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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

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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, 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

   Tom Rogers
   Barry Andrews } 4-22-87   RRM

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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

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 approxi-
mate 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 unclassi-fied 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	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

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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.

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 sub-micron 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.

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

(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.

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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.

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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

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/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.

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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/m³)	Predicted Increased Concentration (ug/m³)	Percent Increment Consumed	PSD Class I Increment (ug/m³)	Predicted Increased Concentration (ug/m³)
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

(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.

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.

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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 visibil.ty 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.   Underlined 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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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.

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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).

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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.

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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 tor each unit. The systems shall meet the EPA monitoring pertormance specitications 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 ot 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 ot 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 ot 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 intormation shall be stated in the report (60.7(c)(4)).

(5) Broward County shall maintain a file ot 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 torm suitable tor inspection (60.7(d)).

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

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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.

CALCULATING EFFICIENCY OF MUNICIPAL WASTE MASS BURNING ENERGY RECOVERY SYSTEMS

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FERDNAND DeGEYTER
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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

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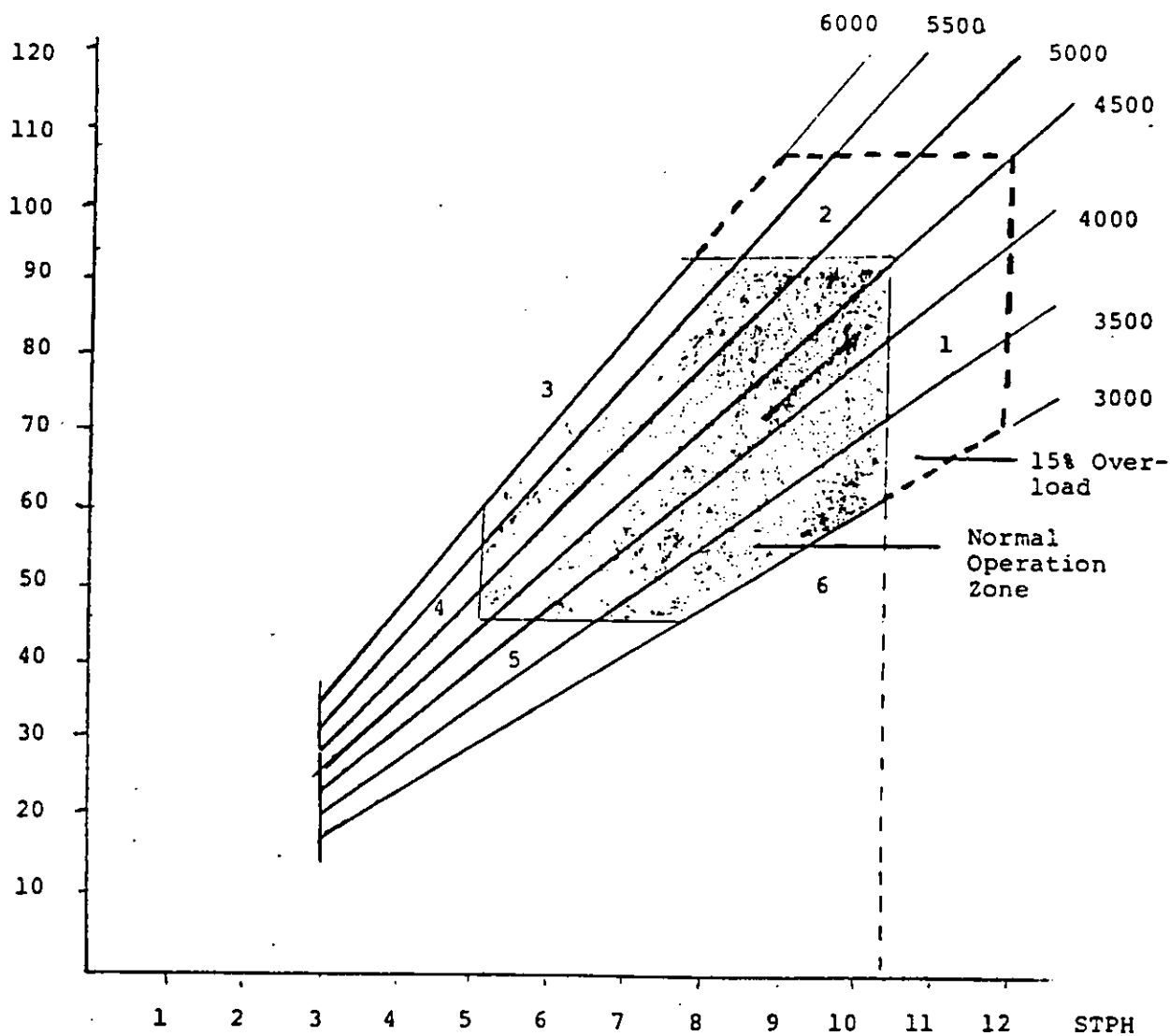
1 Maximum MSW throughput (10.41 STPH)
2 Maximum heat release rate (94 X 10^6 BTU/HR)
3 Maximum expected caloric value (6000 BTU/LB)
4 Minimum MSW through (50% Max)
5 Minimum heat release rate (50% Max)
6 Minimum expected caloric value (3000 BTU/LB)

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
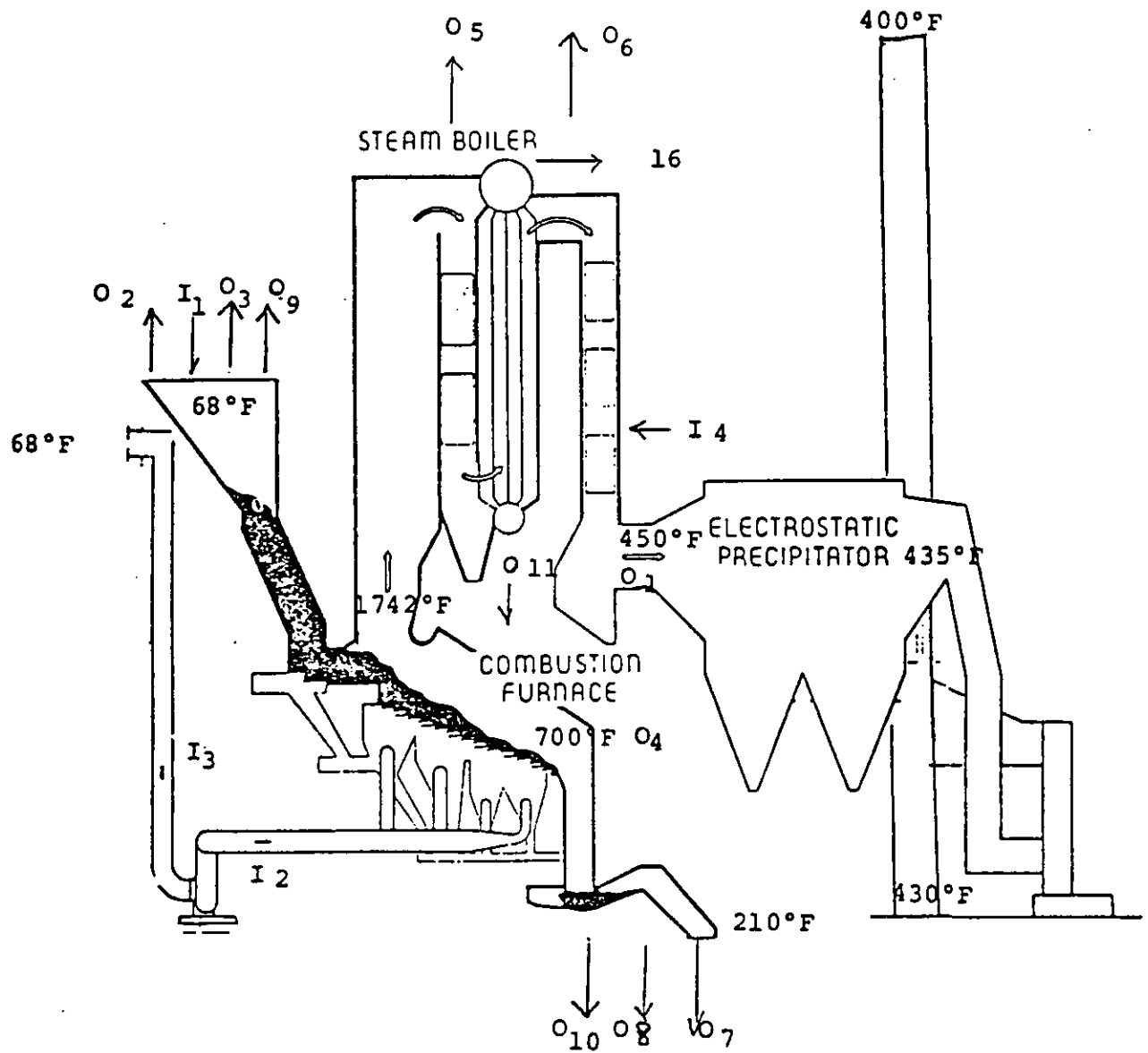
Efficiency = $\dfrac{\text{Net Heat in Steam}}{\text{Net Avail. Heat Input}}$ X 100

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/	
Gas Temperature	1742	1742° F. $(950^\circ$ C.) KG	
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. $(190^\circ$ C.)	
Steam Temperature	750° F.	750° F. $(400^\circ$ C.)	
Steam Pressure	600 psi	600 psi $(41$ ATA)	
Make-Up Water Temperature	250° F.	250° F. $(121^\circ$ 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.

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TABLE 2 REFUSE-FIRED BOILER ENERGY BALANCE

Item	Heat Loss	BTU/LB_R	$BTU \times 10^6/DAY$
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 $Btu/Lb.^\circ F.$ ($400^\circ F - 70^\circ F.$).	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 $Btu/LB^\circ F.$ x ($700^\circ F - 210^\circ F.$).	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) ($210^\circ F.- 70^\circ F.$) x 1 $Btu/LB^\circ F.$	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 $BTU/LB^\circ F.$ ($400^\circ F - 70^\circ F$).	12.1	3.6
010.	Heat loss due to quench vapor. (Heat loss in dry residue $\div$ latent heat of vapor @ atmospheric pressure) x (enthalpy of vapor entering boiler-enthalpy of vapor entering furnace. (33.44 $Btu/LB \div$ 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. $- 32^{\circ}F.$) $6.5583\ LB/LB_R$ x .24 $Btu/LB^{\circ}F.$ x $(70^{\circ}F.-32^{\circ}F.)$.	59.81	17.9
I3	Heat input due to moisture in air. Moisture in air x specific heat of water vapor (ambient air temp. $- 32^{\circ}F.$). $6.5583\ LB/LB_R$ x $.013\ LB_w/LB_{air}$ x .489 $Btu/LB^{\circ}F.$ $(70^{\circ}F. - 32^{\circ}F.)$.	1.6	.5
I4.	Enthalpy of feedwater entering boiler (Feedwater temp.$-32^{\circ}F.$) x specific heat of water x lbs. of water/lb. of refuse. $(250^{\circ}F.-32^{\circ}F.)$ 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

$$\frac{\% \ CO_2 \ \text{Flue Gas} \ X \ \text{Lb./Hr. Flue Gas} \ X \ \text{Lb.}_C/CO_2}{\text{Lbs. Refuse}}$$

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

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

2   Hydrogen Content

H_2O from H_2 Comb. $= H_2O_{Flue \ Gas} -$

$H_2O_{Refuse} - H_2O \ Ash \ Vapor - H_2O \ Comb.Air$

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

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

$$H_2O_{Comb.Air.} = \frac{\text{Lb.}_{Comb.Air} \ X \ \text{Lb.}_{H_2O}/\text{Lb.}_{Ash}}{\text{Lb.}_{Refuse}}$$

$$= \frac{140,067 \ X \ .013}{20,200} = .090$$

$$H_2O_{Ash \ Vap.} = \frac{\text{Cooling Water Flow}}{\text{Lb.}_{Refuse}} - \frac{\% \ \text{Mois.in Ash} \ X \ \text{Lb.}_{Ash}}{\text{Lb.}_{Refuse}}$$

$$= \frac{957}{20,200} - \frac{.15 \ X \ 5155}{20,200} = .007$$

$$H_2O_{Refuse} = \text{Lb.}_{H_2O}/\text{Lb.}_{Refuse}$$
$$= .2774$$

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 Lb.$_{Refuse}$

$H = Lb._{H_2O} \times Lb._H / Lb._{H_2O}$
   = .3115 X .1188   .03484

3   Sulfur Content

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

$\dfrac{.002 \times 155,675 \times .5}{20,200} + \dfrac{.0024 \times 4682}{20,200}$ .0011

4   Moisture Content   .2774

5   Nitrogen Content (Est. Value)   .0060

6   Ash Content

$= Residue − H_2O_{Refuse} − C_{Ash} − S_{Ash}$
$= \dfrac{5515}{20,200} − \dfrac{.15 \times 5515}{20,200} − \dfrac{.05 \times 5515}{20,200} −$
$\dfrac{.001 \times 5515}{20,200}$ .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.

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

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

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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 4U 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:

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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 4U CFR Part 6U.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)].

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4.4 Data Recording and Reporting. As required in Section 6U.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:

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Audit point	Audit range		
	Pollutant monitors	Diluent monitors for --	
		CO2	O2
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

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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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(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 aud·t 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 $|\overline{d}|$ _____.

   6. Confidence coefficient $|CC|$ _____.

   7. Percent relative accuracy (RA) _____percent.

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

B. 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 _____

_____

_____

_____

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MAR 12 1987

4APT-AP/ljf/eaw

Mr. Clair H. Fancy, P.E.
Deputy Chief
Bureau of Air Quality Management
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32301

Re: South Broward Resource Recovery Facility
    PSD-Fl-105

Dear Mr. Fancy:

This is to acknowledge the receipt of the public notice published on
February 12, 1987, regarding the above-referenced project and to provide
specific comment in regard to the BACT for sulfur dioxide.

As you may know, on June 3, 1986, EPA Administrator Lee Thomas remanded a
PSD permit decision involving the North County, California, Resource
Recovery project to Region IX for their reconsideration. The remand strongly
affirms that the permitting authority should take the toxic effects of unregu-
lated pollutants, such as dioxins, furans, heavy metals, and acid gases, into
account in making BACT decisions for regulated pollutants. Therefore, we
feel that potential unregulated pollutant emissions of dioxins, furans,
heavy metals, and acid gases should be considered in making the BACT deter-
mination for SO_2. In making that determination, the SO_2 emission limit
should reflect the amount of control desired for reducing the unregulated
gases by at least 90%. We believe that the installation of acid gas controls
capable of achieving a 75% reduction of SO_2 emissions will achieve at least 90%
reduction of these unregulated pollutants. Therefore, the SO_2 BACT emission
limitation must take these control reductions into consideration.

The emission of sulfur dioxide from municipal incinerators is dependent upon
three somewhat indeterminant factors. These are the fuel sulfur content,
the extent of conversion of sulfur to sulfur dioxide, and the retention of
sulfur dioxide in the ash. Apparently, the great variation in reported
sulfur dioxide emissions appears to be due to the degree of sulfur dioxide
retention in the ash which has been postulated to be from 33% to 75% of the
converted sulfur. Using the data provided in the application, a municipal
solid waste (MSW) fuel with an average sulfur content of 0.12% should pro-
duce approximately 4.8 pounds of sulfur dioxide per ton of MSW. At 4500 Btu's
per pound of MSW (contained in South Broward's application) and a reduction
of the SO_2 emissions by 75%, the emission rate for the proposed South Broward
facility should be 0.133 pounds of sulfur dioxide per million Btu heat input.
This limit equates to approximately 55 ppm of SO_2 on a dry basis corrected
to 7% O_2.

In addition, we have analyzed uncontrolled SO_2 emissions data for several resource recovery facilities. This data, which was submitted by Mr. Thomas Henderson on February 26, 1987, represents uncontrolled SO_2 emissions from 16 facilities throughout the country. We specifically analyzed the data for the Westchester facility which Mr. Henderson feels is representative of the anticipated uncontrolled emissions that might be expected at the Broward County facility. We determined that at the 95% confidence level the uncontrolled SO_2 emissions would be .55 pounds of sulfur dioxide per million Btu's. By requiring 75% control of the SO_2 emissions, an emissions limitation of 0.1375 pounds of sulfur dioxide per million Btu's (.55 x .25 = .1375) would be achieved.

Therefore, based upon the foregoing, we are proposing SO_2 emission limitations of 0.014 pounds SO_2 per million Btu's and 60 ppm of SO_2 on a dry basis corrected to 7% O_2.

If you have any questions or comments, please contact Wayne Aronson of my staff at (404) 347-2864.

Sincerely,

Bruce P. Miller

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

copied: Barry Andrews
        Tom Rogers   } 3/13/87 con
        Pradeep Ravel