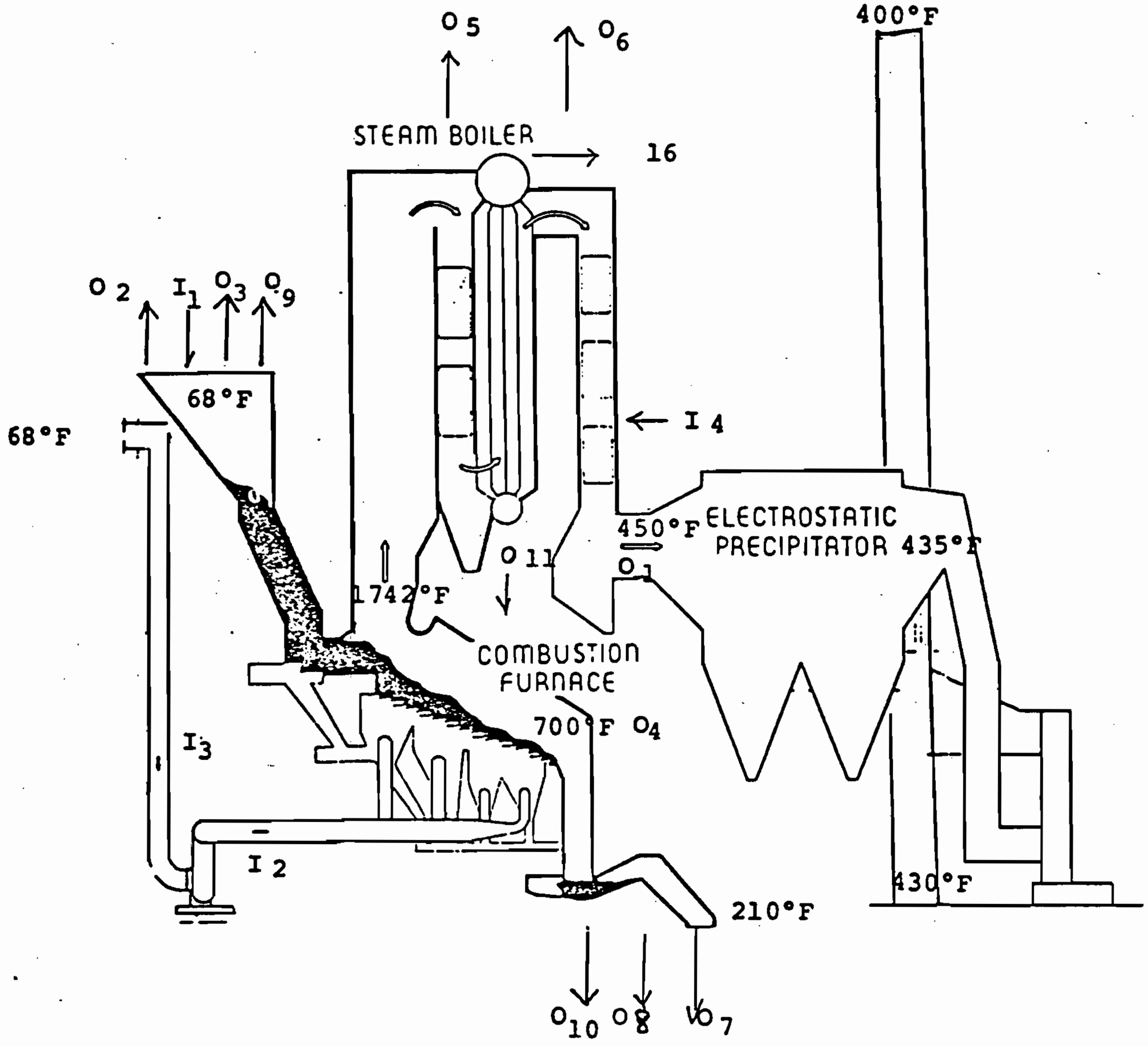
The purpose of this portion of the energy recovery test is to determine whether the facility meets the guaranteed steam raising rate, when processing solid waste, having the heating value of the reference solid waste, at a rate equal to the guaranteed daily throughput capacity under normal operating conditions as to boiler blowdown, exit gas temperatures and excess air ratio.

The test shall be conducted in accordance with the test codes referenced above, as modified herein, for the determination of heat outputs, credits and losses and the calculation of efficiency and fuel heating value by the heat balance method. For the purpose of determining the efficiency, steam output shall be measured at the superheater outlet and hot flue gases shall be measured at the inlet to the stack.

The test shall extend over an 8 hr test period. Pertinent test data shall be recorded at appropriate intervals, in accordance with the test code and shall include the following — all of which are relatively easy to measure with a high degree of accuracy:

- Processible waste feed rate (weight) and moisture
- Boiler outlet steam rate, temperature and pressure
- Feedwater rate and temperatures
- Desuperheater water rate, temperature and pressure (as applicable)
- Boiler drum pressure
- Flue gas rate and temperature at the stack inlet
- CO_2, O_2, SO_2 and H_2O in the flue gas at the stack inlet by various EPA methods
- Residue and fly ash quantities, temperature and unburned carbon and sulfur content
- Barometric pressure
- Combustion air flow and temperatures
- Ambient wet/dry bulb temperatures
- Residue quench water quantity and temperature
- Moisture in residue (after quench)
- In-house steam consumption
- Steam quality — percent moisture or PPM
- Boiler blowdown rate and temperature
- Furnace boiler skin temperature and area

Test measurements should be taken from installed plant instruments which have been previously calibrated



$$\text{Efficiency} = \frac{\text{Net Heat in Steam} \times 100}{\text{Net Avail. Heat Input}}$$

FIG. 2 ENERGY BALANCE FURNACE BOILER SYSTEM

TABLE 1 STEAMING RATE

Assumed Waste Composition	% Moisture	
	20%	25%
Carbon	26.6	22.7
Hydrogen	3.4	4.3
Sulphur	0.2	0.2
Oxygen	25.4	22.6
Nitrogen	0.2	0.2
Moisture	20.0	25.0
Ash	24.2	25.0
High Heat Value	4502	4494 BTU/lb. (2500 KCAL/KG
Gas Temperature	1742	1742° F. (950° C.)
Excess Air	1.3882	1.2503
O_2-Stoichiometric	0.6925	0.6870 lb./lb.
Total Air	7.1445	6.6775 lb./lb.
O_2	0.9614	0.8589 lb./lb.
CO_2	0.9320	0.7875 lb./lb.
H_2O	0.5273	0.6585 lb./lb.
N_2	5.4925	5.1337 lb./lb.
Flue Gas	7.9132	7.4386 lb./lb.
Exhaust Temperature	374° F.	374° F. (190° C.)
Steam Temperature	750° F.	750° F. (400° C.)
Steam Pressure	600 psi	600 psi (41 ATA)
Make-Up Water Temperature	250° F.	250° F. (121° C.)
Steaming Rate, lb.steam/ lb.waste	2.31	2.22

and agreed accurate by the independent engineer. Special portable instrumentation may also be used where required and agreed upon.

Utilizing the test data and measurements from the test, calculations will be made in accordance with the ASME test codes as modified herein, for the determination of boiler heat losses, heat outputs and heat credits (Fig. 2 and Table 2).

METHOD OF DETERMINING SOLID WASTE HIGH HEATING VALUE

With the information accurately obtained during the performance test, the high heating value of the solid waste can be calculated. In order to simplify the method of calculation and the test procedure, the ultimate analysis of the waste will be assumed to consist of only the major components:

- Carbon – Carbon content of the waste is calculated from the percentage of carbon dioxide in the flue gas and the percentage of carbon in the residue.
- Sulfur – Sulfur content of the waste is calculated from the percentage of sulfur dioxide in the flue gas and the percentage of sulfur in the ash.
- Hydrogen – Hydrogen is determined from the amount of moisture in the flue gas taking into account the moisture in the waste, combustion air and ash quench vapor.
- Nitrogen – Nitrogen is an assumed value agreed upon before the test. The nitrogen content of the refuse is very small and will have very little effect on the high heating value of the waste.
- Moisture – Moisture content is determined from samples taken during the performance tests.
- Ash – Ash content is determined from the total residue produced during the test less the moisture, sulfur and carbon contained in the ash.

TABLE 2 REFUSE-FIRED BOILER ENERGY BALANCE

Item	Heat Loss	BTU/LB_R	$BTUX10^6/DAY$
01.	Heat loss due to dry gas. Dry flue gas LB/LB_R x specific heat x (exit gas temp. - ambient air temp.) 6.791 LB/LB_R x .254 Btu/Lb.°F. (400°F-70°F.).	569.2	170.8
02.	Heat loss due to moisture in fuel = (Enthalpy of vapor at 1.0 PSIA @ exit gas temp. - enthalpy of liquid @ ambient air temp.) x moisture in the fuel LB/LB_R (.2119 LB/LB_R x (1240 Btu/LB-48 Btu/LB).	252.6	75.8
03.	Heat loss due to H_2O from comb. of H_2 = 9 x hydrogen in fuel LB/LBL (Enthalpy of vapor - enthalpy of liquid) 9 x .0338 x (1240-48).	362.6	108.8
04.	Heat loss due to combustibles in residue Carbon in residue x 14.500 Btu/LB .0136 x 14.500 Btu/LB.	197.2	59.2
05.	Heat loss due to radiation (ABMA Chart).	45.0	13.5
06.	Unaccounted for losses.	55.0	16.5
07.	Heat loss in residue. Dry residue including unburned carbon x (specific heat of residue) x (residue temp. leaving furnace - residue temp. after quench) .2730 LB/LB_R x .25 Btu/LB°F. x (700°F-210°F.).	33.4	10.0
08.	Heat loss due to moisture in residue. Moisture content of residue x (temp. @ residue leaving quench - temp. of water entering quench) 15/100 (.2730 LB/LB_R)(210°F.-70°F.) x 1 Btu/LB°F.	5.7	1.7
09.	Heat loss due to moisture in air. Total dry air required based on fuel rate x moisture in air x specific heat of air x exit gas temp.-inlet air temp.)(0.5583 LB/LB_R x .013 LB_{water}/LB_{air} x 0.429 BTU/LB°F. (400° F-70°F).	12.1	3.6
010.	Heat loss due to quench vapor. (Heat loss in dry residue ÷ latent heat of vapor @ atmospheric pressure) x (enthalpy of vapor entering boiler-enthalpy of vapor entering furnace. (33.44 Btu/LB ÷ 970.4 Btu/LB) x (1240 Btu/LB-970.4 Btu/LB).	9.3	2.8

TABLE 2 REFUSE-FIRED BOILER ENERGY BALANCE (CONT'D.)

Item	Heat Loss	BTU/LB_R	BTUX10^6/DAY
011.	Heat loss due to blowdown. Estimated steam production x specific heat of steam @ 150 PSIG sat. x blowdown rate. 2.8 LB/LB_R x ~~1196~~ Btu/LBS x 3%	106.5	32
		1648.6	494.6
	Heat Input		
I1.	Fuel heat input. HHV of refuse.	4500	1350
I2.	Dry air heat input. Total dry air required based on fuel rate x specific heat of air x (ambient air temp. - 32°F.) 6.5583 LB/LB_R x .24 Btu/LB$^{\circ}$F. x (70°F.-32°F.).	59.81	17.9
I3	Heat input due to moisture in air. Moisture in air x specific heat of water vapor (ambient air temp. - 32°F.). 6.5583 LB/LB_R x .013 LB_w/LB_{air} x .489 Btu/LB$^{\circ}$ F. (70°F. - 32°F.).	1.6	.5
I4.	Enthalpy of feedwater entering boiler (Feedwater temp.-32°F.) x specific heat of water x lbs. of water/lb. of refuse. (250°F.-32°F.) x 1 Btu/LB$^{\circ}$F x 2.884 LB_w/LB_R	628.7	188.6
		5190.1	1557.0
	Steam Production		
S1.	Heat absorbed in steam. (Items I1 + I2 + I3 +I4)-(Items 1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 + 10 + 11) (4500 + 59.81 + 1.6 + 628.7) - (569.2 + 252.6 + 362.6 + 197.2 + 45.0 + 55.0 + 33.4 + 5.7 + 12.1 + 9.3 + 106.5). 5190.11 - 1648.6.	3541.5	1062.4
		LB_S/LB_R	
	Steaming Rate. Item S1. ÷ enthalpy of lbs. Steam @ 150 PSIG 465° F. 3529.4 ÷ 1254.	2.82	

TABLE 3 SAMPLE FUEL HEATING VALUE DETERMINATION

DATA FROM PERFORMANCE TEST

Flue Gas

CO_2	- 11.19% by wt.
H_2O	- 8.90% " "
O_2	- 11.55% " "
SO_2	- 0.20% " "
Flow	- 155,675 lbs./hr.
Temp.	- 400° F.

Ash

Weight	- 5,515 lbs./hr.
C	- 5.0% by wt.
S	- .1% " "
Temp.	- 210° F.
Mois.	- 15% by wt.

Combustion Air

Flow	- 140,067 lbs.
Temp.	- 70° F.

Refuse

Weight	- 20,200 lbs.
Moisture	- 27,74% by wt.

Ash Cooling Water

Temp.	- 70° F.
Flow	- 957 lbs./hr.

TABLE 3 SAMPLE FUEL HEATING VALUE DETERMINATION (CONTINUED)

DETERMINATION OF ULTIMATE ANALYSIS OF REFUSE

Item **Lbs./Lb. Refuse**

1 Carbon Content

$$\frac{\%\ CO_2\ \text{Flue Gas} \times \text{Lb./Hr. Flue Gas} \times \text{Lb.}_{C}/CO_2}{\text{Lbs. Refuse}}$$

$$+ \frac{\%\ C_{Ash} \times \text{Lb.}_{Ash\ Dry}}{\text{Lbs. Refuse}}$$

$$\frac{.1179 \times 155{,}675 \times .2732}{20{,}200} + \frac{.08 \times 4687}{20{,}200}$$ .2472

2 Hydrogen Content

H_2O from H_2 Comb. = $H_2O_{\text{Flue Gas}}$ − H_2O_{Refuse} − H_2O Ash Vapor − H_2O Comb.Air

$$H_2O_{\text{Flue Gas}} = \frac{\%\ H_2O_{FG} \times \text{Lb.}_{FG}}{\text{Lbs.}_{\text{Refuse}}}$$

$$= \frac{.0890 \times 155.675}{20{,}200} = .6859$$

$$H_2O_{\text{Comb.Air.}} = \frac{\text{Lb.}_{\text{Comb.Air}} \times \text{Lb.}_{H_2O}/\text{Lb.}_{\text{Ash}}}{\text{Lb.}_{\text{Refuse}}}$$

$$= \frac{140{,}067 \times .013}{20{,}200} = .090$$

$$H_2O_{\text{Ash Vap.}} = \frac{\text{Cooling Water Flow}}{\text{Lb. Refuse}} - \frac{\%\ \text{Mois.in Ash} \times \text{Lb.}_{\text{Ash}}}{\text{Lb. Refuse}}$$

$$= \frac{957}{20{,}200} - \frac{.15 \times 5155}{20{,}200} = .007$$

$$H_2O_{\text{Refuse}} = \text{Lb.}_{H_2O}/\text{Lb.}_{\text{Refuse}}$$

$$= .2774$$

TABLE 3 SAMPLE FUEL HEATING VALUE DETERMINATION (CONTINUED)

DETERMINATION OF ULTIMATE ANALYSIS OF REFUSE CONT'D.

Item		Lbs./Lb. Refuse
2	H_2O from H_2 Comb. = .6859 - .090 - .007 - .2774 = .3115	
	Convert to Lb. H per $\text{Lb.}_{\text{Refuse}}$	
	$H = \text{Lb.}_{H_2O} \text{ X } \text{Lb.}_H/\text{Lb.}_{H_2O}$ = .3115 X .1188	.03484
3	Sulfur Content	
	$\frac{\%\ SO_2 \text{ X Lb.}_{FC} \text{ X Lb.}_S/\text{Lb.}_{SO_2}}{\text{Lb.}_{\text{Refuse}}} + \frac{\%\ S_{\text{Ash}} \text{ X Lb.}_{\text{Ash}}}{\text{Lb.}_{\text{Refuse}}}$	
	$\frac{.002 \text{ X } 155{,}675 \text{ X } .5}{20{,}200} + \frac{.0024 \text{ X } 4682}{20{,}200}$	.0011
4	Moisture Content	.2774
5	Nitrogen Content (Est. Value)	.0060
6	Ash Content	
	$= \text{Residue} - H_2O_{\text{Refuse}} - C_{\text{Ash}} - S_{\text{Ash}}$ $= \frac{5515}{20{,}200} - \frac{.15 \text{ X } 5515}{20{,}200} - \frac{.05 \text{ X } 5515}{20{,}200} - \frac{.001 \text{ X } 5515}{20{,}200}$	.21817
7	Oxygen Content	
	1.00 - (Items) + 2 + 3 + 4 + 5 + 6) =	
	1.00 - (.2472 + .03483 + .0011 + .2774 + .0060 + .2183) =	.21529
		1.000

TABLE 3 SAMPLE FUEL HEATING VALUE DETERMINATION (CONTINUED)

DETERMINATION OF HIGH HEATING VALUE OF SOLID WASTE BY BOJE FORMULA

		Weight Fraction	Btu/Lb.	HHV
1	C	.2472	14,976	3702
2	H	.03484	49,374	1720
3	S	.0011	4,500	5
4	Moisture	.2774	-	
5	N	.0060	2,700	16
6	Ash	.21817	-	-
7	O	.21529	- 4,644	- 1000
				4443 Btu/Lb.

- Oxygen – Oxygen content is taken as the remaining component of the refuse after all values have been calculated.

Neglecting the other minor components in the waste will result in a relatively small error in the high heating value calculation.

After the calculated analysis of the solid waste is determined, the heating value can be calculated using the BOJE formula.

This method of determination of heating values makes a number of assumptions and the results are contingent upon good testing methods.

The results reflect an accurate representation of the solid waste during the test period without the elaborate sampling and testing methods needed to do an accurate and representative chemical analysis of this waste.

SUMMARY

Calculating efficiency of municipal waste mass burning energy recovery systems by measuring the output of the system and basically using the furnace as a calorimeter seems to be reasonable and more accurate than trying to determine the precise composition of refuse by sorting and analysis.

All measurements are practical, timely and appropriate to the fuel actually used. Calculations are mathematically accurate and scientifically correct. This method actually answers more questions and leaves less to chance than any previously suggested procedure. More improvements will likely be found, but this seems to be a good place to start.

ACKNOWLEDGMENTS

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Key Words: Calorific value • Efficiency • Energy • Furnace • Performance • Steam • Testing

ATTACHMENT B

Appendix F. Quality Assurance Procedures

Procedure 1. Quality Assurance Requirements for Gas Continuous Emission Monitoring Systems Used for Compliance Determination

1. Applicability and Principle

1.1 Applicability. Procedure 1 is used to evaluate the effectiveness of quality control (QC) and quality assurance QA) procedures and the quality of data produced by any continuous emission monitoring system (CEMS) that is used for determining compliance with the emission standards on a continuous basis as specified in the applicable regulation. The CEMS may include pollutant (e.g., SO_2 and NO_x) and diluent (e.g., O_2 or CO_2) monitors.

This procedure specifies the minimum QA requirements necessary for the control and assessment of the quality of CEMS data submitted to the Environmental Protection Agency (EPA). Source owners and operators responsible for one or more CEMS's used for compliance monitoring must meet these minimum requirements and are encouraged to develop and implement a more extensive QA program or to continue such programs where they already exist.

Data collected as a result of QA and QC measures required in this procedure are to be submitted to the Agency. These data are to be used by both the Agency and the CEMS operator in assessing the effectiveness of the CEMS QC and QA procedures in the maintenance of acceptable CEMS operation and valid emission data.

Appendix F, Procedure 1 is applicable ____________________(6 months after the promulgation date). The first CEMS accuracy assessment shall be a relative accuracy test audit (RATA) (see Section 5) and shall be completed by ________________ (9 months after the promulgation date) or the date of the initial performance test required by the applicable regulation, whichever is later.

1.2 Principle. The QA procedures consist of two distinct and equally important functions. One function is the assessment of the quality of the CEMS data by estimating precision and accuracy. The other function is the control and improvement of the quality of the CEMS data by implementing QC policies and corrective actions. These two functions form a control loop: When the assessment function indicates that the data quality is inadequate, the control effort must be increased until the data quality is acceptable. In order to provide uniformity in the assessment and reporting of data quality, this procedure explicitly specifies the assessment methods for response drift and accuracy. The methods are based on procedures included in the applicable performance specifications (PS's) in Appendix B of 40 CFR Part 60. Procedure 1 also requires the analysis of the EPA audit samples concurrent with certain reference method (RM) analyses as specified in the applicable RM's.

Because the control and corrective action function encompasses a variety of policies, specifications, standards, and corrective measures, this procedure treats QC requirements in general terms to allow each source owner or operator to develop a QC system that is most effective and efficient for the circumstances.

2. Definitions.

2.1 Continuous Emission Monitoring System. The total equipment required for the determination of a gas concentration or emission rate.

2.2 Diluent Gas. A major gaseous constituent in a gaseous pollutant mixture. For combustion sources, CO_2 and O_2 are the major gaseous constituents of interest.

2.3 Span Value. The upper limit of a gas concentration measurement range that is specified for affected source categories in the applicable subpart of the regulation.

2.4 Zero, Low-Level, and High-Level Values. The CEMS response values related to the source specific span value. Determination of zero, low-level, and high-level values is defined in the appropriate PS in Appendix B of this part.

2.5 Calibration Drift (CD). The difference in the CEMS output reading from a reference value after a period of operation during which no unscheduled maintenance, repair or adjustment took place. The reference value may be supplied by a cylinder gas, gas cell, or optical filter and need not be certified.

2.6 Relative Accuracy (RA). The absolute mean difference between the gas concentration or emission rate determined by the CEMS and the value determined by the RM's plus the 2.5 percent error confidence coefficient of a series of tests divided by the mean of the RM tests or the applicable emission limit.

3. QC Requirements.

Each source owner or operator must develop and implement a QC program. As a minimum, each QC program must include written procedures which should describe in detail, complete, step-by-step procedures and operations for each of the following activities:

1. Calibration of CEMS.
2. CD determination and adjustment of CEMS.
3. Preventive maintenance of CEMS (including spare parts inventory).
4. Data recording, calculations, and reporting.
5. Accuracy audit procedures including sampling and analysis methods.
6. Program of corrective action for malfunctioning CEMS.

As described in Section 5.2, whenever excessive inaccuracies occur for two consecutive quarters, the source owner or operator must revise the current written procedures or modify or replace the CEMS to correct the deficiency causing the excessive inaccuracies.

These written procedures must be kept on record and available for inspection by the enforcement agency.

4. CD Assessment.

4.1 CD Requirement. As described in 40 CFR Part 60.13(d), source owners and operators of CEMS must check, record, and quantify the CD at two concentration values at least once daily in accordance with the method prescribed by the manufacturer. The CEMS calibration must, as a minimum, be adjusted whenever the daily zero (or low-level) CD or the daily high-level CD exceeds two times the limits of the applicable PS's in Appendix B of this regulation.

4.2 Recording Requirement for Automatic CD Adjusting Monitors. Monitors that automatically adjust the data to the corrected calibration values, e.g., microprocessor control, must be programmed to record the unadjusted concentration measured in the CD prior to resetting the calibration or record the amount of adjustment.

4.3 Criteria for Excessive CD. If either the zero (or low-level) or high-level CD result exceeds twice the applicable drift specification in Appendix B for five, consecutive, 24-hour periods, the CEMS is out-of-control. If either the zero (or low-level) or high-level CD result exceeds four times the applicable drift specification in Appendix B during any CD check, the CEMS is out-of-control. If the CEMS is out-of-control, take necessary corrective action. Following corrective action, repeat the CD checks.

4.3.1 Out-Of-Control Period Definition. The beginning of the out-of-control period is the time corresponding to the completion of the daily CD check immediately preceding the completion of the daily CD check that results in the excessive CD (e.g., the end of the fifth consecutive, 24-hour period with a CD in excess of two times the allowable limit when the sixth, consecutive daily CD is also in excess of two times the allowable limit; or the time corresponding to the daily CD check preceding the daily CD check with a CD in excess of four times the allowable limit). The end of the out-of-control period is the time corresponding to the completion of the daily CD check immediately preceding the daily CD check that results in the CD's at both the zero (or low-level) and high-level measurement points are within the corresponding allowable CD limit (i.e., either two times or four times the allowable limit in Appendix B).

4.3.2 CEMS Data Status During Out-Of-Control Period. During the period the CEMS is out-of-control, the CEMS data may not be used in calculating emission compliance nor be counted towards meeting minimum data availability as required and described in the applicable subpart [e.g., §60.47a(f)].

4.4 Data Recording and Reporting. As required in Section 60.7(d) of this regulation, all measurements from the CEMS must be retained on file by the source owner for at least 2 years. However, emission data obtained on each successive day while the CEMS is out-of-control may not be included as part of the minimum daily data requirement of the applicable subpart [e.g., §60.47a(f)] nor be used in the calculation of reported emissions for that period.

5. Data Accuracy Assessment.

5.1 Auditing Requirements. Each CEMS must be audited at least once each calendar quarter. Successive quarterly audits shall occur no closer than 2 months. The audits shall be conducted as follows:

5.1.1 Relative Accuracy Test Audit. The RATA must be conducted at least once every four calendar quarters. Conduct the RATA as described for the RA test procedure in the applicable PS in Appendix B (e.g., PS 2 for SO_2 and NO_x). In addition, analyze the appropriate performance audit samples received from EPA as described in the applicable sampling methods (e.g., Methods 6 and 7).

5.1.2 Cylinder Gas Audit (CGA). If applicable, a CGA may be conducted in three of four calendar quarters, but in no more than three quarters in succession.

To conduct a CGA: (1) Challenge the CEMS (both pollutant and diluent portions of the CEMS, if applicable) with an audit gas of known concentration at two points within the following ranges:

Audit point	Audit range		
	Pollutant monitors	Diluent monitors for --	
		CO_2	O_2
1	20 to 30% of span value	5 to 8% by volume.	4 to 6% by volume.
2	50 to 60% of span value	10 to 14% by volume.	8 to 12% by volume.

Challenge the CEMS three times at each audit point, and use the average of the three responses in determining accuracy.

Use a separate audit gas cylinder for audit points 1 and 2. Do not dilute gas from the audit cylinder when challenging the CEMS.

The monitor should be challenged at each audit point for a sufficient period of time to assure adsorption-desorption of the CEMS sample transport surfaces has stabilized.

(2) Operate each monitor in its normal sampling mode, i.e., pass the audit gas through all filters, scrubbers, conditioners, and other monitor components used during normal sampling, and as much of the sampling probe as is practical. At a minimum, the audit gas should be introduced at the connection between the probe and the sample line.

(3) Use audit gases that have been certified by comparison to National Bureau of Standards (NBS) gaseous Standard Reference Materials (SRM's) or NBS/EPA approved gas manufacturer's Certified Reference Materials (CRM's) (See Citation 1) following EPA Traceability Protocol No. 1 (See Citation 2). As an alternative to Protocol No. 1 audit gases, CRM's may be used directly as audit gases. A list of gas manufacturers that have prepared approved CRM's is available from EPA at the address shown

in Citation 1. Procedures for preparation of CRM's are described in Citation 1. Procedures for preparation of EPA Traceability Protocol 1 materials are described in Citation 2.

The difference between the actual concentration of the audit gas and the concentration indicated by the monitor is used to assess the accuracy of the CEMS.

5.1.3 Relative Accuracy Audit. The RAA may be conducted three of four calendar quarters, but in no more than three quarters in succession. To conduct a RAA, follow the procedure described in the applicable PS in Appendix B for the relative accuracy test, except that only three sets of measurement data are required. Analyses of EPA performance audit samples are also required.

The relative difference between the mean of the RM values and the mean of the CEMS responses will be used to assess the accuracy of the CEMS data.

5.1.4 Other Alternative Audits. Other alternative audit procedures may be used as approved by the Administrator for three of four calendar quarters. One RATA is required at least once every four calendar quarters.

5.2 Criteria for Excessive Inaccuracy. If the RA, using the RATA, exceeds 20 percent or 10 percent of the applicable standard, whichever is greater, the CEMS is out-of-control. For SO_2 emission standards between 130 and 86 ng/J (0.30 and 0.20 lb/million Btu), use 15 percent of the applicable standard; below 86 ng/J (0.20 lb/million Btu), use 20 percent of emission standard. If the inaccuracy exceeds ±15 percent using the CGA or the RAA, or, for the RAA, 7.5 percent of the applicable standard, whichever is greater, the CEMS is out-of-control. If the CEMS is out-of-control, take necessary corrective action to eliminate the problem. Following corrective action, the source owner or operator must audit the CEMS accuracy with a RATA, CGA, or RAA to determine whether the CEMS is operating properly. A RATA must always be used following an out-of-control period resulting from a RATA. The audit following corrective action does not require analysis of EPA performance audit samples. If accuracy audit results show the CEMS to be out-of-control, the CEMS operator shall report both the audit results showing the CEMS to be out-of-control and the results of the audit following corrective action showing the CEMS to be operating within specifications.

5.2.1 Out-Of-Control Period Definition. The beginning of the out-of-control period is the time corresponding to the completion of the sampling for the RATA, RAA, or CGA. The end of the out-of-control period is the time corresponding to the completion of the sampling of the subsequent successful audit.

5.2.2 CEMS Data Status During Out-Of-Control Period. During the period the monitor is out-of-control, the CEMS data may not be used in calculating emission compliance nor be counted towards meeting minimum data availability as required and described in the applicable subpart [e.g., §60.47a(f)].

5.3 Criteria for Acceptable QC Procedure. Repeated excessive inaccuracies indicates the QC procedures are inadequate or that the CEMS is incapable of providing quality data. Therefore, whenever excessive inaccuracies occur for two consecutive quarters, the source owner or operator must revise the QC procedures (see Section 3) or modify or replace the CEMS.

6. Calculations for CEMS Data Accuracy

6.1 RATA RA Calculation. Follow the equations described in Section 8 of Appendix B, PS 2 to calculate the RA for the RATA. The RATA must be calculated in units of the applicable emission standard; e.g., ng/J.

6.2 RAA Accuracy Calculation. Use Equation 1-1 to calculate the accuracy for the RAA. The RAA is calculated in units of the applicable standard.

6.3 CGA Accuracy Calculation. Use Equation 1-1 to calculate the accuracy for the CGA. Each component of the CEMS must meet the acceptable accuracy requirement.

$$A = \frac{C_m - C_a}{C_a} \times 100 \qquad \text{Eq. 1-1}$$

where:

A = Accuracy of the CEMS percent.

C_m = Average CEMS response during audit in units of applicable standard or appropriate concentration.

C_a = Average audit value (CGA certified value or three-run average for RAA) in units of applicable standard or appropriate concentration.

6.4 Example Accuracy Calculations. Example calculations for the RATA, RAA, and CGA are available in Citation Number 3.

7. Reporting Requirements.

At the reporting interval specified in the applicable regulation, report for each CEMS the accuracy results from Section 6 and the CD assessment results from Section 4. Report the drift and accuracy information as a Data Assessment Report (DAR), and include one copy of this DAR for each quarterly audit with the report of emissions required under the applicable subparts of this part.

As a minimum, the DAR must contain the following information:

1. Source owner or operator name and address.

2. Identification and location of monitors in the CEMS.

3. Manufacturer and model number of each monitor in the CEMS.

4. Assessment of CEMS data accuracy and date of assessment as determined by a RATA, RAA, or CGA described in Section 5 including the RA for the RATA, the A for the RAA or CGA, the RM results, the cylinder gases certified values, the CEMS responses, and the calculations results as defined in Section 6. If the accuracy audit results show the CEMS to be out-of-control, the CEMS operator shall report both the audit results showing the CEMS to be out-of-control and the results of the audit following corrective action showing the CEMS to be operating within specifications.

5. Results from EPA performance audit samples described in Section 5 and the applicable RM's.

6. Summary of all corrective actions taken when CEMS was determined out-of-control, as described in Sections 4 and 5.

An example of a DAR format is shown in Figure 1.

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Figure 1. EXAMPLE FORMAT FOR DATA ASSESSMENT REPORT

Period ending date ______________________ Year __________

Company name ____

Plant name ______________________ Source unit no. __________

CEMS manufacturer ____________________ Model no. __________

CEMS serial no. ____________ CEMS type (e.g., in situ) __________

CEMS sampling location (e.g., control device outlet) ____________________

CEMS span values as per the applicable regulation, SO_2 __________ ppm,

O_2 __________ percent, NO_x __________ ppm, CO_2 __________ percent

I. Accuracy assessment results (Complete A, B, or C below for each CEMS or for each pollutant and diluent analyzer, as applicable.) If the quarterly audit results show the CEMS to be out-of-control, report the results of both the quarterly audit and the audit following corrective action showing the CEMS to be operating properly.

A. Relative accuracy test audit (RATA) for __________ (e.g., SO_2 in ng/J).

1. Date of audit ______________.
2. Reference methods (RM's) used ____________ (e.g., Methods 3 and 6).
3. Average RM value __________ (e.g., ng/J, mg/dsm^3, or percent volume).
4. Average CEMS value ______________.
5. Absolute value of mean difference $|\bar{d}|$ __________.
6. Confidence coefficient $|CC|$ ______________.
7. Percent relative accuracy (RA) ______________ percent.

Figure 1. EXAMPLE FORMAT FOR DATA ASSESSMENT REPORT (Continued)

8. EPA performance audit results:

   a. Audit lot number (1) __________ (2) __________

   b. Audit sample number (1) __________ (2) __________

   c. Results (mg/dsm^3) (1) __________ (2) __________

   d. Actual value (mg/dsm^3)* (1) __________ (2) __________

   e. Percentage difference* (1) __________ (2) __________

B. Cylinder gas audit (CGA) for ____________________ (e.g., SO_2 in ppm).

1. Date of audit ________________.

	Audit point 1	Audit point 2	
2. Cylinder DOT/ID number	__________	__________	
3. Date of certification	__________	__________	
4. Type of certification	__________	__________	(e.g., EPA protocol 1 or CRM).
5. Certified audit value	__________	__________	(e.g., ppm).
6. CEMS response value	__________	__________	(e.g., ppm).
7. Percentage difference	__________	__________	percent.

C. Relative accuracy audit (RAA) for ______________ (e.g., SO_2 in ng/J).

1. Date of audit ________________________.

2. Reference methods (RM's) used __________ (e.g., Methods 3 and 6).

3. Average RM value __________ (e.g., ng/J).

4. Average CEMS value ______________.

5. Percentage difference ______________ percent.

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* To be completed by the Agency.

Figure 1. EXAMPLE FORMAT FOR DATA ASSESSMENT REPORT
(Continued)

6. EPA performance audit results:

    a. Audit lot number (1)__________ (2)__________

    b. Audit sample number (1)__________ (2)__________

    c. Results (mg/dsm^3)* (1)__________ (2)__________

    d. Actual value (mg/dsm^3)* (1)__________ (2)__________

    e. Percentage difference* (1)__________ (2)__________

D. Corrective action for excessive inaccuracy.

1. Out-of-control periods.

    a. Date(s) __________________.

    b. Number of days __________________.

2. Corrective action taken ______________________________________

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____.

3. Results of audit following corrective action. (Use format of A, B, or C above, as applicable.)

II. Calibration drift assessment.

A. Out-of-control periods.

1. Date(s) __________________.

2. Number of days __________________.

B. Corrective action taken ______________________________________

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