108 pages

Final Determination and Permit Conditions

North Broward County Resource Recovery Facility

Broward County, Florida

PSD-FL-112

Prevention of Significant Deterioration

(40 CFR 52.21)

June 26, 1987

CONTENTS

I. INTRODUCTION

Pursuant to Section 403.505, Florida Statutes, North Broward Resource Recovery Project, Inc. (County), applied to the Florida Department of Environmental Regulation (DER) in February 1986 for certification of a steam electric generating, solid waste energy recovery facility at 2700 Hilton Road in unicorporated Broward County, Florida. After a thorough review by DER, including public hearings, the Florida Power Plant Siting Board issued a site certification to the County. At the time of its application to DER, the County also filed a separate application for the project with the United States Environmental Protection Agency (EPA) under Part C, Subpart 1, of the Clean Air Act.

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 Consequently, EPA determined that the Florida PSD regulations were superseded by the PPSA, and that the PPSA could not legally be approved by EPA as part of the State Implementation Plan (SIP) since it did not comply with EPA PSD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 North Broward County Resource Recovery Facility (RRF) could not be issued a valid PSD permit by FDER. Nor could the PPSA certification substitute for a valid PSD permit. EPA subsequently remanded PSD authority for sources subject to the PPSA while delegating responsibility for the technical and administrative portions of the PSD review to the FDER. The following final determination and permit constitute EPA's final action as well as the culmination of those activities delegated to the FDER by EPA.

The applicant plans to construct a 2200 tons per day (TPD) solid waste-to-energy facility to be located at 2700 Hilton Road in unincorporated Broward County, Florida. Municipal solid waste (MSW) will be combusted to produce steam for power generation. The present plans are to construct four 550 TPD MSW incinerators. An ultimate maximum capacity of 3300 TPD is anticipated in the future which will require the addition of a fifth and sixth incinerator. The County will need to submit an application to construct the fifth and sixth units at a future date. The applicant requests that each unit be permitted at 110% of its rated capacity. At 110% capacity, each of the four energy recovery units will have an approximate heat input of 226.9 million Btu per hour based on a heat content of 4500 Btu/lb for MSW. Each incinerator will be allowed to operate 8760 hours per year. The yearly tonnage of the various air pollutants emitted were calculated on this basis.

II. RULE APPLICABILITY

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

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

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

III. PSD APPLICABILITY DETERMINATION

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

Pollutant	BACT EMISSION LIMITS
Particulate Matter	0.015 gr/dscf, corrected to 12% CO_2
Sulfur Dioxide	0.140 lbs/mmBtu or 65% removal (not to exceed 0.310 lb/mmBtu)
Nitrogen Oxides	0.560 lb/mmBtu
Carbon Monoxide	0.090 lb/mmBtu
Lead	0.00056 lb/mmBtu
Mercury	7.50×10^{-4} lb/mmBtu
Beryllium	9.30×10^{-7} lb/mmBtu
Fluorides	0.0040 lb/mmBtu
Sulfuric Acid Mist	90% removal (not to exceed 4.70×10^{-3} lb/mmBtu)

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

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

Pollutant		Maximum Annual Emissions (tons/year)	PSD Significant Emissions Rate (tons/year)
Particulate	(PM)	128	25
Sulfur Dioxide	(SO_2)	1233	40
Nitrogen Dioxide	(NO)	2227	40
Carbon Monoxide	(CO)	358	100
Lead	(Pb)	2.23	0.6
Mercury	(Hg)	2.98	0.1
Beryllium	(Be)	0.0037	0.0004
Fluorides	(F)	15.91	3
Sulfuric Acid Mist	(H_2SO_4)	18.7	7

IV. BEST AVAILABLE CONTROL TECHNOLOGY DETERMINATION (BACT)

A. Particulate Matter

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

In making the BACT determination, an emissions limit was selected to ensure that hazardous yet unregulated pollutants are controlled in accordance with the North County, California, incinerator PSD remand. The control of dioxins, furans, other condensible organics, and heavy metals is hypothesized to occur due to their condensation and adsorption on particulate matter. As the collective surface area of fine particulate matter is greater than that of larger particles per mass unit and fine particulate matter consists of a significant portion of the total particulate matter, control equipment should be selected which ensures a high degree of control for fine particulates. EPA has agreed that the use of an electrostatic precipitator (ESP) can provide this high degree of control and the limit which was determined to be BACT is 0.015 gr/dscf. This results in an approximate increase in ESP annualized costs of $178,200 per year over the originally proposed emission limit of 0.02 gr/dscf, or an overall cost of $348 per ton of particulate removed. However, the applicant may install either an ESP or baghouse to meet this limitation.

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

B. Sulfur Dioxide

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

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

C. Acid Gases

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

Sulfuric acid mist is generated as a result of the oxidation of sulfur dioxide to sulfur trioxide in the flue gas. Combination of sulfur trioxide and water results in the formation of sulfuric acid mists. The uncontrolled emissions of this pollutant are estimated to be as high as 187 TPY. BACT of 90% control of these emissions results in an emissions reduction of 168 TPY.

Hydrogen fluoride is created through the combustion of waste materials containing fluorine. Although the reported emissions of hydrogen fluoride vary greatly at existing facilities, the emissions have been reported to be as high as 0.02 lb/mmBtu. However, the applicant predicts an uncontrolled emission rate of 0.04 lb/mmBtu or 159 TPY at this facility. A 90% control efficiency for this pollutant results in the control of 143 TPY based on the agreed emission rate of 0.004 lb/mmBtu and is considered BACT.

The formation of hydrogen chloride emissions is due primarily to the combustion of plastics containing chlorine. It is assumed that the plastic content of municipal solid waste is 4.2 wt%, of which 11.2 wt% is PVC resin in plastics. Using the weight percent of chlorine in PVC (45.3 wt%), the expected uncontrolled emissions from this facility are 0.47 lb/mmBtu or 1869 tons per year. Acid gas control will provide control of 90% of these emissions of hydrogen chloride or 1682 TPY.

In assessing the economic impacts, 224 TPY of sulfur dioxide, 168 TPY of sulfuric acid mist, 143 TPY of hydrogen fluoride, and 1682 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 $3,213,200 in annualized costs. This results in a cost of $1449 per ton of total pollutants (listed above) and is considered reasonable.

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

D. Nitrogen Oxides

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

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

E. Carbon Monoxide

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

F. Lead

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

The emission limit judged to be reasonable for lead is based on test results at similar facilities and the degree of emission control that will be provided by the control equipment which has been determined to be BACT for this facility. In accordance with data contained in the California Air Resources Board (CARB) report on resource recovery facilities, the highest uncontrolled lead emission rate from refuse-fired incinerators tested is 0.037 lbs/mmBtu. Based on a heating value of 4500 Btu per pound of refuse and the control efficiency reported for lead emissions using the required BACT (scrubber and particulate control of 0.015 gr/dscf, corrected to 12% CO_2), an emission limitation of 0.00056 lb/mmBtu is judged to be BACT.

G. Mercury

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

H. Beryllium

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

V. AIR QUALITY ANALYSIS

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

A. Modeling Methodology

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

Table V-1

North 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	583.6	2907.6	61.0	380	18.2 (2)	1.5
Unit 2	583.6	2907.6	61.0	380	18.2 (2)	1.5
Unit 3	583.6	2907.6	61.0	380	18.2 (2)	1.5
Unit 4	583.6	2907.6	61.0	380	18.2 (2)	1.5

(1) Four 605 TPD incinerators, each with a flue to a common stack. For modeling purposes the common stack was given a stack diameter of 3.0 m and an exit velocity of 18.2 m/s.

(2) Estimated by using a flow rate of 68,260 ACFM for each unit and calculated using given diameters.

Table V-2
North Broward County Resource Recovery Facility
Maximum Emission Rates[a]

Pollutant	(lb/ton)	(lb/MMBTU)	(PPM)	(lb/hr)	(ton/yr)
PM	0.29	0.032	---	29.2[b]	102
SO_2	2.8	0.31	124-60[c]	281	896[c]
NO_x	5.04	0.56	350[d]	508	1618
CO	0.81	0.090	e	262.5	260
VOC	0.12	0.013[f]	---	11.8	37.6
Pb	0.005	0.00056	---	0.51	2.23
F^-	0.036	0.004	---	3.63	11.6
H_2SO_4 Mist[g]	0.042	0.0047	---	4.27	13.5
Be	$8.4x10^{-6}$	$9.3x10^{-7}$	---	0.00084	0.0027
Hg	0.00675	$7.5x10^{-4}$	---	0.68	2.2
As	$2.8x10^{-4}$	0.000031	---	0.028	0.090

a. Based on facility capacity of 907.6 MMBTU/hr firing 2420 TPD of MSW, which is 110 percent of nameplate capcity. Maximum emissions in lb/hr calculated based on maximum ppm level if applicable. Maximum tons per year based on 80 percent annual availability factor of nameplate capacity and maximum lb/hr emission rate except for NO_x and CO; these are based on maximum lb/MMBTU or lb/ton level.

b. Based on 0.015 gr/dscf corrected to 12% CO_2.

c. A maximum 3-hour rolling average corrected to 12% CO_2. A removal efficiency of 65% required. Actual tons per year will be between 890 and 431 depending on actual sulfur in MSW.

d. A maximum 3-hour rolling average corrected to 12% CO_2.

e. 400 ppm maximum 1-hour rolling average ppm and maximum 4-day rolling average of 88 ppm; corrected to 12% CO_2, dry.

f. Covered under nonattainment provisions for O_3 and not applicable for PSD review.

g. Operating practice to reduce SO_2 (see c).

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

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

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

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

B. Analysis of Existing Air Quality

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

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

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

Table V-3

North Broward County Resource Recovery Facility
Maximum Air Quality Impacts
Compared to the *De Minimis* Ambient Levels

Pollutant and Averaging Time	Predicted Impact (ug/m^3)	*De Minimus* Ambient Impact Level (ug/m^3)
SO_2 (24-hour)	4.4	13
PM (24-hour)	0.46	10
NO_2 (Annual)	1.1	14
CO (8-hour)*	11.1	575
Pb (24-hour)	0.01	0.1 (quarterly)
F^- (24-hour)	0.06	0.25
Be (24-hour)	0.00001	0.0005
Hg (24-hour)	0.011	0.025

* Based on an assumed maximum of 400 ppm, 8-hour average.

Table V-4

North Broward County Resource Recovery
Facility Nearest Monitoring Station to
or Within 10 km of the RRF

Site	Location with Respect to the Proposed Facility Direction (degrees)	Distance (km)	Pollutant	Concentration 1984 Annual (ug/m^3)	24-hour (ug/m^3)	8-hour (ug/m^3)	1-hour (ug/m^3)
3700003	85	6.2	PM	36	63		
			Pb (quarterly)	0.2			
3700002	14	6.1	PM	48	120		
2270001 (G01)	199	13.5	PM	38	76		
			NO_2	33			
			SO_2	3	6		
			CO			5	7
2270001 (G09)	199	13.5	PM	38	76		
			NO_2	34			
			SO_2	6	12		
0420003	267	12.4	O_3				202
3700004	170	7.5	CO			5	7
2560002	232	6.5	PM	29	59		
			Pb (quarterly)	0.1			

C. PSD Increment Analysis

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

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

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

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

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

D. AAQS Analysis

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

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

Table V-5

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

	PSD Class II Analysis			PSD Class I Analysis		
Pollutant and Averaging Time	PSD Class II Increment (ug/m^3)	Predicted Increased Concentration (ug/m^3)	Percent Increment Consumed	PSD Class I Increment (ug/m^3)	Predicted Increased Concentration (ug/m^3)	Percent Increment Consumed
SO_2*						
3-hour	512	17.6	3	25	2	8
24-hour	91	4.4	5	5	0.3	6
Annual	20	<1	<5	2	<<1	<<1
PM						
24-hour	37	<1	<3	10	<1	<1
Annual	19	<<1	<<5	5	<<1	<<1

*Based on a maximum emission of 281 lb/hr; actual emissions would likely be much lower based on 65% SO_2 removal efficiency.

Table V-6

North 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)	Florida AAQS (ug/m^3)
SO_2					
3-hour	18	332	27 (3)	359	1300
24-hour	4	92	12	104	260
Annual	<1 (4)	-	6	-	60
PM					
24-hour	<1 (4)	-	120	-	150
Annual	<<1 (4)	-	48	-	60
NO_2					
Annual	1 (4)	-	34	-	100
CO					
1-hour	39 (4)	-	7,000	-	40,000
8-hour	10 (4)	-	5,000	-	10,000
Pb					
3-months	<0.1	-	0.2	-	1.5

(1) Maximum impact includes the FPL Port Everglades and Fort Lauderdale power plants and minor sources within 10 km of proposed facility.

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

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

(4) Less than significant, no further analysis completed. For CO, analysis based on 400 ppm, 8-hour average.

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

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

VI. ADDITIONAL IMPACTS ANALYSIS

A. Impacts on Soils and Vegetation

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

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

B. Impact on Visibility

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

C. Growth-Related Air Quality Impacts

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

D. GEP Stack Height Determination

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

E. Noncriteria Pollutants

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

F. Unregulated Pollutants

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

VII. FINAL PERMIT

PART I. - Specific Conditions

1. Emission Limitations

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

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

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

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

The 124 ppm limit above shall be modified to reflect a new emission limit (in ppm) from the control device at 65% control efficiency. Within 18 months of start-up of operation, the County shall submit compliance tests that will be used to determine the new SO_2 emission limit (in ppm). The limit will be determined by observed average emission rate (u) from the submitted compliance tests and will be statistically analyzed using the one tailed student T test ($t_{.05} = (\bar{x} - u)\, n^{0.5}/s$) at the 95% confidence level to derive a mean emission rate ($\bar{x}$), where s is the standard deviation of observed values n. The final operating SO_2 emission limit (in ppm) shall be this mean emission rate ($\bar{x}$). This value shall be restricted to no more than 124 ppm or less than 60 ppm (3-hr rolling average, dry volume, corrected to 12% CO_2).

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

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

Lead: .00056 lb/mmBtu

Fluorides: .0040 lb/mmBtu

Beryllium: 9.30×10^{-7} lb/mmBtu

Mercury: 7.50×10^{-4} lb/mmBtu

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

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

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

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

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

c. (1) None of the four individual municipal solid waste incinerators shall be charged in excess of 226.9 mmBtu/hr and 605 tons per day MSW (110% rated capacity) nor produce in excess of 129,500 lbs/hr of steam (3-hr rolling average).

(2) The temperature of the flue gas exiting the final combustion chamber of the incinerator shall not be less than 1800°F.

d. Compliance Tests

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3. Devices shall be installed to continuously monitor and record steam production, the final combustion chamber temperature, and flue gases temperature at the exit of the acid gas removal equipment. These devices shall be adequately maintained and operating during all periods of operation.

4. The height of each boiler exhaust stack shall not be less than 61.0 meters above ground level at the base of the stack.

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

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

7. Fuel

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

8. Air Pollution Control Equipment

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

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

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

   c. The temperature of flue gases exiting the acid gas control equipment shall not exceed 300°F.

9. Continuous Emission Monitoring

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

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

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

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

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

(4) The temperatures of the final combustion chamber of the furnace and flue gases exiting the acid gas control device shall be continuously monitored.

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

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

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

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

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

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

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

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

10. 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.

11. Reporting

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

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

c. Addresses for submitting reports are:

EPA Region IV

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

Florida Department of Environmental Regulation (DER)

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

Southeast District Office of DER

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

Broward County

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

PART II. - General Conditions

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

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

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

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

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

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

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

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

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

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

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

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

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

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

VIII. PUBLIC COMMENTS/NOTICE

Comments were received by the Florida DER from eleven commentors in regard to the construction of the North Broward Resource Recovery Facility. All commentors urged that the facility not be permitted to construct without acid gas control and stringent particulate emissions limits. As this facility has been required to comply with the EPA BACT determination which includes acid gas control and stringent particulate emissions, the concerns of these commentors have been addressed in the Final Determination and Permit for the North Broward County Resource Recovery Facility.

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RECEIVED NOV 26 1986

FORT LAUDERDALE NEWS/SUN-SENTINEL

Published Daily

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

STATE OF FLORIDA
COUNTY OF BROWARD/PALM BEACH

Before the undersigned authority personally appeared Nancy Goldberg who on oath says that he is Classified Supervisor of the Fort Lauderdale News/Sun-Sentinel, Daily newspapers published in Broward/Palm Beach County, Florida that the attached copy of advertisement, being a Notice of Certification Hearing in the matter of operate an electrical power plant

in the ______ Court,

was published in said newspaper in the issues of Sept. 13, 1986

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

Sworn to and subscribed before me

this 15th day of September

A.D. 1986

Nancy Goldberg

(SEAL) Notary Public

Notary Public, State of Florida
My Commission Expires Nov. 1, 1988
Bonded thru Troy Fain Insurance, Inc.

BEST AVAILABLE COPY

RDALE NEWS/SUN-SENTINEL

Published Daily

lale, Broward County, Florida

Palm Beach County, Florida

ALM BEACH

hority personally appeared Nancy Goldberg

10 on oath says that he is ____

___ of the Fort Lauderdale News/Sun-Sentinel, Daily

ward/Palm Beach County, Florida that the attached

a Notice of Certification Hearing

an electrical power plant

____ in the ____ Court,

per in the issues of ____

Fort Lauderdale News/Sun-Sentinel are newspapers published in Florida, and that the said newspapers have heretofore been ird/Palm Beach County, Florida, each day, and have been entered :e in Fort Lauderdale, in said Broward County, Florida, for a period ublication of the attached copy of advertisement; and affiant says l any person, firm or corporation any discount, rebate, commission this advertisement for publication in said newspapers.

tember Nancy Goldberg

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1. Application number PA 86-22 for certification to authorize construction and operation of an electrical power plant near Pompano Beach, Florida, is now pending before the Department of Environmental Regulation, pursuant to the Florida Electrical Power Plant Siting Act, Part II, Chapter 403, F.S.

2. The proposed 25 acre resource recovery site is located in unicorporated Broward County near the southwest quadrant of the intersection of Powerline Road and N.W. 48th Street (Hilton Road). The facility site is directly east of the Florida Turnpike adjoining an existing sanitary landfill. The proposed plant will consist initially of a 55.5 MW unit Solid Waste Burning Resource Recovery Facility. The power plant will ultimantly be expanded to 83.25 MW. A short transmission line will connect to an existing FP & L substation to the south of the facility.

3. The Department of Environmental Regulation has evaluated the application for the proposed power plant. Certification of the plant would allow its construction and operation. The application, DER report, BACT and PSD determinations are available for public inspection at the addresses listed below:

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

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

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

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

POMPANO BEACH
CITY LIBRARY
1213 E. Atlantic Boulevard
Pompano Beach, Florida 33060

4. Pursuant
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NOTICE OF CERTIFICATION HEARING ON AN A[...] AND OPERATE AN ELECTRICAL POWER PLANT [...] NEAR POMPANO BEACH, F[...]

1. Application number PA 86-22 for certification to authorize construction and operation of an electrical power plant near Pompano Beach, Florida, is now pending before the Department of Environmental Regulation, pursuant to the Florida Electrical Power Plant Siting Act, Part II, Chapter 403, F.S.

2. The proposed 25 acre resource recovery site is located in unicorporated Broward County near the southwest quadrant of the intersection of Powerline Road and N.W. 48th Street (Hilton Road). The facilty site is directly east of the Florida Turnpike adjoining an existing sanitary landfill. The proposed plant will consist initially of a 55.5 MW unit Solid Waste Burning Resource Recovery Facility. The power plant will ultimantly be expanded to 83.25 MW. A short transmission line will connect to an existing FP & L substation to the south of the facility.

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115 South Andrews Avenue
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SOUTH FLORIDA WATER
MANAGEMENT DISTRICT
3301 Gun Club Road
West Palm Beach, Florida 33402

POMPANO BEACH
CITY LIBRARY
1213 E. Atlantic Boulevard
Pompano Beach, Florida 33060

4. Pursuant to Section 403.508, Florida Statutes, the certification hearing will be held by the Division of Administrative Hearings on October 14, 1986, at 10:00 a.m., in the Coral Room, Palm-Aire Resort and Conference Center, 2501 Palm-Aire Drive North, Pompano Beach, Florida, in order to take written or oral testimony on the effects of the proposed electrical power plant or any other matter appropriate to the consideration of the site. Need for the facitlity has been predetermined by the Public Service Commission at a separate hearing. Written comments may be sent to the Hearing Officer on or before October 3, 1986.

5. Pursuant to 403.508(4), F.S.: "(a) Parties to the proceeding shall include: the applicant; the Public Service Commission; the Division of State Planning; the water management district as defined in Chapter 373, in whose jurisdiction the proposed electrical power plant is to be located; and the Department." (b) Upon the filing with the Department of a notice of intent to be a party at least 15 days prior to the date set for the land use hearing, the following shall also be parties to the proceeding:

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

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

3. Any domestic non-profit corporation or association formed in whole or in part to promote conservation or natural beauty; to protect the environment, personal health, or other biological values; to preserve historical sites; to promote consumer interest; to represent labor, commercial or industrial groups; or to promote orderly development of the area in which the proposed electrical power plant is to be located.

(c) Notwithstanding paragraph (4) (d), failure of an agency described in subparagraphs (4) (b) 1 and (4) (b) 2 to file a notice of intent to be a party within the time provided herein shall constitute a waiver of the right of the agency to participate as a party in the proceeding.

(d) Other parties may include any person, including those persons enumerated in paragraph (4) (b) who failed to timely file a notice of intent to be a party, whose substantial interests are affected and being determined by the proceeding and who timely file a motion to intervene pursuant to Chapter 120, F.S., and applicable rules. Intervention pursuant to this paragraph may be granted at the discretion of the disignated hearing officer and upon such conditions as he may prescribe any time prior to 15 days before the comencement of the certification hearing.

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

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

Mr. William J. Kendrick
Division of Administrative Hearings
Oakland Office Building
2009 Apalachee Parkway
Tallahasee, Florida 32301

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HEARING ON AN APPLICATION TC CONSTRUCT ;AL POWER PLANT ON A SITE TO BE LOCATED POMPANO BEACH, FLORIDA

(d) Other parties may include any person, including those persons enumerated in paragraph (4) (b) who failed to timely file a notice of intent to be a party, whose substantial interests are affected and being determined by the proceeding and who timely file a motion to intervene pursuant to Chapter 120, F.S., and applicable rules. Intervention pursuant to this paragraph may be granted at the discretion of the disignated hearing officer and upon such conditions as he may prescribe any time prior to 15 days before the comencement of the certification hearing.

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Mr. William J. Kendrick
Division of Administrative Hearings
Oakland Office Building
2009 Apalachee Parkway
Tallahasee, Florida 32301

8. Those wishing to intervene in these proceedings must be represented by an attorney or other person who can be determined to be qualified to appear in administrative hearings pursuant to chapter 120, F.S., or Chapter 17-1.21, FAC.

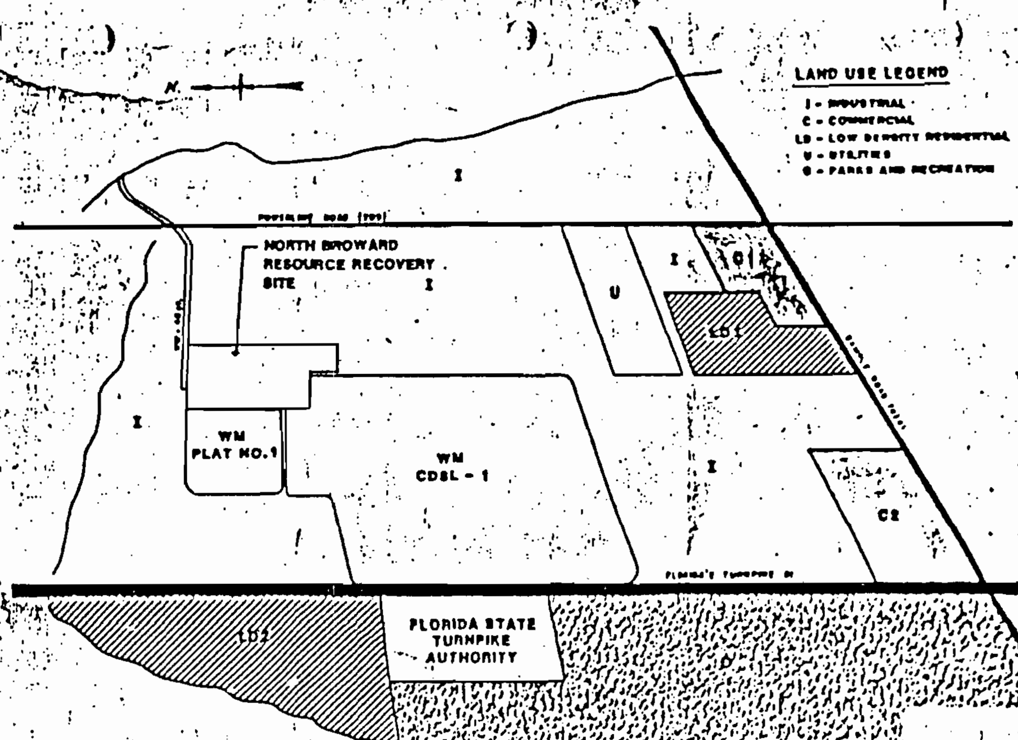
9. This Public Notice is also provided in compliance with the Federal Coastal Zone Management Act, as specified in 15 CFR Part 930, subpart D. Public comments on the applicant's federal consistency certification should be directed to the Federal Consistency Coordinator, Division of Environmental Permitting,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

10. On February 26, 1986, Broward county applied to the DER to construct the aforementioned resource recovery plant. The application is also subject to U.S. Environmental Protection Agency (EPA) regulations for Prevention of Significant Deterioration of air quality (PSD), codified at 40 CFR 52.21. These regulations require that, before construction on a source of air pollution subject to PSD may begin, a permit must be obtained from EPA. Such permit can only be issued if the new construction has been determined by EPA to comply with the requirements of the PSD regulations, which are described in 40 CFR 52.21. These requirements include a restriction on incremental increases in air quality due to the new source and application of best available control technology (BACT).

The DER has been granted a delegation by EPA to carry out the PSD review of this source, except for the final signature of the federal PSD permit. Acting under that delegation, the DER has prepared a draft permit which is included in the DER's staff analysis report. The DER has made a preliminary determination that the proposed construction will comply with all applicable PSD regulations. The degree of Class II increment consumption that will result from the construction is:

Pollutant	Annual Average	24-hr. Average	3-hr. Average
Particulate	4%	3%	
Sulfur Dioxide	5%	10%	7%

The source is located approximately 78 kilometers from the nearest Class I area.



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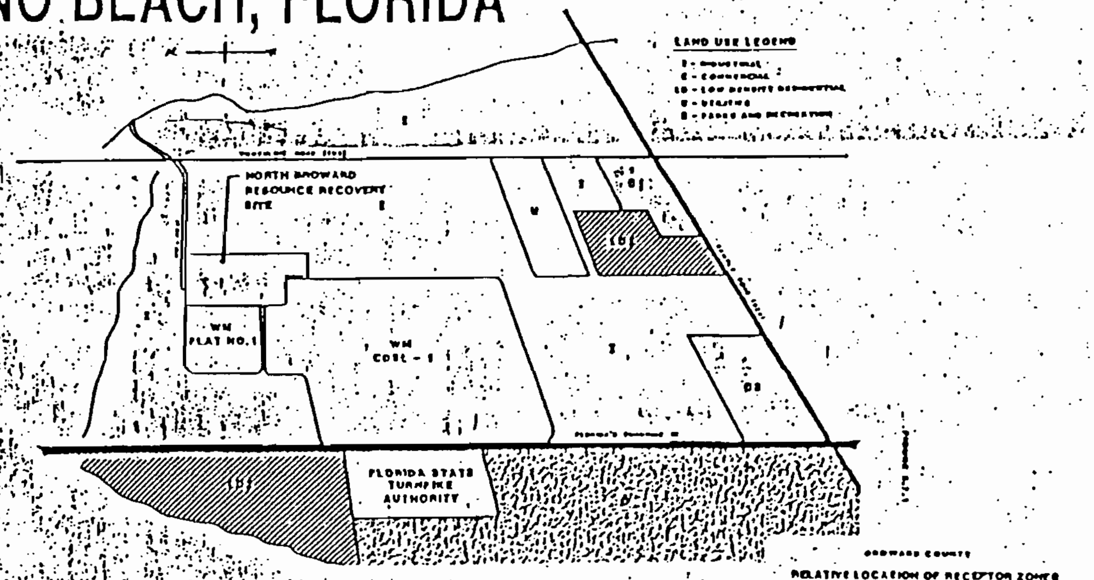
NOTICE OF CERTIFICATION HEARING ON AN APPLICATION TO CONSTRUCT AND OPERATE AN ELECTRICAL POWER PLANT ON A SITE TO BE LOCATED NEAR POMPANO BEACH, FLORIDA



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Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32301

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

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

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

POMPANO BEACH CITY LIBRARY
1213 E. Atlantic Boulevard
Pompano Beach, Florida 33060

4. Pursuant to Section 403.508, Florida Statutes, the certification hearing ›be held by the Division of Administrative Hearings on October 14, 1986, 10:00 a.m., in the Coral Room, Palm Aire Resort and Conference Center, ›1 Palm-Aire Drive North, Pompano Beach, Florida, in order to take written oral testimony on the effects of the proposed consideration of the site. ›d for the facility has been predetermined by the Public Service Commis- n at a separate hearing. Written comments may be sent to the Hearing lcer on or before October 3, 1986:

5. Pursuant to 403.508(4), F.S.: "(a) Parties to the proceeding shall include: applicant; the Public Service Commission; the Division of State Planning; water management district as defined in Chapter 373, in whose jurisdic- ı the proposed electrical power plant is to be located; and the Department. Upon the filing with the Department of a notice of intent to be a party at st 15 days prior to the date set for the land use hearing, the following ıll also be parties to the proceeding:

... in whose jurisdiction the proposed electrical

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

3. Any domestic non-profit corporation or association formed in whole or in part to promote conservation or natural beauty; to protect the environment, personal health, or other biological values; to preserve historical sites; to promote consumer interests; to represent labor, commercial or industrial groulps; or to promote orderly development of the area in which the proposed electrical power plant is to be located.

(c) Notwithstanding paragraph (4)(d), failure to an agency described in subparagraphs (4)(d), failure of an agency described in subparagraphs (4)(b)1 and (4)(b)2 to file a notice of intent to be a party within the time provided herein shall constitute a waiver of the right of the agency to participate as a party in the proceeding.

(d) Other parties may include any person, including those persons enumerated in paragraph (4)(b) who failed to timely file a notice of intent to be a party, whose substantial interests are affected and being determined by the proceeding and who timely file a motion to intervene pursuant to Chapter 120 F.S., and applicable rules. Intervention pursuant to this paragraph may be granted at the discretion of the designated hearing officer and upon such conditions as he may prescribe any time prior to 15 days before the comencement of the certification hearing.

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

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

Mr. William J. Kendrick
Division of Administrative Hearings
Oakland Office Building
2009 Apalachee Parkway
Tallahassee, Florida 32301

8. Those wishing to intervene in these proceedings must be represented by an attorney or other person who can be determined to be qualified to appear in administrative hearings pursuant to Chapter 120, F.S. or Chapter 17-1.21, FAC.

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

10. On February 26, 1986, Broward County applied to the DER to construct the aforementioned resource recovery plant. The application is also subject to U.S. Environmental Protection Agency (EPA) regulations for Prevention of Significant Deterioration of air quality (PSD), codified at 40 CFR 52.21. These regulations require that, before construction on a source of air pollution subject to PSD may begin, a permit must be obtained from EPA Such permit can only be issued if the new construction has been determined by EPA to comply with the requirements of the PSD regulations, which are described in 40 CFR 52.21. These requirements include a restriction on incremental increases in air quality due to the new source and application of best available control technologh (BACT).

The DER has been granted a delegation by EPA to carry out the PSD review of this source, except for the final signature of the federal PSD permit. Acting under that delegation, the DER has prepared a draft permit which is included in the DER's staff analysis report. The DER has made a preliminary determination that the proposed construction wil comply with all applicable PSD regulations. The degree of Class II increment consumption that will result from the construction is

Pollutant	Annual Average	24-Hr Average	3-Hr Average
Particulate	4%	3%	
Sulfur Dioxide	5%	10%	7%

The source is located approximately 78 kilometers from the nearest Class I area.

PLACE: Sheraton Orlando International Airport Inn, 3835 Beeline Expressway, Orlando, Florida.
PURPOSE: To receive public comment on the latest draft of the G-I rule.
A copy of the agenda may be obtained by writing to the Department of Environmental Regulation, Bureau of Ground Water Protection, Twin Towers Office Building, 2600 Blair Stone Road, Tallahassee, Florida 32399-2400, Attn: Donnie McClaugherty.

The Florida Department of Environmental Regulation announces the public hearing described below to which the public is invited.
DATE AND TIME: October 14, 1986, 9:30 a.m.
PLACE: Coral Room, Palm-Aire Resort and Conference Center, 2501 Palm Aire Drive North, Pompano Beach, Florida
PURPOSE: To conduct a certification hearing relative to the environmental impacts and other concerns relating to Broward County's proposed site for a 55.5 megawatt solid waste energy recovery facility power plant as required by the Florida Electrical Power Plant Siting Act, Section 403.508, Florida Statutes. Mr. William J. Kendrick, Hearing Officer, will conduct the hearing.
Anyone wishing to become a party to the hearing should contact Mr. Kendrick at the Division of Administrative Hearings, The Oakland Building, 2009 Apalachee Parkway, Tallahassee, Florida.

The Florida Board of Architecture announces the next official Board Meeting to which all interested persons are invited.
DATE AND TIME: Friday, October 3, 1986, 10:00 A.M.
PLACE: Sundial Beach and Tennis Resort, 1246 Middle Gulf Drive, Sanibel Island, Florida 33957
PURPOSE: Official Board Business
If any person decides to appeal any decision made by the Board with respect to any matter considered at this meeting or hearing, he/she will need a record of the proceedings, and for such purpose, he/she will need to ensure that a verbatim record of the proceedings is made which records include the testimony and evidence upon which the appeal is to be based.
For information, contact the Florida Board of Architecture, 130 North Monroe Street, Tallahassee, Florida 32301.

The Florida Board of Architecture announces the next official Workshop to which all interested persons are invited.
DATE AND TIME: Saturday, October 4, 1986, 9:00 A.M.
PLACE: Sundial Beach and Tennis Resort, 1246 Middle Gulf Drive, Sanibel Island, Florida 33957
PURPOSE: Sunset Review
If any person decides to appeal any decision made by the Board with respect to any matter considered at this meeting or hearing, he/she will need a record of the proceedings, and for such purpose, he/she will need to ensure that a verbatim record of the proceedings is made which records include the testimony and evidence upon which the appeal is to be based.
For information, contact the Florida Board of Architecture, 130 North Monroe Street, Tallahassee, Florida 32301.

The Florida Board of Cosmetology announces a meeting open to the public and all persons are invited to attend.*
DATE AND TIME: September 29, 1986; 9:00 A.M.
PLACE: Executive Suite, 522 Scotty's Lane, Tallahassee, FL 32303
PURPOSE: Regular Board Business and Disciplinary Matters.
*A copy of the agenda may be obtained by writing: Florida Board of Cosmetology, 130 N. Monroe St., Suite 35, Tallahassee, FL 32301
**If a person decides to appeal any decision made by the Board with respect to any matter considered at this meeting or hearing, he will need a record of the proceedings, and for such purpose he may need to ensure that a verbatim record of the proceedings is made, which record includes the testimony and evidence upon which the appeal is to be based.

The Advisory Council of Respiratory Care, Board of Medical Examiners, announces a public meeting to which all persons are invited.
DATE AND TIME: Wednesday, October 1, 1986, beginning at 8:00 a.m.
PLACE: Orlando International Airport, Airside B, Conference Room, Orlando, Florida
PURPOSE: To conduct general business of the Advisory Council on Respiratory Care.
A copy of the agenda may be obtained by writing to Mrs. Marcelle Flanagan, Executive Director, Advisory Council on Respiratory Care, 130 North Monroe Street, Tallahassee, Florida 32301.
Please note that if a person decides to appeal any decision made by the Council with respect to any matter considered at the above cited meeting or hearing, he/she will need a record of the proceedings, and for such purpose may need to insure that a verbatim record of the proceeding is made, which record includes the testimony and evidence upon which the appeal is based.

The Disciplinary Guidelines Committee, Florida Board of Medical Examiners announces a public meeting to which all persons are invited.
DATE AND TIME: Thursday, October 2, 1986, beginning at 9:00 a.m., or soon thereafter
PLACE: Tampa Marriott Airport Hotel, Tampa International Airport, Tampa, Florida
PURPOSE: To conduct general business of the Florida Board of Medical Examiners, Disciplinary Guidelines Committee
A copy of the agenda may be obtained by writing to Mrs. Dorothy J. Faircloth, Executive Director, 130 North Monroe Street, Tallahassee, Florida 32301.
Please note that if a person decides to appeal a decision made by the Board with respect to any matter considered at the

APPENDICES

ASME
1986 NATIONAL WASTE
PROCESSING CONFERENCE

ATTACHMENT A

AN EXAMINATION OF PROPOSED ACCEPTANCE TESTING METHODS

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

ABSTRACT

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

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

INTRODUCTION

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

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

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

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

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

ELEMENTS OF A GOOD ACCEPTANCE TEST

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

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

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

THERMAL EFFICIENCY TESTING PROCEDURES

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

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

Input–output method:

Thermal efficiency (%)

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

Heat-loss method:

Thermal efficiency (%)

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

Modified heat-loss method:

Thermal efficiency (%)

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

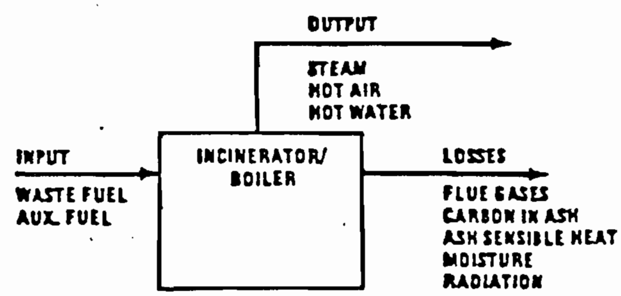


FIG. 1 ENERGY FLOW

Calorimeter method:

Thermal efficiency (%)

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

INPUT-OUTPUT

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

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

HEAT LOSS

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

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

SHORT FORM (MODIFIED) HEAT LOSS

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

CALORIMETER

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

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

AN ALTERNATE CONCEPT

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

CONCLUSIONS AND RECOMMENDATIONS

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

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

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

REFERENCES

[1] Hathaway, S. A., and Dealy R. J. "Technical Evaluation of Army-Scale Waste-to-Energy Systems." Interim Report E-110/ADA042578. USA-CERL, July 1977.

[2] Hathaway, S. A. "Recovery of Energy from Solid Waste at Army Installations." Technical Manuscript E-118/ADA044514. USA-CERL, August 1977."

[3] Hathaway, S. A. "Application of the Package Controlled-Air, Heat Recovery Solid Waste Incinerator on Army Fixed Facilities and Installations." Technical Report E-151/ADA071539. USA-CERL, June 1979.

[4] Stabenow, G. "Predicting and Testing Incinerator-Boiler Efficiency. . . ." In *Proceedings of the 9th National Waste Processing Conference.* New York: The American Society of Mechanical Engineers, 1980, 301–313.

[5] Hecklinger, R., and Grillo, L. "Thermal Performance Eval-

TABLE 1 COMPARISON OF METHODS

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

uation of MSW Fired Steam Generators. . . ." In *Proceedings of the 10th National Waste Processing Conference.* New York: The American Society of Mechanical Engineers, 1982, 65–69.

[6] Beckman, Dragovich, and DeGeyter. "Calculating Efficiency of Muncipal Waste Mass Burning Energy Recovery Systems." In *Proceedings of the 11th National Waste Processing Conference.* New York: The American Society of Mechanical Engineers, 1984, 217–229.

[7] Fernandes, J. "Uncertainties and Probable Errors Involved in Various Methods of Testing Incinerator/Boiler." In *Proceedings of the 11th National Waste Processing Conference.* New York: The American Society of Mechanical Engineers, 1984, 230–240.

ASI. 7
1984 NATIONAL WASTE
PROCESSING CONFERENCE

CALCULATING EFFICIENCY OF MUNICIPAL WASTE MASS BURNING ENERGY RECOVERY SYSTEMS

ARTHUR H. BECKMAN and MARK G. DRAGOVICH
Katy-Seghers, Incorporated
St. Louis, Missouri

FERDNAND DeGEYTER
Seghers Engineering, SA

ABSTRACT

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

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

INTRODUCTION

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

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

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

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

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

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

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

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

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

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

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

PERFORMANCE GUARANTEES

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

Common guarantees are:

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

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

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

(d) maximum particulate emissions and other environmental factors.

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

ADJUSTMENTS TO OBSERVED THROUGHPUT CAPACITY AND ENERGY RECOVERY RATES

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

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

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

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

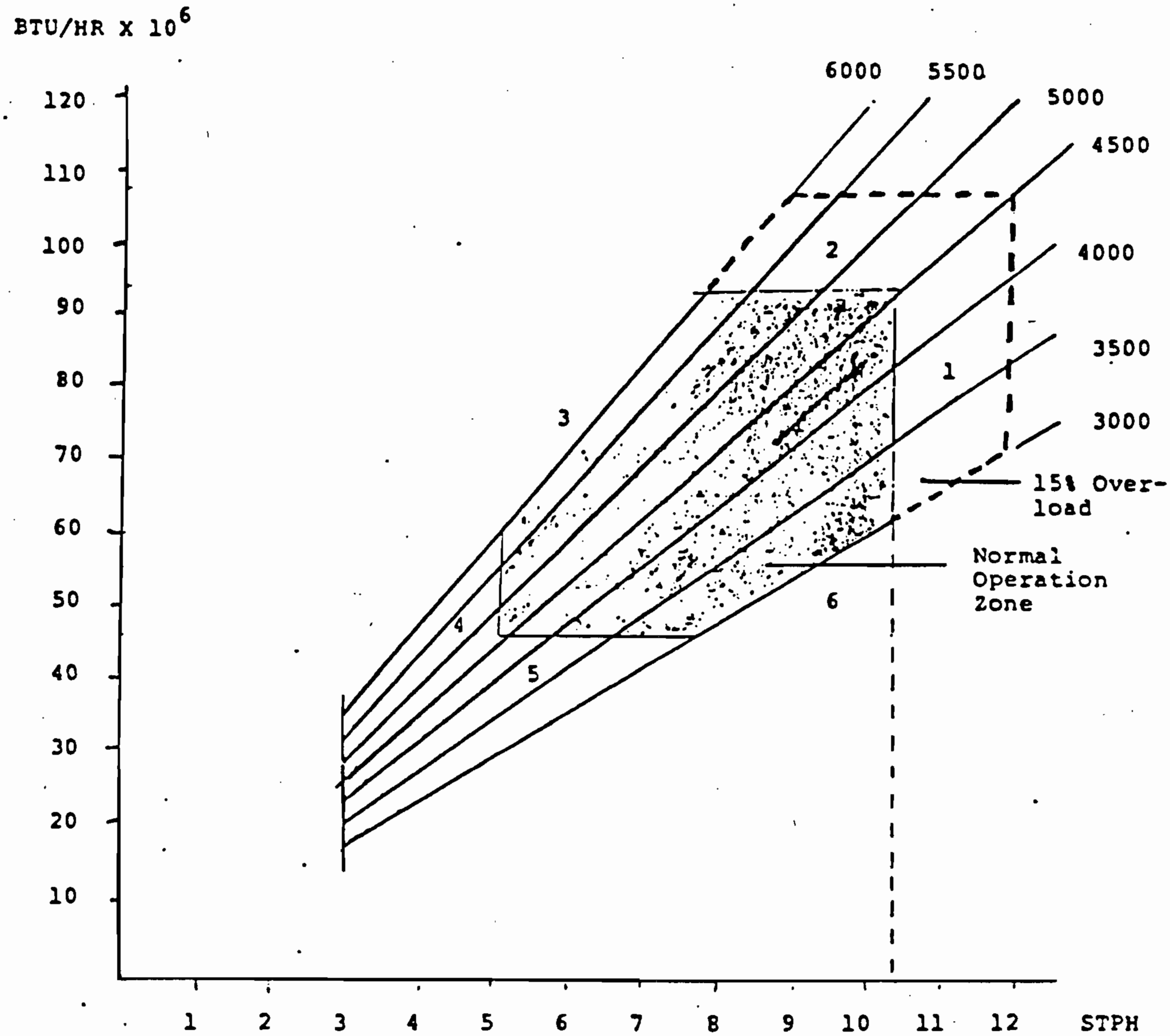
We also measure flue gas temperature and flow so we know everything going in and coming out.

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

SPECIFIC TEST PROCEDURES

INCINERATOR CAPACITY TEST

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



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

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

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

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

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

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

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

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

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

ENERGY RECOVERY TEST

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

Steam Raising Rate

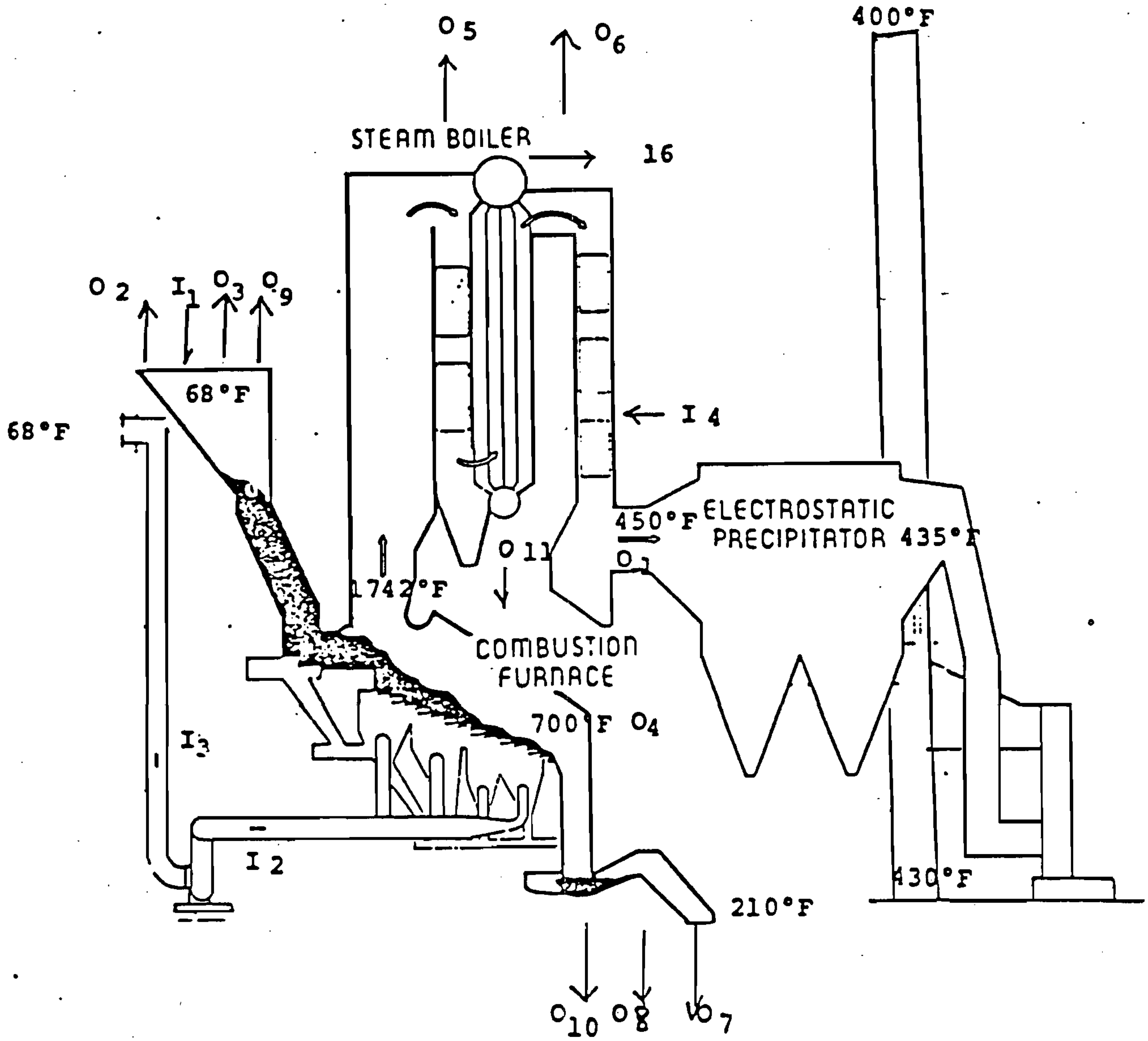
The purpose of this portion of the energy recovery test is to determine whether the facility meets the guaranteed steam raising rate, when processing solid waste, having the heating value of the reference solid waste, at a rate equal to the guaranteed daily throughput capacity under normal operating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

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

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

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

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



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

FIG. 2 ENERGY BALANCE FURNACE BOILER SYSTEM

TABLE 1 STEAMING RATE

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

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

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

METHOD OF DETERMINING SOLID WASTE HIGH HEATING VALUE

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

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

TABLE 2 REFUSE-FIRED BOILER ENERGY BALANCE

Item	Heat Loss	BTU/LB_R	$BTUX10^6/DAY$
01.	Heat loss due to dry gas. Dry flue gas LB/LB_R x specific heat x (exit gas temp. - ambient air temp.) 6.791 LB/LB_R x .254 Btu/Lb. °F. (400°F-70°F.).	569.2	170.8
02.	Heat loss due to moisture in fuel = (Enthalpy of vapor at 1.0 PSIA @ exit gas temp. - enthalpy of liquid @ ambient air temp.) x moisture in the fuel LB/LB_R (.2119 LB/LB_R x (1240 Btu/LB-48 Btu/LB).	252.6	75.8
03.	Heat loss due to H_2O from comb. of H_2 = 9 x hydrogen in fuel LB/LBL (Enthalpy of vapor - enthalpy of liquid) 9 x .0338 x (1240-48).	362.6	108.8
04.	Heat loss due to combustibles in residue Carbon in residue x 14.500 Btu/LB .0136 x 14.500 Btu/LB.	197.2	59.2
05.	Heat loss due to radiation (ABMA Chart).	45.0	13.5
06.	Unaccounted for losses.	55.0	16.5
07.	Heat loss in residue. Dry residue including unburned carbon x (specific heat of residue) x (residue temp. leaving furnace - residue temp. after quench) .2730 LB/LB_R x .25 Btu/LB°F. x (700°F-210°F.).	33.4	10.0
08.	Heat loss due to moisture in residue. Moisture content of residue x (temp. @ residue leaving quench - temp. of water entering quench) 15/100 (.2730 LB/LB_R)(210°F.-70°F.) x 1 Btu/LB°F.	5.7	1.7
09.	Heat loss due to moisture in air. Total dry air required based on fuel rate x moisture in air x specific heat of air x exit gas temp.-inlet air temp.)(0.5583 LB/LB_R x .013 LB_{water}/LB_{air} x 0.429 BTU/LB°F. (400° F-70°F).	12.1	3.6
D10.	Heat loss due to quench vapor. (Heat loss in dry residue ÷ latent heat of vapor @ atmospheric pressure) x (enthalpy of vapor entering boiler-enthalpy of vapor entering furnace. (33.44 Btu/LB ÷ 970.4 Btu/LB) x (1240 Btu/LB-970.4 Btu/LB).	9.3	2.8

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

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

TABLE 3 SAMPLE FUEL HEATING VALUE DETERMINATION

DATA FROM PERFORMANCE TEST

Flue Gas

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

Ash

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

Combustion Air

Flow	-	140,067 lbs.
Temp.	-	70° F.

Refuse

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

Ash Cooling Water

Temp.	-	70° F.
Flow	-	957 lbs./hr.

TABLE 3 SAMPLE FUEL HEATING VALUE DETERMINATION (CONTINUED)

DETERMINATION OF ULTIMATE ANALYSIS OF REFUSE

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

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	
	$\frac{\%\ SO_2 \times Lb._{FG} \times Lb._S/Lb._{SO_2}}{Lb._{Refuse}} + \frac{\%\ S_{Ash} \times Lb._{Ash}}{Lb._{Refuse}}$	
	$\frac{.002 \times 155{,}675 \times .5}{20{,}200} + \frac{.0024 \times 4682}{20{,}200}$	.0011
4	Moisture Content	.2774
5	Nitrogen Content (Est. Value)	.0060
6	Ash Content	
	$= Residue - H_2O_{Refuse} - C_{Ash} - S_{Ash}$	
	$= \frac{5515}{20{,}200} - \frac{.15 \times 5515}{20{,}200} - \frac{.05 \times 5515}{20{,}200} - \frac{.001 \times 5515}{20{,}200}$	.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.

ACKNOWLEDGMENTS

1982 National Waste Processing Conference Proceedings, various papers.

REFERENCES

[1] *Steam/It's Generation and Use*, The Babcock & Wilcox Company, 1978.

[2] *Handbook of Solid Waste Management*, David Gordon Wilson, 1977.

[3] *Steam Generating Units – Power Test Codes*, ASME PTC 4.1, 1964.

[4] *Industrial Guide for Air Pollution Control*, EPA Handbook.

[5] *Predicting & Testing Incinerator-Boiler Efficiency. A Proposed Short Form Method in Line with the ASME Test Code PTC-33*, Georg Stabenow, 1980.

[6] *Large Incinerators*, ASME, PTC 33-1978.

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

ATTACHMENT B

Promulgation of Quality Assurance Requirements for Gaseous Continuous Emission Monitoring Systems Used for NSPS Compliance Determination

On June 4, 1987 quality assurance final rules were promulgated (40 CFR 60, Appendix F, Procedure 1) for gaseous continuous emission monitoring systems (CEMS) used for new source performance standards compliance determinations. These quality assurance requirements must be implemented by December 4, 1987 for the following source categories:

Subpart D_a (40 CFR 60): Electric Utility Steam Generating Units (constructed after 9-18-78). Both SO_2 and NO_x CEMS must implement the quality assurance requirements.

Subpart D_b (40 CFR 60): Industrial-Commercial-Institutional Steam Generating Units (constructed after 6-19-84). Both SO_2 and NO_x CEMS must implement the quality assurance requirements.

The quality assurance requirements include the following:

1. A quarterly performance audit to measure the CEMS accuracy and make sure the system is operating properly.

2. Criteria that defines when the CEMS is out of control and corrective action must be taken.

3. Criteria for invalidating CEMS measurement data.

4. A QC program must be developed that includes step-by-step written procedures for six activities described in Section 3 of the final rules.

Enclosed is a copy of the June 4 Federal Register containing the final rules. Also enclosed are the following three guidance documents which you may find useful in implementing the final rules:

Section 3.0.4. This is the revised EPA Traceability Protocol No. 1 for cylinder gases. Section 5.1.2 of the final rules requires that gases used for Cylinder Gas Audits (CGA) must be prepared according to this Section 3.0.4.

Section 3.0.7. This provides example calculations for the Relative Accuracy Test Audit (RATA), Relative Accuracy Audit (RAA) and the CGA.

Section 3.0.10. This provides guidance on the six activities that need written procedures as part of the QC program described in Section 3 of the final rules.

Sections 3.0.4, 3.0.7 and 3.0.10 will be published as part of the Quality Assurance Handbook for Air Pollution Measurement Systems. Volume III - Stationary Source Specific Methods (EPA-600/4-77-027b). These sections are included here to provide guidance in advance in order to meet the December 4, 1987 implementation date for the final rule.

After the final rules are implemented, the Quality Assurance Division of the Environmental Monitoring Systems Laboratory (EMSL) at RTP, NC plans an "Annual Report on CEMS Accuracy and Problems" based on the Data Assessment Reports (DAR) submitted quarterly by the source owners/operators.

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 60

[AD-FRL-3021-7]

Standards of Performance for New Stationary Sources; Quality Assurance Requirements for Gaseous Continuous Emission Monitoring Systems Used for Compliance Determination

AGENCY: Environmental Protection Agency (EPA).

ACTION: Final rule.

SUMMARY: Addition of Appendix F, Procedure 1—Quality Assurance Requirements for Gaseous Continuous Emission Monitoring Systems (CEMS's) Used for Compliance Determination was proposed in the Federal Register on March 14, 1984 (49 FR 9676). This action promulgates the addition of Appendix F, Procedure 1, that will be applicable for evaluating effectiveness of quality control (QC) and quality assurance (QA) procedures and the quality of data produced by any CEMS used to demonstrate compliance with 40 CFR Part 60 emission regulations on a continuous basis. Procedure 1 applies to steam generating units subject to 4 CFR Part 60, Subpart Da. The intended effect of this regulation is to require sources that are required to use CEMS's for continuous compliance determination to evaluate CEMS data quality and report results of quarterly accuracy determinations and calibration drift (CD) tests with the required emission reports. Procedure 1 defines the test procedures and criteria for acceptable data quality.

EFFECTIVE DATE: June 4, 1987.

Under section 307(b)(1) of the Clean Air Act, judicial review of these additions to 40 CFR Part 60 is available *only* by the filing of a petition for review in the U.S. Courts of Appeals for the District of Columbia Circuit within 60 days of today's publication of this rule. Under section 307(b)(2) of the Clean Air Act, the requirements that are the subject of today's notice may not be challenged later in civil or criminal proceedings brought by EPA to enforce these requirements.

ADDRESSES: *Summary of Comments and Responses.* The summary of comments and responses for the proposed addition of Appendix F, Procedure 1, may be obtained from the U.S. EPA Library (MD-35), Research Triangle Park, North Carolina 27711, telephone number (919) 541-2777. Please refer to "Appendix F—Quality Assurance Procedures, Procedure 1—Quality Assurance Requirements for Gaseous Continuous Emission Monitoring Systems Used for Compliance Determination (Proposed March 14, 1984, 49 FR 09676)—Summary of Comments and Responses, EPA-450/3-87-009." The document contains (1) a summary of the changes made to Procedure 1 since proposal and (2) a summary of all the public comments made on the proposed addition and the Agency's response to the comments.

Quality Assurance Guidelines: A document entitled "Calculation and Interpretation of Accuracy for Continuous Emission Monitoring Systems" is available from the U.S. EPA, Office of Research and Development Publications, 26 West St. Clair Street, Cincinnati, Ohio 45268. It is Section 3.0.7 of the Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, Stationary Source Specific Methods, EPA-600/4-77-0276. The purpose of this document is to provide operators and reviewers of CEMS's with guidelines for evaluating results of CEMS relative accuracy tests and audits.

Docket. A docket, number A-80-29, containing information considered by the Agency in the development of the additions is available for public inspection between 8:00 a.m. and 4:00 p.m. Monday through Friday, at EPA's Central Docket Section (LE-131), West Tower Lobby, Gallery 1, 401 M Street, S.W., Washington, D.C. 20460. A reasonable fee may be charged for copying.

FOR FURTHER INFORMATION CONTACT: Darryl J. von Lehmden, Quality Assurance Division, Environmental Monitoring Systems Laboratory (MD-77), U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711, telephone (919) 541-2415; or Peter R. Westlin, Emission Standards and Engineering Division, (MD-19), U.S. EPA, Research Triangle Park, North Carolina 27711, telephone number (919) 541-2237.

SUPPLEMENTARY INFORMATION:

I. Public Participation

The addition of Appendix F, Procedure 1, was proposed in the Federal Register on March 14, 1984 (49 FR 9676). Public comments were solicited at the time of proposal. To provide interested persons the opportunity for oral presentation of data, views, or arguments concerning the proposed procedures, a public hearing was scheduled for April 9, 1984, beginning at 9:00 a.m. However, the hearing was not held because no one requested to speak. The public comment period was from March 14, 1984, to May 14, 1984, and was later extended to July 13, 1984 (49 FR 24151).

Thirty-nine comment letters concerning the issues relative to the proposed procedures were received. The comments have been carefully considered; and, where determined to be appropriate by the Agency, changes have been made in the proposed addition.

II. Significant Comments and Changes to the Proposed Appendix F, Procedure 1

Comments on the proposed addition of Appendix F, Procedure 1, were received from industry, Federal agencies, State air pollution control agencies, trade associations, and equipment manufacturers. A detailed discussion of these comments and responses can be found in the document described in the ADDRESSES section of the preamble. The summary of comments and responses are summarized in this preamble. Most of the comment letters contained multiple comments. The comments have been divided into categories cited below.

Applicability

Several commenters were concerned that Procedure 1 would become applicable to Subpart D sources which in turn would have to undertake significant changes to CEM's installed under less stringent regulations. The commenters suggested that the applicability of appendix F be limited to CEMS's installed after the promulgation of the regulation. The Agency has determined that QA procedures are necessary when CEMS's are used for compliance determinations. Revisions to Subpart D were proposed on October 21, 1983 (48 FR 48960), and the proposal contained continuous compliance provisions. However, the burden of any CEMS changes required because of the application of Procedure 1 will be evaluated when and if revisions to Subpart D are promulgated.

Two commenters stated that 6 months would be insufficient time to incorporate the data reduction procedures, write the QC procedures, and hire and train additional personnel needed to comply with the requirements in Procedure 1. The Agency revised Procedure 1 as proposed to eliminate the precision determination that would have required considerable revision of existing computer operated systems. It is the opinion of the Agency that, without the precision determination provisions, 6 months is sufficient time to prepare to comply with Procedure 1. The proposed revisions to Subpart D included a provision to allow affected sources 1 full year to develop CEMS's before having to comply with the revised regulations.

Several commenters expressed concerns about the applicability of continuous compliance regulations and the use of CEMS's for compliance determinations. The determination that a CEMS is an appropriate compliance tool for new source performance standards was not within the scope of the procedure 1 proposal. Such a determination was made with respect to Subpart Da in that rulemaking and is a subject of the pending Subpart D rulemaking. Procedure 1 provides a basis for evaluating CEMS data that are used for compliance determinations.

Quality Control Requirements

Three commenters suggested that the criteria list in the QC section be expanded to include several site-specific factors. The Agency believes that the list in Procedure 1 is as complete as reasonably possible in a general regulation. The CEMS operator is encouraged to develop a quality control list specifically suited to the situation.

One commenter stated that the rewriting of the QC procedures following successive audit failures will not improve the performance of a poorly designed CEMS. The Agency recognizes that the design and application of a CEMS are important factors in the successful operation of the CEMS. Replacement of an inadequate CEMS may be the only appropriate action available after continued poor operation and is an action that should be considered in developing the QC plan.

Assessment of Data Precision

Many commenters stated that assignment of cylinder gas or gas cell concentration values using CEMS responses should not be allowed. The commenters suggested using reference methods for this determination. The Agency notes that the cylinder gas or gas cells are used in this case to measure CEMS response drift. For this purpose, it is not necessary to know the input values with absolute accuracy, but only that the value is stable.

Many commenters noted that present regulations require daily zero and span CD check and adjustment and that additional precision determinations were unnecessary. Reporting requirements for these precision assessments were burdensome, as well. The Agency agrees that the precision calculation and reporting are unnecessary for QA and has removed the precision section from Procedure 1. The CD determination procedure has been expanded to include the zero (or low-level) value as well as the upper-level value.

Zero and Upper-Level Calibration Drift

Three commenters stated that it would be appropriate to declare a CEMS to be out-of-control when drift exceeded twice the Appendix B specifications on any day, rather than only after 5 successive days. The Agency's experience is that application of this lower limit over an extended period of time may lead to excessive adjustment frequency and CEMS instability. A single drift measurement in excess of the lower limit could be a result of a statistical aberration, a dirty window which could be easily cleaned, or a nearly empty gas cylinder, none of which would be cause for declaring the CEMS out-of-control.

Many commenters stated that the requirement to conduct a relative accuracy audit (RAA) following an out-of-control caused by excessive drift period is excessive. The Agency agrees with this comment and revised the proposal to include the determination of the end of the out-of-control period that is a result of excessive drift by demonstrating that the CEMS is operating within drift specifications.

Several commenters noted that this section and other sections of Procedure 1 required that source operators use alternate methods of obtaining emissions data when the CEMS is out-of-control. This requirement in Procedure 1 could lead to significant expenditures for alternate monitoring. The Agency has clarified the language from the proposal to note that Procedure 1 defines the criteria which determine when a CEMS is out-of-control. Under such conditions, the CEMS data are not valid for meeting the minimum data availability requirements found in continuous compliance regulations. The applicable regulations specify the minimum data availability requirements and these requirements, not Appendix F, dictate the necessity for alternate emission monitoring when the CEMS is out-of-control. The alternate monitoring method may be another CEMS which would also be subject to the requirements in Appendix F, Procedure 1.

Three commenters suggested the use of historical data for CEMS out-of-control periods as a valid alternative method. The Agency agrees that historical diluent emission data could be considered a valid alternative method, but that review of the alternative procedure and data by the Agency would be necessary before approval for specific or general use. Description of the procedure is included in 40 CFR 60.13(i).

One commenter provided a review of CEMS CD data (collected by EPA during a CEMS demonstration project) that indicated substantial invalidation of data because of excessive drift. The Agency reviewed the commenter's analyses and determined that the commenter erred in establishing the appropriate CD limits and in determining the number of out-of-control periods. The drift limit established by the commenter was about one-half of that defined in Procedure 1. This significant difference in CD on drift limits produced a significantly larger number of apparent drift limit violations than would be determined following the criteria in Procedure 1.

In addition, the commenter divided relatively long periods of poor CEMS performance into several periods of out-of-control operation. If the criteria in Procedure 1 had been followed, these individual periods of out-of-control performance would have been consolidated into relatively few out-of-control periods that would have ended only when corrective action was completed. The Agency has determined the long term CEMS operation can continue uninterrupted or with only few interruptions attributable to drift criteria violations.

Assessment of Data Accuracy

Many commenters expressed the opinion that quarterly assessment of data accuracy is too frequent. Suggestions for alternative schedules ranged from annual to only once at the time of CEMS installation. The commenters provided no information supporting a reduction in audit frequency. While the Agency agrees that CEMS design, application, and maintenance are critical to proper operation and high data quality, the Agency is convinced that the only measure of QC effectiveness is a periodic accuracy audit. The Agency's experience indicates that a quarterly audit frequency is appropriate; this is based on the results of studies of long term performance of CEM's performed by the EPA Office of Research and Development (technical paper describing the work is in the docket).

Procedure 1 has been revised from the proposal to reduce the burden of accuracy auditing within the scope of quarterly audit periods. The relative accuracy test audit (RATA) is performed as defined in the applicable performance specification in Appendix B and is required only once per year. Either of two other audit procedures is allowed for the other three audit periods each year; these procedures are the cylinder gas audit (CGA) and the RAA based on a three-run, manual method test.

Five commenters urged the use of calibration gas cells as acceptable audit materials. The Agency has no independent procedure for determining accurately the appropriate CEMS response a gas cell should produce. Without an independent certification of gas cells or an appropriate application procedure, the Agency has determined that gas cell audit material is unacceptable for accuracy auditing.

Several commenters proposed alternative audit procedures including fuel sampling and analysis, process rate measurements, and inclusion of new test method procedures (e.g., Methods 6A and 6B). The Agency has no data to support the use of fuel sampling and analysis procedures as a basis for CEMS accuracy auditing on any reasonable time scale (e.g., hourly or daily). The imprecision associated with fuel data for these short test periods is much greater than the acceptable drift limits specified for CEMS. Process rate measurements are also inappropriate as accuracy audit bases because of the source-specific nature of such procedures. The Agency provides means for reviewing and approving acceptable alternative procedures applicable to specific sources.

The Agency agrees that promulgated methods, such as Methods 3A, 6A, 6B, 6C, and 7E should be allowed as accuracy audit methods and has revised the appropriate paragraphs in the General Provisions accordingly.

Two commenters questioned the need to specify that all audits be completed in the first 2 months of any quarter. The Agency agrees and has changed the requirement in Procedure 1 to allow the audit to occur any time during a quarter, but there must be a minimum of 60 days between two quarterly audits.

Two commenters recommended three-point calibration checks in lieu of the two-point audit specified in Procedure 1 as a more appropriate audit procedure. The Agency disagrees that a three-point, repeated, calibration error test is a more appropriate audit. The calibration error test provides information about the linearity of the CEMS response throughout the range of the instrument response. The CGA in Procedure 1 tests the CEMS for the accuracy of responses to two audit gases with concentrations representing and bracketing the expected level of emissions at the level of the emission standard. This is a procedure that more appropriately represents an independent audit.

Several commenters proposed to allow manual method analysis of cylinder gas concentrations for the CGA. The Agency has determined that independent analysis of audits is necessary and has established a policy of traceability to National Bureau of Standards standard gaseous reference materials (SGRM's) or manufacturers' certified reference materials (CRM's) for this purpose.

Two commenters stated that use of the CGA and prohibition of the use of gas cells for auditing favors some CEMS technology over other types of systems. This, the commenters argued, discourages research and development of new equipment. The Agency believes the CGA is a technically acceptable, demonstrated, independent auditing procedure for CEM's. As noted earlier, the gas cell is not acceptable at this time as an audit material. Approval of a demonstrated alternative procedure, such as the CGA, is not favoritism nor should it discourage development of other audit procedures or CEMS instrumentation.

Three commenters requested clarification or the definition of when an out-of-control period begins and ends. There are two tests that may result in out-of-control periods: the CD check and the accuracy audit. An out-of-control period resulting from excessive CEMS drift begins when the fifth consecutive excessive drift determination (or first drift determination in excess of four times the drift specification) occurs. The out-of-control period ends when corrective action is completed and the CEMS is demonstrated to operate within acceptable drift specifications again (i.e., at the end of the day when the CD measurements are within specifications).

The CEMS is determined to be out-of-control as a result of excessive inaccuracy from the time the accuracy audit sampling is completed. This does not include the time for sample analysis and data reduction. The out-of-control period ends when the CEMS completes the audit sampling successfully; again, time for sample analysis and data reduction is not included. This approach emphasizes the importance of expediting sample analysis and data reduction.

Two commenters questioned the requirement to conduct accuracy audits periodically when the source is operated seasonally or otherwise intermittently. The cost of possible forced-operation of a source in order to conduct an accuracy audit would be significant. Procedure 1 as promulgated requires only an annual RATA while quarterly audits may be completed using CGA or RAA. The Agency believes it is not burdensome to require a RATA and at least 50 percent load operation once per year. The Agency also believes it is critical to maintain operation of a CEMS regardless of operation of the source if that CEMS is to provide compliance data when the source is operating at compliance levels. The operator of a source that operates seasonally can request a revised schedule for auditing from the Agency that would include the RATA.

EPA Performance Audit Program

One commenter questioned the ability of the Agency to supply the EPA methods performance audit samples required for every RATA. The Agency has made the necessary plans with suppliers to have a sufficient supply of audit samples available not only for the RATA's but also for other compliance testing required using EPA methods.

Calculation of Data Accuracy

One commenter questioned the use of the confidence interval in calculating relative accuracy (RA) with fewer than nine data sets. While it is correct statistically to include the confidence interval with any number of data sets, the potential size of the confidence interval can overshadow the mean or average value when the number of data sets is reduced to as few as three. For this reason, the RAA quarterly audit alternative using only three runs will be determined based on the average values only. The RATA is conducted annually and will include the sum of the nine run average and the confidence interval in calculating RA.

Reporting Requirements

Five commenters stated that the promulgation of Appendix F, Procedure 1, would significantly increase recordkeeping and reporting requirements for affected facilities. They questioned whether the increase in labor and associated costs would yield a commensurate improvement in data quality. The Agency has eliminated a great deal of the data reduction and reporting requirements from the Procedure 1 proposal with the deletion of the precision determinations. The Agency believes it is not burdensome to require a source to supply audit results, drift assessments, and information about out-of-control periods with other compliance reports. Procedure 1 will not significantly increase the reporting requirements for sources using CEMS's for compliance monitoring.

One commenter proposed that Procedure 1 include a provision that would not preclude control agencies from taking into account QA results when reviewing CEMS data, but prohibit sources from doing so. The Agency's response is that it is technically incorrect to adjust CEMS data using RAA results. This applies to both the source owner/operator reporting the data and the control agency reviewing the results. Source operators must comply with reporting and recordkeeping requirements as they are written.

The bases for not allowing adjustment of CEMS results are the imprecision and error associated with both the CEMS and the audit method results. These measurement factors are the reason for allowing a range of audit results (e.g., 20 percent for the RATA) that indicates acceptable CEMS performance. In addition, the audits represent only a brief period of CEMS and process operation while compliance data represent relatively long periods of operation. There is no technical basis for adjusting CEMS results using QA data. Quality assurance results should be considered only in assuring that the CEMS performance is within specifications.

Costs of Implementation

Five commenters recalculated the estimated labor-years required to implement Procedure 1 at Subpart Da sources and found the number to be 124 person-years instead of the 80 person-years mentioned in the proposed preamble. The Agency determined the labor needed to meet the Procedure 1 requirements in the industry recognizing that not all Subpart Da sources would be operating the entire evaluation period (5 years). The commenters' figures represent the worst case view, but the Agency's 80 person-year value is also a conservative figure that more closely represents the expected costs.

Many commenters noted that the level of effort included in the proposal substantially underestimates the expected costs, because the proposal has labor estimates based on an evaluation of a unit having only one SO_2 and one NO_x monitor. Subpart Da sources are required to monitor SO_2 control efficiency which dicates that uncontrolled SO_2 emissions and diluent gases also be monitored. The Agency underestimated the costs of implementing Procedure 1 at a Subpart Da source by a factor of two, according to the commenters.

The Agency agrees that the cost estimates in the proposal were derived for only an outlet CEMS. However, adding the costs incurred by including an inlet CEMS will not necessarily double the costs of applying Procedure 1. Many QA tasks can be consolidated and duplication avoided so that total costs should be considerably less than twice the conservative costs mentioned in the proposal.

There are a number of other changes incorporated into Procedure 1 since proposal that will decrease estimated costs of implementation. The precision assessment and reporting have been eliminated. The RATA has been changed to once annually instead of semiannually, and the CGA and abbreviated RAA are allowed the other three quarters. The Agency has estimated effort for implementing Procedure 1 based on the promulgation version and determined these costs to be between 326 and 704 labor hours per year for a Subpart Da facility depending on the type of audit used, CGA or RAA. This cost is consistent with the estimate described in the proposal and does not significantly change the estimated effects on the industry.

The Agency believes that the benefits from providing useable, valid, compliance emission data apply to both the source operator and the regulatory agency. The expenses for implementing Procedure 1 are worthwhile for the increased confidence in demonstrating compliance and in instituting enforcement action. Source operators further benefit through the availability of continuous, valid information on the operation of the control system and can use such data to optimize operation.

Miscellaneous

One commenter suggested that the Agency should focus on the research and development of CEMS technology in developing less burdensome QA requirements. The Agency believes CEMS technology is sufficiently developed to apply it to continuous compliance determinations. Numerous, successful, long-term, CEMS demonstrations have been reported by both the Agency and by industrial users. There is no substantive reason for delaying the implementation of Procedure 1.

III. Docket

The docket is an organized and complete file of the information considered by EPA in the development of this rulemaking. The docket is a dynamic file, since material is added throughout the rulemaking development. The docketing system is intended to allow members of the public and industries involved to identify and locate documents readily so they can intelligently and effectively participate in the rulemaking process. Along with the statement of basis and purposes of the proposed and promulgated rule and EPA responses to significant comments, the contents of the docket will serve as the record in case of judicial review [section 307(d)(7)(a)].

IV. Miscellaneous

Under Executive Order 12291, EPA must judge whether a regulation is "major" and, therefore, subject to the requirement of a regulatory impact analysis. This regulation is not major because it will not have an annual effect on the economy of $100 million or more; it will not result in a major increase in costs or prices; and there will be no significant adverse effects on competition, employment, investment, productivity, innovation, or on the ability of U.S.-based entrprises to compete with foreign-based enterprises in domestic or export markets.

The Regulatory Flexibility Act of 1980 requires identification of potentially adverse impacts of Federal regulations upon small business entities. The Act specifically requires the completion of a Regulatory Flexibility Analysis in those instances where small business impacts are possible. Because this regulation affects only one source category, large utility boilers, and does not affect small business entities, no Regulatory Flexibility Analysis has been conducted.

Pursuant to the provisions of 5 U.S.C. 605(b), I hereby certify that the proposed rule will not have a significant economic impact on any small entities.

This regulation was submitted to the Office of Management and Budget (OMB) for review as required by Executive Order 12291. Any written comments from OMB and any written EPA responses are available in the docket.

Dated: May 27, 1987.

Lee M. Thomas,

Administrator.

List of Subjects in 40 CFR Part 60

Air pollution control, sulfur dioxide.

PART 60—[AMENDED]

40 CFR Part 60 is amended as follows:

1. The authority for testing, monitoring, and reporting in Part 60 continues to read.

Authority: Secs. 101, 111, 114, 116, 301 of the Clean Air Act, as amended 42 U.S.C. 7401, 7411, 7414, 7416, 7601.

2. Section 60.13 is amended by revising paragraph (a) to read as follows:

§ 60.13 Monitoring requirements.

(a) For the purposes of this section, all continuous monitoring systems required under applicable subparts shall be subject to the provisions of this section upon promulgation of peformance specifications for continuous monitoring systems under Appendix B to this part and, if the continuous monitoring system is used to demonstrate compliance with emission limits on a continuous basis, Appendix F to this part, unless otherwise specified in an applicable subpart or by the Administrator. Appendix F is applicable December 4, 1987.

* * * * *

3. Section 60.45 is amended by revising paragraph (c)(1) to read as follows:

§ 60.45 Emission and fuel monitoring.

* * * * *

(c) * * *

(1) Methods 3 or 3A, 6, 6A, 6B or 6C, and 7, 7A, 7C, 7D or 7E, as applicable, shall be used for conducting relative accuracy evaluations of sulfur dioxide and nitrogen oxides continuous emission monitoring systems. Methods 3A, 6C, and 7E shall be used only at the sole discretion of the source owner or operator.

* * * * *

4. Section 60.47a is amended by revising paragraphs (h), (h)(1), (h)(2), and (i)(1) to read as follows:

§ 60.47a Emission monitoring.

* * * * *

(h) Methods used to supplement continuous emission monitoring system data to meet the minimum data requirements in § 60.47a(f) will be used as specified below or as otherwise approved by the Administrator.

(1) Methods 3 or 3A, 6 or 6C and 7, 7A, 7C, 7D or 7E as applicable, are used. Method 6A or 6B may be used whenever Methods 6 and 3 data are required to determine the SO_2 emission rate in ng/J. Methods 3A, 6C, and 7E are used only at the sole discretion of the source owner or operator. The sampling location(s) are the same as those specified for the continuous emission monitoring system.

(2) For Method 6 or 6A, the minimum sampling is 20 minutes and the minimum sampling volume is 0.02 dsm^3 (0.71 dscf) for each sample. Samples are collected at approximately 60-minute intervals. Each sample represents a 1-hour average. Method 6B shall be operated for 24 hours per sample, and the minimum sample volume is 0.02 dsm^3 (0.71 dscf) for each sample. Each Method 6b sample represents 24 1-hour averages.

* * * * *

(i) * * *

(1) Methods 3 or 3A, 6, 6A, 6B or 6C, and 7, 7A, 7C, 7D or 7E, as applicable, are used for conducting relative accuracy evaluations of sulfur dioxide and nitrogen oxides continuous emission monitoring systems. Methods 3A, 6C, and 7E are used only at the sole discretion of the source owner or operator.

* * * * *

5. By adding Appendix F, Procedure 1, to read as follows:

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 December 4, 1987. The first CEMS accuracy assessment shall be a relative accuracy test audit (RATA) (see section 5) and shall be completed by March 4, 1988 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 accuracy. The other function is the control and improvement of the quality of the CEMS data by implementing QC policies and corrective actions. These two functions form a control loop: When the assessment function indicates that the data quality is inadequate, the control effort must be increased until the data quality is acceptable. In order to provide uniformity in the assessment and reporting of data quality, this procedure explicitly specifies the assessment methods for response drift and accuracy. The methods are based on procedures included in the applicable performance specifications (PS's) in Appendix B of 40 CFR Part 60. Procedure 1 also requires the analysis of the EPA audit samples concurrent with certain reference method (RM) analyses as specified in the applicable RM's.

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

2. Definitions

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

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

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

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

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

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

3. QC Requirements

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

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

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

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

4. CD Assessment

4.1 CD Requirement. As described in 40 CFR Part 60.13(d), source owners and operators of CEMS must check, record, and quantify the CD at two concentration values at least once daily (approximately 24 hours) in accordance with the method prescribed by the manufacturer. The CEMS calibration must, as 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, if performed, or record the amount of adjustment.

4.3 Criteria for Excessive CD. If either the zero (for low-level) or high-level CD result exceeds twice the applicable drift specification in Appendix B for five, consecutive, daily 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 fifth, consecutive, daily CD check with a CD in excess of two times the allowable limit, or the time corresponding to the completion of the daily CD check preceding the daily CD check that results in 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 CD check following corrective action that results in the CD's at both the zero (or low-level) and high-level measurement points being within the corresponding allowable CD limit (i.e., either two times or four times the allowable limit in Appendix B).

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

4.4 Data Recording and Reporting. As required in § 60.7(d) of this regulation (40 CFR Part 60), 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 (RATA). 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:

Please note that section 5.2 - Criteria for Excessive Inaccuracy has not been published correctly and should be as follows:

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 100 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 perent of the applicable standard. If the inaccuracy exceeds $\pm$ 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, then corrective action must be taken and following the corrective action the source owner or operator must audit the CEMs accuracy with a RATA, CGA or RAA. RATA must always be used following an out-of-control period resulting from a RATA. The CEMS audit following corrective action does not require the 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 showing the CEMS to be out-of-control and the result of the audit following corrective action showing the CEMS to be operating within specifications.

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

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

Use of separate audit gas cylinder for audit points 1 and 2. Do not dilute gas from 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 comparision 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 (RAA). 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.

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 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, corrective action, the source owner or operator must audit the CEMS accuracy with a RATA, CGA, or 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 showing the dems 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 availabilty as required end described in the applicable subpart (e.g., § 60.47a(f)).

5.3 Criteria for Acceptable QC Procedure. Repeated excessive inaccuracies (i.e., out-of-control conditions resulting from the quarterly audits) indicates the QC procedures are inadequate or that the CEMS is incapable of providing quality data. Therefore, whenever excessive inaccuracies occur for two consective 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 must be calculated in units of the applicable emission standard (e.g., ng/J).

6.3 CGA Accuracy Calculation. Use Equation 1-1 to calculate the accuracy for the CGA, which is calculated in units of the appropriate concentration (e.g., ppm SO_2 or percent O_2). 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 3.

7. Reporting Requirements

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

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

1. Source owner or operator name and address.

2. Identification and location of monitors in the CEMS.

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

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

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

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

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

8. Bibliography

1. "A Procedure for Establishing Traceability of Gas Mixtures to Certain National Bureau of Standards Standard Reference Materials." Joint publication by NBS and EPA-600/7-81-010. Available from the U.S. Environmental Protection Agency. Quality Assurance Division (MD-77). Research Triangle Park, North Carolina 27711.

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

3. Calculation and Interpretation of Accuracy for Continuous Emission Monitoring Systems (CEMS). Section 3.0.7 of the Quality Assurance Handbook for Air Pollution Measurement Systems. Volume III. Stationary Source Specific Methods. EPA-600/4-77-027b. August 1977. U.S. Environmental Protection Agency. Office of

Research and Development Publications, 26 West St. Clair Street, Cincinnati, Ohio 45268.

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, NOx ____ ppm, CO_2 ____ percent

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

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

1. Date of audit ____
2. Reference methods (RM's) used ____ (e.g., Methods 3 and 6).
3. Average RM value ____ (e.g., ng/J, mg/dsm³, or percent volume).
4. Average CEMS value ____.
5. Absolute value of mean difference [d] ____
6. Confidence coefficient [CC] ____.
7. Percent relative accuracy (RA) ____ percent.
8. EPA performance audit results:
a. Audit lot number (1) ____ (2) ____
b. Audit sample number (1) ____ (2) ____
c. Results (mg/dsm³) (1) ____ (2) ____
d. Actual value (mg/dsm³)* (1) ____ (2) ____
e. Relative error* (1) ____ (2) ____

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

	Audit point 1	Audit point 2	
1. Date of audit	____	____	
2. Cylinder 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. Accuracy	____	____	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. Accuracy ____ percent.
6. EPA performance audit results:
a. Audit lot number (1) ____ (2) ____
b. Audit sample number (1) ____ (2) ____
c. Results (mg/dsm³) (1) ____ (2) ____
d. Actual value (mg/dsm³) *(1) ____ (2) ____
e. Relative error* (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 ____

[FR Doc. 87-12564 Filed 6-3-87; 8:45 am]

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3.0.4. PROCEDURE FOR NBS-TRACEABLE CERTIFICATION OF COMPRESSED GAS WORKING STANDARDS USED FOR CALIBRATION AND AUDIT OF CONTINUOUS SOURCE EMISSION MONITORS (Revised Traceability Protocol No. 1)

CONTENTS

4.0 GENERAL INFORMATION

4.0.1 Purpose and Scope of the Procedure

Section 3.0.4 describes a procedure for assaying the concentration of gaseous pollutant concentration standards and certifying that the assay concentrations are traceable to an authoritative reference concentration standard. This procedure is recommended for certifying the local working concentration standards required by the pollutant monitoring regulations of 40 CFR Part 60[1,2] for the calibration and audit of continuous source emission monitors. The procedure covers certification of compressed gas (cylinder) standards for CO, CO_2, NO, NO_2, and SO_2 (Procedure G1).

4.0.2 Reference Standards

Part 60 of the monitoring regulations[1,2] require that working standards used for calibration and audit of continuous source emission monitors be traceable to either a National Bureau of Standards (NBS) gaseous Standard Reference Material (SRM) or a NBS/EPA-approved Certified Reference Material (CRM)[3]. Accordingly, the reference standard used for assaying and certifying a working standard for these purposes must be an SRM, a CRM, or a suitable intermediate standard (see the next paragraph). SRM cylinder gas standards available from NBS are listed in Table 7.2 at the end of subsection 4.0. A current list of CRM cylinder gases and CRM vendors is available from the Quality Assurance Division (MD-77), Environmental Monitoring Systems Laboratory, U. S. EPA, Research Triangle Park, NC 27711.

The EPA regulations define a "traceable" standard as one which "...has been compared and certified, either directly or via not more than one intermediate standard, to a primary standard such as a...NBS [gaseous] SRM or...CRM"[4,5]. Certification of a working standard directly to an SRM or CRM primary standard is, of course, preferred and recommended because of the lower error. However, an intermediate reference standard is permitted, if necessary. In particular, a Gas Manufacturer's Intermediate Standard (see subsection 4.0.2.1) that has been referenced directly to an SRM or a CRM according to Procedure G1 is an acceptable intermediate standard and could be used as the reference standard on that basis. However, purchasers of commercial gas standards referenced to an intermediate standard such as a GMIS should be aware that, according to the above definition, such a standard would have to be used directly for calibration or audit. Since a second intermediate standard is not permitted, such a standard could not be used as a reference standard to certify other standards.

4.0.2.1 Gas Manufacturer's Intermediate Standard (GMIS). A GMIS is a compressed (cylinder) gas standard that has been assayed with direct reference to an SRM or CRM and certified according to Procedure G1, and also meets the following requirements:

1. A candidate GMIS must be assayed a minimum of three (3) times, uniformly spaced over a three (3) month period.

2. Each of the three (or more) assays must be within 1.0 percent of the mean of the three (or more) assays.

3. The difference between the last assay and the first assay must not exceed 1.5 percent of the mean of the three (or more) assays.

4. The GMIS must be recertified every three months, and the reassay must be within 1.5 percent of the previous certified assay. The recertified concentration of the GMIS is the mean of the previous certified concentration and the reassay concentration.

4.0.2.2 Recertification of Reference Standards. Recertification requirements for SRMs and CRMs are specified by NBS and NBS/EPA, respectively. See 4.0.2.1 for GMIS recertification requirements.

4.0.3 Using the Procedure

The assay/certification procedure described here is carefully designed to minimize both systematic and random errors in the assay process. Therefore, the procedure should be carried out as closely as possible to the way it is described. Similarly, the assay apparatus has been specifically designed to minimize errors and should be configured as closely as possible to the design specified. Good laboratory practice should be observed in the selection of inert materials (e.g. Teflon, stainless steel, or glass, if possible) and clean, non-contaminating components for use in portions of the apparatus in contact with the candidate or reference gas concentrations.

4.0.4 Certification Documentation

Each assay/certification must be documented in a written certification report signed by the analyst and containing at least the following information:

1. Identification number (cylinder number).

2. Certified concentration of the standard, in ppm or mole percent.

3. Balance gas in the standard mixture.

4. Cylinder pressure at certification.

5. Date of the assay/certification.

6. Certification expiration date (see 4.0.6.3).

7. Identification of the reference standard used: SRM number, cylinder number, and concentration for an SRM; cylinder number and concentration for a CRM or GMIS.

8. Statement that the assay/certification was performed according to this Section 3.0.4.

9. Identification of the laboratory where the standard was certified and the analyst who performed the certification.

10. Identification of the gas analyzer used for the certification, including the make, model, serial number, the measurement principle, and the date of the last multipoint calibration.

11. All analyzer readings used during the assay/certification and the calculations used to obtain the reported certified value.

12. Chronological record of all certifications for the standard.

Certification concentrations should be reported to 3 significant digits. Certification documentation should be maintained for at least 3 years.

4.0.5 Certification Label

A label or tag bearing the information described in items 1 through 9 of subsection 4.0.4 must be attached to each certified gas cylinder.

4.0.6 Assay/Certification of Compressed Gas (Cylinder) Standards

4.0.6.1 Aging of newly-prepared gas standards. Freshly prepared gas standard concentrations and newly filled gas cylinders must be aged before being assayed and certified. SO_2 concentrations contained in steel cylinders must be aged at least 15 days; other standards must be aged at least 4 days.

4.0.6.2 Stability test for reactive gas standards. Reactive gas standards, including nitric oxide (NO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and carbon monoxide (CO), that have not been previously certified must be tested for stability as follows: Reassay the concentration at least 7 days after the first assay and compare the two assays. If the second assay differs from the first assay by 1.5% or less, the cylinder may be considered stable, and the mean of the two assays should be reported as the certified concentration. Otherwise, age the cylinder for a week or more and repeat the test, using the second and third assays as if they were the first and second assays. Cylinders that are not stable may not be sold and/or used for calibration or audit purposes.

4.0.6.3 Recertification of compressed gas standards. Compressed gas standards must be recertified according to this Section 3.0.4 within the time limits specified in Table 7.1[3,6,7]. The reassay concentration must be within 5% of the previous certified concentration. If not, the cylinder must be retested for stability (subsection 4.0.6.2). The certified concentration of a recertified standard should be reported as the mean of all assays, unless a clear trend or substantial change suggests that previous assays are no longer valid.

Table 7.1 Recertification limits for compressed gas standards.

Pollutant	Balance gas	Concentration range	Maximum months until recertification for cylinder material: Al or SS	other
Carbon monoxide	N_2 or air	≥ 5 ppm	18	6
Nitric oxide	N_2	≥ 10 ppm	18	6
Sulfur dioxide	N_2	≥ 10 ppm	18	6
Nitrogen dioxide	N_2 or air	≥ 10 ppm	6	6
Carbon dioxide	N_2 or air	≥ 300 ppm	18	18
Oxygen	N_2	≥ 2 percent	18	18
Sulfur dioxide and carbon dioxide	N_2	≥ 200 ppm SO_2, ≥ 10 percent CO_2	18	6
Propane	N_2 or air	≥ 5 ppm	18	6
Others not specifically listed			6	6

4.0.6.4 Minimum cylinder pressure. No compressed gas cylinder standard should be used when its gas pressure is below 700 kPa (100 psi), as indicated by the cylinder pressure gauge.

4.0.6.5 Assay/certification of multi-component compressed gas standards. Procedure G1 may be used to assay and certify individual components of multi-component gas standards, provided that none of the components other than the component being assayed cause a detectable response on the analyzer.

4.0.7 Analyzer Calibration

4.0.7.1 Basic analyzer calibration requirements. The assay procedure described in this Section 3.0.4 employs a direct ratio referencing technique that inherently corrects for minor analyzer calibration variations (drift) and DOES NOT depend on the absolute accuracy of the analyzer calibration. What is required of the analyzer is as follows: 1) it must have a linear response to the pollutant of interest (see subsection 4.0.7.5), 2) it must have good resolution and low noise, 3) its response calibration must be reasonably stable during the assay/certification process, and 4) all assay concentration measurements must fall within the calibrated response range of the analyzer.

4.0.7.2 Analyzer multipoint calibration. The gas analyzer used for the assay/certification must have had a multipoint calibration within 3 months of its use when used with this procedure. This calibration is not used to quantitatively interpret analyzer readings during the assay/certification of the candidate gas because a more accurate, direct ratio comparison of the candidate concentration to the reference standard concentration is used. However, this multipoint calibration is necessary to establish the calibrated range of the analyzer and its response linearity.

The multipoint calibration should consist of analyzer responses to at least 5 concentrations, including zero, approximately evenly spaced over the concentration range. Analyzer response units may be volts, millivolts, percent of scale, or other measurable analyzer response units. The upper range limit of the calibrated range is determined by the highest calibration point used. If the analyzer has a choice of concentration ranges, the optimum range for the procedure should be selected and calibrated. Plot the calibration points and compute the linear regression slope and intercept. See subsection 4.0.7.5 for linearity requirements and the use of a mathematical transformation, if needed. The intercept should be less than 1 percent of the upper concentration range limit, and the correlation coefficient (r) should be at least 0.999.

4.0.7.3 Zero and span check and adjustment. On each day that the analyzer will be used for assay/certification, its response calibration must be checked with a zero and at least one span concentration near the upper concentration range limit. If necessary, the zero and span controls of the analyzer should be adjusted so that the analyzer's response (i.e. calibration slope) is within about ±5 percent of the response indicated by the most recent multipoint calibration. If a zero or span adjustment is made, allow the analyzer to stabilize for at least an hour or more before beginning the assay procedure, since some analyzers drift for a period of time following zero or span adjustment. If the analyzer is not in continuous operation, turn it on and allow it to stabilize for at least 12 hours before the zero and span check.

4.0.7.4 Pollutant standard for multipoint calibration and zero and span adjustment. The pollutant standard or standards used for multipoint calibration or zero and span checks or adjustments must be obtained from a compressed gas standard certified traceable to an NBS SRM or a NBS/EPA CRM according to Procedure G1 of this Section 3.0.4. This standard need not be the same as the reference standard used in the assay/certification. The zero gas must meet the requirements in subsection 4.0.8.

4.0.7.5 Linearity of analyzer response. The direct ratio assay technique used in Procedure G1 requires that the analyzer have a linear response to concentration. Linearity is determined by comparing the quantitative difference between a smoothly-drawn calibration curve based on all calibration points and a straight line drawn between zero and an upper reference point (see Figure 1). This difference is measured in concentration units, parallel to the concentration axis, from a point on the calibration curve to the corresponding point for the same response on the straight line.

For the general linearity requirement, the straight line is drawn between zero and the highest calibration point (Figure 1a). Linearity is then acceptable when no point on the smooth calibration curve deviates from the straight line by more than 1.5 percent of the value of the highest calibration concentration. An alternative linearity requirement is defined on the basis of the actual reference and candidate concentrations to be used for the assay. In this case, the reference and candidate concentrations are plotted on the calibration curve, and the straight line is drawn from zero to the reference concentration and extrapolated, if necessary, beyond the candidate concentration (Figure 1b). The deviation of the smooth calibration curve from the straight line at the candidate concentration point then must not exceed 0.8 percent of the value of the reference concentration. This latter specification may allow the use of an analyzer having greater nonlinearity when the reference and candidate concentrations are nearly the same.

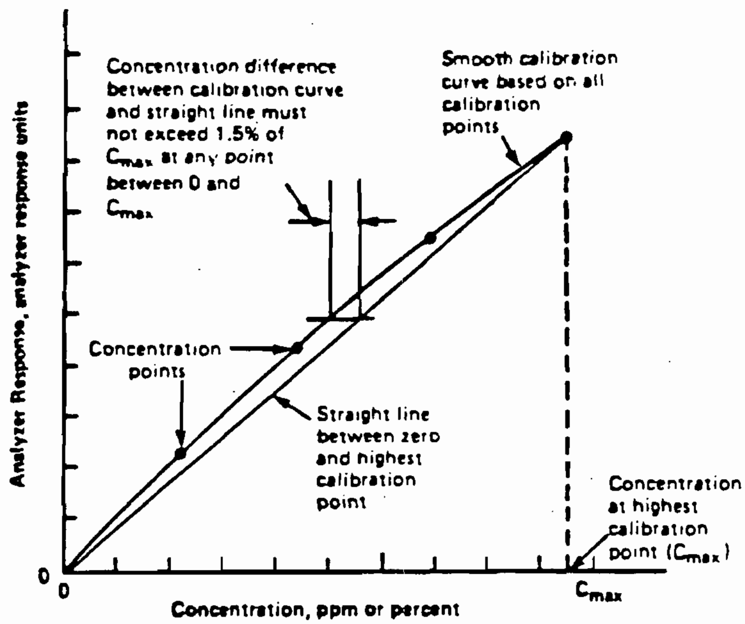
For analyzers having an inherently non-linear response, the response can usually be linearized with a simple mathematical transformation of the response values, such as R'= square root(R) or R'= log(R), where R' is the transformed response value and R is the actual analyzer response value. Using the transformed response values, the multipoint calibration should meet one of the above linearity requirements as well as the requirements for intercept and correlation coefficient given in subsection 4.0.7.2.

4.0.8 Zero Gas

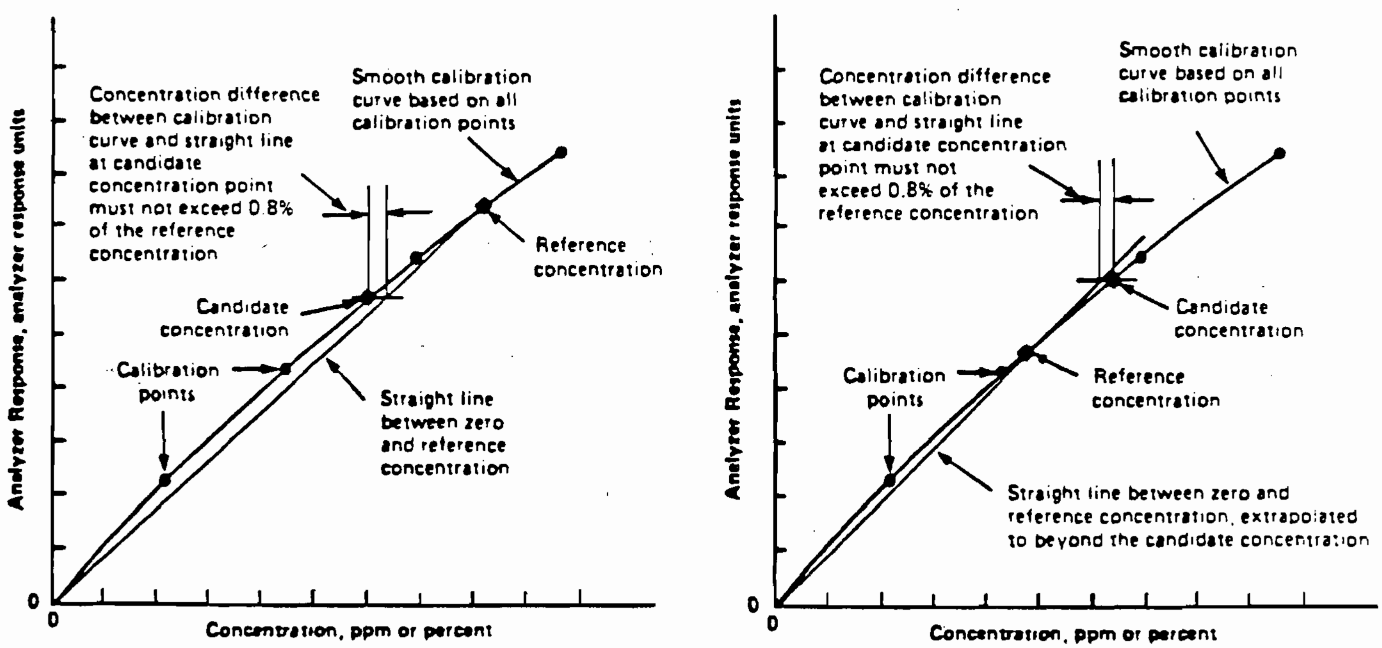
Zero gas used for dilution of any candidate or reference standard should be clean, dry, zero-grade air or nitrogen containing a concentration of the pollutant of interest equivalent to less than 0.5 percent of the analyzer's upper range limit concentration. The zero gas also should contain no contaminant that causes a detectable response on the analyzer or that suppresses or enhances the analyzer's response to the pollutant. The oxygen content of zero air should be the same as that of ambient air.

4.0.9 Accuracy Assessment of Commercially Available Standards

Periodically, the USEPA will assess the accuracy of commercially available compressed gas standards that have been assayed and certified according to this Section 3.0.4. Accuracy will be assessed by EPA audit analysis of representative actual commercial standards obtained via an anonymous agent. The accuracy audit results, identifying the actual gas manufacturers or vendors, will be published as public information.



a) General linearity requirement



b) Alternative linearity requirement

Figure 1. Illustration of linearity requirements.

Table 7.2. NBS SRM reference gases.

SRM number	Type	Nominal concentration	SRM number	Type	Nominal concentration
2627	NO/N_2	5 ppm	1693	SO_2/N_2	50 ppm
2628	NO/N_2	10 ppm	1694	SO_2/N_2	100 ppm
2629	NO/N_2	20 ppm	1661a	SO_2/N_2	500 ppm
1683b	NO/N_2	50 ppm	1662a	SO_2/N_2	1000 ppm
1684b	NO/N_2	100 ppm	1663a	SO_2/N_2	1500 ppm
1685b	NO/N_2	250 ppm	1664a	SO_2/N_2	2500 ppm
1686b	NO/N_2	500 ppm	1696	SO_2/N_2	3500 ppm
1687b	NO/N_2	1000 ppm			
2630	NO/N_2	1500 ppm	1670	CO_2/Air	330 ppm
2631	NO/N_2	3000 ppm	1671	CO_2/Air	340 ppm
			1672	CO_2/Air	350 ppm
2653	NO_2/Air	250 ppm			
2654	NO_2/Air	500 ppm	2632	CO_2/N_2	300 ppm
2655	NO_2/Air	1000 ppm	2633	CO_2/N_2	400 ppm
2656	NO_2/Air	2500 ppm	2634	CO_2/N_2	800 ppm
			2619a	CO_2/N_2	0.5 percent
2612a	CO/Air	10 ppm	2620a	CO_2/N_2	1.0 percent
2613a	CO/Air	20 ppm	2621a	CO_2/N_2	1.5 percent
2614a	CO/Air	45 ppm	2622a	CO_2/N_2	2.0 percent
			2623a	CO_2/N_2	2.5 percent
1677c	CO/N_2	10 ppm	2624a	CO_2/N_2	3.0 percent
2635	CO/N_2	25 ppm	2625a	CO_2/N_2	3.5 percent
1678c	CO/N_2	50 ppm	2626a	CO_2/N_2	4.0 percent
1679c	CO/N_2	100 ppm	1674b	CO_2/N_2	7.0 percent
2636	CO/N_2	250 ppm	1675b	CO_2/N_2	14.0 percent
1680c	CO/N_2	500 ppm			
1681c	CO/N_2	1000 ppm	1665b	C_3H_8/Air	3 ppm
2637	CO/N_2	2500 ppm	1666b	C_3H_8/Air	10 ppm
2638	CO/N_2	5000 ppm	1667b	C_3H_8/Air	50 ppm
2639	CO/N_2	1 percent	1668b	C_3H_8/Air	100 ppm
2640	CO/N_2	2 percent	1669b	C_3H_8/Air	500 ppm
2641	CO/N_2	4 percent			
2642	CO/N_2	8 percent	2643	C_3H_8/N_2	100 ppm
			2644	C_3H_8/N_2	250 ppm
2657	O_2/N_2	2 percent	2645	C_3H_8/N_2	500 ppm
2658	O_2/N_2	10 percent	2646	C_3H_8/N_2	1000 ppm
2659	O_2/N_2	21 percent	2647	C_3H_8/N_2	2500 ppm
			2648	C_3H_8/N_2	5000 ppm
			2649	C_3H_8/N_2	1 percent
			2650	C_3H_8/N_2	2 percent

NBS-SRM cylinders contain approximately 870 liters of gas at STP.

For availability, contact: Office of Standard Reference Materials
Chemistry Building, Room B311
NBS, Gaithersburg, Maryland 20899
(301) 975-6776. (FTS 879-6776)

4.1 PROCEDURE G1: ASSAY AND CERTIFICATION OF A COMPRESSED GAS STANDARD WITHOUT DILUTION

4.1.1 Applicability

This procedure may be used to assay the concentration of a candidate compressed gas (cylinder) pollutant standard, based on the concentration of a compressed gas (cylinder) reference standard of the same pollutant compound, and certify that the assayed concentration thus established for the candidate standard is traceable to the reference standard. The procedure employs a pollutant gas analyzer to compare the candidate and reference gas concentrations by direct measurement--without dilution of either gas--to minimize assay error.

4.1.2 Limitations

1. The concentration of the candidate gas standard must be between 0.3 and 1.3 times the concentration of the reference gas standard.

2. The analyzer must have a calibrated range capable of directly measuring both the candidate and the reference gas concentrations.

3. The analyzer's response (or transformed response) must be linear with respect to concentration.

4. The balance gas in both the candidate and reference standards must be identical, unless it can be shown that the analyzer is insensitive to any difference in the balance gases.

5. A source of clean, dry zero gas is required.

4.1.3 Assay Apparatus

Figure G1 illustrates the relatively simple assay apparatus. The configuration is designed to allow convenient routing of the zero gas and undiluted samples of the reference gas and candidate gases, in turn, to the analyzer for measurement, as selected by three-way valves V1 and V2. Pressure regulators and needle valves (V3 and V4) control the individual gas flows. The pollutant concentrations are delivered to the analyzer via a vented tee, which discharges excess flow and insures that the assay concentrations sampled by the analyzer are always at a fixed (atmospheric) pressure. A small, uncalibrated rotameter monitors the vent flow to verify that the total gas flow rate exceeds the sample flow rate demand of the analyzer so that no room air is admitted through the vent. Valves V1 and V2 could be replaced by a single four-way valve (with 3 inputs and 1 output) or by manually moving the output connection to each of the gases as needed. See also subsection 4.0.3.

4.1.4 Analyzer

See subsection 4.0.7.1. The pollutant gas analyzer must have a linear response function and a calibrated range capable of measuring the full concentration of both the candidate and the reference gas standards directly, without dilution. It must

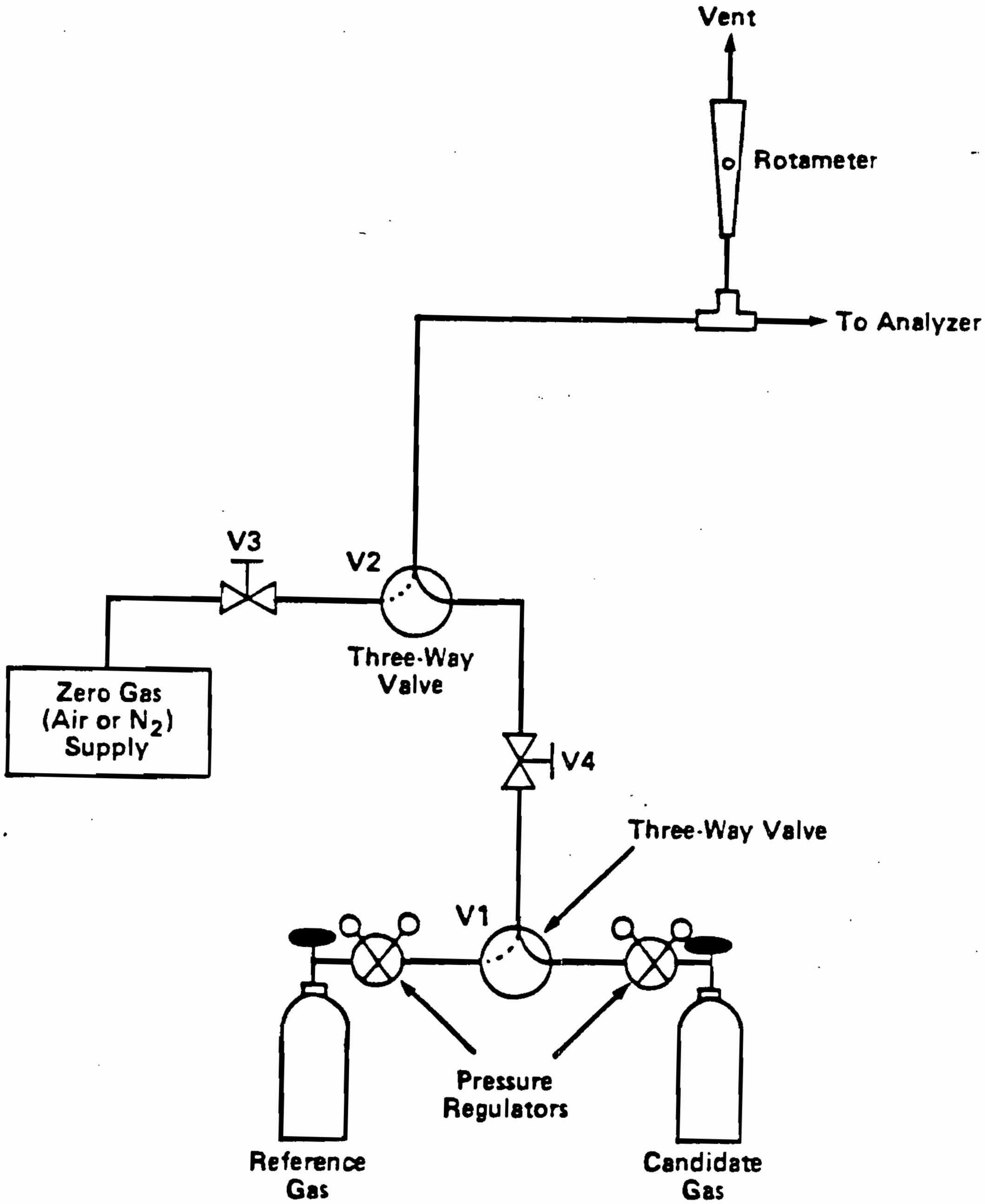


Figure G1. Suggested assay apparatus for Procedure G1.

have good resolution (readability), good precision, a stable response, and low output signal noise. In addition, the analyzer must have good specificity for the pollutant of interest so that it has no detectable response to any contaminant that may be contained in either the candidate or reference gas. If the candidate and reference gases contain dissimilar balance gases (air versus nitrogen or different proportions of oxygen in the balance air, for example), the analyzer must be proven to be insensitive to the two different balance gases. This may be accomplished by showing no difference in analyzer response when measuring pollutant concentrations diluted with identical flow rates of the two balance gases.

The analyzer should be connected to a suitable, precision chart recorder or other data acquisition device to facilitate graphical observation and documentation of the analyzer responses obtained during the assay.

4.1.5 Analyzer Calibration

4.1.5.1 Multipoint calibration. See subsections 4.0.7.2 and 4.0.7.4.

4.1.5.2 Calibration range. The calibrated range of the analyzer must include both the candidate and reference gas concentrations, such that the higher concentration does not exceed 97 percent of the upper range limit, and the lower concentration is not below 25 percent of the upper range limit (assuming a lower range limit of zero). Within these limits, select a calibrated analyzer range that will produce the highest analyzer responses.

4.1.5.3 Linearity. The direct ratio assay technique used in this procedure requires that the analyzer have a linear response to concentration (see subsection 4.0.7.5). High-concentration-range analyzers of the type that are required for this procedure may not be inherently linear, but they usually have a predictable, non-linear response characteristic that can be mathematically transformed to produce a sufficiently linear response characteristic suitable for use in this procedure. Any such response transformation should be verified by using it for the multipoint calibration. Caution should be exercised in using a transformed response curve because physical zero or span adjustments to the analyzer may produce unexpected effects on the transformed characteristic.

4.1.5.4 Zero and span adjustment. See subsections 4.0.7.3 and 4.0.7.4. Prior to carrying out the assay/certification procedure, check the calibration of the analyzer and, if necessary, adjust the analyzer's zero and span controls to re-establish the response characteristic determined at the most recent multipoint calibration. Allow the analyzer to stabilize for an hour or more after any zero or span adjustment. If there is any doubt that a transformed response characteristic is still linear following a zero or span adjustment, verify linearity with a multipoint calibration (subsection 4.0.7.2) using at least 3 known pollutant concentrations, including zero.

4.1.6 Assay Gases

4.1.6.1 Candidate gas standard. See subsections 4.0.6 and 4.1.2.

4.1.6.2 Reference gas standard. See subsections 4.0.2, 4.1.2, and 4.0.6.4. Select a reference standard such that the concentration of the candidate gas is not more than 30 percent above nor less than 70 percent below the concentration of the standard.

4.1.6.3 Zero gas. See subsection 4.0.8. The zero gas should match the balance gas used in the cylinder concentrations.

4.1.7 Assay Procedure

1. Verify that the assay apparatus is properly configured, as described in subsection 4.1.3 and shown in Figure G1.

2. Verify that the linearity of the analyzer has been checked within the last 3 months (see subsections 4.0.7.2, 4.0.7.5, and 4.1.4), that the zero and span are adjusted correctly (subsection 4.0.7.3), that the candidate and reference gas concentrations are within 25 and 97 percent of the upper range limit of the calibrated measurement range of the analyzer, and that the analyzer is operating stably.

3. Adjust the flow rates of the three gases (reference, candidate, and zero) to approximately the same value that will provide enough flow for the analyzer and sufficient excess to assure that no ambient air will be drawn into the vent.

4. Conduct a triad of measurements with the analyzer. Each triad consists of a measurement of the zero gas concentration, a measurement of the reference gas concentration, and a measurement of the candidate gas concentration. Use valves V1 and V2 to select each of the three concentrations for measurement. For each measurement, allow ample time for the analyzer to achieve a stable response reading. Record the stable analyzer response for each measurement, using the same response units (volt, millivolts, percent of scale, etc.) used for the multipoint calibration and any transformation of the response readings necessary for linearity. Do not translate the response readings to concentration values via the calibration curve (see the footnote following Equation G1). Do not make any zero, span, or other physical adjustments to the analyzer during the triad of measurements.

5. Conduct at least 2 additional measurement triads, similar to step 4 above. However, for these subsequent triads, change the order of the three measurements (e.g. measure reference gas, zero gas, candidate gas for the second triad and zero gas, candidate gas, reference gas for the third triad, etc.).

6. If any one or more of the measurements of a triad is invalid or abnormal for any reason, discard all three measurements of the triad and repeat the triad.

7. For each triad of measurements, calculate the assay concentration of the candidate gas as follows:

$$C_c = C_r \frac{R_c - R_z}{R_r - R_z} \qquad \text{Equation G1}$$

where: C_c = Assay concentration of the candidate gas standard, ppm or percent;
C_r = Concentration of the reference gas standard, ppm or percent;
R_c = Stable response reading of the analyzer for the candidate gas, analyzer response units;*
R_z = Stable response reading of the analyzer for the zero gas, analyzer response units;*
R_r = Stable response reading of the analyzer for the reference gas, analyzer response units.*

*Analyzer response units are the units used to express the direct response readings of the analyzer, such as volts, millivolts, percent of scale, etc. DO NOT convert these direct response readings to concentration units with the multipoint calibration curve or otherwise adjust these readings except for transformation necessary to achieve response linearity.

8. Calculate the mean of the 3 (or more) valid assays. Calculate the percent difference of each assay from the mean. If any one of the assay values differs from the mean by more than 1.5%, discard that assay value and conduct another triad of measurements to obtain another assay value. When at least 3 assay values all agree within 1.5% of their mean, report the mean value as the certified concentration of the candidate gas standard. For newly-prepared reactive standards, a reassay at least 7 days later is required to check the stability of the standard; see subsection 4.0.6.2.

4.1.8 Stability Test for Newly-Prepared Standards

See subsections 4.0.6.1 and 4.0.6.2.

4.1.9 Certification Documentation

See subsections 4.0.4 and 4.0.5.

4.1.10 Recertification Requirements

See subsections 4.0.6.3 and 4.0.6.4.

4.2 References.

1. Code of Federal Regulations, Title 40, Part 60, "Standards of Performance for New Stationary Sources," Appendix A, Method 20 (1982).

2. Standards of Performance for New Stationary Sources; Quality Assurance Requirements for Gaseous Continuous Emission Monitoring Systems Used for Compliance Determination, promulgated in the Federal Register, June 4, 1987, pp. 21003-21010.

3. "A Procedure for Establishing Traceability of Gas Mixtures to Certain National Bureau of Standards Standard Reference Materials. EPA-600/7-81-010. Joint publication by NBS and EPA, May 1981. Available from the U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory (MD-77), Research Triangle Park, NC 27711.

4. Code of Federal Regulations, Title 40, Part 50, "National Ambient Air Quality Measurement Methodology".

5. Code of Federal Regulations, Title 40, Part 58, "Ambient Air Quality Surveillance," Appendixes A and B.

6. Shores, R. C. and F. Smith, "Stability Evaluation of Sulfur Dioxide, Nitric Oxide, and Carbon Monoxide Gases in Cylinders. NTIS No. PB 85-122646. Available from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.

7. Method 6A and 6B, "Determination of Sulfur Dioxide, Moisture, and Carbon Dioxide Emissions from Fossil Fuel Combustion Sources," Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, Section 3.13.8, July 1986. Available from the U.S. Environmental Protection Agency, Center for Environmental Research Information, Cincinnati, OH 45268.

8. "List of Designated Reference and Equivalent Methods." Current edition available from the U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Quality Assurance Division (MD-77), Research Triangle Park, NC 27711.

Willson

7.0 CALCULATION AND INTERPRETATION OF ACCURACY FOR CONTINUOUS EMISSION MONITORING SYSTEM (CEMS)

This section contains a discussion on the accuracy calculations required in Appendix F[1] and their interpretation. The goals of Appendix F, Procedure 1, are to (1) assess CEMS accuracy, (2) indicate when a CEMS is out-of-control and correction is required, and (3) specify criteria for unacceptable CEMS data. The quarterly accuracy assessments required in Appendix F provide a mechanism for identifying and correcting CEMS's that are out-of-control. This results in an increase in acceptable CEMS data. Increasing acceptable CEMS data strengthens decisions made with regard to compliance.

The following subsections discuss the meaning, interpretation, calculation, and reporting of accuracy data.

7.1 Meaning of Accuracy

Accuracy is the measure of the closeness of a measurement to its "true value." Although the true value is not known, it can be approximated by the use of an appropriate standard of reference, for example, an NBS-SRM (National Bureau of Standards - Standard Reference Materials), a primary standard. Secondary standards are also used as an approximation to "truth," although errors may be introduced in this process.

The preferred measure of accuracy depends on the situation. If the magnitude of the difference tends to be dependent on the true value, T, then the percentage difference is preferable. If it is desired to follow or observe the pattern of the differences over time, then the signed difference or signed percentage difference is preferable.

In the context of accuracy data based on Appendix F, three types of audits for CEMS accuracy assessment are specified: Relative Accuracy Test Audits (RATA), Relative Accuracy Audits (RAA), and Cylinder Gas Audits (CGA). The procedure for the RATA and the RAA are the same as for the Relative Accuracy Test described in the applicable EPA performance specification (e.g., Performance Specification 2 for SO_2 and NO_x, and Performance Specification 3 for O_2 and CO_2), with the exception that the RAA requires three rather than nine sets of measurements, and the accuracy is based on the average of the three sets of data. In addition, EPA performance audit samples must be analyzed concurrently with the RATA samples to demonstrate and document the proficiency and accuracy of the analytical system. The same person must conduct the RATA and the EPA audit sample analysis. Thus, the RATA approximates "truth" by the reference method test results, which are in turn checked for analytical accuracy by EPA audit sample analyses. The EPA audit sample analysis must agree within 5 percent of the audit concentration on each of two SO_2 audit samples or within 10 percent of the audit concentration on each of two NO_x audit samples.

In Appendix F, each CEMS must be audited at least once each calendar quarter. Successive audits shall occur no closer than two months apart. The audits must be conducted as follows:

1. The RATA must be conducted at least once every four calendar quarters. The RATA is conducted as described in the Performance Specifications in Appendix B (e.g., Performance Specification 2 for SO_2 and NO_x). In addition, the appropriate performance audit samples received from EPA are analyzed as described in the applicable Reference Methods (e.g., Methods 6 for SO_2 and 7 for NO_x).

2. If applicable, a CGA may be conducted in three of the four calendar quarters. A CGA is conducted by challenging the CEMS's (both pollutant and diluent monitors, if applicable) with an audit gas of known concentration at two points within the following ranges:

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

A separate audit gas cylinder must be used for audit points 1 and 2. No dilution of the gas from the audit cylinder is allowed when challenging the CEMS. Challenge the CEMS three times at each point, and use the average of the three responses in determining accuracy. The monitor should be challenged at each point for a sufficient period of time to assure absorption-desorption of the CEMS sample transport surfaces has stabilized. Each monitor is audited 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. Audit gases must be certified by comparison with gaseous NBS-SRM or NBS/EPA approved CRM (Certified Reference Material) following EPA Traceability Protocol No. 1. Procedures for preparation of CRM's are described in Reference 2. Procedures for preparation of EPA Traceability Protocol No. 1 gases are described in Reference 3. 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.

3. The RAA may be conducted three of the four calendar quarters. To conduct a RAA, follow the procedures described in the applicable Performance Specification in Appendix B for the Relative Accuracy Test, except that only three sets of measurement data are required. Analysis of EPA performance audit samples is required for the RAA. The relative difference between the mean of the reference method values and the mean of the CEMS values (in terms of the standard) are used to assess the accuracy of the CEMS.

The performance of RATA's, RAA's, and CGA's provides an independent check of the CEMS accuracy. These independent audits serve to document that the CEMS is providing quality data. Examples of audit calculations are given in the subsection that follows.

In summary, an accuracy assessment is a measure of the deviation of a measurement obtained under standard operational procedures from a known reference measurement. There is no reason to expect that accuracy will remain constant over each quarter because of changes in calibration gases, analysts, and environment.

7.2 Example Calculations and Interpretation for Accuracy

7.2.1 Relative Accuracy Test Audit Calculations - Example data from a RATA on a SO_2/O_2 CEMS are shown in Table 7.1.

The SO_2 and O_2 CEMS data shown in Table 7.1 were corrected to a dry basis using Equation 7-1:

$$CEMS_{ppm,\ dry} = \frac{CEMS_{ppm,\ wet}}{1 - B_{ws}} \qquad \text{Equation 7-1}$$

where

B_{ws} = moisture fraction of the CEMS gas sampled.

TABLE 7.1 RELATIVE ACCURACY TEST AUDIT DATA FOR SO_2 AND O_2 CEMS

	SO_2	SO_2	O_2	O_2	SO_2	SO_2	SO_2
Run number	RM_d, ppm	$CEMS_d$, ppm	RM_d, %	$CEMS_d$, %	RM_d, ng/J	$CEMS_d$, ng/J	Diff, ng/J
1	500	475	3.0	3.1	422.4	403.5	18.9
2	505	480	3.0	3.1	426.6	407.7	18.9
3	510	480	3.0	3.0	430.8	405.4	25.4
4	510	480	2.9	2.9	428.4	403.2	25.2
5	500	480	2.9	3.0	420.0	405.4	14.6
6	500	500	3.0	3.1	422.4	424.7	-2.3
7	510	510	3.0	3.1	430.8	433.3	-2.5
8	505	505	2.9	3.0	424.2	426.6	-2.4
9	510	520	2.9	3.0	428.4	439.3	-10.9
Avg	---	---	---	---	426.0	413.1	9.43

RM_d = reference method data, dry basis.

$CEMS_d$ = monitor data, dry basis.

The SO_2 and O_2 CEMS and RATA data in Table 7.1 were converted to the units of the applicable standard using Equation 7-2:

$$E = CF \frac{20.9}{20.9 - \text{percent } O_2} \qquad \text{Equation 7-2}$$

where

E = pollutant emission, ng/J (lb/million Btu),

C = pollutant concentration, ng/dsm^3 (lb/dscf),

F = factor representing a ratio of the volume of dry flue gas generated to the calorific value of the fuel, dsm^3/J (dscf/million Btu), and

Percent O_2 = oxygen content by volume (expressed as percent), dry basis.

Note: For the calculations shown in Table 7.1, ppm of SO_2 was converted to ng/J using a conversion factor of 2.66 x 10^6 ng/scm/ppm and an F factor of 2.72 x 10^{-7} dsm^3/J.

For complete explanation of the equations and calculations, see 40 CFR; Part 60; Appendix A; Method 19; 5. Calculation of Particulate, Sulfur Dioxide, and Nitrogen Oxides Emission Rates.

After the data are converted to the units of the standard, the Relative Accuracy (RA) is calculated by using the equations in Section 8 of Performance Specification 2. For convenience in illustrating the calculation, these equations (7-3 through 7-8) are also shown here.

The average difference, $\bar{d}$, is calculated for the SO_2 monitor using Equation 7-3:

$$\bar{d} = \frac{1}{n} \sum_{i=1}^{n} (X_i - Y_i) = \frac{1}{n} \sum_{i=1}^{n} d_i \qquad \text{Equation 7-3}$$

$$= \frac{1}{9} (84.9) = 9.43 \text{ ng/J}$$

where

n = number of data points,

X_i = concentration from reference method (RM_d in Table 7.1), ng/J,

Y_i = concentration from the CEMS ($CEMS_d$ in Table 7.1), ng/J,

d_i = signed difference between individual pairs, X_i and Y_i, ng/J, and

Σd_i = algebraic sum of the individual differences, d_i, ng/J.

The standard deviation S_d is calculated using Equation 7-4:

$$S_d = \sqrt{\frac{1}{n-1}\left[\sum_{i=1}^{n} d_i^2 - \frac{1}{n} \left(\sum_{i=1}^{n} d_i\right)^2\right]} \qquad \text{Equation 7-4}$$

$$= \sqrt{\left[\frac{1}{8} \quad 2344 - \frac{1}{9} \quad (84.9)^2\right]} = 13.9 \text{ ng/J.}$$

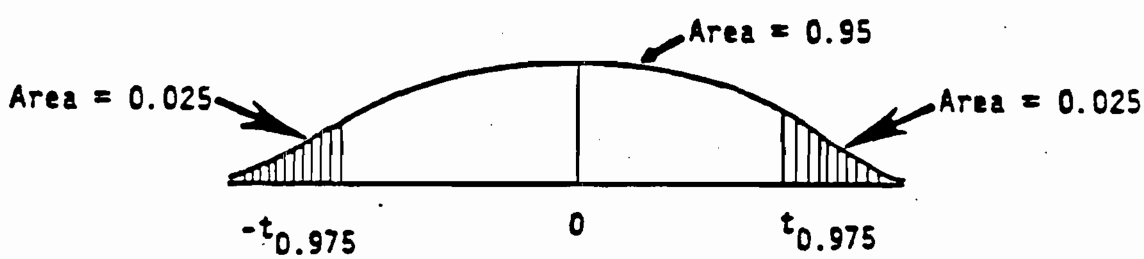
The 2.5 percent error confidence coefficient, CC, is calculated using Equation 7-5:

$$CC = t_{0.975} \frac{S_d}{\sqrt{n}} \qquad \text{Equation 7-5}$$

$$= 2.306 \quad \frac{13.9}{\sqrt{9}} = 10.68 \text{ ng/J.}$$

where $t_{0.975}$ = t-values in Table 7.2 for n = 9.

TABLE 7.2. VALUES OF t FOR 95 PERCENT PROBABILITY[a]



n^a	$t_{0.975}$	n^a	$t_{0.975}$	n^a	$t_{0.975}$
2	12.706	7	2.447	12	2.201
3	4.303	8	2.365	13	2.179
4	3.182	9	2.306	14	2.160
5	2.776	10	2.262	15	2.145
6	2.571	11	2.228	16	2.131

[a] The values in this table are already corrected for n-1 degrees of freedom. Use n equal to the number of individual values.

The RA for the RATA is calculated using Equation 7-6:

$$RA = \frac{|\bar{d}| + |CC|}{\overline{RM}} \times 100 \qquad \text{Equation 7-6}$$

$$= \frac{|9.43| + |10.68|}{426} \times 100 = 4.72\%$$

where

RA = relative accuracy, %,

$|\bar{d}|$ = absolute value of the mean differences from Equation 7-3, ng/J,

$|CC|$ = absolute value of the confidence coefficient from Equation 7-5, ng/J, and

$\overline{RM}$ = average reference method value or applicable standard, ng/J.

7.2.2 Relative Accuracy Audit Calculations - Example data from an RAA on an SO_2/O_2 CEMS are shown in Table 7.3.

TABLE 7.3 RELATIVE ACCURACY AUDIT DATA FOR SO_2 AND O_2 CEMS

	SO_2	SO_2	O_2	O_2	SO_2	SO_2
Run number	RM_d, ppm	$CEMS_d$, ppm	RM_d, %	$CEMS_d$, %	RM_d, ng/J	$CEMS_d$, ng/J
1	500	475	3.0	3.1	422.4	403.5
2	505	480	3.0	3.1	426.6	407.7
3	510	480	3.0	3.0	430.8	405.4
Avg	---	---	---	---	426.6	405.5

RM_d = reference method data, dry basis.

$CEMS_d$ = monitor data, dry basis.

The SO_2 and O_2 CEMS data shown in Table 7.3 were corrected to a dry basis using Equation 7-1. The SO_2 and O_2 CEMS and RAA data were converted to the units of the applicable standard using Equation 7-2.

The accuracy (A) for the RAA is calculated using Equation 7-7.

$$A = \frac{C_m - C_a}{C_a} \times 100 \qquad \text{Equation 7-7}$$

$$= \frac{405.5 - 426.6}{426.6} \times 100 = -4.95\%$$

where

A = accuracy of the CEMS, %,

C_m = average CEMS response during audit in units of applicable standard, and

C_a = average audit value of the three reference method runs in units of the applicable standard.

7.2.3 Cylinder Gas Audit Calculations - Example data from a CGA on an SO_2/O_2 CEMS are shown in Table 7.4.

TABLE 7.4 CYLINDER GAS AUDIT DATA FOR SO_2 AND O_2 CEMS

		SO_2	SO_2	A	O_2	O_2	A
Audit number	Reading No.	CGA_d, ppm	$CEMS_d$, ppm	Diff, %	CGA_d, %	$CEMS_d$, %	Diff, %
1	1	212	218		5.0	5.2	
	2	212	219		5.0	5.3	
	3	208	225		5.1	5.2	
	Avg	210.7	220.7	4.75	5.03	5.23	3.98
2	1	398	409		9.1	8.9	
	2	399	416		9.1	8.9	
	3	403	414		8.9	8.9	
	Avg	400.0	413	3.25	9.03	8.90	-1.44

CGA_d = cylinder gas audit value, dry basis.

$CEMS_d$ = average of the three monitor values, dry basis.

The SO_2 and O_2 CEMS data shown in Table 7.4 were corrected to a dry basis using Equation 7-1. The accuracy (A) for the GCA is calculated using Equation 7-8.

$$A = \frac{C_m - C_a}{C_a} \times 100 \qquad \text{Equation 7-8}$$

$$= \frac{220.7 - 210.7}{210.7} \times 100 = 4.75\%$$

where

A = accuracy of the CEMS component, %,

C_m = CEMS component mean response for three values during audit with CGA in units of the appropriate concentration, and

C_a = audit value of the cylinder gas in units of appropriate concentration.

7.3 Reporting Requirements

At the reporting interval specified in the applicable regulation, a report of each CEMS accuracy audit must be submitted in the form of a Data Accuracy Report (DAR). One copy of the DAR must be included for each quarterly audit along with the report of emissions required under the applicable regulation. 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, including the RA for the RATA, the A for the RAA or CGA, the reference method results, certified values for the cylinder gases, the CEMS responses, and the CEMS accuracy calculation results. 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 the EPA performance audit samples.

6. Summary of all corrective actions taken when the monitor was determined out-of-control.

An example of a DAR form is shown in Figure 7.1.

Period ending date ____________________ Year ____________________

Company name ____

Plant name ___________________________ Source unit no. __________

CEMS manufacturer ___________________________ Model no. ______________

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

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

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

O_2 ____________ percent, NO_x ____________ ppm, CO_2 ____________ percent

I. Accuracy assessment results (Complete A, B, or C below for each CEMS or for each pollutant and diluent analyzer, as applicable.) If the quarterly audit results show the CEMS to be out-of-control, report the results of both the quarterly audit and the audit following the 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 the mean difference $|\bar{d}|$ ____________.

6. Confidence coefficient |CC| ______________.

7. Percent relative accuracy (RA) __________________ percent.

8. EPA performance audit results:

a.	Audit lot number	(1) ____________	(2) ____________
b.	Audit sample number	(1) ____________	(2) ____________
c.	Results (mg/dsm^3)	(1) ____________	(2) ____________
d.	Actual value (mg/dsm^3)*	(1) ____________	(2) ____________
e.	Relative error*	(1) ____________	(2) ____________

*To be completed by the Agency.

Figure 7.1 Example format for data assessment report (DAR).

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

1. Date of audit ________________.

	Audit point 1	Audit point 2	
2. Cylinder 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. Accuracy	______	______	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. Accuracy _________________ percent.

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. Relative error* (1)___________ (2)___________

*To be completed by the Agency.

Figure 7.1 (continued)

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 ______________________________

____

____

____.

Figure 7.1 (continued)

7.4 References

1. Standards of Performance for New Stationary Sources: 40 CFR 60, Appendix F - Quality Assurance Procedures, Procedure 1 - Quality Assurance Requirements for Gaseous Continuous Emission Monitoring Systems Used for Compliance Determination.

2. A Procedure for Establishing Traceability of Gas Mixtures to Certain National Bureau of Standards Standard Reference Materials. Joint publication by NBS and EPA, EPA-600/7-81-010. Available from the U. S. Environmental Protection Agency, Quality Assurance Division (MD-77), Research Triangle Park, North Carolina 27711.

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

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10.0 GUIDELINE FOR DEVELOPING QUALITY CONTROL PROCEDURES FOR GASEOUS CONTINUOUS EMISSION MONITORING SYSTEMS

10.1 Introduction

This guideline describes the minimum content for a quality control plan to satisfy the requirements of Section 3 of Appendix F, Procedure 1 to 40 CFR Part 60. Source owners or operators may wish to add other items to assure the generation and reporting of valid data from their continuous emission monitoring systems (CEMS's).

Appendix F, Procedure 1 requires written procedures for each of the following activities:

1. Calibration of the CEMS.

2. Calibration drift determination and adjustment of the CEMS.

3. Preventive maintenance of the CEMS (including maintaining a spare parts inventory).

4. Data recording, calculations, and reporting for emissions and QA data.

5. Accuracy audit procedures including sampling and analysis methods.

6. Program of corrective action for the malfunctioning CEMS.

Figure 1 is a flow chart showing the requirements in Appendix F, Procedure 1 for quality assurance and in Part 60.13 for monitoring requirements. This flow chart is included to show how these requirements for CEMS's interact.

10.2 Calibration of the CEMS

Calibration refers to the adjustment of the CEMS response relative to specified standards such as gas cells or calibration gases, or relative to independent effluent measurements. Appendix F, Procedure 1 requires that sources have written procedures for CEMS calibration. Sources may develop their own written procedures; alternatively, they may specify applicable sections of the instrument manual as their written procedures.

There are no currently promulgated regulations that require either specific calibration frequencies or specific criteria for initiating calibration procedures. Sources may therefore choose their own frequency or criteria for calibration based on operating experience or manufacturer's recommendations.

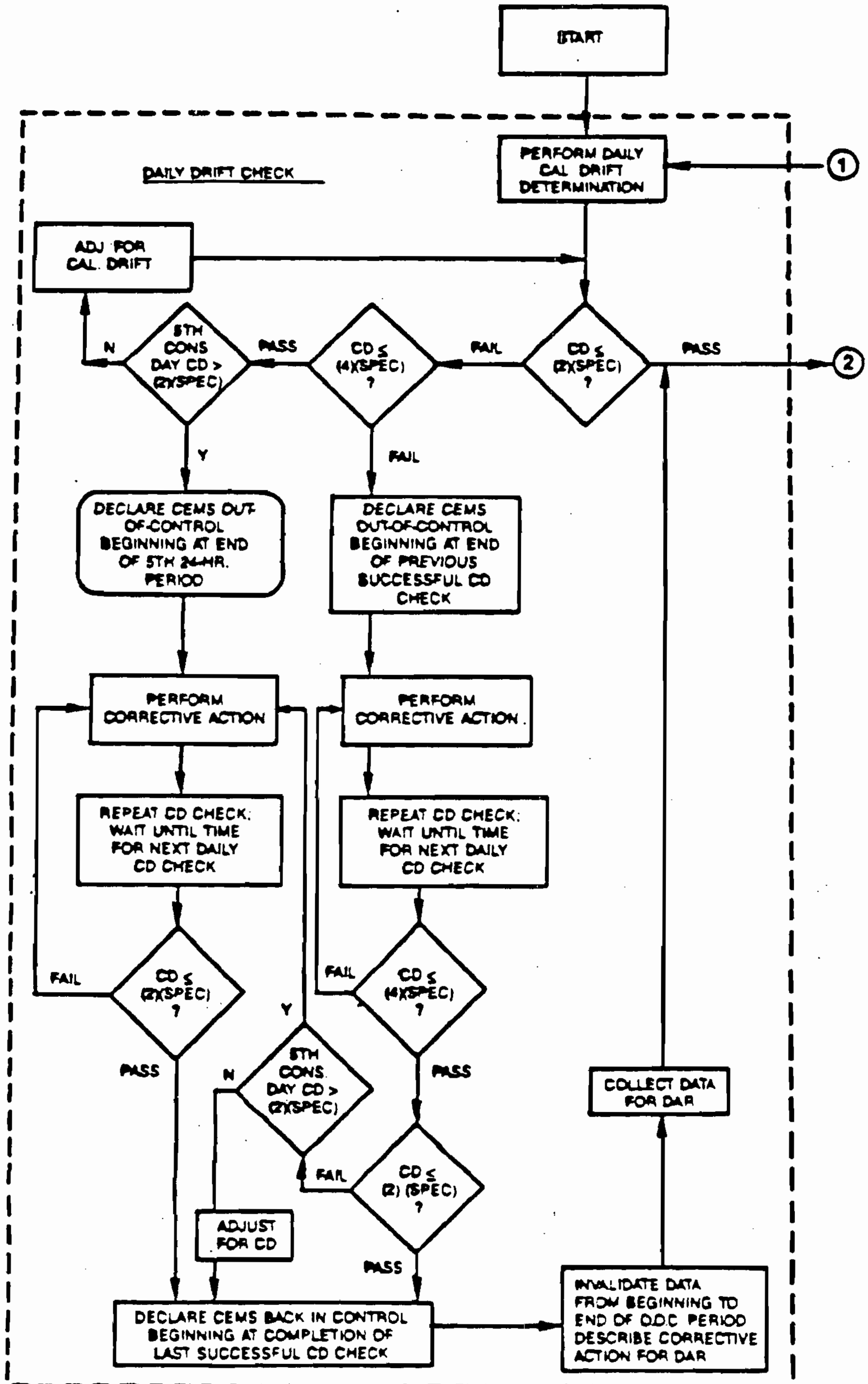
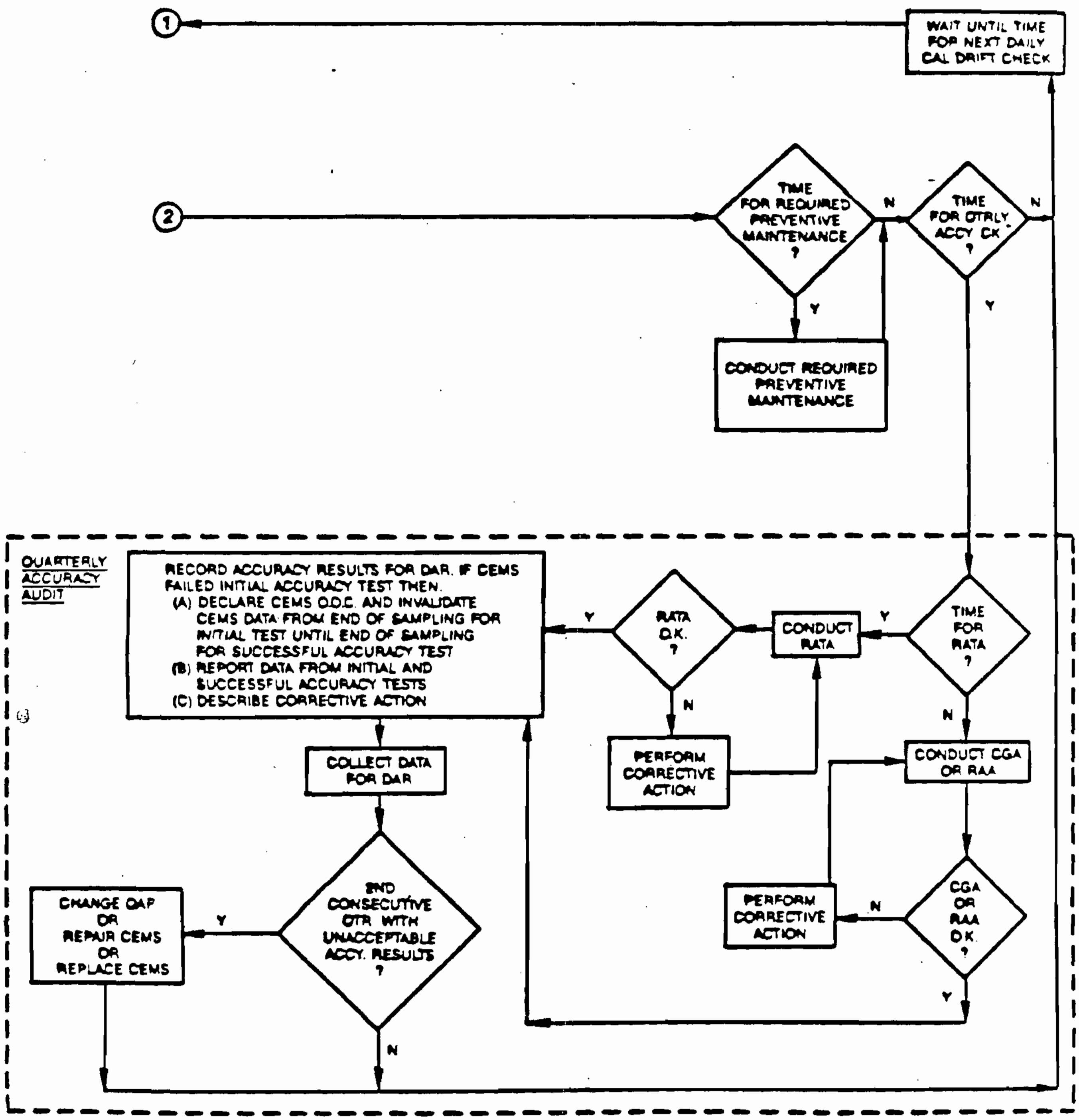


Figure 1. Flow Chart for Required QC Procedures.



CODE

≤	= "EQUAL TO OR LESS THAN"	N	= NO
>	= "GREATER THAN"	O.O.C	= OUT-OF-CONTROL
CD	= CALIBRATION DRIFT	QCP	= QUALITY CONTROL PROCEDURES
CONS	= CONSECUTIVE	SPEC	= DRIFT LIMITS IN PERFORMANCE SPECIFICATIONS 2 OR 3
DAR	= DATA ASSESSMENT REPORT	Y	= YES

Figure 1. (continued)

For calibrations based on external gas cells, sufficient time should be allowed for the cell and/or analyzer cabinet to reach normal operating temperature; accordingly, it is recommended that procedures be incorporated into the QC program that ensure sufficient time for the monitor response to stabilize before it is compared to the cell's named value. Some in-situ analyzers partially or totally disable temperature compensation circuitry during cell-type calibrations. In these cases, it is recommended that additional procedures addressing the calibration of this circuitry be incorporated into the QC program.

For analyzers calibrated using calibration gases as the reference, the written procedures should specify (1) at what point in the sampling system the calibration gases are to be introduced and (2) either the specific gas flow rate to be used or how the flow rate is determined. Although current continuous emission monitoring (CEM) regulations do not require establishing the traceability of calibration gases to higher standards, it is strongly recommended that procedures be established and included within the QC program for verifying the concentrations of calibration gases. One acceptable procedure is EPA's traceability protocol 1 (Reference 1).

In cases where a portable CEMS is to be used as the reference for adjusting the installed CEMS, written procedures should specify calibration and operating procedures for the portable CEMS, including the portable CEMS sampling location.

The written calibration procedures for the installed CEMS may be incorporated into one or more of the following sections of a QC program:

1. A Stand-Alone "Calibration" Section of the QC Program. In this case, the frequency of calibration or the criteria for initiating calibration activities should be clearly specified.

2. Preventive Maintenance. Within the section delineating the preventive maintenance procedures, calibration may be specified as a routine maintenance activity to be performed at regular, specified intervals. Alternatively, calibration may be specified on an as-needed basis with stated criteria for the implementation of calibration activities.

3. Corrective Action. Calibration procedures may be included within the section delineating corrective action activities to be performed at the discretion of CEMS repair personnel in response to an out-of-control CEMS.

Regardless of how the calibration procedures are incorporated into the QC program, it is recommended that the individual or group responsible for CEMS calibration be identified within the written QC plan.

10.3 Calibration Drift and Adjustment of the CEMS

Calibration drift (CD) refers to the difference between the CEMS output reading and a reference value after a period of operation during which no unscheduled maintenance, repair, or adjustment took place. Daily zero (or low level) and span drift checks are required by 40 CFR 60.13; these checks are to be used to fulfill the calibration drift check requirement of Appendix F, Procedure 1. Appendix F, Procedure 1 requires written procedures that specify how the zero (or low level) and span calibration drift determinations are to be performed. These procedures must be consistent with the monitor vendor's prescribed method for checking CD.

Table 10.1 presents CD criteria and the corresponding required source responses. Sources may choose to establish more stringent criteria for adjustment of CEMS for zero (or low level) and/or span calibration drift. It is recommended that the CD criteria selected for adjustment of the CEMS be incorporated into the written instructions for the calibration drift check procedures, so that the need for adjustment based on calibration drift may be determined immediately.

Corrections for excessive drift may consist of any adjustments or activities that the operator or technician deems necessary to correct for the observed drift. These activities typically consist of routine checks and adjustments of calibration gas flow rates and pressures, verification of proper sample cell temperatures, verification of the status of monitor specific auxiliary monitoring parameters, and adjustment of zero and/or span potentiometers. Written procedures should be available for performing these routine activities and should include criteria for determining that adjustments have been successful.

10.4 Preventive Maintenance of the CEMS

Preventive maintenance is comprised of activities designed to detect and prevent the development of monitoring problems. These activities typically include both routine maintenance procedures and maintenance, repairs, or adjustments performed on an as-needed basis. An example of as-needed preventive maintenance would be the repairing of the protective covering of an extractive sample line following damage resulting from an accident during the construction activities. If the sample line itself were not damaged, the repair would be considered preventive maintenance and would not consititute corrective action for a malfunctioning CEMS. The importance of this type of

TABLE 10.1. CEMS CALIBRATION DRIFT CRITERIA

Parameter	Criterion*	Action Required
Zero (or low) level calibration drift	CD > 2 x (Spec)**	Adjust CEMS for calibration drift
	CD > 2 x (Spec) for 5 consecutive 24-hour periods	CEMS out-of-control period begins at end of 5th day the CD exceeds 2 x (Spec); perform corrective action and repeat CD check
	CD > 4 x (Spec)	CEMS out-of-control period begins at the time corresponding to the completion of the last acceptable CD check preceding the CD check which exceeds 4 x (Spec); perform corrective action and repeat the CD check
Span calibration drift	CD > 2 x (Spec)**	Adjust CEMS for calibration drift
	CD > 2 x (Spec) for 5 consecutive 24-hour periods	CEMS out-of-control period begins at end of 5th day the CD exceeds 2 x (Spec); perform corrective action and repeat CD check
	CD > 4 x (Spec)	CEMS out-of-control period begins at the time corresponding to the completion of the last successful CD check preceding the CD check that exceeds 4 x (Spec); perform corrective action and repeat the CD check

*Spec refers to the applicable performance specification in Appendix B.

**This is the minimum criterion for adjustment of the CEMS. More stringent criteria, which may be preferred by many sources, are also acceptable.

maintenance is recognized; however, it is neither practical nor necessary to develop written procedures for such needed activities.

Written procedures must be available for routine maintenance activities. These procedures should specify what procedures are to be conducted and the frequency with which the various activities are to be performed. The QC program should specify the individual or office responsible for ensuring that the preventive maintenance procedures are conducted at the appropriate frequencies and the individual or group who will perform the actual routine maintenance procedures.

The applicable regulations do not specify the minimum level of routine preventive maintenance. It is suggested that, at a minimum, the initial procedures should incorporate the vendor's recommendations regarding preventive maintenance activities and frequencies. These procedures may later be adjusted to reflect actual operating experience with individual CEMS installations.

A list of spare parts for the CEMS must be included in the written QC plan. At a minimum, those spare parts recommended by the monitor vendor should be available. The QC program should specify the individual or office who is responsible for maintaining the listed spare parts inventory.

10.5 Data Records, Calculations, and Reporting for the CEMS

The QA/QC program must address recordkeeping, calculations, and reporting of emissions and quality assurance data. The requirements for these activities are contained in the subparts of 40 CFR 60 that specify the use of CEM. A Data Assessment Report (DAR) must be provided with emissions reports required by the applicable subpart of 40 CFR 60. The DAR must contain, at a minimum:

1. The name and address of the source owner or operator.

2. Identification and location of each monitor in the CEMS.

3. The manufacturer and model number of each monitor in the CEMS.

4. Quarterly accuracy results, including dates, CEMS responses, and either reference method results or certified gas values; if either a RATA or a RAA was performed, the results from the EPA performance audit sample analysis must also be included.

5. A summary of corrective actions taken when the monitor was determined to be out-of-control.

For emissions data, a list or diagram should be provided indicating the offices or individuals responsible for (1) retrieving the data from the CEMS, (2) calculating emissions rates from the CEMS data, (3) compiling emissions reports, and (4) reviewing and/or approving emissions reports. Formulas and example calculations should be provided for emission rate calculations. Similar information should be provided for emissions data from alternative monitoring methods that may be necessary during CEMS out-of-control periods.

A list or diagram should also be provided indicating the offices or individuals responsible for (1) collecting quality assurance (QA) data, (2) performing applicable calculations of QA/QC results, (3) recording the QA/QC results in appropriate logs (as applicable), (4) preparing the DAR, and (5) approving and/or reviewing the DAR. Formulas and example calculations should be provided for all required QA data calculations.

10.6 Accuracy Audit Procedures Including Sampling and Analysis Methods

Appendix F, Procedure 1 requires that each CEMS be audited at least once each calendar quarter. Three audit techniques are acceptable:

1. Relative accuracy test audits (RATA's);
2. Cylinder Gas Audits (CGA's); and
3. Relative accuracy audits (RAA's).

In addition, other alternative audit procedures may be used as approved by the Administrator.

If the CEMS does not demonstrate acceptable accuracy during the quarterly audit, then corrective actions must be initiated, and the CEMS must be declared out-of-control from the time corresponding to the completion of the sampling for the unsuccessful audit until the completion of the sampling for a successful follow-up audit. If the CEMS demonstrates unacceptable accuracy for two consecutive quarters, then the QA program must be revised, or the CEMS must be modified or replaced.

Table 10.2 presents the specific requirements and the corresponding CEMS performance criteria for each of the three acceptable audit techniques.

The QC program must include written sampling and analysis procedures to be used during the required quarterly accuracy audits. At a minimum, these procedures must describe the methods to be used to conduct a RATA. Applicable sections of Appendix A (Reference Methods) and Appendix B (Performance Specifications)

TABLE 10.2. REQUIREMENTS AND CRITERIA FOR APPENDIX F, PROCEDURE 1 AUDIT TECHNIQUES

Technique	Requirements	Performance Criteria
RATA	Conduct as per applicable performance specification (PS) in Appendix B (e.g., PS 2 for SO_2 and NO_x) Analyze appropriate performance audit samples from EPA	RA must not exceed 20% or 10% of applicable standard, whichever is greater For SO_2 standards from 0.20 to 0.30 lb/10^6 Btu, RA must not exceed 15% of the standard For SO_2 standards below 0.20 lb/10^6 Btu, RA must not exceed 20% of the standard
RAA	Conduct as per applicable PS in Appendix B <u>except</u> only 3 runs are required Use relative difference between the mean reference method values and the mean of the CEMS responses to assess the accuracy of the CEMS data	Inaccuracy must not exceed $\pm$ 15% or 7.5% of the applicable standard, whichever is greater
CGA	Challenge both pollutant and diluent channels (if applicable) of CEMS three times at the two points specified in Procedure 1 Use gases that have been certified by comparison to NBS SRM's or NBS/EPA approved gas manufacturer's CRM's Operate analyzer in normal sampling mode Use average difference between actual gas value and concentration indicated by CEMS to access accuracy	Inaccuracy must not exceed $\pm$ 15%

may be cited where possible to describe audit procedures. The written procedures should specify individuals or groups responsible for audit program oversight, sampling, analysis, and accuracy assessment calculations. If the source chooses to conduct RAA's and/or CGA's during quarters when RATA's are not required, the QC plan should include written procedures for these audit techniques. Again, applicable sections of Appendix A, Appendix B, and/or instrument operation manuals may be cited where possible.

Sources may choose to have an outside contractor perform some or all of the accuracy audit activities. Since contractor selection may be subject to competitive bidding, the QC program need not specify a particular contractor. However, the specific activities for which the contractor will be responsible should be listed.

10.7 Program of Corrective Action for the Malfunctioning CEMS

Appendix F, Procedure 1 specifies that corrective action must be performed when a CEMS is out-of-control. Appropriate corrective action will depend on the nature of the CEMS malfunction. At a minimum, written procedures must be available, to be applied as necessary, for instrument start-up and trouble shooting. Appropriate sections of instrument operation and/or repair manuals may be referenced to fulfill this requirement. Where possible, it is recommended that additional quality assessment procedures be provided to verify proper operation of the CEMS following repair or adjustment.

A list should be provided to indicate what alternative methods are to be used for monitoring emissions during CEMS out-of-control periods in order to fulfill the minimum data availability requirements of the applicable subpart. Written procedures should be available for operation of these alternative methods.

A list or chart should be provided to indicate the offices or individuals (1) to be contacted when a CEMS out-of-control period occurs, (2) to approve the corrective action (if applicable), and (3) to be responsible for determining when alternative monitoring procedures are to be employed. Criteria should be provided for determining when the CEMS is out-of-control. As a minimum, these must include the Appendix F, Procedure 1 criteria for excessive drift and excessive inaccuracy.

10.8 References

1. Traceability Protocol for Establishing True Concentrations of Gases Used for Calibration and Audits of Continuous Source Emission Monitors (Protocol Number 1). June 1978, Section 3.0.4 of the Quality Assurance Handbook for Air

Pollution Measurement Systems, Volume III, Stationary Source Specific Methods. EPA-600/4-77-027b. August 1977. U. S. Environmental Protection Agency, Office of Research and Development Publications, 26 West St. Clair Street, Cincinnati, Ohio 45268.

PSD-FL-112 PERMITTING HISTORY

Wheelabrator North Broward, Inc.
North Broward Waste-to-Energy Facility

Facility ID No.: 0112120

PSD Permit History (for tracking purposes):

Permit No.	Issue Date	PERMITTING ACTION DESCRIPTION
PSD-FL-112	7/28/87	To construct/install 4 municipal solid waste units. A site certification (PA 86-22) issued on 2/9/89.
PSD-FL-112	2/09/89	EPA revision to change the number of units to 3 and to indicate the steam and heat input capacity accordingly.
PSD-FL-112A	5/22/97	Permit amendment to allow the use of EPA Method 29 in lieu of Method 101A.
PSD-FL-122A		Draft Modification to revise fuels allowed to be burned. Not issued (1998).
PSD-FL-112B	9/28/99	Permit modification to include the 40 CFR, Subpart Cb requirements and to describe in detail the waste allowed to be burn. Other minor permit modifications. Refer to specific conditions.

Appendix H-1, Permit History/ID Number Changes

Wheelabrator North Broward, Inc.
North Broward Waste-to-Energy Facility

Facility ID No.: 0112120

Permit History (for tracking purposes):

E.U. ID No.	Description	Permit No.	Issue Date	Expiration Date	ExtendedDate[1, 2]	Revised Date(s)
001, 002, 003	Municipal Solid Waste Combustors	PSD-FL-112	07/28/87			02/09/89; 05/22/97; 09/28/99
		PA 86-22	03/09/87			04/12/88; 02/01/89; 10/04/91; 11/30/92
004	Lime Silo	AC06-186998	03/12/91	02/28/92		
		AO06-208187	05/14/92	02/28/96		
005	Ash Handling System	AC06-186997	03/12/91	02/28/92		
		AO06-208187	05/14/92	02/28/96		

(if applicable) ID Number Changes (for tracking purposes):

From: **Facility ID No.**: 30BRO062120

To: **Facility ID No.**: 0112120

Notes:
1 - AO permit(s) automatic extension(s) in Rule 62-210.300(2)(a)3.a., F.A.C., effective 03/21/96.
2 - AC permit(s) automatic extension(s) in Rule 62-213.420(1)(a)4., F.A.C., effective 03/20/96.
{Rule 62-213.420(1)(b)2., F.A.C., allows Title V Sources to operate under existing valid permits that were in effect at the time of application until the Title V permit becomes effective}

Permitting Application

Permit #:	PATS:	Issue:	Expire:

Project #/Name	Owner/Company	Type/Sub	Receive
001/WHEELABRATOR NORTH BROWAR	**WHEELABRATOR NORTH BROWARD,**	**AV /00**	**17-JUN-1996**
/NORTH BROWARD RESOURCE RE	WHEELABRATOR NORTH BROWARD,	AC /1E	27-SEP-1990
/NORTH BROWARD RESOURCE RE	WHEELABRATOR NORTH BROWARD,	AC /1E	27-SEP-1990
/WHEELABRATOR ENV. SYSTEMS	WHEELABRATOR NORTH BROWARD,	AO /2B	06-FEB-1992
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11-9-88
Atlanta, GA

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET
ATLANTA, GEORGIA 30365

NOV 0 8 1988

4APT/APB-aes

Mr. Clair H. Fancy, P.E.,
Deputy Bureau Chief
Florida Department of Environmental
Regulation
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Re: North Broward County Resource Recovery Facility

Dear Mr. Fancy:

We have received correspondence from Ms. Kerri L. Barsh of Greenberg, Traurig, Hoffman, Lipoff, Rosen, and Quentel, P.A., dated September 29, 1988, and addressed to Ms. Betsy Pittman, Esq., Assistant General Counsel, Florida Department of Environmental Regulation (DER), regarding a request for modifications to the Power Plant Site (PPS) Certification for the North Broward County Resource Recovery Facility (RRF). In reviewing the proposed modifications, we have found numerous discrepancies between the specific conditions of the proposed certification and the July 28, 1987, U.S. Environmental Protection Agency (EPA) Prevention of Significant Deterioration (PSD) permit issued to this facility. Many of these discrepancies are of serious concern to EPA, and through this letter, we wish to convey our specific comments to you in hopes that any PPS Certification modification issued by the Governor of Florida will be consistent with the EPA issued permit. For your convenience, we are enclosing a copy of the July 28, 1987, EPA issued PSD permit and a copy of the September 29, 1988, letter from Ms. Kerri L. Barsh, which includes the proposed modifications and permit conditions for the North Broward County RRF.

Recommended Order 12

Under paragraph 30 listed on this page, the applicant has described the facility as to "initially consist of three incinerators, and ultimately four incinerators, each designed as a complete unit capable of processing 750 tons of MSW per day." On Application Page 3-12, however, the initial installed capacity is listed as 2,250 tons per day (3 incinerators), and ultimate installed capacity is listed as 3,300 tons per day (4 incinerators). This leads us to believe that the projected fourth incinerator must be capable of firing 1050 tons per day of MSW, and not 750 tons as stated. Although the fourth incinerator is not a unit under evaluation in the current permitting action, we believe that this discrepancy should be addressed by the applicant.

ATLANTA GA NOV-9'88

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EPA

United States
Environmental Protection
Agency
Region IV
345 Courtland Street, N.E.
Atlanta, GA 30365

Official Business
Penalty for Private Use
$300

AIR-4

Mr. Clair H. Fancy, P.E.
Deputy Bureau Chief
Florida Department of
Environmental Regulation
Twin Towers Office Bldg.
2600 Blair Stone Road
Tallahassee, FL 32399-2400

Conditions Pages 11-13

1. Emission Limitations

a. Regarding emissions of sulfur dioxide (SO_2), the applicant has proposed a limit of 0.55 lb/mmBTU average heat input for each unit to be determined by annual stack tests. This limit was also stated to be "subject to change in accordance with current state rulemaking for resource recovery facilities or by petition under 403.516." This SO_2 emission limit differs dramatically from the EPA issued PSD permit limit which states:

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

(2) 65% reduction of uncontrolled SO_2 emissions. In no case shall the SO_2 emissions exceed 0.310 lb/mmBTU heat input and 124 ppm (3-hr rolling average, dry volume, corrected to 12% CO_2). The 124 ppm limit above shall be modified to reflect a new emission limit (in ppm) from the control device at 65% control efficiency. Within 18 months of start-up of operation, the County shall submit compliance test that will be used to determine the new SO_2 emission limit (in ppm). The limit will be determined by observed average emission rate (u) from the submitted compliance tests and will be statistically analyzed using the one tailed student T test ($t_{.05} = (\bar{x} - u)\, n^{0.5}/s$) at the 95% confidence level to derive a mean emission rate (x), where s is the standard deviation of observed values n. The final operating SO_2 emission limit (in ppm) shall be this mean emission rate (x). This value shall be restricted to no more than 124 ppm or less than 60 ppm (3-hr rolling average, dry volume, corrected to 12% CO_2).

As proposed, the SO_2 emission limit of 0.55 lb/mmBTU average heat input is approximately 44% higher than the maximum allowed by the EPA issued PSD permit. (We have reviewed several other RRF SO_2 permitted emission limits and have found the EPA issued PSD permit requirements to be consistent with those reviewed.) EPA is also opposed to the word "average" as contained in the proposed permit since this term is undefined. Because EPA is also requiring the use of a continuous emission monitor (CEM) to measure SO_2 emissions, and because this monitor will be used to determine compliance with the ppm limits as contained in the EPA issued permit, we suggest that the Florida DER require similar SO_2 emission limits (in ppm) and CEM requirements.

b. Regarding nitrogen oxides (NO_x) emissions, we suggest that an emission limit of 350 ppm (3-hr rolling average, dry volume, corrected to 12% CO_2) be added. Similarly to emissions of SO_2, EPA is also requiring the installation of a CEM for NO_x. This CEM will be used as a compliance method for determining NO_x emissions levels. Again, these requirements are consistent with previous determinations for RRFs. The EPA issued permit also requires annual compliance testing for this pollutant. This is not required in the applicant's proposed PPS certification modifications.

c. Regarding carbon monoxide (CO) emissions, North Broward County RRF has proposed emission limits which are substantially less stringent than those contained in the EPA issued permit. In the EPA issued permit, CO emission limits of 0.090 lb/mmBTU heat input; 400 ppm (1-hr rolling average, dry volume, corrected to 12% CO_2); and 88 ppm (4-day rolling average, dry volume, corrected to 12% CO_2) have been imposed. The CO limits proposed by the facility for this modification are 400 ppm (8-hour average, dry volume, corrected to 7% O_2) and 130 ppm (4-day average, dry volume, corrected to 7% O_2). Furthermore, the facility has not proposed to conduct annual compliance testing nor to install a CEM for measuring CO emissions as is required in the EPA issued permit.

d. The facility has proposed that mercury emissions be limited to 9.2×10^{-4} lb/mmBTU. The EPA issued permit limits mercury emissions to 7.5×10^{-4} lb/mmBTU. The EPA issued permit also requires annual compliance testing for this pollutant.

e. Visible emission (VE) limitations are also not identical in the proposed modifications and EPA issued permit. Although stack emissions are limited to 15% opacity in both references, the applicant is proposing an exception of 20% opacity (for up to three consecutive minutes in any one hour) in the proposed modifications. The requirements for allowing excess emissions as a result of startup, shutdown, and malfunction should also be made consistent in both permits. The EPA permit allows excess VEs during startup and shutdown provided that: (1) best operational practices to minimize emissions are adhered to, and (2) the duration of excess opacity is minimized but in no case allowed to exceed two hours in any 24-hour period, unless specifically authorized by EPA for longer durations. The proposed modifications allow for excess opacities caused by startups or upsets in accordance with Florida Administrative Code (FAC) 17-2.250. The EPA issued permit also imposes a 10% opacity limit on the refuse bunker and the ash handling and loadout. Work practice standards to minimize fugitive emissions are also prescribed in the EPA issued permit. An opacity monitor is required on the exit stack in the EPA issued permit but is not required in the proposed modifications.

f. The EPA issued permit requires annual compliance testing for lead and beryllium. Neither pollutant is required to undergo annual compliance testing in the proposed modifications.

g. The emission limits for fluorides are dissimilar in the two references. The EPA issued permit limits fluoride emissions to 0.0040 lb/mmBTU and also requires annual compliance testing for this pollutant. The proposed modifications limit fluoride emissions to 0.018 lb/mmBTU with no requirement for annual compliance testing.

h. The allowed incinerator operating capacities in both references should be made identical. We suggest that the Florida DER mandate the following permit provision:

> None of the three individual municipal solid waste incinerators shall be charged in excess of 302.5 mmBTU/hr and 806.6 tons per day MSW nor produce in excess of 186,000 lb/hr of steam (3-hr rolling average).

2. Emission Control Equipment

The proposed modifications state that "[t]he Facility shall be designed to allow installation of an acid gas scrubbing system if such a system should become required by regulation." This statement should be deleted since acid gas scrubbing is required.

Other Comments

1. There is no reference in the proposed modifications to compliance with the New Source Performance Standards (NSPS) Subparts E and Db.

2. There are no annual capacity factor limitations for use of natural gas and oil. Without specifying an annual capacity factor of 10 percent or less, the facility would have to comply with the NO_x emission standards contained in 40 CFR 60.44b.

3. The proposed modifications do not require that the temperature of the flue gas exiting the final combustion chamber of the incinerator be equal to or greater than 1800 degrees F.

4. The proposed modifications do not include provisions to require devices to continuously monitor and record steam production, the final combustion chamber temperature, and flue gases temperature at the exit of the acid gas removal equipment. These devices should be maintained and operated during all periods of operation.

5. The proposed modifications do not prohibit the burning of grease, scum, grit screenings, or sewage sludge.

6. Regarding air pollution control equipment, there should be provisions requiring:

   a. Each boiler shall be equipped with a particulate emission control device.

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

   c. The temperature of flue gases exiting the acid gas control equipment shall not exceed 300 degrees F.

7. A continuous emission monitoring system to determine stack gas opacity and SO_2, NO_x, CO, CO_2, and O_2 concentrations for each unit should be required as in the EPA issued permit. These monitors should be required to meet the EPA monitoring performance specifications of 40 CFR 60.13 and 40 CFR 60, Appendix B, during initial compliance testing and annually thereafter. Quality control for the monitors should be required in accordance with 40 CFR 60, Appendix F. Furthermore, devices should be installed to continuously monitor the temperatures of the final combustion chamber of the furnace and flue gases exiting the acid gas control device.

8. Quarterly reporting of excess emissions for opacity, CO, NO_x, and SO_2 as measured by the continuous monitors should be required and used for compliance determinations.

In summary, we urge you to closely compare the enclosed materials, i.e., the proposed certification modifications and EPA issued PSD permit. We will assist your agency in any way possible to promote consistency in our permitting actions and to ensure resultant environmental benefit.

If you need further assistance, please contact me or Mr. Mark Armentrout of my staff at (404) 347-2864.

Sincerely yours,

Bruce P. Miller

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

Enclosure

cc: Mr. Thomas M. Henderson
Project Director
Broward County Resource Recovery Office

Mr. Scott Benyon, Deputy Assistant Secretary
Southeast Florida District
1900 S. Congress Avenue, Suite A
West Palm Beach, Florida 33406

Mr. Gary Carlson, Chief
Air Permitting
Broward County Environmental Quality
Control Board

Mr. Hamilton S. Oven, Jr.
Division of Environmental Permitting
Florida Department of Environmental Regulation

copied: Barry Andrews
Tom Rogers
CHF/BT

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET
ATLANTA, GEORGIA 30365

OCT 2 0 1988

4APB/APT-aes

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

Re: North Broward Resource Recovery Facility, PSD-FL-113

Dear Mr. Henderson:

This letter is in response to your request of August 15, 1988, to modify PSD-FL-113 by substituting three von Roll incinerator units for four Volund incinerator units.

We understand with this substitution that: (1) source parameters of exit temperature, exit velocity, and equivalent diameter will now be the same as the South Broward unit, and (2) there will be no increase in the emission rates on other conditions of the permit used to assure that the estimated annual emissions are not exceeded.

Upon review of the new source parameters and comparing the dispersion modeling results presented in Tables IV-5 of both the South Broward and North Broward final determinations, we agree with your position that the modeled impacts for the North Broward units will approximate those of the South Broward units with the substitution of the changed stack parameters. Therefore, we concur that a new modeling analysis will not be required. We do require that a public notice be issued to advise the public of the changes being made and how the PSD increment will be impacted.

If I can be of further assistance, please contact me or Mr. Wayne Aronson of my staff at (404) 347-2864.

Sincerely yours,

Bruce P. Miller

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

cc: Clair H. Fancy, Deputy Chief
Bureau of Air Quality Management
Florida Department of Environmental
Regulation

PM
15 Sept. 87
Atlanta, GA

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET
ATLANTA, GEORGIA 30365

SEP 15 1987

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DER
SEP 18 1987
BAQM

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

Re: North Broward Resource Recovery Facility
(PSD-Fl-112)

Dear Mr. Henderson:

This is to notify you that no petitions have been filed with the Administrator regarding the above issued Prevention of Significant Deterioration (PSD) permit which you received on August 3, 1987, for the above referenced municipal solid waste incineration facility in Broward County, Florida. Therefore, in accordance with the provisions of the above permit, the effective date is September 3, 1987. If construction does not commence within eighteen (18) months after this effective date, or if construction is discontinued for a period of eighteen (18) months or more, or if construction is not completed within a reasonable time, this permit shall expire and authorization to construct shall become invalid.

Please direct any questions you may have to Mr. Wayne Aronson of my staff at (404) 347-2864.

Sincerely yours,

Winston A. Smith

Winston A. Smith, Director
Air, Pesticides, and Toxics
Management Division

cc: Mr. Clair Fancy, Deputy Chief
Bureau of Air Quality Management
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32301-2400

Copied: Clair Fancy
Barry Andrews
Pradeep Raval
} 9/21/87 (mr)

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

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Bureau of Air Quality Management
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2600 Blair Stone Road
Tallahassee, FL 32399-2400

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088-269

BROWARD COUNTY • FLORIDA

Resource Recovery Office
Room 521, 115 South Andrews Avenue
Fort Lauderdale, Florida 33301
(305) 357-6458

August 15, 1988

Mr. Bruce Miller, Chief, Air Program Branch
United States Environmental Protection Agency
Region IV
345 Courtland Street
Atlanta, Georgia 30365

Re: North Broward Resource Recovery Facility, PSD-FL-112

Dear Mr. Miller:

Thank you again for meeting with representatives of Broward County, its consulting engineer and project vendor on Thursday, August 4, 1988, concerning the potential for changing the incinerator equipment supplier for the North Broward Resource Recovery project.

It is our understanding that a major modification review would be triggered by an increase in either the emission rates stated in the Permit's specific conditions or in the facility's estimated annual emissions if such emissions exceed significant levels. Further, it is our understanding that a major modification review would not be triggered if there is no change in the emission rates or the other conditions of the permit used to assure that the estimated annual emissions are not exceeded, i.e. facility heat input rate, waste charging rate and steam flow rate. We would also have to demonstrate by modeling or other means that the changes in physical characteristics of the stack, such as flue exit diameters, would not result in significantly different ambient impacts.

Based upon our above described understanding, we request that the agency consider the following rewording of Part I, Specific Condition 1.c.(1) of the PSD Permit as a minor and not a major permit modification:

> "c. (1) None of the three ~~four~~ individual municipal incinerators shall be charged in excess of 302.5 ~~226.9~~ mmBtu/hr and 806.6 ~~605~~ tons per day MSW (1.08 ~~1.10%~~ rated capacity) nor produce in excess of 186,000 ~~139,500~~ lbs/hr of steam (3-hr rolling average)."

[New material underlined. Deleted material ~~struck~~.]

This change **would** allow for the substitution of three von Roll incinerator units for four Volund incinerator units. It **would** **not** change the specified emission rates or total facility heat input rate, waste charging rate or steam flow rate. We, therefore, believe such a change to be a "minor modification" in the context of the PSD Permit. See the two attached tables labeled "Physical Facilities and Permit Capacity Parameters" and "PSD Permit Emission Limitations."

After review, we believe further modeling to demonstrate compliance with ambient air quality standards (AAQS) and PSD increments is unnecessary. The reason for this is that the data that would be input into the model would be the same as that used in the modeling for the South Broward facility. These parameters include stack gas velocity, temperature and diameter, emissions and metrological data. The difference in stack height between the facilities, i.e. +1.6 meters, actually favors lower predicted concentrations for the North Broward facility. Thus, the impacts predicted for the South Broward facility as listed in Table V-5 and V-6 of the Final Determination can be used directly to assure compliance with AAQS and PSD increments for the North Broward facility.

Either Ron Mills or I will be in contact with Wayne Aronson later this week to verify our understanding of the "minor modification" nature of the proposed change and acceptability of using South Broward modeling results.

Again, thank you for meeting with us last Thursday on short notice. Your timely consideration of this matter is most appreciated.

Sincerely,

Thomas M. Henderson
Project Director

TMH/bd

cc: Wayne Aronson and Janet Hayward, USEPA Region IV
Neil Moses, Mark Hepp and Bruno Dunn, Wheelabrator Environmental Systems, Inc.
Ron Mills and David Cerrato, Malcolm Pirnie, Inc.
Steve Smallwood and Hamilton Oven, Florida Department of Environmental Regulation

PHYSICAL FACILITIES AND PERMIT CAPACITY PARAMETERS

PARAMETERS	NORTH FACILITY	SOUTH FACILITY	Proposed NORTH FACILITY
Number of Units	4	3	3
Nameplate Capacity			
Per Unit (tons/day)	550	750	750
Per Facility (tons/day)	2200	2250	2250
Maximum Heat Input Rate			
Per Unit (mmBtu/hour)	226.9	323.6	302.5
Per Facility (mmBtu/hour)	907.6	970.8	907.6
Maximum Charging Rate			
Per Unit (tons/day)	605	863	806.6
Per Facility (tons/day)	2420	2588	2420
Maximum Steam Rate			
Per Unit (lbs/hr)	139,500	192,000	186,000
Per Facility (lbs/hr)	558,000	576,000	558,000

Stack Exit Above Grade	61.0 M	59.4 M	61.0 M
Number of Flues per Stack	4	3	3
Flue Exit Diameters	1.5 M	2.29 M	2.29 M
Flue Exit Temperature	380 °K	381 °K	381 °K
Flue Gas Exit Velocity	18.2 M/Sec	18.0 M/Sec	18.0 M/Sec
Flue Gas Exit Flow Rate	68,260 ACFM/Flue	157,000 ACFM/Flue	157,000 ACFM/Flue
Assumed Equivalent Single Flue - Stack Diameter	3.0 M	5.03 M	5.03 M
Assumed Equivalent Single Flue - Exit Velocity	18.2 M/Sec	11.2 M/Sec	11.2 M/Sec

PSD PERMIT EMISSION LIMITATIONS

POLLUTANTS*	NORTH FACILITY	SOUTH FACILITY	Proposed NORTH FACILITY
Particulate Matter	0.015gr/dscf corrected to 12% CO_2	0.015gr/dscf corrected to 12% CO_2	0.015gr/dscf corrected to 12% CO_2
Sulfur Dioxide	0.140 or 65% removal (not to exceed 0.310)	0.140 or 65% removal (not to exceed 0.310)	0.140 or 65% removal (not to exceed 0.310)
Nitrogen Oxides	0.560	0.560	0.560
Carbon Monoxide	0.090	0.090	0.090
Lead	0.00056	0.00150	0.00056
Mercury	7.50×10^{-4}	7.50×10^{-4}	7.50×10^{-4}
Beryllium	9.30×10^{-7}	9.30×10^{-7}	9.30×10^{-7}
Floride	0.0040	0.0040	0.0040
Sulfuric Acid Mist	>90% removal not to exceed 4.70×10^{-3}	>90% removal not to exceed 4.70×10^{-3}	>90% removal not to exceed 4.70×10^{-3}
Opacity:			
Stack	15%	15%	15%
Refuse Bunker, Ash Handling & Load Out	10%	10%	10%

* Note: Values in lbs/mmBtu unless otherwise noted. Assumed Heat Content of MSW = 4500 Btu/lb.

81 pages

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET
ATLANTA, GEORGIA 30365

JUL 28 1987

APT-APB/eaw

RECEIVED

APR 4 1988

DER-BAQM

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

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

Re: North Broward Resource Recovery Facility (PSD-FL-112)

Dear Mr. Henderson:

Review of your February 14, 1986, application to construct a four unit, 226.9 mmBTU/hr (each) heat input, mass burn, municipal solid waste fired, energy recovery facility in Broward County, Florida, has been completed. The construction is subject to rules for the Prevention of Significant Deterioration (PSD) of air quality contained in 40 CFR §52.21. The Florida Department of Environmental Regulation (FDER) performed the preliminary determination concerning the proposed construction and published a request for public comment on September 13, 1986. Eleven public comments were received and addressed in the final determination. On June 26, 1987, the Environmental Protection Agency (EPA) prepared a final determination recommending issuance of the PSD permit by EPA.

EPA has determined that the construction as described in the application meets all the applicable requirements of 40 CFR §52.21. Accordingly, pursuant to 40 CFR §124.15, the Regional Administrator has made a final decision to issue the enclosed Permit to Construct: Part I. - Specific Conditions and Part II. - General Conditions. This authority to construct, granted as of the effective date of the permit, is based solely on the requirements of 40 CFR §52.21, air quality. It does not apply to other permits issued by this Agency or by other agencies. Please be advised that a violation of any permit condition, as well as any construction which proceeds in material variance with information contained in the final determination, will be subject to enforcement action.

This final permit decision is subject to appeal under 40 CFR §124.19 by petitioning the Administrator of the EPA within thirty (30) days after receipt thereof. The petitioner must submit a statement of reasons for the appeal and the Administrator must decide on the petition within a reasonable time period. If the petition is denied, the permit shall become effective upon notice of such action to the parties to the appeal. If no appeal is filed with the Administrator, the permit shall become effective thirty (30) days after receipt of this letter. Upon the expiration of the thirty (30) day period, EPA will notify you of the status of the permit's effective date.

Receipt of this letter does not constitute authority to construct. Approval to construct this four unit, mass burn, municipal solid waste fired, energy recovery facility shall be granted as of the effective date of the permit. The complete analysis which justifies this approval has been fully documented for future reference, if necessary. Any questions concerning this approval may be directed to Mr. Bruce Miller, Chief, Air Programs Branch at (404) 347-2864.

Sincerely yours,

Winston A. Smith

Winston A. Smith, Director
Air, Pesticides, and Toxics
Management Division

Enclosure

cc: Mr. Steve Smallwood, P.E., Chief
Bureau of Air Quality Management
Florida Department of Environmental
Regulation

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

Pursuant to and in accordance with the provisions of Part C, Subpart 1 of the Clean Air Act, as amended, 42 U.S.C. §7470 et. seq., and the regulations promulgated thereunder at 40 CFR §52.21, as amended at 50 Fed. Reg. 28550 (July 12, 1985),

North Broward County Resource Recovery Facility

is, as of the effective date of this permit (PSD-FL-112) authorized to construct a resource recovery facility consisting of four 605 ton per day (maximum capacity) mass burn, municipal solid waste incinerators and appurtenances at the following location:

2700 Hilton Road (N.W. 48th Street)
Pompano Beach, Florida 33060
Unincorporated Broward County, Florida.

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

This permit is hereby issued on JUL 28 1987 and shall become effective thirty (30) days after receipt hereof unless a petition for administrative review is filed with the Administrator during that time. If a petition is filed any applicable effective date shall be determined in accordance with 40 CFR §124.19(f)(1).

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

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

July 28, 1987
Date Signed

Lee A. DeHihns, III, for

Lee A. DeHihns, III, Deputy
Regional Administrator

PART I. - Specific Conditions

1. Emission Limitations

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

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

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

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

The 124 ppm limit above shall be modified to reflect a new emission limit (in ppm) from the control device at 65% control efficiency. Within 18 months of start-up of operation, the County shall submit compliance tests that will be used to determine the new SO_2 emission limit (in ppm). The limit will be determined by observed average emission rate (u) from the submitted compliance tests and will be statistically analyzed using the one tailed student T test ($t_{.05} = (\bar{x} - u)\, n^{0.5}/s$) at the 95% confidence level to derive a mean emission rate ($\bar{x}$), where s is the standard deviation of observed values n. The final operating SO_2 emission limit (in ppm) shall be this mean emission rate ($\bar{x}$). This value shall be restricted to no more than 124 ppm or less than 60 ppm (3-hr rolling average, dry volume, corrected to 12% CO_2).

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

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

Lead: .00056 lb/mmBtu

Fluorides: .0040 lb/mmBtu

Beryllium: 9.30×10^{-7} lb/mmBtu

Mercury: 7.50×10^{-4} lb/mmBtu

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

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

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

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

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

c. (1) None of the four individual municipal solid waste incinerators shall be charged in excess of 226.9 mmBtu/hr and 605 tons per day MSW (110% rated capacity) nor produce in excess of 129,500 lbs/hr of steam (3-hr rolling average).

(2) The temperature of the flue gas exiting the final combustion chamber of the incinerator shall not be less than 1800°F.

d. Compliance Tests

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3. Devices shall be installed to continuously monitor and record steam production, the final combustion chamber temperature, and flue gases temperature at the exit of the acid gas removal equipment. These devices shall be adequately maintained and operating during all periods of operation.

4. The height of each boiler exhaust stack shall not be less than 61.0 meters above ground level at the base of the stack.

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

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

7. Fuel

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

8. Air Pollution Control Equipment

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

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

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

   c. The temperature of flue gases exiting the acid gas control equipment shall not exceed 300°F.

9. Continuous Emission Monitoring

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

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

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

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

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

(4) The temperatures of the final combustion chamber of the furnace and flue gases exiting the acid gas control device shall be continuously monitored.

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

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

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

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

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

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

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

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

10. 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.

11. Reporting

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

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

c. Addresses for submitting reports are:

EPA Region IV

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

Florida Department of Environmental Regulation (DER)

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

Southeast District Office of DER

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

Broward County

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

PART II. - General Conditions

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

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

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

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

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

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

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

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

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

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

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

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

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

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

ASME
1986 NATIONAL WASTE
PROCESSING CONFERENCE

ATTACHMENT A

AN EXAMINATION OF PROPOSED ACCEPTANCE TESTING METHODS

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

ABSTRACT

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

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

INTRODUCTION

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

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

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

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

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

ELEMENTS OF A GOOD ACCEPTANCE TEST

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

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

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

THERMAL EFFICIENCY TESTING PROCEDURES

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

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

Input–output method:

Thermal efficiency (%)

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

Heat-loss method:

Thermal efficiency (%)

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

Modified heat-loss method:

Thermal efficiency (%)

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

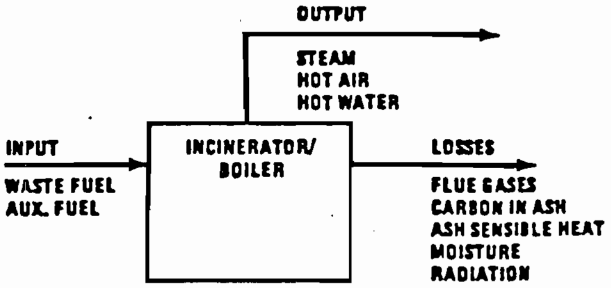

FIG. 1 ENERGY FLOW

Calorimeter method:

Thermal efficiency (%)

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

INPUT-OUTPUT

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

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

HEAT LOSS

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

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

SHORT FORM (MODIFIED) HEAT LOSS

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

CALORIMETER

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

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

AN ALTERNATE CONCEPT

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

CONCLUSIONS AND RECOMMENDATIONS

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

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

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

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TABLE 1 COMPARISON OF METHODS

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

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CALCULATING EFFICIENCY OF MUNICIPAL WASTE MASS BURNING ENERGY RECOVERY SYSTEMS

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ABSTRACT

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

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

INTRODUCTION

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

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

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

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

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

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

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

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

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

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

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

PERFORMANCE GUARANTEES

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

Common guarantees are:

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

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

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

(d) maximum particulate emissions and other environmental factors.

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

ADJUSTMENTS TO OBSERVED THROUGHPUT CAPACITY AND ENERGY RECOVERY RATES

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

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

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

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

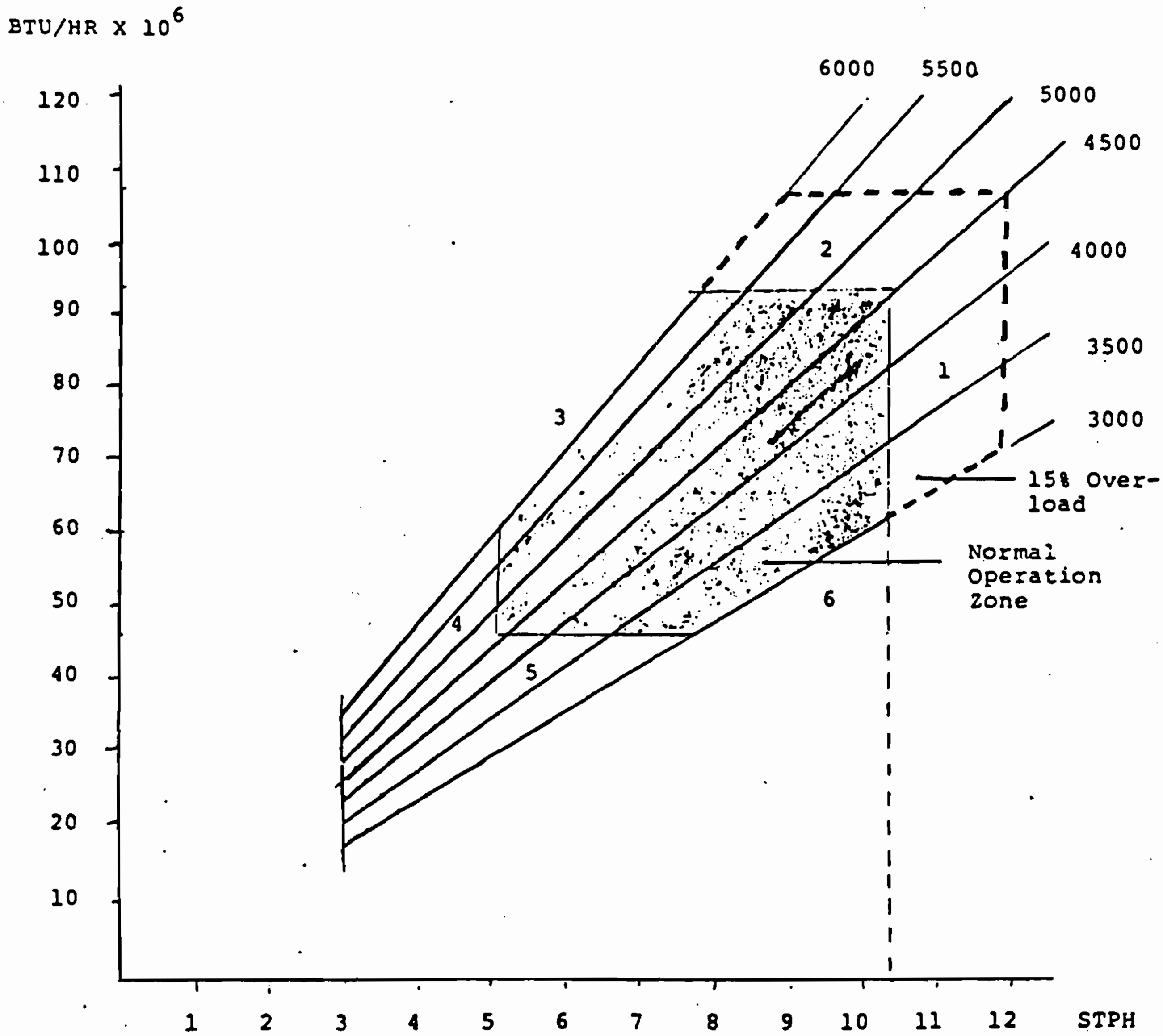
We also measure flue gas temperature and flow so we know everything going in and coming out.

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

SPECIFIC TEST PROCEDURES

INCINERATOR CAPACITY TEST

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



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

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

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

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

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

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

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

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

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

ENERGY RECOVERY TEST

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

Steam Raising Rate

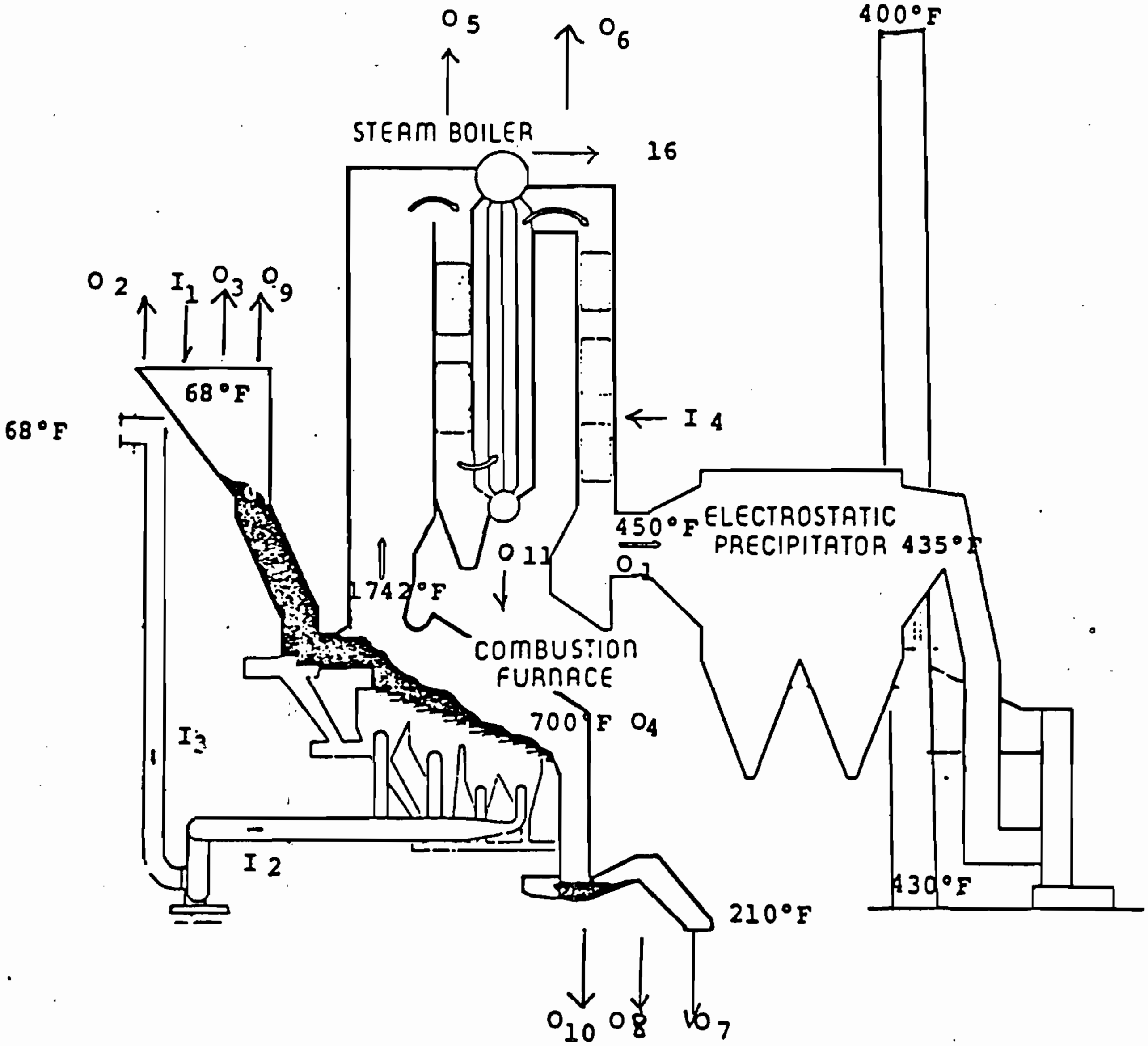
The purpose of this portion of the energy recovery test is to determine whether the facility meets the guaranteed steam raising rate, when processing solid waste, having the heating value of the reference solid waste, at a rate equal to the guaranteed daily throughput capacity under normal operating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

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

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

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

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



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

FIG. 2 ENERGY BALANCE FURNACE BOILER SYSTEM

TABLE 1 STEAMING RATE

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

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

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

METHOD OF DETERMINING SOLID WASTE HIGH HEATING VALUE

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

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

TABLE 2 REFUSE-FIRED BOILER ENERGY BALANCE

Item	Heat Loss	BTU/LB_R	$BTU X 10^6/DAY$
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. °F. (400°F-70°F.).	569.2	170.8
02.	Heat loss due to moisture in fuel = (Enthalpy of vapor at 1.0 PSIA @ exit gas temp. - enthalpy of liquid @ ambient air temp.) x moisture in the fuel LB/LB_R (.2119 LB/LB_R x (1240 Btu/LB-48 Btu/LB).	252.6	75.8
03.	Heat loss due to H_2O from comb. of H_2 = 9 x hydrogen in fuel LB/LBL (Enthalpy of vapor - enthalpy of liquid) 9 x .0338 x (1240-48).	362.6	108.8
04.	Heat loss due to combustibles in residue Carbon in residue x 14.500 Btu/LB .0136 x 14.500 Btu/LB.	197.2	59.2
05.	Heat loss due to radiation (ABMA Chart).	45.0	13.5
06.	Unaccounted for losses.	55.0	16.5
07.	Heat loss in residue. Dry residue including unburned carbon x (specific heat of residue) x (residue temp. leaving furnace - residue temp. after quench) .2730 LB/LB_R x .25 Btu/LB°F. x (700°F-210°F.).	33.4	10.0
08.	Heat loss due to moisture in residue. Moisture content of residue x (temp. @ residue leaving quench - temp. of water entering quench) 15/100 (.2730 LB/LB_R)(210°F.-70°F.) x 1 Btu/LB°F.	5.7	1.7
09.	Heat loss due to moisture in air. Total dry air required based on fuel rate x moisture in air x specific heat of air x exit gas temp.-inlet air temp.)(0.5583 LB/LB_R x .013 LB_{water}/LB_{air} x 0.429 BTU/LB°F. (400° F-70°F).	12.1	3.6
010.	Heat loss due to quench vapor. (Heat loss in dry residue ÷ latent heat of vapor @ atmospheric pressure) x (enthalpy of vapor entering boiler-enthalpy of vapor entering furnace. (33.44 Btu/LB ÷ 970.4 Btu/LB) x (1240 Btu/LB-970.4 Btu/LB).	9.3	2.8

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

Item	Heat Loss	BTU/LB_R	$BTU X 10^6/DAY$
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^oF.) $6.5583\ LB/LB_R$ x .24 Btu/LB^oF. x ($70^oF.-32^oF$.).	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^oF.). $6.5583\ LB/LB_R$ x .013 LB_w/LB_{air} x .489 Btu/LB^o F. ($70^oF. - 32^oF$.).	1.6	.5
I4.	Enthalpy of feedwater entering boiler (Feedwater temp.-32^oF.) x specific heat of water x lbs. of water/lb. of refuse. ($250^oF.-32^oF$.) x 1 Btu/LB^oF 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^o F. 3529.4 ÷ 1254.	2.82	

TABLE 3 SAMPLE FUEL HEATING VALUE DETERMINATION

DATA FROM PERFORMANCE TEST

Flue Gas

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

Ash

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

Combustion Air

Flow	- 140,067 lbs.
Temp.	- 70° F.

Refuse

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

Ash Cooling Water

Temp.	- 70° F.
Flow	- 957 lbs./hr.

TABLE 3 SAMPLE FUEL HEATING VALUE DETERMINATION (CONTINUED)

DETERMINATION OF ULTIMATE ANALYSIS OF REFUSE

Item		Lbs./Lb. Refuse
1	Carbon Content	
	$\frac{\%\ CO_2\ \text{Flue Gas} \times \text{Lb./Hr. Flue Gas} \times \text{Lb.}_C/CO_2}{\text{Lbs. Refuse}} + \frac{\%\ C_{Ash} \times \text{Lb.}_{Ash\ Dry}}{\text{Lbs. Refuse}}$	
	$\frac{.1179 \times 155{,}675 \times .2732}{20{,}200} + \frac{.08 \times 4687}{20{,}200}$	.2472
2	Hydrogen Content	

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

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

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

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

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

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

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

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

$$= .2774$$

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	
	$\frac{\% SO_2 \times Lb._{FG} \times Lb._S/Lb._{SO_2}}{Lb._{Refuse}} + \frac{\% S_{Ash} \times Lb._{Ash}}{Lb._{Refuse}}$	
	$\frac{.002 \times 155{,}675 \times .5}{20{,}200} + \frac{.0024 \times 4682}{20{,}200}$	.0011
4	Moisture Content	.2774
5	Nitrogen Content (Est. Value)	.0060
6	Ash Content	
	$= \text{Residue} - H_2O_{Refuse} - C_{Ash} - S_{Ash}$	
	$= \frac{5515}{20{,}200} - \frac{.15 \times 5515}{20{,}200} - \frac{.05 \times 5515}{20{,}200} - \frac{.001 \times 5515}{20{,}200}$	.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 calcrimeter seems to be reasonable and more accurate than trying to determine the precise composition of refuse by sorting and analysis.

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

ACKNOWLEDGMENTS

1982 National Waste Processing Conference Proceedings, various papers.

REFERENCES

[1] *Steam/It's Generation and Use*, The Babcock & Wilcox Company, 1978.

[2] *Handbook of Solid Waste Management*, David Gordon Wilson, 1977.

[3] *Steam Generating Units – Power Test Codes*, ASME PTC 4.1, 1964.

[4] *Industrial Guide for Air Pollution Control*, EPA Handbook.

[5] *Predicting & Testing Incinerator-Boiler Efficiency. A Proposed Short Form Method in Line with the ASME Test Code PTC-33*, Georg Stabenow, 1980.

[6] *Large Incinerators*, ASME, PTC 33-1978.

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

Promulgation of Quality Assurance Requirements for Gaseous Continuous Emission Monitoring Systems Used for NSPS Compliance Determination

On June 4, 1987 quality assurance final rules were promulgated (40 CFR 60, Appendix F, Procedure 1) for gaseous continuous emission monitoring systems (CEMS) used for new source performance standards compliance determinations. These quality assurance requirements must be implemented by December 4, 1987 for the following source categories:

Subpart D_a (40 CFR 60): Electric Utility Steam Generating Units (constructed after 9-18-78). Both SO_2 and NO_x CEMS must implement the quality assurance requirements.

Subpart D_b (40 CFR 60): Industrial-Commercial-Institutional Steam Generating Units (constructed after 6-19-84). Both SO_2 and NO_x CEMS must implement the quality assurance requirements.

The quality assurance requirements include the following:

1. A quarterly performance audit to measure the CEMS accuracy and make sure the system is operating properly.

2. Criteria that defines when the CEMS is out of control and corrective action must be taken.

3. Criteria for invalidating CEMS measurement data.

4. A QC program must be developed that includes step-by-step written procedures for six activities described in Section 3 of the final rules.

Enclosed is a copy of the June 4 Federal Register containing the final rules. Also enclosed are the following three guidance documents which you may find useful in implementing the final rules:

Section 3.0.4. This is the revised EPA Traceability Protocol No. 1 for cylinder gases. Section 5.1.2 of the final rules requires that gases used for Cylinder Gas Audits (CGA) must be prepared according to this Section 3.0.4.

Section 3.0.7. This provides example calculations for the Relative Accuracy Test Audit (RATA), Relative Accuracy Audit (RAA) and the CGA.

Section 3.0.10. This provides guidance on the six activities that need written procedures as part of the QC program described in Section 3 of the final rules.

Sections 3.0.4, 3.0.7 and 3.0.10 will be published as part of the Quality Assurance Handbook for Air Pollution Measurement Systems. Volume III - Stationary Source Specific Methods (EPA-600/4-77-027b). These sections are included here to provide guidance in advance in order to meet the December 4, 1987 implementation date for the final rule.

After the final rules are implemented, the Quality Assurance Division of the Environmental Monitoring Systems Laboratory (EMSL) at RTP, NC plans an "Annual Report on CEMS Accuracy and Problems" based on the Data Assessment Reports (DAR) submitted quarterly by the source owners/operators.

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 60

[AD-FRL-3021-7]

Standards of Performance for New Stationary Sources; Quality Assurance Requirements for Gaseous Continuous Emission Monitoring Systems Used for Compliance Determination

AGENCY: Environmental Protection Agency (EPA).

ACTION: Final rule.

SUMMARY: Addition of Appendix F, Procedure 1—Quality Assurance Requirements for Gaseous Continuous Emission Monitoring Systems (CEMS's) Used for Compliance Determination was proposed in the Federal Register on March 14, 1984 (49 FR 9676). This action promulgates the addition of Appendix F, Procedure 1, that will be applicable for evaluating effectiveness of quality control (QC) and quality assurance (QA) procedures and the quality of data produced by any CEMS used to demonstrate compliance with 40 CFR Part 60 emission regulations on a continuous basis. Procedure 1 applies to steam generating units subject to 4 CFR Part 60, Subpart Da. The intended effect of this regulation is to require sources that are required to use CEMS's for continuous compliance determination to evaluate CEMS data quality and report results of quarterly accuracy determinations and calibration drift (CD) tests with the required emission reports. Procedure 1 defines the test procedures and criteria for acceptable data quality.

EFFECTIVE DATE: June 4, 1987.

Under section 307(b)(1) of the Clean Air Act, judicial review of these additions to 40 CFR Part 60 is available *only* by the filing of a petition for review in the U.S. Courts of Appeals for the District of Columbia Circuit within 60 days of today's publication of this rule. Under section 307(b)(2) of the Clean Air Act, the requirements that are the subject of today's notice may not be challenged later in civil or criminal proceedings brought by EPA to enforce these requirements.

ADDRESSES: *Summary of Comments and Responses*. The summary of comments and responses for the proposed addition of Appendix F, Procedure 1, may be obtained from the U.S. EPA Library (MD-35), Research Triangle Park, North Carolina 27711, telephone number (919) 541-2777. Please refer to "Appendix F—Quality Assurance Procedures, Procedure 1—Quality Assurance Requirements for Gaseous Continuous Emission Monitoring Systems Used for Compliance Determination (Proposed March 14, 1984, 49 FR 09676)—Summary of Comments and Responses, EPA-450/3-87-009." The document contains (1) a summary of the changes made to Procedure 1 since proposal and (2) a summary of all the public comments made on the proposed addition and the Agency's response to the comments.

Quality Assurance Guidelines: A document entitled "Calculation and Interpretation of Accuracy for Continuous Emission Monitoring Systems" is available from the U.S. EPA, Office of Research and Development Publications, 26 West St. Clair Street, Cincinnati, Ohio 45268. It is Section 3.0.7 of the Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, Stationary Source Specific Methods, EPA-600/4-77-027b. The purpose of this document is to provide operators and reviewers of CEMS's with guidelines for evaluating results of CEMS relative accuracy tests and audits.

Docket. A docket, number A-80-29, containing information considered by the Agency in the development of the additions is available for public inspection between 8:00 a.m. and 4:00 p.m. Monday through Friday, at EPA's Central Docket Section (LE-131), West Tower Lobby, Gallery 1, 401 M Street, S.W., Washington, D.C. 20460. A reasonable fee may be charged for copying.

FOR FURTHER INFORMATION CONTACT: Darryl J. von Lehmden, Quality Assurance Division, Environmental Monitoring Systems Laboratory (MD-77), U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711, telephone (919) 541-2415; or Peter R. Westlin, Emission Standards and Engineering Division, (MD-19), U.S. EPA, Research Triangle Park, North Carolina 27711, telephone number (919) 541-2237.

SUPPLEMENTARY INFORMATION:

I. Public Participation

The addition of Appendix F, Procedure 1, was proposed in the Federal Register on March 14, 1984 (49 FR 9676). Public comments were solicited at the time of proposal. To provide interested persons the opportunity for oral presentation of data, views, or arguments concerning the proposed procedures, a public hearing was scheduled for April 9, 1984, beginning at 9:00 a.m. However, the hearing was not held because no one requested to speak. The public comment period was from March 14, 1984, to May 14, 1984, and was later extended to July 13, 1984 (49 FR 24151).

Thirty-nine comment letters concerning the issues relative to the proposed procedures were received. The comments have been carefully considered; and, where determined to be appropriate by the Agency, changes have been made in the proposed addition.

II. Significant Comments and Changes to the Proposed Appendix F, Procedure 1

Comments on the proposed addition of Appendix F, Procedure 1, were received from industry, Federal agencies, State air pollution control agencies, trade associations, and equipment manufacturers. A detailed discussion of these comments and responses can be found in the document described in the ADDRESSES section of the preamble. The summary of comments and responses are summarized in this preamble. Most of the comment letters contained multiple comments. The comments have been divided into categories cited below.

Applicability

Several commenters were concerned that Procedure 1 would become applicable to Subpart D sources which in turn would have to undertake significant changes to CEM's installed under less stringent regulations. The commenters suggested that the applicability of appendix F be limited to CEMS's installed after the promulgation of the regulation. The Agency has determined that QA procedures are necessary when CEMS's are used for compliance determinations. Revisions to Subpart D were proposed on October 21, 1983 (48 FR 48960), and the proposal contained continuous compliance provisions. However, the burden of any CEMS changes required because of the application of Procedure 1 will be evaluated when and if revisions to Subpart D are promulgated.

Two commenters stated that 6 months would be insufficient time to incorporate the data reduction procedures, write the QC procedures, and hire and train additional personnel needed to comply with the requirements in Procedure 1. The Agency revised Procedure 1 as proposed to eliminate the precision determination that would have required considerable revision of existing computer operated systems. It is the opinion of the Agency that, without the precision determination provisions, 6 months is sufficient time to prepare to comply with Procedure 1. The proposed revisions to Subpart D included a provision to allow affected sources 1 full year to develop CEMS's before having to comply with the revised regulations.

Several commenters expressed concerns about the applicability of continuous compliance regulations and the use of CEMS's for compliance determinations. The determination that a CEMS is an appropriate compliance tool for new source performance standards was not within the scope of the procedure 1 proposal. Such a determination was made with respect to Subpart Da in that rulemaking and is a subject of the pending Subpart D rulemaking. Procedure 1 provides a basis for evaluating CEMS data that are used for compliance determinations.

Quality Control Requirements

Three commenters suggested that the criteria list in the QC section be expanded to include several site-specific factors. The Agency believes that the list in Procedure 1 is as complete as reasonably possible in a general regulation. The CEMS operator is encouraged to develop a quality control list specifically suited to the situation.

One commenter stated that the rewriting of the QC procedures following successive audit failures will not improve the performance of a poorly designed CEMS. The Agency recognizes that the design and application of a CEMS are important factors in the successful operation of the CEMS. Replacement of an inadequate CEMS may be the only appropriate action available after continued poor operation and is an action that should be considered in developing the QC plan.

Assessment of Data Precision

Many commenters stated that assignment of cylinder gas or gas cell concentration values using CEMS responses should not be allowed. The commenters suggested using reference methods for this determination. The Agency notes that the cylinder gas or gas cells are used in this case to measure CEMS response drift. For this purpose, it is not necessary to know the input values with absolute accuracy, but only that the value is stable.

Many commenters noted that present regulations require daily zero and span CD check and adjustment and that additional precision determinations were unnecessary. Reporting requirements for these precision assessments were burdensome, as well. The Agency agrees that the precision calculation and reporting are unnecessary for QA and has removed the precision section from Procedure 1. The CD determination procedure has been expanded to include the zero (or low-level) value as well as the upper-level value.

Zero and Upper-Level Calibration Drift

Three commenters stated that it would be appropriate to declare a CEMS to be out-of-control when drift exceeded twice the Appendix B specifications on any day, rather than only after 5 successive days. The Agency's experience is that application of this lower limit over an extended period of time may lead to excessive adjustment frequency and CEMS instability. A single drift measurement in excess of the lower limit could be a result of a statistical aberration, a dirty window which could be easily cleaned, or a nearly empty gas cylinder, none of which would be cause for declaring the CEMS out-of-control.

Many commenters stated that the requirement to conduct a relative accuracy audit (RAA) following an out-of-control caused by excessive drift period is excessive. The Agency agrees with this comment and revised the proposal to include the determination of the end of the out-of-control period that is a result of excessive drift by demonstrating that the CEMS is operating within drift specifications.

Several commenters noted that this section and other sections of Procedure 1 required that source operators use alternate methods of obtaining emissions data when the CEMS is out-of-control. This requirement in Procedure 1 could lead to significant expenditures for alternate monitoring. The Agency has clarified the language from the proposal to note that Procedure 1 defines the criteria which determine when a CEMS is out-of-control. Under such conditions, the CEMS data are not valid for meeting the minimum data availability requirements found in continuous compliance regulations. The applicable regulations specify the minimum data availability requirements and these requirements, not Appendix F, dictate the necessity for alternate emission monitoring when the CEMS is out-of-control. The alternate monitoring method may be another CEMS which would also be subject to the requirements in Appendix F, Procedure 1.

Three commenters suggested the use of historical data for CEMS out-of-control periods as a valid alternative method. The Agency agrees that historical diluent emission data could be considered a valid alternative method, but that review of the alternative procedure and data by the Agency would be necessary before approval for specific or general use. Description of the procedure is included in 40 CFR 60.13(i).

One commenter provided a review of CEMS CD data (collected by EPA during a CEMS demonstration project) that indicated substantial invalidation of data because of excessive drift. The Agency reviewed the commenter's analyses and determined that the commenter erred in establishing the appropriate CD limits and in determining the number of out-of-control periods. The drift limit established by the commenter was about one-half of that defined in Procedure 1. This significant difference in CD on drift limits produced a significantly larger number of apparent drift limit violations than would be determined following the criteria in Procedure 1.

In addition, the commenter divided relatively long periods of poor CEMS performance into several periods of out-of-control operation. If the criteria in Procedure 1 had been followed, these individual periods of out-of-control performance would have been consolidated into relatively few out-of-control periods that would have ended only when corrective action was completed. The Agency has determined the long term CEMS operation can continue uninterrupted or with only few interruptions attributable to drift criteria violations.

Assessment of Data Accuracy

Many commenters expressed the opinion that quarterly assessment of data accuracy is too frequent. Suggestions for alternative schedules ranged from annual to only once at the time of CEMS installation. The commenters provided no information supporting a reduction in audit frequency. While the Agency agrees that CEMS design, application, and maintenance are critical to proper operation and high data quality, the Agency is convinced that the only measure of QC effectiveness is a periodic accuracy audit. The Agency's experience indicates that a quarterly audit frequency is appropriate; this is based on the results of studies of long term performance of CEM's performed by the EPA Office of Research and Development (technical paper describing the work is in the docket).

Procedure 1 has been revised from the proposal to reduce the burden of accuracy auditing within the scope of quarterly audit periods. The relative accuracy test audit (RATA) is performed as defined in the applicable performance specification in Appendix B and is required only once per year. Either of two other audit procedures is allowed for the other three audit periods each year; these procedures are the cylinder gas audit (CGA) and the RAA based on a three-run, manual method test.

Five commenters urged the use of calibration gas cells as acceptable audit materials. The Agency has no independent procedure for determining accurately the appropriate CEMS response a gas cell should produce. Without an independent certification of gas cells or an appropriate application procedure, the Agency has determined that gas cell audit material is unacceptable for accuracy auditing.

Several commenters proposed alternative audit procedures including fuel sampling and analysis, process rate measurements, and inclusion of new test method procedures (e.g., Methods 6A and 6B). The Agency has no data to support the use of fuel sampling and analysis procedures as a basis for CEMS accuracy auditing on any reasonable time scale (e.g., hourly or daily). The imprecision associated with fuel data for these short test periods is much greater than the acceptable drift limits specified for CEMS. Process rate measurements are also inappropriate as accuracy audit bases because of the source-specific nature of such procedures. The Agency provides means for reviewing and approving acceptable alternative procedures applicable to specific sources.

The Agency agrees that promulgated methods, such as Methods 3A, 6A, 6B, 6C, and 7E should be allowed as accuracy audit methods and has revised the appropriate paragraphs in the General Provisions accordingly.

Two commenters questioned the need to specify that all audits be completed in the first 2 months of any quarter. The Agency agrees and has changed the requirement in Procedure 1 to allow the audit to occur any time during a quarter, but there must be a minimum of 60 days between two quarterly audits.

Two commenters recommended three-point calibration checks in lieu of the two-point audit specified in Procedure 1 as a more appropriate audit procedure. The Agency disagrees that a three-point, repeated, calibration error test is a more appropriate audit. The calibration error test provides information about the linearity of the CEMS response throughout the range of the instrument response. The CGA in Procedure 1 tests the CEMS for the accuracy of responses to two audit gases with concentrations representing and bracketing the expected level of emissions at the level of the emission standard. This is a procedure that more appropriately represents an independent audit.

Several commenters proposed to allow manual method analysis of cylinder gas concentrations for the CGA. The Agency has determined that independent analysis of audits is necessary and has established a policy of traceability to National Bureau of Standards standard gaseous reference materials (SGRM's) or manufacturers' certified reference materials (CRM's) for this purpose.

Two commenters stated that use of the CGA and prohibition of the use of gas cells for auditing favors some CEMS technology over other types of systems. This, the commenters argued, discourages research and development of new equipment. The Agency believes the CGA is a technically acceptable, demonstrated, independent auditing procedure for CEM's. As noted earlier, the gas cell is not acceptable at this time as an audit material. Approval of a demonstrated alternative procedure, such as the CGA, is not favoritism nor should it discourage development of other audit procedures or CEMS instrumentation.

Three commenters requested clarification or the definition of when an out-of-control period begins and ends. There are two tests that may result in out-of-control periods: the CD check and the accuracy audit. An out-of-control period resulting from excessive CEMS drift begins when the fifth consecutive excessive drift determination (or first drift determination in excess of four times the drift specification) occurs. The out-of-control period ends when corrective action is completed and the CEMS is demonstrated to operate within acceptable drift specifications again (i.e., at the end of the day when the CD measurements are within specifications).

The CEMS is determined to be out-of-control as a result of excessive inaccuracy from the time the accuracy audit sampling is completed. This does not include the time for sample analysis and data reduction. The out-of-control period ends when the CEMS completes the audit sampling successfully; again, time for sample analysis and data reduction is not included. This approach emphasizes the importance of expediting sample analysis and data reduction.

Two commenters questioned the requirement to conduct accuracy audits periodically when the source is operated seasonally or otherwise intermittently. The cost of possible forced-operation of a source in order to conduct an accuracy audit would be significant. Procedure 1 as promulgated requires only an annual RATA while quarterly audits may be completed using CGA or RAA. The Agency believes it is not burdensome to require a RATA and at least 50 percent load operation once per year. The Agency also believes it is critical to maintain operation of a CEMS regardless of operation of the source if that CEMS is to provide compliance data when the source is operating at compliance levels. The operator of a source that operates seasonally can request a revised schedule for auditing from the Agency that would include the RATA.

EPA Performance Audit Program

One commenter questioned the ability of the Agency to supply the EPA methods performance audit samples required for every RATA. The Agency has made the necessary plans with suppliers to have a sufficient supply of audit samples available not only for the RATA's but also for other compliance testing required using EPA methods.

Calculation of Data Accuracy

One commenter questioned the use of the confidence interval in calculating relative accuracy (RA) with fewer than nine data sets. While it is correct statistically to include the confidence interval with any number of data sets, the potential size of the confidence interval can overshadow the mean or average value when the number of data sets is reduced to as few as three. For this reason, the RAA quarterly audit alternative using only three runs will be determined based on the average values only. The RATA is conducted annually and will include the sum of the nine run average and the confidence interval in calculating RA.

Reporting Requirements

Five commenters stated that the promulgation of Appendix F, Procedure 1, would significantly increase recordkeeping and reporting requirements for affected facilities. They questioned whether the increase in labor and associated costs would yield a commensurate improvement in data quality. The Agency has eliminated a great deal of the data reduction and reporting requirements from the Procedure 1 proposal with the deletion of the precision determinations. The Agency believes it is not burdensome to require a source to supply audit results, drift assessments, and information about out-of-control periods with other compliance reports. Procedure 1 will not significantly increase the reporting requirements for sources using CEMS's for compliance monitoring.

One commenter proposed that Procedure 1 include a provision that would not preclude control agencies from taking into account QA results when reviewing CEMS data, but prohibit sources from doing so. The Agency's response is that it is technically incorrect to adjust CEMS data using RAA results. This applies to both the source owner/operator reporting the data and the control agency reviewing the results. Source operators must comply with reporting and recordkeeping requirements as they are written.

The bases for not allowing adjustment of CEMS results are the imprecision and error associated with both the CEMS and the audit method results. These measurement factors are the reason for allowing a range of audit results (e.g., 20 percent for the RATA) that indicates acceptable CEMS performance. In addition, the audits represent only a brief period of CEMS and process operation while compliance data represent relatively long periods of operation. There is no technical basis for adjusting CEMS results using QA data. Quality assurance results should be considered only in assuring that the CEMS performance is within specifications.

Costs of Implementation

Five commenters recalculated the estimated labor-years required to implement Procedure 1 at Subpart Da sources and found the number to be 124 person-years instead of the 80 person-years mentioned in the proposed preamble. The Agency determined the labor needed to meet the Procedure 1 requirements in the industry recognizing that not all Subpart Da sources would be operating the entire evaluation period (5 years). The commenters' figures represent the worst case view, but the Agency's 80 person-year value is also a conservative figure that more closely represents the expected costs.

Many commenters noted that the level of effort included in the proposal substantially underestimates the expected costs, because the proposal has labor estimates based on an evaluation of a unit having only one SO_2 and one NO_x monitor. Subpart Da sources are required to monitor SO_2 control efficiency which dicates that uncontrolled SO_2 emissions and diluent gases also be monitored. The Agency underestimated the costs of implementing Procedure 1 at a Subpart Da source by a factor of two, according to the commenters.

The Agency agrees that the cost estimates in the proposal were derived for only an outlet CEMS. However, adding the costs incurred by including an inlet CEMS will not necessarily double the costs of applying Procedure 1. Many QA tasks can be consolidated and duplication avoided so that total costs should be considerably less than twice the conservative costs mentioned in the proposal.

There are a number of other changes incorporated into Procedure 1 since proposal that will decrease estimated costs of implementation. The precision assessment and reporting have been eliminated. The RATA has been changed to once annually instead of semiannually, and the CGA and abbreviated RAA are allowed the other three quarters. The Agency has estimated effort for implementing Procedure 1 based on the promulgation version and determined these costs to be between 326 and 704 labor hours per year for a Subpart Da facility depending on the type of audit used, CGA or RAA. This cost is consistent with the estimate described in the proposal and does not significantly change the estimated effects on the industry.

The Agency believes that the benefits from providing useable, valid, compliance emission data apply to both the source operator and the regulatory agency. The expenses for implementing Procedure 1 are worthwhile for the increased confidence in demonstrating compliance and in instituting enforcement action. Source operators further benefit through the availability of continuous, valid information on the operation of the control system and can use such data to optimize operation.

Miscellaneous

One commenter suggested that the Agency should focus on the research and development of CEMS technology in developing less burdensome QA requirements. The Agency believes CEMS technology is sufficiently developed to apply it to continuous compliance determinations. Numerous, successful, long-term, CEMS demonstrations have been reported by both the Agency and by industrial users. There is no substantive reason for delaying the implementation of Procedure 1.

III. Docket

The docket is an organized and complete file of the information considered by EPA in the development of this rulemaking. The docket is a dynamic file, since material is added throughout the rulemaking development. The docketing system is intended to allow members of the public and industries involved to identify and locate documents readily so they can intelligently and effectively participate in the rulemaking process. Along with the statement of basis and purposes of the proposed and promulgated rule and EPA responses to significant comments, the contents of the docket will serve as the record in case of judicial review [section 307(d)(7)(a)].

IV. Miscellaneous

Under Executive Order 12291, EPA must judge whether a regulation is "major" and, therefore, subject to the requirement of a regulatory impact analysis. This regulation is not major because it will not have an annual effect on the economy of $100 million or more; it will not result in a major increase in costs or prices; and there will be no significant adverse effects on competition, employment, investment, productivity, innovation, or on the ability of U.S.-based entrprises to compete with foreign-based enterprises in domestic or export markets.

The Regulatory Flexibility Act of 1980 requires identification of potentially adverse impacts of Federal regulations upon small business entities. The Act specifically requires the completion of a Regulatory Flexibility Analysis in those instances where small business impacts are possible. Because this regulation affects only one source category, large utility boilers, and does not affect small business entities, no Regulatory Flexibility Analysis has been conducted.

Pursuant to the provisions of 5 U.S.C. 605(b), I hereby certify that the proposed rule will not have a significant economic impact on any small entities.

This regulation was submitted to the Office of Management and Budget (OMB) for review as required by Executive Order 12291. Any written comments from OMB and any written EPA responses are available in the docket.

Dated: May 27, 1987.

Lee M. Thomas,

Administrator.

List of Subjects in 40 CFR Part 60

Air pollution control, sulfur dioxide.

PART 60—[AMENDED]

40 CFR Part 60 is amended as follows:

1. The authority for testing, monitoring, and reporting in Part 60 continues to read.

Authority: Secs. 101, 111, 114, 116, 301 of the Clean Air Act, as amended 42 U.S.C. 7401, 7411, 7414, 7416, 7601.

2. Section 60.13 is amended by revising paragraph (a) to read as follows:

§ 60.13 Monitoring requirements.

(a) For the purposes of this section, all continuous monitoring systems required under applicable subparts shall be subject to the provisions of this section upon promulgation of peformance specifications for continuous monitoring systems under Appendix B to this part and, if the continuous monitoring system is used to demonstrate compliance with emission limits on a continuous basis, Appendix F to this part, unless otherwise specified in an applicable subpart or by the Administrator. Appendix F is applicable December 4, 1987.

* * * * *

3. Section 60.45 is amended by revising paragraph (c)(1) to read as follows:

§ 60.45 Emission and fuel monitoring.

* * * * *

(c) * * *

(1) Methods 3 or 3A, 6, 6A, 6B or 6C, and 7, 7A, 7C, 7D or 7E, as applicable, shall be used for conducting relative accuracy evaluations of sulfur dioxide and nitrogen oxides continuous emission monitoring systems. Methods 3A, 6C, and 7E shall be used only at the sole discretion of the source owner or operator.

* * * * *

4. Section 60.47a is amended by revising paragraphs (h), (h)(1), (h)(2), and (i)(l) to read as follows:

§ 60.47a Emission monitoring.

* * * * *

(h) Methods used to supplement continuous emission monitoring system data to meet the minimum data requirements in § 60.47a(f) will be used as specified below or as otherwise approved by the Administrator.

(1) Methods 3 or 3A, 6 or 6C and 7, 7A, 7C, 7D or 7E as applicable, are used. Method 6A or 6B may be used whenever Methods 6 and 3 data are required to determine the SO_2 emission rate in ng/J. Methods 3A, 6C, and 7E are used only at the sole discretion of the source owner or operator. The sampling location(s) are the same as those specified for the continuous emission monitoring system.

(2) For Method 6 or 6A, the minimum sampling is 20 minutes and the minimum sampling volume is 0.02 dsm^3 (0.71 dscf) for each sample. Samples are collected at approximately 60-minute intervals. Each sample represents a 1-hour average. Method 6B shall be operated for 24 hours per sample, and the minimum sample volume is 0.02 dsm^3 (0.71 dscf) for each sample. Each Method 6b sample represents 24 1-hour averages.

* * * * *

(i) * * *

(1) Methods 3 or 3A, 6, 6A, 6B or 6C, and 7, 7A, 7C, 7D or 7E, as applicable, are used for conducting relative accuracy evaluations of sulfur dioxide and nitrogen oxides continuous emission monitoring systems. Methods 3A, 6C, and 7E are used only at the sole discretion of the source owner or operator.

* * * * *

5. By adding Appendix F, Procedure 1, to read as follows:

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 December 4, 1987. The first CEMS accuracy assessment shall be a relative accuracy test audit (RATA) (see section 5) and shall be completed by March 4, 1988 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 accuracy. The other function is the control and improvement of the quality of the CEMS data by implementing QC policies and corrective actions. These two functions form a control loop: When the assessment function indicates that the data quality is inadequate, the control effort must be increased until the data quality is acceptable. In order to provide uniformity in the assessment and reporting of data quality, this procedure explicitly specifies the assessment methods for response drift and accuracy. The methods are based on procedures included in the applicable performance specifications (PS's) in Appendix B of 40 CFR Part 60. Procedure 1 also requires the analysis of the EPA audit samples concurrent with certain reference method (RM) analyses as specified in the applicable RM's.

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

2. Definitions

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

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

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

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

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

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

3. QC Requirements

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

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

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

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

4. CD Assessment

4.1 CD Requirement. As described in 40 CFR Part 60.13(d), source owners and operators of CEMS must check, record, and quantify the CD at two concentration values at least once daily (approximately 24 hours) in accordance with the method prescribed by the manufacturer. The CEMS calibration must, as 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, if performed, or record the amount of adjustment.

4.3 Criteria for Excessive CD. If either the zero (for low-level) or high-level CD result exceeds twice the applicable drift specification in Appendix B for five, consecutive, daily 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 fifth, consecutive, daily CD check with a CD in excess of two times the allowable limit, or the time corresponding to the completion of the daily CD check preceding the daily CD check that results in 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 CD check following corrective action that results in the CD's at both the zero (or low-level) and high-level measurement points being within the corresponding allowable CD limit (i.e., either two times or four times the allowable limit in Appendix B).

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

4.4 Data Recording and Reporting. As required in § 60.7(d) of this regulation (40 CFR Part 60), 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 (RATA). 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:

Please note that section 5.2 - Criteria for Excessive Inaccuracy has not been published correctly and should be as follows:

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 100 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 perent of the applicable standard. If the inaccuracy exceeds $\pm$ 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, then corrective action must be taken and following the corrective action the source owner or operator must audit the CEMs accuracy with a RATA, CGA or RAA. RATA must always be used following an out-of-control period resulting from a RATA. The CEMS audit following corrective action does not require the 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 showing the CEMS to be out-of-control and the result of the audit following corrective action showing the CEMS to be operating within specifications.

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

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

Use of seperate audit gas cylinder for audit points 1 and 2. Do not dilute gas from 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 comparision 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 (RAA). 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.

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 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, corrective action, the source owner or operator must audit the CEMS accuracy with a RATA, CGA, or 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 showing the dems 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 availabilty as required and described in the applicable subpart [e.g., § 60.47a(f)].

5.3 Criteria for Acceptable QC Procedure. Repeated excessive inaccuracies (i.e., out-of-control conditions resulting from the quarterly audits) indicates the QC procedures are inadequate or that the CEMS is incapable of providing quality data. Therefore, whenever excessive inaccuracies occur for two consective 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 must be calculated in units of the applicable emission standard (e.g., ng/J).

6.3 CGA Accuracy Calculation. Use Equation 1-1 to calculate the accuracy for the CGA, which is calculated in units of the appropriate concentration (e.g., ppm SO_2 or percent O_2). 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 3.

7. Reporting Requirements

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

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

1. Source owner or operator name and address.
2. Identification and location of monitors in the CEMS.
3. Manufacturer and model number of each monitor in the CEMS.
4. Assessment of CEMS data accuracy and date of assessment as determined by a RATA, RAA, or CGA described in Section 5 including the RA for the RATA, the A for the RAA or CGA, the RM results, the cylinder gases certified values, the CEMS responses, and the calculations results as defined in Section 6. If the accuracy audit results show the CEMS to be out-of-control, the CEMS operator shall report both the audit results showing the CEMS to be out-of-control and the results of the audit following corrective action showing the CEMS to be operating within specifications.
5. Results from EPA performance audit samples described in Section 5 and the applicable RM's.
6. Summary of all corrective actions taken when CEMS was determined out-of-control, as described in Sections 4 and 5.

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

8. Biblography

1. "A Procedure for Establishing Traceability of Gas Mixtures to Certain National Bureau of Standards Standard Reference Materials." Joint publication by NBS and EPA-600/7-81-010. Available from the U.S. Environmental Protection Agency, Quality Assurance Division (MD-77), Research Triangle Park, North Carolina 27711.

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

3. Calculation and Interpretation of Accuracy for Continuous Emission Monitoring Systems (CEMS). Section 3.0.7 of the Quality Assurance Handbook for Air Pollution Measurement Systems. Volume III. Stationary Source Specific Methods. EPA-600/4-77-027b. August 1977. U.S. Environmental Protection Agency. Office of

Research and Development Publications, 26 West St. Clair Street, Cincinnati, Ohio 45268.

Figure 1. Example Format for Data Assessment Report

Period ending date ______
Year ______
Company name ______
Plant name ______
Source unit no. ______
CEMS manufacturer ______
Model no. ______
CEMS serial no. ______
CEMS type (e.g., in situ) ______
CEMS sampling location (e.g., control device outlet) ______
CEMS span values as per the applicable regulation. SO_2 ______ ppm, O_2 ______ percent, NO_x ______ ppm, CO_2 ______ percent

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

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

1. Date of audit ______
2. Reference methods (RM's) used ______ (e.g., Methods 3 and 6).
3. Average RM value ______ (e.g., ng/J, mg/dsm³, or percent volume).
4. Average CEMS value ______
5. Absolute value of mean difference [d] ______
6. Confidence coefficient [CC] ______
7. Percent relative accuracy (RA) ______ percent.
8. EPA performance audit results:

a. Audit lot number (1) ______ (2) ______
b. Audit sample number (1) ______ (2) ______
c. Results (mg/dsm³) (1) ______ (2) ______
d. Actual value (mg/dsm³)* (1) ______ (2) ______
e. Relative error* (1) ______ (2) ______

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

	Audit point 1	Audit point 2	
1. Date of audit	______	______	
2. Cylinder 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. Accuracy	______	______	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. Accuracy ______ percent.
6. EPA performance audit results:

a. Audit lot number (1) ______ (2) ______
b. Audit sample number (1) ______ (2) ______
c. Results (mg/dsm³) (1) ______ (2) ______
d. Actual value (mg/dsm³) *(1) ______ (2) ______
e. Relative error* (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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BILLING CODE 6560-50-M

3.0.4. PROCEDURE FOR NBS-TRACEABLE CERTIFICATION OF COMPRESSED GAS WORKING STANDARDS USED FOR CALIBRATION AND AUDIT OF CONTINUOUS SOURCE EMISSION MONITORS (Revised Traceability Protocol No. 1)

CONTENTS

4.0 GENERAL INFORMATION

4.0.1 Purpose and Scope of the Procedure

Section 3.0.4 describes a procedure for assaying the concentration of gaseous pollutant concentration standards and certifying that the assay concentrations are traceable to an authoritative reference concentration standard. This procedure is recommended for certifying the local working concentration standards required by the pollutant monitoring regulations of 40 CFR Part 60[1,2] for the calibration and audit of continuous source emission monitors. The procedure covers certification of compressed gas (cylinder) standards for CO, CO_2, NO, NO_2, and SO_2 (Procedure G1).

4.0.2 Reference Standards

Part 60 of the monitoring regulations[1,2] require that working standards used for calibration and audit of continuous source emission monitors be traceable to either a National Bureau of Standards (NBS) gaseous Standard Reference Material (SRM) or a NBS/EPA-approved Certified Reference Material (CRM)[3]. Accordingly, the reference standard used for assaying and certifying a working standard for these purposes must be an SRM, a CRM, or a suitable intermediate standard (see the next paragraph). SRM cylinder gas standards available from NBS are listed in Table 7.2 at the end of subsection 4.0. A current list of CRM cylinder gases and CRM vendors is available from the Quality Assurance Division (MD-77), Environmental Monitoring Systems Laboratory, U. S. EPA, Research Triangle Park, NC 27711.

The EPA regulations define a "traceable" standard as one which "...has been compared and certified, either directly or via not more than one intermediate standard, to a primary standard such as a...NBS [gaseous] SRM or...CRM"[4,5]. Certification of a working standard directly to an SRM or CRM primary standard is, of course, preferred and recommended because of the lower error. However, an intermediate reference standard is permitted, if necessary. In particular, a Gas Manufacturer's Intermediate Standard (see subsection 4.0.2.1) that has been referenced directly to an SRM or a CRM according to Procedure G1 is an acceptable intermediate standard and could be used as the reference standard on that basis. However, purchasers of commercial gas standards referenced to an intermediate standard such as a GMIS should be aware that, according to the above definition, such a standard would have to be used directly for calibration or audit. Since a second intermediate standard is not permitted, such a standard could not be used as a reference standard to certify other standards.

4.0.2.1 Gas Manufacturer's Intermediate Standard (GMIS). A GMIS is a compressed (cylinder) gas standard that has been assayed with direct reference to an SRM or CRM and certified according to Procedure G1, and also meets the following requirements:

1. A candidate GMIS must be assayed a minimum of three (3) times, uniformly spaced over a three (3) month period.

2. Each of the three (or more) assays must be within 1.0 percent of the mean of the three (or more) assays.

3. The difference between the last assay and the first assay must not exceed 1.5 percent of the mean of the three (or more) assays.

4. The GMIS must be recertified every three months, and the reassay must be within 1.5 percent of the previous certified assay. The recertified concentration of the GMIS is the mean of the previous certified concentration and the reassay concentration.

4.0.2.2 Recertification of Reference Standards. Recertification requirements for SRMs and CRMs are specified by NBS and NBS/EPA, respectively. See 4.0.2.1 for GMIS recertification requirements.

4.0.3 Using the Procedure

The assay/certification procedure described here is carefully designed to minimize both systematic and random errors in the assay process. Therefore, the procedure should be carried out as closely as possible to the way it is described. Similarly, the assay apparatus has been specifically designed to minimize errors and should be configured as closely as possible to the design specified. Good laboratory practice should be observed in the selection of inert materials (e.g. Teflon, stainless steel, or glass, if possible) and clean, non-contaminating components for use in portions of the apparatus in contact with the candidate or reference gas concentrations.

4.0.4 Certification Documentation

Each assay/certification must be documented in a written certification report signed by the analyst and containing at least the following information:

1. Identification number (cylinder number).

2. Certified concentration of the standard, in ppm or mole percent.

3. Balance gas in the standard mixture.

4. Cylinder pressure at certification.

5. Date of the assay/certification.

6. Certification expiration date (see 4.0.6.3).

7. Identification of the reference standard used: SRM number, cylinder number, and concentration for an SRM; cylinder number and concentration for a CRM or GMIS.

8. Statement that the assay/certification was performed according to this Section 3.0.4.

9. Identification of the laboratory where the standard was certified and the analyst who performed the certification.

10. Identification of the gas analyzer used for the certification, including the make, model, serial number, the measurement principle, and the date of the last multipoint calibration.

11. All analyzer readings used during the assay/certification and the calculations used to obtain the reported certified value.

12. Chronological record of all certifications for the standard.

Certification concentrations should be reported to 3 significant digits. Certification documentation should be maintained for at least 3 years.

4.0.5 Certification Label

A label or tag bearing the information described in items 1 through 9 of subsection 4.0.4 must be attached to each certified gas cylinder.

4.0.6 Assay/Certification of Compressed Gas (Cylinder) Standards

4.0.6.1 Aging of newly-prepared gas standards. Freshly prepared gas standard concentrations and newly filled gas cylinders must be aged before being assayed and certified. SO_2 concentrations contained in steel cylinders must be aged at least 15 days; other standards must be aged at least 4 days.

4.0.6.2 Stability test for reactive gas standards. Reactive gas standards, including nitric oxide (NO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and carbon monoxide (CO), that have not been previously certified must be tested for stability as follows: Reassay the concentration at least 7 days after the first assay and compare the two assays. If the second assay differs from the first assay by 1.5% or less, the cylinder may be considered stable, and the mean of the two assays should be reported as the certified concentration. Otherwise, age the cylinder for a week or more and repeat the test, using the second and third assays as if they were the first and second assays. Cylinders that are not stable may not be sold and/or used for calibration or audit purposes.

4.0.6.3 Recertification of compressed gas standards. Compressed gas standards must be recertified according to this Section 3.0.4 within the time limits specified in Table 7.1[3,6,7]. The reassay concentration must be within 5% of the previous certified concentration. If not, the cylinder must be retested for stability (subsection 4.0.6.2). The certified concentration of a recertified standard should be reported as the mean of all assays, unless a clear trend or substantial change suggests that previous assays are no longer valid.

Table 7.1 Recertification limits for compressed gas standards.

Pollutant	Balance gas	Concentration range	Maximum months until recertification for cylinder material: Al or SS	other
Carbon monoxide	N_2 or air	≥ 5 ppm	18	6
Nitric oxide	N_2	≥ 10 ppm	18	6
Sulfur dioxide	N_2	≥ 10 ppm	18	6
Nitrogen dioxide	N_2 or air	≥ 10 ppm	6	6
Carbon dioxide	N_2 or air	≥ 300 ppm	18	18
Oxygen	N_2	≥ 2 percent	18	18
Sulfur dioxide and carbon dioxide	N_2	≥ 200 ppm SO_2, ≥ 10 percent CO_2	18	6
Propane	N_2 or air	≥ 5 ppm	18	6
Others not specifically listed			6	6

4.0.6.4 Minimum cylinder pressure. No compressed gas cylinder standard should be used when its gas pressure is below 700 kPa (100 psi), as indicated by the cylinder pressure gauge.

4.0.6.5 Assay/certification of multi-component compressed gas standards. Procedure G1 may be used to assay and certify individual components of multi-component gas standards, provided that none of the components other than the component being assayed cause a detectable response on the analyzer.

4.0.7 Analyzer Calibration

4.0.7.1 Basic analyzer calibration requirements. The assay procedure described in this Section 3.0.4 employs a direct ratio referencing technique that inherently corrects for minor analyzer calibration variations (drift) and DOES NOT depend on the absolute accuracy of the analyzer calibration. What is required of the analyzer is as follows: 1) it must have a linear response to the pollutant of interest (see subsection 4.0.7.5), 2) it must have good resolution and low noise, 3) its response calibration must be reasonably stable during the assay/certification process, and 4) all assay concentration measurements must fall within the calibrated response range of the analyzer.

4.0.7.2 Analyzer multipoint calibration. The gas analyzer used for the assay/certification must have had a multipoint calibration within 3 months of its use when used with this procedure. This calibration is not used to quantitatively interpret analyzer readings during the assay/certification of the candidate gas because a more accurate, direct ratio comparison of the candidate concentration to the reference standard concentration is used. However, this multipoint calibration is necessary to establish the calibrated range of the analyzer and its response linearity.

The multipoint calibration should consist of analyzer responses to at least 5 concentrations, including zero, approximately evenly spaced over the concentration range. Analyzer response units may be volts, millivolts, percent of scale, or other measurable analyzer response units. The upper range limit of the calibrated range is determined by the highest calibration point used. If the analyzer has a choice of concentration ranges, the optimum range for the procedure should be selected and calibrated. Plot the calibration points and compute the linear regression slope and intercept. See subsection 4.0.7.5 for linearity requirements and the use of a mathematical transformation, if needed. The intercept should be less than 1 percent of the upper concentration range limit, and the correlation coefficient (r) should be at least 0.999.

4.0.7.3 Zero and span check and adjustment. On each day that the analyzer will be used for assay/certification, its response calibration must be checked with a zero and at least one span concentration near the upper concentration range limit. If necessary, the zero and span controls of the analyzer should be adjusted so that the analyzer's response (i.e. calibration slope) is within about ±5 percent of the response indicated by the most recent multipoint calibration. If a zero or span adjustment is made, allow the analyzer to stabilize for at least an hour or more before beginning the assay procedure, since some analyzers drift for a period of time following zero or span adjustment. If the analyzer is not in continuous operation, turn it on and allow it to stabilize for at least 12 hours before the zero and span check.

4.0.7.4 Pollutant standard for multipoint calibration and zero and span adjustment. The pollutant standard or standards used for multipoint calibration or zero and span checks or adjustments must be obtained from a compressed gas standard certified traceable to an NBS SRM or a NBS/EPA CRM according to Procedure G1 of this Section 3.0.4. This standard need not be the same as the reference standard used in the assay/certification. The zero gas must meet the requirements in subsection 4.0.8.

4.0.7.5 Linearity of analyzer response. The direct ratio assay technique used in Procedure G1 requires that the analyzer have a linear response to concentration. Linearity is determined by comparing the quantitative difference between a smoothly-drawn calibration curve based on all calibration points and a straight line drawn between zero and an upper reference point (see Figure 1). This difference is measured in concentration units, parallel to the concentration axis, from a point on the calibration curve to the corresponding point for the same response on the straight line.

For the general linearity requirement, the straight line is drawn between zero and the highest calibration point (Figure 1a). Linearity is then acceptable when no point on the smooth calibration curve deviates from the straight line by more than 1.5 percent of the value of the highest calibration concentration. An alternative linearity requirement is defined on the basis of the actual reference and candidate concentrations to be used for the assay. In this case, the reference and candidate concentrations are plotted on the calibration curve, and the straight line is drawn from zero to the reference concentration and extrapolated, if necessary, beyond the candidate concentration (Figure 1b). The deviation of the smooth calibration curve from the straight line at the candidate concentration point then must not exceed 0.8 percent of the value of the reference concentration. This latter specification may allow the use of an analyzer having greater nonlinearity when the reference and candidate concentrations are nearly the same.

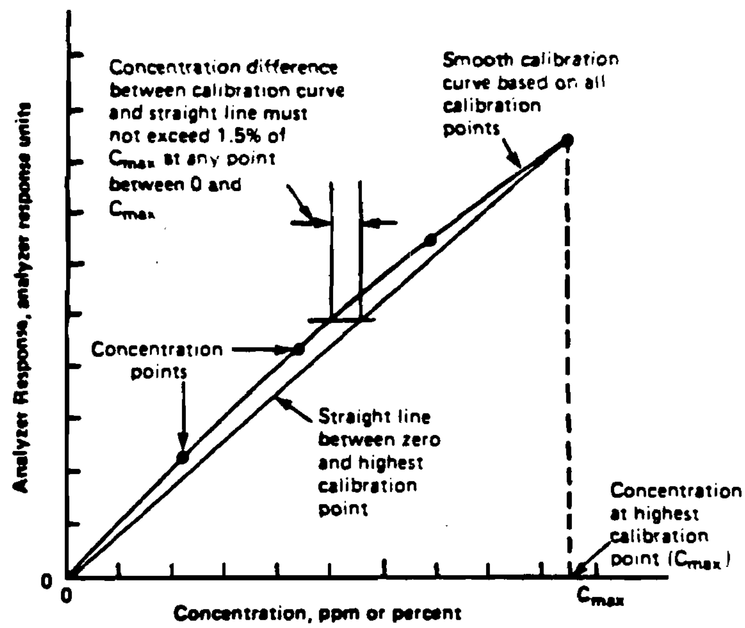
For analyzers having an inherently non-linear response, the response can usually be linearized with a simple mathematical transformation of the response values, such as R'= square root(R) or R'= log(R), where R' is the transformed response value and R is the actual analyzer response value. Using the transformed response values, the multipoint calibration should meet one of the above linearity requirements as well as the requirements for intercept and correlation coefficient given in subsection 4.0.7.2.

4.0.8 Zero Gas

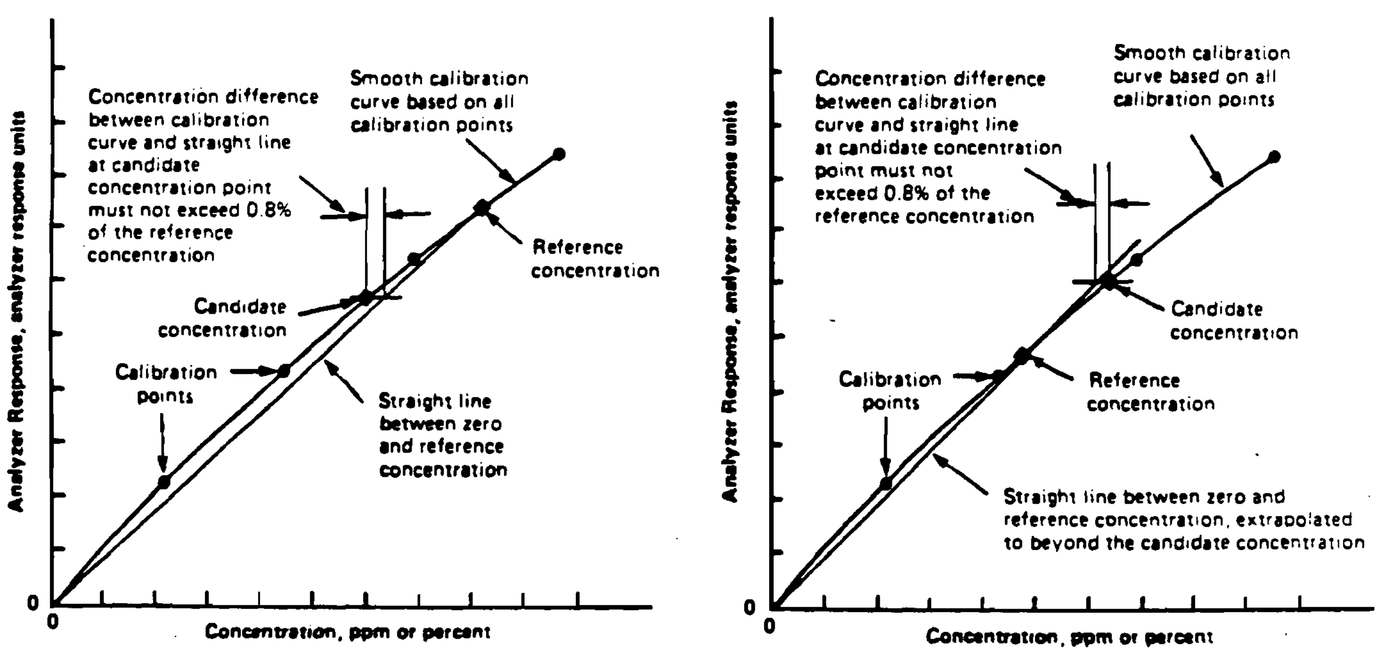
Zero gas used for dilution of any candidate or reference standard should be clean, dry, zero-grade air or nitrogen containing a concentration of the pollutant of interest equivalent to less than 0.5 percent of the analyzer's upper range limit concentration. The zero gas also should contain no contaminant that causes a detectable response on the analyzer or that suppresses or enhances the analyzer's response to the pollutant. The oxygen content of zero air should be the same as that of ambient air.

4.0.9 Accuracy Assessment of Commercially Available Standards

Periodically, the USEPA will assess the accuracy of commercially available compressed gas standards that have been assayed and certified according to this Section 3.0.4. Accuracy will be assessed by EPA audit analysis of representative actual commercial standards obtained via an anonymous agent. The accuracy audit results, identifying the actual gas manufacturers or vendors, will be published as public information.



a) General linearity requirement



b) Alternative linearity requirement

Figure 1. Illustration of linearity requirements.

Table 7.2. NBS SRM reference gases.

SRM number	Type	Nominal concentration
2627	NO/N_2	5 ppm
2628	NO/N_2	10 ppm
2629	NO/N_2	20 ppm
1683b	NO/N_2	50 ppm
1684b	NO/N_2	100 ppm
1685b	NO/N_2	250 ppm
1686b	NO/N_2	500 ppm
1687b	NO/N_2	1000 ppm
2630	NO/N_2	1500 ppm
2631	NO/N_2	3000 ppm
2653	NO_2/Air	250 ppm
2654	NO_2/Air	500 ppm
2655	NO_2/Air	1000 ppm
2656	NO_2/Air	2500 ppm
2612a	CO/Air	10 ppm
2613a	CO/Air	20 ppm
2614a	CO/Air	45 ppm
1677c	CO/N_2	10 ppm
2635	CO/N_2	25 ppm
1678c	CO/N_2	50 ppm
1679c	CO/N_2	100 ppm
2636	CO/N_2	250 ppm
1680c	CO/N_2	500 ppm
1681c	CO/N_2	1000 ppm
2637	CO/N_2	2500 ppm
2638	CO/N_2	5000 ppm
2639	CO/N_2	1 percent
2640	CO/N_2	2 percent
2641	CO/N_2	4 percent
2642	CO/N_2	8 percent
2657	O_2/N_2	2 percent
2658	O_2/N_2	10 percent
2659	O_2/N_2	21 percent
1693	SO_2/N_2	50 ppm
1694	SO_2/N_2	100 ppm
1661a	SO_2/N_2	500 ppm
1662a	SO_2/N_2	1000 ppm
1663a	SO_2/N_2	1500 ppm
1664a	SO_2/N_2	2500 ppm
1696	SO_2/N_2	3500 ppm
1670	CO_2/Air	330 ppm
1671	CO_2/Air	340 ppm
1672	CO_2/Air	350 ppm
2632	CO_2/N_2	300 ppm
2633	CO_2/N_2	400 ppm
2634	CO_2/N_2	800 ppm
2619a	CO_2/N_2	0.5 percent
2620a	CO_2/N_2	1.0 percent
2621a	CO_2/N_2	1.5 percent
2622a	CO_2/N_2	2.0 percent
2623a	CO_2/N_2	2.5 percent
2624a	CO_2/N_2	3.0 percent
2625a	CO_2/N_2	3.5 percent
2626a	CO_2/N_2	4.0 percent
1674b	CO_2/N_2	7.0 percent
1675b	CO_2/N_2	14.0 percent
1665b	C_3H_8/Air	3 ppm
1666b	C_3H_8/Air	10 ppm
1667b	C_3H_8/Air	50 ppm
1668b	C_3H_8/Air	100 ppm
1669b	C_3H_8/Air	500 ppm
2643	C_3H_8/N_2	100 ppm
2644	C_3H_8/N_2	250 ppm
2645	C_3H_8/N_2	500 ppm
2646	C_3H_8/N_2	1000 ppm
2647	C_3H_8/N_2	2500 ppm
2648	C_3H_8/N_2	5000 ppm
2649	C_3H_8/N_2	1 percent
2650	C_3H_8/N_2	2 percent

NBS-SRM cylinders contain approximately 870 liters of gas at STP.

For availability, contact: Office of Standard Reference Materials
Chemistry Building, Room B311
NBS, Gaithersburg, Maryland 20899
(301) 975-6776. (FTS 879-6776)

4.1 PROCEDURE G1: ASSAY AND CERTIFICATION OF A COMPRESSED GAS STANDARD WITHOUT DILUTION

4.1.1 Applicability

This procedure may be used to assay the concentration of a candidate compressed gas (cylinder) pollutant standard, based on the concentration of a compressed gas (cylinder) reference standard of the same pollutant compound, and certify that the assayed concentration thus established for the candidate standard is traceable to the reference standard. The procedure employs a pollutant gas analyzer to compare the candidate and reference gas concentrations by direct measurement--without dilution of either gas--to minimize assay error.

4.1.2 Limitations

1. The concentration of the candidate gas standard must be between 0.3 and 1.3 times the concentration of the reference gas standard.

2. The analyzer must have a calibrated range capable of directly measuring both the candidate and the reference gas concentrations.

3. The analyzer's response (or transformed response) must be linear with respect to concentration.

4. The balance gas in both the candidate and reference standards must be identical, unless it can be shown that the analyzer is insensitive to any difference in the balance gases.

5. A source of clean, dry zero gas is required.

4.1.3 Assay Apparatus

Figure G1 illustrates the relatively simple assay apparatus. The configuration is designed to allow convenient routing of the zero gas and undiluted samples of the reference gas and candidate gases, in turn, to the analyzer for measurement, as selected by three-way valves V1 and V2. Pressure regulators and needle valves (V3 and V4) control the individual gas flows. The pollutant concentrations are delivered to the analyzer via a vented tee, which discharges excess flow and insures that the assay concentrations sampled by the analyzer are always at a fixed (atmospheric) pressure. A small, uncalibrated rotameter monitors the vent flow to verify that the total gas flow rate exceeds the sample flow rate demand of the analyzer so that no room air is admitted through the vent. Valves V1 and V2 could be replaced by a single four-way valve (with 3 inputs and 1 output) or by manually moving the output connection to each of the gases as needed. See also subsection 4.0.3.

4.1.4 Analyzer

See subsection 4.0.7.1. The pollutant gas analyzer must have a linear response function and a calibrated range capable of measuring the full concentration of both the candidate and the reference gas standards directly, without dilution. It must

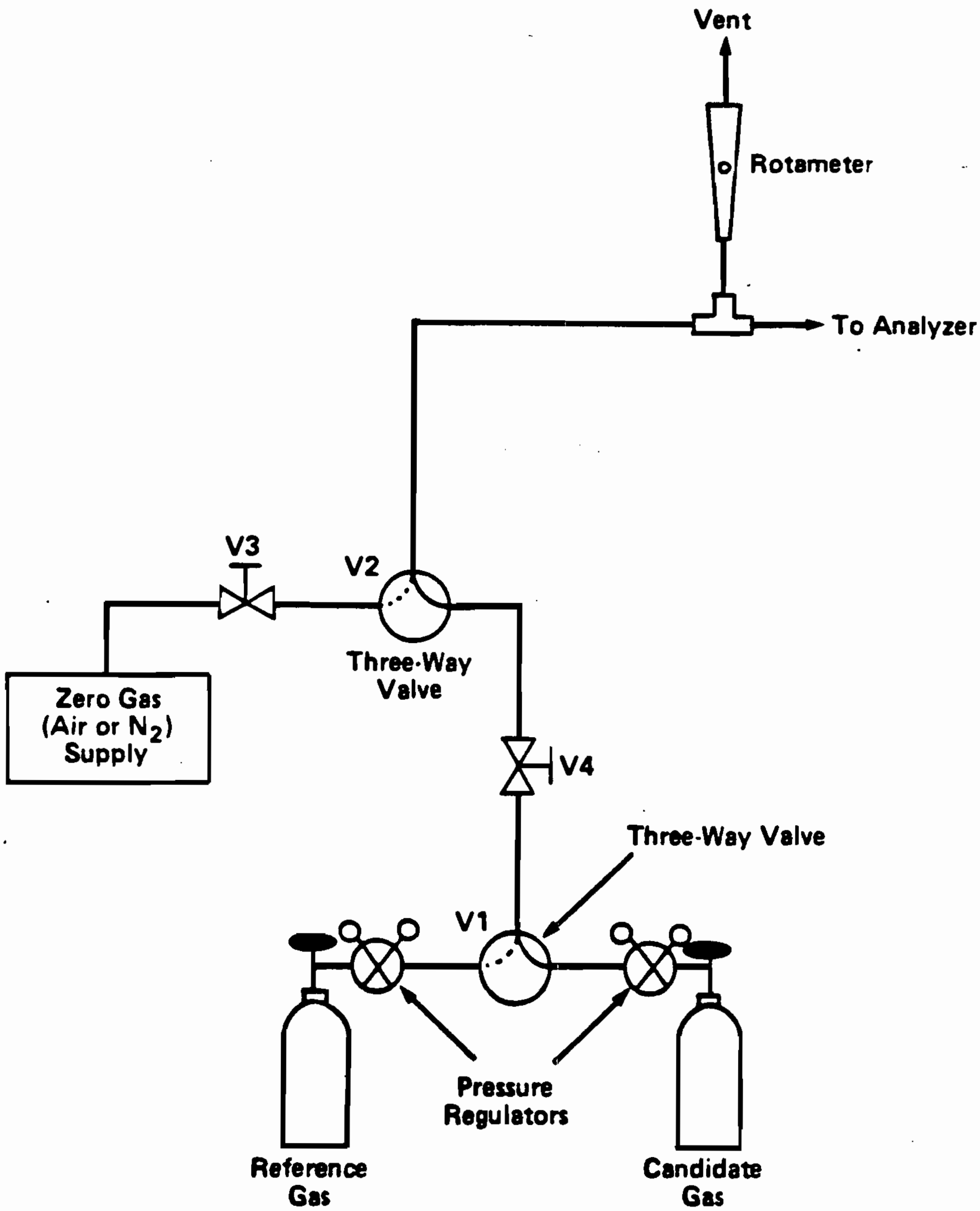


Figure G1. Suggested assay apparatus for Procedure G1.

have good resolution (readability), good precision, a stable response, and low output signal noise. In addition, the analyzer must have good specificity for the pollutant of interest so that it has no detectable response to any contaminant that may be contained in either the candidate or reference gas. If the candidate and reference gases contain dissimilar balance gases (air versus nitrogen or different proportions of oxygen in the balance air, for example), the analyzer must be proven to be insensitive to the two different balance gases. This may be accomplished by showing no difference in analyzer response when measuring pollutant concentrations diluted with identical flow rates of the two balance gases.

The analyzer should be connected to a suitable, precision chart recorder or other data acquisition device to facilitate graphical observation and documentation of the analyzer responses obtained during the assay.

4.1.5 Analyzer Calibration

4.1.5.1 Multipoint calibration. See subsections 4.0.7.2 and 4.0.7.4.

4.1.5.2 Calibration range. The calibrated range of the analyzer must include both the candidate and reference gas concentrations, such that the higher concentration does not exceed 97 percent of the upper range limit, and the lower concentration is not below 25 percent of the upper range limit (assuming a lower range limit of zero). Within these limits, select a calibrated analyzer range that will produce the highest analyzer responses.

4.1.5.3 Linearity. The direct ratio assay technique used in this procedure requires that the analyzer have a linear response to concentration (see subsection 4.0.7.5). High-concentration-range analyzers of the type that are required for this procedure may not be inherently linear, but they usually have a predictable, non-linear response characteristic that can be mathematically transformed to produce a sufficiently linear response characteristic suitable for use in this procedure. Any such response transformation should be verified by using it for the multipoint calibration. Caution should be exercised in using a transformed response curve because physical zero or span adjustments to the analyzer may produce unexpected effects on the transformed characteristic.

4.1.5.4 Zero and span adjustment. See subsections 4.0.7.3 and 4.0.7.4. Prior to carrying out the assay/certification procedure, check the calibration of the analyzer and, if necessary, adjust the analyzer's zero and span controls to reestablish the response characteristic determined at the most recent multipoint calibration. Allow the analyzer to stabilize for an hour or more after any zero or span adjustment. If there is any doubt that a transformed response characteristic is still linear following a zero or span adjustment, verify linearity with a multipoint calibration (subsection 4.0.7.2) using at least 3 known pollutant concentrations, including zero.

4.1.6 Assay Gases

4.1.6.1 Candidate gas standard. See subsections 4.0.6 and 4.1.2.

4.1.6.2 Reference gas standard. See subsections 4.0.2, 4.1.2, and 4.0.6.4. Select a reference standard such that the concentration of the candidate gas is not more than 30 percent above nor less than 70 percent below the concentration of the standard.

4.1.6.3 Zero gas. See subsection 4.0.8. The zero gas should match the balance gas used in the cylinder concentrations.

4.1.7 Assay Procedure

1. Verify that the assay apparatus is properly configured, as described in subsection 4.1.3 and shown in Figure G1.

2. Verify that the linearity of the analyzer has been checked within the last 3 months (see subsections 4.0.7.2, 4.0.7.5, and 4.1.4), that the zero and span are adjusted correctly (subsection 4.0.7.3), that the candidate and reference gas concentrations are within 25 and 97 percent of the upper range limit of the calibrated measurement range of the analyzer, and that the analyzer is operating stably.

3. Adjust the flow rates of the three gases (reference, candidate, and zero) to approximately the same value that will provide enough flow for the analyzer and sufficient excess to assure that no ambient air will be drawn into the vent.

4. Conduct a triad of measurements with the analyzer. Each triad consists of a measurement of the zero gas concentration, a measurement of the reference gas concentration, and a measurement of the candidate gas concentration. Use valves V1 and V2 to select each of the three concentrations for measurement. For each measurement, allow ample time for the analyzer to achieve a stable response reading. Record the stable analyzer response for each measurement, using the same response units (volt, millivolts, percent of scale, etc.) used for the multipoint calibration and any transformation of the response readings necessary for linearity. Do not translate the response readings to concentration values via the calibration curve (see the footnote following Equation G1). Do not make any zero, span, or other physical adjustments to the analyzer during the triad of measurements.

5. Conduct at least 2 additional measurement triads, similar to step 4 above. However, for these subsequent triads, change the order of the three measurements (e.g. measure reference gas, zero gas, candidate gas for the second triad and zero gas, candidate gas, reference gas for the third triad, etc.).

6. If any one or more of the measurements of a triad is invalid or abnormal for any reason, discard all three measurements of the triad and repeat the triad.

7. For each triad of measurements, calculate the assay concentration of the candidate gas as follows:

$$C_c = C_r \frac{R_c - R_z}{R_r - R_z} \quad \text{Equation G1}$$

where: C_c = Assay concentration of the candidate gas standard, ppm or percent;
C_r = Concentration of the reference gas standard, ppm or percent;
R_c = Stable response reading of the analyzer for the candidate gas, analyzer response units;*
R_z = Stable response reading of the analyzer for the zero gas, analyzer response units;*
R_r = Stable response reading of the analyzer for the reference gas, analyzer response units.*

*Analyzer response units are the units used to express the direct response readings of the analyzer, such as volts, millivolts, percent of scale, etc. DO NOT convert these direct response readings to concentration units with the multipoint calibration curve or otherwise adjust these readings except for transformation necessary to achieve response linearity.

8. Calculate the mean of the 3 (or more) valid assays. Calculate the percent difference of each assay from the mean. If any one of the assay values differs from the mean by more than 1.5%, discard that assay value and conduct another triad of measurements to obtain another assay value. When at least 3 assay values all agree within 1.5% of their mean, report the mean value as the certified concentration of the candidate gas standard. For newly-prepared reactive standards, a reassay at least 7 days later is required to check the stability of the standard; see subsection 4.0.6.2.

4.1.8 Stability Test for Newly-Prepared Standards

See subsections 4.0.6.1 and 4.0.6.2.

4.1.9 Certification Documentation

See subsections 4.0.4 and 4.0.5.

4.1.10 Recertification Requirements

See subsections 4.0.6.3 and 4.0.6.4.

4.2 References.

1. Code of Federal Regulations, Title 40, Part 60, "Standards of Performance for New Stationary Sources," Appendix A, Method 20 (1982).

2. Standards of Performance for New Stationary Sources; Quality Assurance Requirements for Gaseous Continuous Emission Monitoring Systems Used for Compliance Determination, promulgated in the Federal Register, June 4, 1987, pp. 21003-21010.

3. "A Procedure for Establishing Traceability of Gas Mixtures to Certain National Bureau of Standards Standard Reference Materials. EPA-600/7-81-010. Joint publication by NBS and EPA, May 1981. Available from the U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory (MD-77), Research Triangle Park, NC 27711.

4. Code of Federal Regulations, Title 40, Part 50, "National Ambient Air Quality Measurement Methodology".

5. Code of Federal Regulations, Title 40, Part 58, "Ambient Air Quality Surveillance," Appendixes A and B.

6. Shores, R. C. and F. Smith, "Stability Evaluation of Sulfur Dioxide, Nitric Oxide, and Carbon Monoxide Gases in Cylinders. NTIS No. PB 85-122646. Available from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.

7. Method 6A and 6B, "Determination of Sulfur Dioxide, Moisture, and Carbon Dioxide Emissions from Fossil Fuel Combustion Sources," Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, Section 3.13.8, July 1986. Available from the U.S. Environmental Protection Agency, Center for Environmental Research Information, Cincinnati, OH 45268.

8. "List of Designated Reference and Equivalent Methods." Current edition available from the U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Quality Assurance Division (MD-77), Research Triangle Park, NC 27711.

7.0 CALCULATION AND INTERPRETATION OF ACCURACY FOR CONTINUOUS EMISSION MONITORING SYSTEM (CEMS)

This section contains a discussion on the accuracy calculations required in Appendix F[1] and their interpretation. The goals of Appendix F, Procedure 1, are to (1) assess CEMS accuracy, (2) indicate when a CEMS is out-of-control and correction is required, and (3) specify criteria for unacceptable CEMS data. The quarterly accuracy assessments required in Appendix F provide a mechanism for identifying and correcting CEMS's that are out-of-control. This results in an increase in acceptable CEMS data. Increasing acceptable CEMS data strengthens decisions made with regard to compliance.

The following subsections discuss the meaning, interpretation, calculation, and reporting of accuracy data.

7.1 Meaning of Accuracy

Accuracy is the measure of the closeness of a measurement to its "true value." Although the true value is not known, it can be approximated by the use of an appropriate standard of reference, for example, an NBS-SRM (National Bureau of Standards - Standard Reference Materials), a primary standard. Secondary standards are also used as an approximation to "truth," although errors may be introduced in this process.

The preferred measure of accuracy depends on the situation. If the magnitude of the difference tends to be dependent on the true value, T, then the percentage difference is preferable. If it is desired to follow or observe the pattern of the differences over time, then the signed difference or signed percentage difference is preferable.

In the context of accuracy data based on Appendix F, three types of audits for CEMS accuracy assessment are specified: Relative Accuracy Test Audits (RATA), Relative Accuracy Audits (RAA), and Cylinder Gas Audits (CGA). The procedure for the RATA and the RAA are the same as for the Relative Accuracy Test described in the applicable EPA performance specification (e.g., Performance Specification 2 for SO_2 and NO_x, and Performance Specification 3 for O_2 and CO_2), with the exception that the RAA requires three rather than nine sets of measurements, and the accuracy is based on the average of the three sets of data. In addition, EPA performance audit samples must be analyzed concurrently with the RATA samples to demonstrate and document the proficiency and accuracy of the analytical system. The same person must conduct the RATA and the EPA audit sample analysis. Thus, the RATA approximates "truth" by the reference method test results, which are in turn checked for analytical accuracy by EPA audit sample analyses. The EPA audit sample analysis must agree within 5 percent of the audit concentration on each of two SO_2 audit samples or within 10 percent of the audit concentration on each of two NO_x audit samples.

In Appendix F, each CEMS must be audited at least once each calendar quarter. Successive audits shall occur no closer than two months apart. The audits must be conducted as follows:

1. The RATA must be conducted at least once every four calendar quarters. The RATA is conducted as described in the Performance Specifications in Appendix B (e.g., Performance Specification 2 for SO_2 and NO_x). In addition, the appropriate performance audit samples received from EPA are analyzed as described in the applicable Reference Methods (e.g., Methods 6 for SO_2 and 7 for NO_x).

2. If applicable, a CGA may be conducted in three of the four calendar quarters. A CGA is conducted by challenging the CEMS's (both pollutant and diluent monitors, if applicable) with an audit gas of known concentration at two points within the following ranges:

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

A separate audit gas cylinder must be used for audit points 1 and 2. No dilution of the gas from the audit cylinder is allowed when challenging the CEMS. Challenge the CEMS three times at each point, and use the average of the three responses in determining accuracy. The monitor should be challenged at each point for a sufficient period of time to assure absorption-desorption of the CEMS sample transport surfaces has stabilized. Each monitor is audited 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. Audit gases must be certified by comparison with gaseous NBS-SRM or NBS/EPA approved CRM (Certified Reference Material) following EPA Traceability Protocol No. 1. Procedures for preparation of CRM's are described in Reference 2. Procedures for preparation of EPA Traceability Protocol No. 1 gases are described in Reference 3. 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.

3. The RAA may be conducted three of the four calendar quarters. To conduct a RAA, follow the procedures described in the applicable Performance Specification in Appendix B for the Relative Accuracy Test, except that only three sets of measurement data are required. Analysis of EPA performance audit samples is required for the RAA. The relative difference between the mean of the reference method values and the mean of the CEMS values (in terms of the standard) are used to assess the accuracy of the CEMS.

The performance of RATA's, RAA's, and CGA's provides an independent check of the CEMS accuracy. These independent audits serve to document that the CEMS is providing quality data. Examples of audit calculations are given in the subsection that follows.

In summary, an accuracy assessment is a measure of the deviation of a measurement obtained under standard operational procedures from a known reference measurement. There is no reason to expect that accuracy will remain constant over each quarter because of changes in calibration gases, analysts, and environment.

7.2 Example Calculations and Interpretation for Accuracy

7.2.1 Relative Accuracy Test Audit Calculations - Example data from a RATA on a SO_2/O_2 CEMS are shown in Table 7.1.

The SO_2 and O_2 CEMS data shown in Table 7.1 were corrected to a dry basis using Equation 7-1:

$$CEMS_{ppm,\ dry} = \frac{CEMS_{ppm,\ wet}}{1 - B_{ws}} \qquad \text{Equation 7-1}$$

where

B_{ws} = moisture fraction of the CEMS gas sampled.

TABLE 7.1 RELATIVE ACCURACY TEST AUDIT DATA FOR SO_2 AND O_2 CEMS

	SO_2	SO_2	O_2	O_2	SO_2	SO_2	SO_2
Run number	RM_d, ppm	$CEMS_d$, ppm	RM_d, %	$CEMS_d$, %	RM_d, ng/J	$CEMS_d$, ng/J	Diff, ng/J
1	500	475	3.0	3.1	422.4	403.5	18.9
2	505	480	3.0	3.1	426.6	407.7	18.9
3	510	480	3.0	3.0	430.8	405.4	25.4
4	510	480	2.9	2.9	428.4	403.2	25.2
5	500	480	2.9	3.0	420.0	405.4	14.6
6	500	500	3.0	3.1	422.4	424.7	-2.3
7	510	510	3.0	3.1	430.8	433.3	-2.5
8	505	505	2.9	3.0	424.2	426.6	-2.4
9	510	520	2.9	3.0	428.4	439.3	-10.9
Avg	---	---	---	---	426.0	413.1	9.43

RM_d = reference method data, dry basis.

$CEMS_d$ = monitor data, dry basis.

The SO_2 and O_2 CEMS and RATA data in Table 7.1 were converted to the units of the applicable standard using Equation 7-2:

$$E = CF \frac{20.9}{20.9 - \text{percent } O_2} \qquad \text{Equation 7-2}$$

where

E = pollutant emission, ng/J (lb/million Btu),

C = pollutant concentration, ng/dsm^3 (lb/dscf),

F = factor representing a ratio of the volume of dry flue gas generated to the calorific value of the fuel, dsm^3/J (dscf/million Btu), and

Percent O_2 = oxygen content by volume (expressed as percent), dry basis.

Note: For the calculations shown in Table 7.1, ppm of SO_2 was converted to ng/J using a conversion factor of 2.66×10^6 ng/scm/ppm and an F factor of 2.72×10^{-7} dsm^3/J.

For complete explanation of the equations and calculations, see 40 CFR; Part 60; Appendix A; Method 19; 5. Calculation of Particulate, Sulfur Dioxide, and Nitrogen Oxides Emission Rates.

After the data are converted to the units of the standard, the Relative Accuracy (RA) is calculated by using the equations in Section 8 of Performance Specification 2. For convenience in illustrating the calculation, these equations (7-3 through 7-8) are also shown here.

The average difference, $\bar{d}$, is calculated for the SO_2 monitor using Equation 7-3:

$$\bar{d} = \frac{1}{n} \sum_{i=1}^{n} (X_i - Y_i) = \frac{1}{n} \sum_{i=1}^{n} d_i \qquad \text{Equation 7-3}$$

$$= \frac{1}{9} (84.9) = 9.43 \text{ ng/J}$$

where

n = number of data points,

X_i = concentration from reference method (RM_d in Table 7.1), ng/J,

Y_i = concentration from the CEMS ($CEMS_d$ in Table 7.1), ng/J,

d_i = signed difference between individual pairs, X_i and Y_i, ng/J, and

Σd_i = algebraic sum of the individual differences, d_i, ng/J.

The standard deviation S_d is calculated using Equation 7-4:

$$S_d = \sqrt{\frac{1}{n-1}\left[\sum_{i=1}^{n} d_i^2 - \frac{1}{n} \left(\sum_{i=1}^{n} d_i\right)^2\right]} \qquad \text{Equation 7-4}$$

$$= \sqrt{\left[\frac{1}{8} \quad 2344 - \frac{1}{9} \quad (84.9)^2\right]} = 13.9 \text{ ng/J.}$$

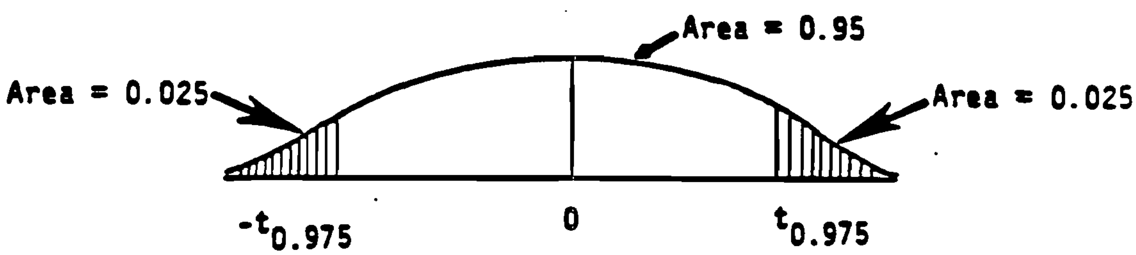
The 2.5 percent error confidence coefficient, CC, is calculated using Equation 7-5:

$$CC = t_{0.975} \frac{s_d}{\sqrt{n}} \qquad \text{Equation 7-5}$$

$$= 2.306 \; \frac{13.9}{\sqrt{9}} = 10.68 \text{ ng/J.}$$

where $t_{0.975}$ = t-values in Table 7.2 for n = 9.

TABLE 7.2. VALUES OF t FOR 95 PERCENT PROBABILITY[a]



n[a]	$t_{0.975}$	n[a]	$t_{0.975}$	n[a]	$t_{0.975}$
2	12.706	7	2.447	12	2.201
3	4.303	8	2.365	13	2.179
4	3.182	9	2.306	14	2.160
5	2.776	10	2.262	15	2.145
6	2.571	11	2.228	16	2.131

[a]The values in this table are already corrected for n-1 degrees of freedom. Use n equal to the number of individual values.

The RA for the RATA is calculated using Equation 7-6:

$$RA = \frac{|\bar{d}| + |CC|}{\overline{RM}} \times 100 \qquad \text{Equation 7-6}$$

$$= \frac{|9.43| + |10.68|}{426} \times 100 = 4.72\%$$

where

RA = relative accuracy, %,

$|\bar{d}|$ = absolute value of the mean differences from Equation 7-3, ng/J,

$|CC|$ = absolute value of the confidence coefficient from Equation 7-5, ng/J, and

$\overline{RM}$ = average reference method value or applicable standard, ng/J.

7.2.2 Relative Accuracy Audit Calculations - Example data from an RAA on an SO_2/O_2 CEMS are shown in Table 7.3.

TABLE 7.3 RELATIVE ACCURACY AUDIT DATA FOR SO_2 AND O_2 CEMS

	SO_2	SO_2	O_2	O_2	SO_2	SO_2
Run number	RM_d, ppm	$CEMS_d$, ppm	RM_d, %	$CEMS_d$, %	RM_d, ng/J	$CEMS_d$, ng/J
1	500	475	3.0	3.1	422.4	403.5
2	505	480	3.0	3.1	426.6	407.7
3	510	480	3.0	3.0	430.8	405.4
Avg	---	---	---	---	426.6	405.5

RM_d = reference method data, dry basis.

$CEMS_d$ = monitor data, dry basis.

The SO_2 and O_2 CEMS data shown in Table 7.3 were corrected to a dry basis using Equation 7-1. The SO_2 and O_2 CEMS and RAA data were converted to the units of the applicable standard using Equation 7-2.

The accuracy (A) for the RAA is calculated using Equation 7-7.

$$A = \frac{C_m - C_a}{C_a} \times 100 \qquad \text{Equation 7-7}$$

$$= \frac{405.5 - 426.6}{426.6} \times 100 = -4.95\%$$

where

A = accuracy of the CEMS, %,

C_m = average CEMS response during audit in units of applicable standard, and

C_a = average audit value of the three reference method runs in units of the applicable standard.

7.2.3 Cylinder Gas Audit Calculations - Example data from a CGA on an SO_2/O_2 CEMS are shown in Table 7.4.

TABLE 7.4 CYLINDER GAS AUDIT DATA FOR SO_2 AND O_2 CEMS

		SO_2	SO_2	A	O_2	O_2	A
Audit number	Reading No.	CGA_d, ppm	$CEMS_d$, ppm	Diff, %	CGA_d, %	$CEMS_d$, %	Diff, %
1	1	212	218		5.0	5.2	
	2	212	219		5.0	5.3	
	3	208	225		5.1	5.2	
	Avg	210.7	220.7	4.75	5.03	5.23	3.98
2	1	398	409		9.1	8.9	
	2	399	416		9.1	8.9	
	3	403	414		8.9	8.9	
	Avg	400.0	413	3.25	9.03	8.90	-1.44

CGA_d = cylinder gas audit value, dry basis.

$CEMS_d$ = average of the three monitor values, dry basis.

The SO_2 and O_2 CEMS data shown in Table 7.4 were corrected to a dry basis using Equation 7-1. The accuracy (A) for the GCA is calculated using Equation 7-8.

$$A = \frac{C_m - C_a}{C_a} \times 100 \qquad \text{Equation 7-8}$$

$$= \frac{220.7 - 210.7}{210.7} \times 100 = 4.75\%$$

where

A = accuracy of the CEMS component, %,

C_m = CEMS component mean response for three values during audit with CGA in units of the appropriate concentration, and

C_a = audit value of the cylinder gas in units of appropriate concentration.

7.3 Reporting Requirements

At the reporting interval specified in the applicable regulation, a report of each CEMS accuracy audit must be submitted in the form of a Data Accuracy Report (DAR). One copy of the DAR must be included for each quarterly audit along with the report of emissions required under the applicable regulation. 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, including the RA for the RATA, the A for the RAA or CGA, the reference method results, certified values for the cylinder gases, the CEMS responses, and the CEMS accuracy calculation results. 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 the EPA performance audit samples.

6. Summary of all corrective actions taken when the monitor was determined out-of-control.

An example of a DAR form is shown in Figure 7.1.

Period ending date ______________ Year ______________

Company name ______________________________

Plant name ______________ Source unit no. ________

CEMS manufacturer ______________ Model no. ________

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

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

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

O_2 __________ percent, NO_x __________ ppm, CO_2 __________ percent

I. Accuracy assessment results (Complete A, B, or C below for each CEMS or for each pollutant and diluent analyzer, as applicable.) If the quarterly audit results show the CEMS to be out-of-control, report the results of both the quarterly audit and the audit following the 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 the mean difference $|\bar{d}|$ __________.

6. Confidence coefficient |CC| __________.

7. Percent relative accuracy (RA) ______________ percent.

8. EPA performance audit results:

a. Audit lot number (1)__________ (2)__________
b. Audit sample number (1)__________ (2)__________
c. Results (mg/dsm^3) (1)__________ (2)__________
d. Actual value (mg/dsm^3)* (1)__________ (2)__________
e. Relative error* (1)__________ (2)__________

*To be completed by the Agency.

Figure 7.1 Example format for data assessment report (DAR).

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

1. Date of audit ______________.

	Audit point 1	Audit point 2	
2. Cylinder 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. Accuracy	______	______	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. Accuracy ______________ percent.

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. Relative error*	(1) __________	(2) __________

*To be completed by the Agency.

Figure 7.1 (continued)

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 ______________________________

____

____

____.

Figure 7.1 (continued)

7.4 References

1. Standards of Performance for New Stationary Sources: 40 CFR 60, Appendix F - Quality Assurance Procedures, Procedure 1 - Quality Assurance Requirements for Gaseous Continuous Emission Monitoring Systems Used for Compliance Determination.

2. A Procedure for Establishing Traceability of Gas Mixtures to Certain National Bureau of Standards Standard Reference Materials. Joint publication by NBS and EPA, EPA-600/7-81-010. Available from the U. S. Environmental Protection Agency, Quality Assurance Division (MD-77), Research Triangle Park, North Carolina 27711.

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

10.0 GUIDELINE FOR DEVELOPING QUALITY CONTROL PROCEDURES FOR GASEOUS CONTINUOUS EMISSION MONITORING SYSTEMS

10.1 Introduction

This guideline describes the minimum content for a quality control plan to satisfy the requirements of Section 3 of Appendix F, Procedure 1 to 40 CFR Part 60. Source owners or operators may wish to add other items to assure the generation and reporting of valid data from their continuous emission monitoring systems (CEMS's).

Appendix F, Procedure 1 requires written procedures for each of the following activities:

1. Calibration of the CEMS.

2. Calibration drift determination and adjustment of the CEMS.

3. Preventive maintenance of the CEMS (including maintaining a spare parts inventory).

4. Data recording, calculations, and reporting for emissions and QA data.

5. Accuracy audit procedures including sampling and analysis methods.

6. Program of corrective action for the malfunctioning CEMS.

Figure 1 is a flow chart showing the requirements in Appendix F, Procedure 1 for quality assurance and in Part 60.13 for monitoring requirements. This flow chart is included to show how these requirements for CEMS's interact.

10.2 Calibration of the CEMS

Calibration refers to the adjustment of the CEMS response relative to specified standards such as gas cells or calibration gases, or relative to independent effluent measurements. Appendix F, Procedure 1 requires that sources have written procedures for CEMS calibration. Sources may develop their own written procedures; alternatively, they may specify applicable sections of the instrument manual as their written procedures.

There are no currently promulgated regulations that require either specific calibration frequencies or specific criteria for initiating calibration procedures. Sources may therefore choose their own frequency or criteria for calibration based on operating experience or manufacturer's recommendations.

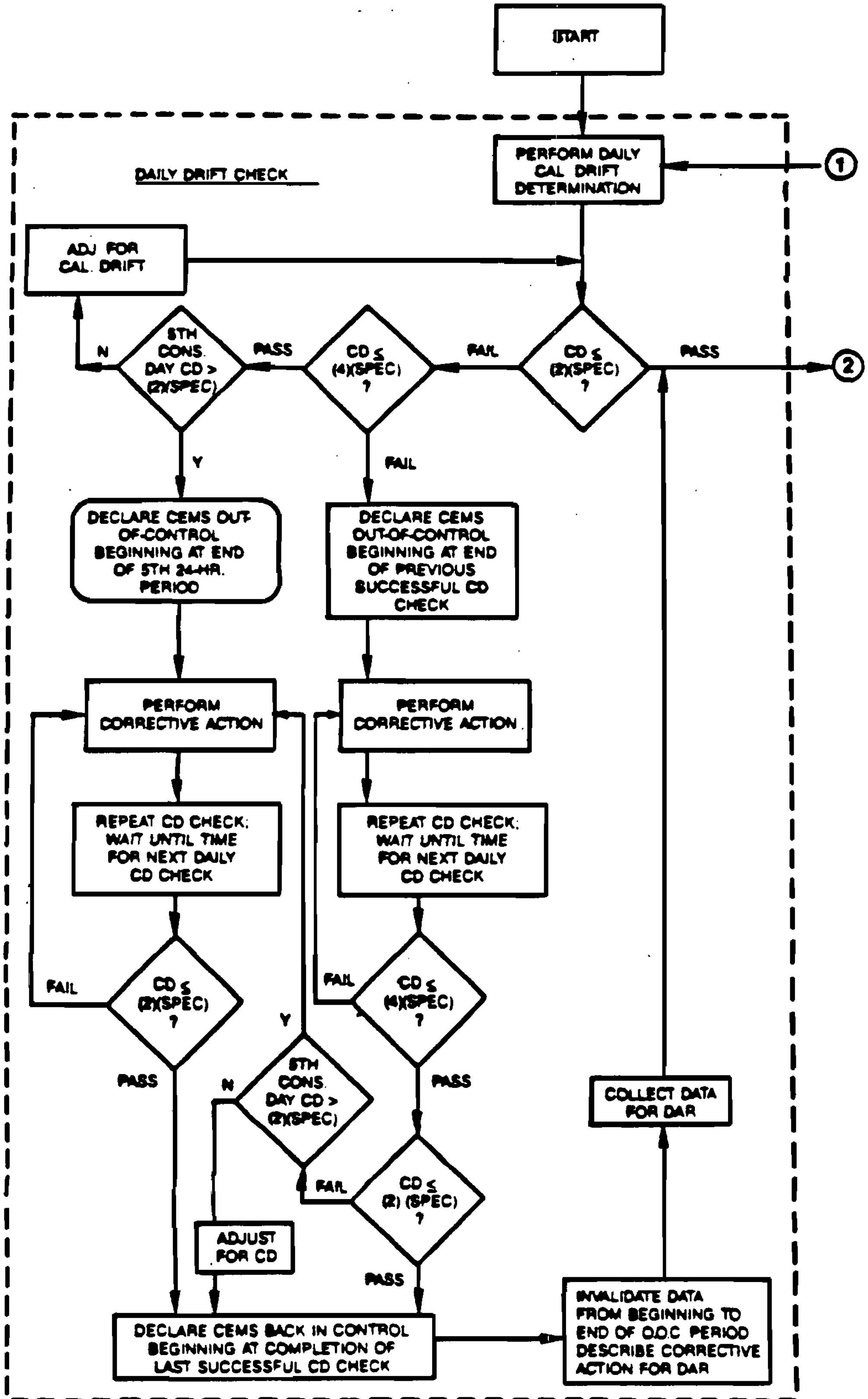


Figure 1. Flow Chart for Required QC Procedures.

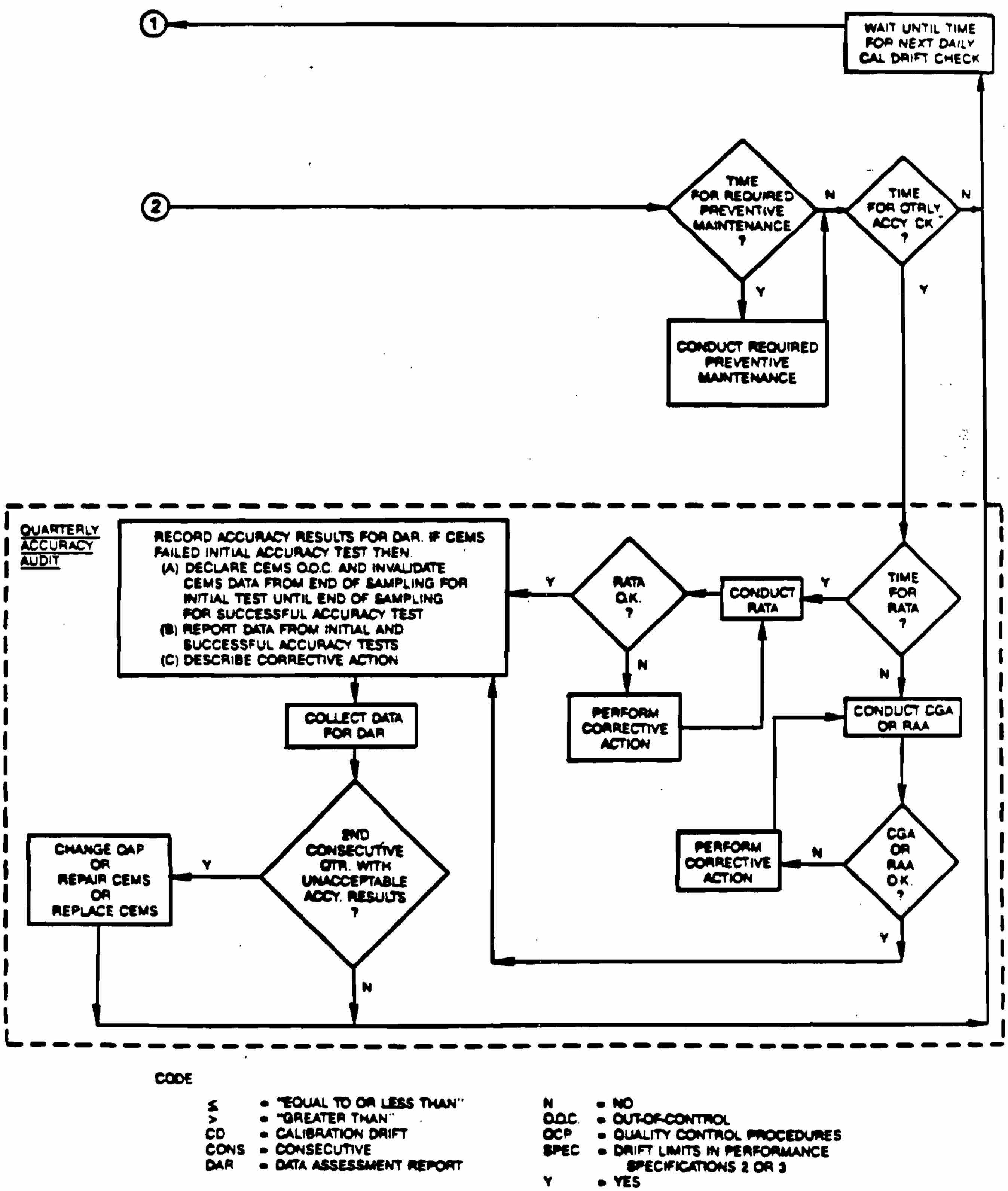


Figure 1. (continued)

For calibrations based on external gas cells, sufficient time should be allowed for the cell and/or analyzer cabinet to reach normal operating temperature; accordingly, it is recommended that procedures be incorporated into the QC program that ensure sufficient time for the monitor response to stabilize before it is compared to the cell's named value. Some in-situ analyzers partially or totally disable temperature compensation circuitry during cell-type calibrations. In these cases, it is recommended that additional procedures addressing the calibration of this circuitry be incorporated into the QC program.

For analyzers calibrated using calibration gases as the reference, the written procedures should specify (1) at what point in the sampling system the calibration gases are to be introduced and (2) either the specific gas flow rate to be used or how the flow rate is determined. Although current continuous emission monitoring (CEM) regulations do not require establishing the traceability of calibration gases to higher standards, it is strongly recommended that procedures be established and included within the QC program for verifying the concentrations of calibration gases. One acceptable procedure is EPA's traceability protocol 1 (Reference 1).

In cases where a portable CEMS is to be used as the reference for adjusting the installed CEMS, written procedures should specify calibration and operating procedures for the portable CEMS, including the portable CEMS sampling location.

The written calibration procedures for the installed CEMS may be incorporated into one or more of the following sections of a QC program:

1. <u>A Stand-Alone "Calibration" Section of the QC Program.</u> In this case, the frequency of calibration or the criteria for initiating calibration activities should be clearly specified.

2. <u>Preventive Maintenance</u>. Within the section delineating the preventive maintenance procedures, calibration may be specified as a routine maintenance activity to be performed at regular, specified intervals. Alternatively, calibration may be specified on an as-needed basis with stated criteria for the implementation of calibration activities.

3. <u>Corrective Action</u>. Calibration procedures may be included within the section delineating corrective action activities to be performed at the discretion of CEMS repair personnel in response to an out-of-control CEMS.

Regardless of how the calibration procedures are incorporated into the QC program, it is recommended that the individual or group responsible for CEMS calibration be identified within the written QC plan.

10.3 Calibration Drift and Adjustment of the CEMS

Calibration drift (CD) refers to the difference between the CEMS output reading and a reference value after a period of operation during which no unscheduled maintenance, repair, or adjustment took place. Daily zero (or low level) and span drift checks are required by 40 CFR 60.13; these checks are to be used to fulfill the calibration drift check requirement of Appendix F, Procedure 1. Appendix F, Procedure 1 requires written procedures that specify how the zero (or low level) and span calibration drift determinations are to be performed. These procedures must be consistent with the monitor vendor's prescribed method for checking CD.

Table 10.1 presents CD criteria and the corresponding required source responses. Sources may choose to establish more stringent criteria for adjustment of CEMS for zero (or low level) and/or span calibration drift. It is recommended that the CD criteria selected for adjustment of the CEMS be incorporated into the written instructions for the calibration drift check procedures, so that the need for adjustment based on calibration drift may be determined immediately.

Corrections for excessive drift may consist of any adjustments or activities that the operator or technician deems necessary to correct for the observed drift. These activities typically consist of routine checks and adjustments of calibration gas flow rates and pressures, verification of proper sample cell temperatures, verification of the status of monitor specific auxiliary monitoring parameters, and adjustment of zero and/or span potentiometers. Written procedures should be available for performing these routine activities and should include criteria for determining that adjustments have been successful.

10.4 Preventive Maintenance of the CEMS

Preventive maintenance is comprised of activities designed to detect and prevent the development of monitoring problems. These activities typically include both routine maintenance procedures and maintenance, repairs, or adjustments performed on an as-needed basis. An example of as-needed preventive maintenance would be the repairing of the protective covering of an extractive sample line following damage resulting from an accident during the construction activities. If the sample line itself were not damaged, the repair would be considered preventive maintenance and would not consititute corrective action for a malfunctioning CEMS. The importance of this type of

TABLE 10.1. CEMS CALIBRATION DRIFT CRITERIA

Parameter	Criterion*	Action Required
Zero (or low) level calibration drift	CD > 2 x (Spec)**	Adjust CEMS for calibration drift
	CD > 2 x (Spec) for 5 consecutive 24-hour periods	CEMS out-of-control period begins at end of 5th day the CD exceeds 2 x (Spec); perform corrective action and repeat CD check
	CD > 4 x (Spec)	CEMS out-of-control period begins at the time corresponding to the completion of the last acceptable CD check preceding the CD check which exceeds 4 x (Spec); perform corrective action and repeat the CD check
Span calibration drift	CD > 2 x (Spec)**	Adjust CEMS for calibration drift
	CD > 2 x (Spec) for 5 consecutive 24-hour periods	CEMS out-of-control period begins at end of 5th day the CD exceeds 2 x (Spec); perform corrective action and repeat CD check
	CD > 4 x (Spec)	CEMS out-of-control period begins at the time corresponding to the completion of the last successful CD check preceding the CD check that exceeds 4 x (Spec); perform corrective action and repeat the CD check

*Spec refers to the applicable performance specification in Appendix B.

**This is the minimum criterion for adjustment of the CEMS. More stringent criteria, which may be preferred by many sources, are also acceptable.

maintenance is recognized; however, it is neither practical nor necessary to develop written procedures for such needed activities.

Written procedures must be available for routine maintenance activities. These procedures should specify what procedures are to be conducted and the frequency with which the various activities are to be performed. The QC program should specify the individual or office responsible for ensuring that the preventive maintenance procedures are conducted at the appropriate frequencies and the individual or group who will perform the actual routine maintenance procedures.

The applicable regulations do not specify the minimum level of routine preventive maintenance. It is suggested that, at a minimum, the initial procedures should incorporate the vendor's recommendations regarding preventive maintenance activities and frequencies. These procedures may later be adjusted to reflect actual operating experience with individual CEMS installations.

A list of spare parts for the CEMS must be included in the written QC plan. At a minimum, those spare parts recommended by the monitor vendor should be available. The QC program should specify the individual or office who is responsible for maintaining the listed spare parts inventory.

10.5 Data Records, Calculations, and Reporting for the CEMS

The QA/QC program must address recordkeeping, calculations, and reporting of emissions and quality assurance data. The requirements for these activities are contained in the subparts of 40 CFR 60 that specify the use of CEM. A Data Assessment Report (DAR) must be provided with emissions reports required by the applicable subpart of 40 CFR 60. The DAR must contain, at a minimum:

1. The name and address of the source owner or operator.

2. Identification and location of each monitor in the CEMS.

3. The manufacturer and model number of each monitor in the CEMS.

4. Quarterly accuracy results, including dates, CEMS responses, and either reference method results or certified gas values; if either a RATA or a RAA was performed, the results from the EPA performance audit sample analysis must also be included.

5. A summary of corrective actions taken when the monitor was determined to be out-of-control.

For emissions data, a list or diagram should be provided indicating the offices or individuals responsible for (1) retrieving the data from the CEMS, (2) calculating emissions rates from the CEMS data, (3) compiling emissions reports, and (4) reviewing and/or approving emissions reports. Formulas and example calculations should be provided for emission rate calculations. Similar information should be provided for emissions data from alternative monitoring methods that may be necessary during CEMS out-of-control periods.

A list or diagram should also be provided indicating the offices or individuals responsible for (1) collecting quality assurance (QA) data, (2) performing applicable calculations of QA/QC results, (3) recording the QA/QC results in appropriate logs (as applicable), (4) preparing the DAR, and (5) approving and/or reviewing the DAR. Formulas and example calculations should be provided for all required QA data calculations.

10.6 Accuracy Audit Procedures Including Sampling and Analysis Methods

Appendix F, Procedure 1 requires that each CEMS be audited at least once each calendar quarter. Three audit techniques are acceptable:

1. Relative accuracy test audits (RATA's);
2. Cylinder Gas Audits (CGA's); and
3. Relative accuracy audits (RAA's).

In addition, other alternative audit procedures may be used as approved by the Administrator.

If the CEMS does not demonstrate acceptable accuracy during the quarterly audit, then corrective actions must be initiated, and the CEMS must be declared out-of-control from the time corresponding to the completion of the sampling for the unsuccessful audit until the completion of the sampling for a successful follow-up audit. If the CEMS demonstrates unacceptable accuracy for two consecutive quarters, then the QA program must be revised, or the CEMS must be modified or replaced.

Table 10.2 presents the specific requirements and the corresponding CEMS performance criteria for each of the three acceptable audit techniques.

The QC program must include written sampling and analysis procedures to be used during the required quarterly accuracy audits. At a minimum, these procedures must describe the methods to be used to conduct a RATA. Applicable sections of Appendix A (Reference Methods) and Appendix B (Performance Specifications)

TABLE 10.2. REQUIREMENTS AND CRITERIA FOR APPENDIX F, PROCEDURE 1 AUDIT TECHNIQUES

Technique	Requirements	Performance Criteria
RATA	Conduct as per applicable performance specification (PS) in Appendix B (e.g., PS 2 for SO_2 and NO_x) Analyze appropriate performance audit samples from EPA	RA must not exceed 20% or 10% of applicable standard, whichever is greater For SO_2 standards from 0.20 to 0.30 lb/10^6 Btu, RA must not exceed 15% of the standard For SO_2 standards below 0.20 lb/10^6 Btu, RA must not exceed 20% of the standard
RAA	Conduct as per applicable PS in Appendix B <u>except</u> only 3 runs are required Use relative difference between the mean reference method values and the mean of the CEMS responses to assess the accuracy of the CEMS data	Inaccuracy must not exceed $\pm$ 15% or 7.5% of the applicable standard, whichever is greater
CGA	Challenge both pollutant and diluent channels (if applicable) of CEMS three times at the two points specified in Procedure 1 Use gases that have been certified by comparison to NBS SRM's or NBS/EPA approved gas manufacturer's CRM's Operate analyzer in normal sampling mode Use average difference between actual gas value and concentration indicated by CEMS to access accuracy	Inaccuracy must not exceed $\pm$ 15%

may be cited where possible to describe audit procedures. The written procedures should specify individuals or groups responsible for audit program oversight, sampling, analysis, and accuacy assessment calculations. If the source chooses to conduct RAA's and/or CGA's during quarters when RATA's are not required, the QC plan should include written procedures for these audit techniques. Again, applicable sections of Appendix A, Appendix B, and/or instrument operation manuals may be cited where possible.

Sources may choose to have an outside contractor perform some or all of the accuracy audit activities. Since contractor selection may be subject to competitive bidding, the QC program need not specify a particular contractor. However, the specific activities for which the contractor will be responsible should be listed.

10.7 Program of Corrective Action for the Malfunctioning CEMS

Appendix F, Procedure 1 specifies that corrective action must be performed when a CEMS is out-of-control. Appropriate corrective action will depend on the nature of the CEMS malfunction. At a minimum, written procedures must be available, to be applied as necessary, for instrument start-up and trouble shooting. Appropriate sections of instrument operation and/or repair manuals may be referenced to fulfill this requirement. Where possible, it is recommended that additional quality assessment procedures be provided to verify proper operation of the CEMS following repair or adjustment.

A list should be provided to indicate what alternative methods are to be used for monitoring emissions during CEMS out-of-control periods in order to fulfill the minimum data availability requirements of the applicable subpart. Written procedures should be available for operation of these alternative methods.

A list or chart should be provided to indicate the offices or individuals (1) to be contacted when a CEMS out-of-control period occurs, (2) to approve the corrective action (if applicable), and (3) to be responsible for determining when alternative monitoring procedures are to be employed. Criteria should be provided for determining when the CEMS is out-of-control. As a minimum, these must include the Appendix F, Procedure 1 criteria for excessive drift and excessive inaccuracy.

10.8 References

1. Traceability Protocol for Establishing True Concentrations of Gases Used for Calibration and Audits of Continuous Source Emission Monitors (Protocol Number 1). June 1978, Section 3.0.4 of the Quality Assurance Handbook for Air

Pollution Measurement Systems, Volume III, Stationary Source Specific Methods. EPA-600/4-77-027b. August 1977. U. S. Environmental Protection Agency, Office of Research and Development Publications, 26 West St. Clair Street, Cincinnati, Ohio 45268.

Received DEP

OCT 26 1988

DPS

BROWARD COUNTY • FLORIDA

Resource Recovery Office
Room 521, 115 South Andrews Avenue
Fort Lauderdale, Florida 33301
(305) 357-6458

October 26, 1988

Hamilton S. Oven, Jr., P.E.
Administrator, Siting Coordination Section
Division of Air Resources Management
Florida Department of Environmental Regulation
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Re: Request for Modification - North Broward County Resource Recovery Facility PA 86-22

Dear Buck:

I am responding to your letter of October 14, 1988, which requested air dispersion modeling runs and supporting information demonstrating the proposed modification to the captioned project would not violate ambient air quality standards and impacts would be within the envelope considered in the original proceedings.

After receiving your letter, I requested Ken Kosky of KBN Engineering to contact Tom Rogers of the Division of Air Resources to discuss the details of your request. Based upon their discussion, I am forwarding copies of the following correspondence which we believe is responsive to your request:

1. Letter of April 9, 1987, from Thomas M. Henderson to Wayne Aronson of USEPA Region IV. Attached were tables subsequently incorporated into the PSD Permit for the South Broward Project. The tables summarize modeling assumptions and results. Specifically source parameters, emission rates, predicted ambient impacts and comparisons to PSD Increments and AAQS data were provided.

2. Letter of August 15, 1988, from Thomas M. Henderson to Bruce Miller of USEPA Region IV. The letter reviews the modification request to the North Broward Project PSD Permit and County's rational for not performing additional modeling. See second paragraph on page 2 of the letter and attachments.

3. Letter of October 20, 1988, from Bruce Miller of USEPA Region IV to Thomas M. Henderson. This letter states USEPA's agreement with the County's position on the need for further modeling.

If you or Tom Rogers need more information or clarification of points addressed in the enclosed correspondence, then please contact either Ken Kosky or I.

Sincerely yours,

Thomas M. Henderson
Project Director

TMH/bd
Enclosures
cc: Clair Fancy, FDER
✓Tom Rogers, FDER
Ron Mills, Malcolm Pirnie
Ken Kosky, KBN Engineering
Kerri Barsh, Greenberg Traurig
Neil Moses, Wheelabrator Environmental Systems
Jim Wiegner, Wheelabrator Environmental Systems

United States Department of the Interior
NATIONAL PARK SERVICE
SOUTHEAST REGIONAL OFFICE
75 Spring Street, S.W.
Atlanta, Georgia 30303

DER
MAY 21 1986
BAQM

IN REPLY REFER TO:
N3615(SER-OPS)

MAY 16 1986

Mr. Tom Rogers
Bureau of Air Quality Management
State of Florida
Department of Environmental Regulations
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32301-8241

Dear Mr. Rogers:

Thank you for sending us a copy of North Broward County Resource Recovery Project, Incorporated's power plant site certification for a proposed resource recovery facility in Broward County, Florida. The proposed project would be located approximately 78 kilometers (km) northeast of Everglades National Park, a Class I area, and 65 km northeast of Big Cypress National Preserve, a Class II area.

Our review of the information sent to us is contained in the enclosed technical review document. The North Broward application makes the sixth application we have reviewed within the last 12 months for such facilities in the vicinity of these park units. If this trend continues, the National Park Service is concerned that the cumulative impacts from numerous such facilities, if not controlled using what we feel is best available control technology, would cause potential adverse impacts on park resources. Therefore, we are requesting that a flue gas scrubbing system be installed to control SO_2 (reduce SO_2 by over 80 percent), fluoride, hydrogen chloride and sulfuric acid mist, and that nitrogen oxides and particulate matter be controlled at a more stringent level than that proposed by the applicant. Once your technical review of the project is completed, we would like to review your preliminary determination document. We will submit any additional comments regarding the project during the 30-day public comment period.

If you have any questions regarding the enclosed comments, please contact Miguel Flores of our Air Quality Division in Denver at (303) 236-8765.

Sincerely,

Frank Catroppa

Acting Regional Director
Southeast Region

Enclosure

Technical Review of Power Plant Site Certification Application
for North Broward County Resource Recovery Project, Inc.

by

Permit Review and Technical Support Branch
Air Quality Division - Denver

North Broward County Resource Recovery Project, Inc. (North Broward) is proposing to construct a resource recovery facility in north Broward County. The location is approximately 78 kilometers (km) NE of Everglades National Park, a PSD class I area administered by the National Park Service. The proposed project is also located approximately 65 km NE of the closest point of Big Cypress National Preserve, a class II area, also administered by the National Park Service. The purpose of the proposed facility is to dispose of solid waste generated in north Broward County. The proposed project is a mass-burn facility with a continuous design rated capacity of 2,200 tons per day (TPD) of solid waste, and an electrical generating capacity of 55.5 megawatts. North Broward has mentioned that they may have an ultimate generating capacity of approximately 83 megawatts using 3300 TPD of solid waste. If North Broward wants to increase the capacity to 3300 TPD, the project must be re-evaluated to determine the effects of the associated increase in emissions.

The emissions from the proposed facility are estimated as follows based on 2,200 TPD of refuse burned: 134 tons per year (TPY) of particulate matter (PM), 1,592 TPY of sulfur dioxide (SO_2), 1,620 TPY of nitrogen oxides (NO_x), 260 TPY of carbon monoxide (CO), 37.6 TPY of volatile organic compounds (VOC), 5.79 TPY of lead (Pb), 52.1 TPY of fluorides (F), 136 TPY of sulfuric acid mist (H_2SO_4), 0.0027 TPY of beryllium (Be), 2.7 TPY of mercury (Hg), and 0.09 TPY of arsenic (As). Under the PSD regulations, these emission rates are considered significant for all except VOC. Therefore, new source review is required for PM, SO_2, NO_x, CO, Pb, F, H_2SO_4, Be, Hg, and As. Following are our comments on the best available control technology, air quality, and air quality related values analyses with respect to the project's expected impacts.

BEST AVAILABLE CONTROL TECHNOLOGY (BACT) ANALYSIS

The major sources of emissions at the proposed North Broward County Resource Recovery Facility are the four associated furnaces. Therefore, our review focuses on emission controls on these units. Our BACT comments for the proposed furnaces are similar to the comments we submitted for the proposed Collier County and south Broward County resource recovery facilities. These comments were submitted to the Florida Department of Environmental Regulation (DER) previously. We again reference the publication entitled, "Air Pollution Control at Resource Recovery Facilities". This document was published in May 1984 by the California Air Resources Board (CARB) and discusses resource recovery facilities in detail. As of 1984, all refuse burning facilities with applications pending in California are proposing control technologies that are the same as, or more stringent than, the guideline emission limits discussed in this report.

For a new major source, a BACT analysis is required for each regulated pollutant emitted in significant amounts. For the proposed facility, the following pollutants will be emitted in significant amounts and require BACT review: PM, SO_2, NO_x, CO, Pb, F, Be, Hg, H_2SO_4, and As.

Particulate Matter

North Broward is proposing to use electrostatic precipitators (ESPs) to minimize PM emissions generated by combustion of the solid waste in the furnaces. Each ESP will be designed to reduce the exhaust gas PM concentration to 0.02 grains per dry standard cubic foot (gr/dscf). North Broward states that an ESP with an outlet grain loading of 0.02 gr/dscf is best available control technology for the proposed facility. We agree with North Broward that high efficiency control devices such as ESPs or baghouses represent BACT. However, stack testing data for other solid waste incinerators indicate these devices are capable of controlling PM emissions below the proposed 0.02 gr/dscf rate. In fact, based on information provided in the CARB document mentioned above, an emission limit of 0.01 gr/dscf can be achieved with these devices. This is the guideline emission limit proposed by the CARB for new resource recovery facilities in California and should be considered as the BACT limit for Florida facilities as well. The 0.01 gr/dscf rate is also the rate specified in the Maine Department of Environmental Protection's recent license to Penobscot Energy Recovery Company (PERC) for a resource recovery facility in Orrington, Maine. Therefore, we recommend the DER specify 0.01 as the BACT limit for North Broward.

Sulfur Dioxide

North Broward is proposing no control devices for limiting SO_2 emissions; rather, they are proposing the firing of low sulfur refuse as BACT for the proposed facility. The resulting BACT limit proposed is 0.55 pounds per million Btu heat input ($lb/10^6$ Btu).

The emission guideline recommended in the CARB document is 30 ppm, which corresponds to an SO_2 emission rate of approximately 0.08 $lb/10^6$ Btu. To achieve this emission level, which is significantly more stringent than the rate proposed by North Broward County, flue gas controls such as wet or dry scrubbing are required. Dry scrubbing processes have been effectively employed at pilot and full-scale refuse burning facilities in Europe, Japan, and the United States. Wet scrubbers have also been employed at full-scale refuse burning facilities. Also, applicants for two resource recovery facilities in Maine recently proposed the use of spray dryer scrubbers to minimize SO_2 and acid gas emissions. The resulting SO_2 emissions from the PERC facility referenced above were recently permitted at 0.067 $lb/10^6$ Btu after the scrubbing. The SO_2 emissions from Regional Waste Systems' (RWS) proposed facility in Portland, Maine, were estimated to be 0.074 $lb/10^6$ Btu.

It is our understanding that flue gas scrubbers will also be installed at the Palm Beach County resource recovery facility. In addition, for the Collier County resource recovery facility, the DER made a preliminary determination that flue gas scrubbing or similar technology was BACT for control of acid gases. The DER also indicated that the installation of an acid gas removal system would also provide control for SO_2 emissions. We assume that the DER will make a similar determination for North Broward and require flue gas scrubbing for the proposed facility. Therefore, because the flue gas scrubbing system required for control of acid gases will also reduce SO_2 emissions, we recommend the DER specify SO_2 limits for North Broward that reflect the SO_2 reductions achievable with a flue gas scrubbing system, and are comparable with the above CARB limits.

Nitrogen Oxides and Carbon Monoxide

The two primary variables that affect the formation of NO_x from resource recovery furnaces are the temperature and the concentration of oxygen in the combustion zone. North Broward is proposing furnace design and good combustion practices as NO_x BACT. Combustion controls include use of low excess air, limiting peak combustion temperature, and good air/fuel mixing in the combustion chamber. North Broward determined that a NO_x emission rate of 5.0 lb/ton (0.55 lb/10^6 Btu) represent BACT for the proposed facility. We agree with North Broward that the proposed use of combustion controls represent BACT. However, based on information presented in the CARB report and other reports referenced in North Broward's PSD application, we feel combustion control can reduce NO_x emissions to the 3.0 lb/ton or lower range. For example, on page 4-10 of the PSD application it states that Camp, Dresser and McKee (1984) reported emission factors for five operating solid waste fired facilities in the United States ranging from 2.1 to 4.6 lb/ton. Three other facilities were permitted at a rate of about 3.0 lb/ton. EPA (1984a) also cites a factor of 3.0 lb/ton. The application also states that Henningson, Durham and Richardson (1985b) surveyed eleven solid waste incinerators throughout the United States and found NO_x emissions ranging between 1.1 and 4.7 lb/ton. In addition, A.D. Little's (1981) survey showed emissions to range from 0.7 to 4.4 lb/ton. Based on this information, we do not understand why North Broward feels a 5.0 lb/ton rate represents BACT.

Carbon monoxide emissions result primarily from incomplete combustion. North Broward is proposing as BACT a combustion control system that will insure sufficient mixing of the solid waste fuel and air so that the emissions of products of incomplete combustion are minimized. We agree with North Broward that the proposed combustion controls represent BACT for emission of CO from the proposed facility. North Broward is proposing to emit 260 TPY of CO.

Other Pollutants

Other pollutants emitted from the proposed facility that require BACT review include, Pb, F, Be, Hg, H_2SO_4 and As. In addition, although presently not a regulated pollutant, significant amounts of hydrogen chloride (HCl) can be emitted from municipal incinerators and should be minimized.

Lead, Be, and As are emitted in the solid phase. Therefore, the ESPs proposed to control PM emissions will also control these pollutants. We agree that the proposed ESPs represent BACT for these pollutants.

Fluorides, H_2SO_4, HCl, and mercury are emitted primarily in the gaseous phase. North Broward did not propose additional controls for these pollutants. However, assuming the DER determines dry scrubbing is BACT for acid gas control, as they did for the Collier County resource recovery facility, these emissions would be reduced by as much as 90 percent. We feel a dry scrubbing system or equivalent is BACT for these pollutants.

AIR QUALITY ANALYSIS

The application indicates that ISCST was used to predict the maximum air quality impacts due to the proposed plant. This seems to be an appropriate application of this model for this source. The air quality modeling analysis predicts maximum SO_2 3-hour and 24-hour concentration increases of 3.2 micrograms per cubic meter (ug/m^3) and 0.61 ug/m^3 that added to the background values of 27 ug/m^3 and 12 ug/m^3 would give total concentration levels of 30.2 ug/m^3 and 12.61 ug/m^3 respectively in Everglades National Park. The proposed plant is predicted to add only a minor amount to the annual concentration level in the park.

The attached table (from the application) shows the maximum predicted concentrations of the pollutants to be emitted from the proposed plant and concentrations known to adversely impact vegetation. Using a ratioing technique we calculated the maximum concentration of arsenic to be 0.0005 ug/m^3. We have also converted each concentration expressed in ug/m^3 to parts per million (ppm) for the heavy metals, for easier comparison to known effects levels.

AIR QUALITY RELATED VALUES ANALYSIS

There are numerous air quality related values (AQRVs) found in Everglades National Park. These include 14 Federally listed endangered and threatened species, and a number of unlisted rare and threatened species. There are also many species of epiphytes, including certain species of orchids, that are not found anywhere else in the National Park system and are uniquely sensitive to air pollution.

In addition to the resources of Everglades National Park, we are concerned about the resources of Big Cypress National Preserve. It is the responsibility of the National Park Service, under the Organic Act of 1916, to ensure that the unique resources of Everglades National Park and Big Cypress National Preserve are protected from degradation. Big Cypress contains 10 Federally threatened or endangered species and is famous for a high diversity of rare bromeliads and orchids.

The discussion below on the sensitive resources of Everglades National Park and Big Cypress National Preserve is partially from testimony given by Jack Morehead, former Superintendent of Everglades National Park, outlining NPS concerns over air pollution effects on park resources from a Dade County power plant. Because of these concerns the NPS and Florida Power and Light have instituted some research projects that are not yet complete.

Dade County Slash Pine. This pine (Pinus elliotti var. densa) is a variety of slash pine that is biologically distinct from the slash pine that is found in other parts of the southeastern U.S. (Tomlinson, 1980). Originally including some 200,000 to 300,000 acres along a limestone ridge in southeast Florida, it has been seriously cut back by farming and urban development so that the only remaining contiguous population (approximately 20,000 acres) of this variety in the world is in Everglades National Park. The species is known to be sensitive to ozone: levels as low as 0.05 parts per million (ppm) for 18 weeks of exposure have been shown to depress photosynthesis nine percent (Barnes, 1972). Stands of this pine are very open, thus increasing the flux of pollutants to many individual trees. In addition, this species does not grow with only one annual ring per year as temperate pines do. Instead, this species can produce as many as five growth flushes a year, thus subjecting five new sets of needles to air pollutants. NPS is currently funding fumigation studies exposing the pine to both ozone and SO_2 because the likelihood of synergistic effects is high (pines are known to be highly sensitive to both pollutants (Smith, 1981). These studies, conducted by the Environmental Protection Agency Corvallis Environmental Research Laboratory, have shown that south Florida slash pine is extremely sensitive to a few episodes of acute SO_2 when ozone levels average only .04 - .05 ppm/7 hour daylight mean. One exposure to one hour of SO_2 at 534 ug/m^3 plus three exposures at 267 ug/m^3 throughout the growing season caused significant reductions in biomass and size of seedling trees, even without the appearance of foliar injury symptoms. Permanent plots and potted seedlings of slash pine have been installed in Everglades National Park to monitor effects of these pollutants. So far, there have been reports of ozone-like symptoms on pines in Everglades National Park.

Lichens. Tropical hardwood trees in the hammocks in the park are typically covered with many species of foliose lichens. Lichens are extremely sensitive to low annual averages of SO_2 (less than 0.01 ppm) and have been observed to disappear in areas where such concentrations are found (Skye, 1968; Richardson, D.H.S. et al., 1981; Manning, W.J. & W. A. Feder, 1980). Lichens are the food base for the unique and rare Liguus tree snails for which Everglades National Park serves as a significant portion of their remaining habitat and population (George, 1972). The effects of SO_2 on these lichens could lead to irreversible loss of the tree snails. NPS is currently conducting studies of the SO_2 sensitivities of lichens in Everglades National Park. Of the lichens studied, one, Ramalina denticulata, appears to be sensitive to SO_2 levels at 100 ug/m^3 for six hours a week for 10 weeks. This lichen is in a genus that is known to die out at SO_2 annual average concentrations between 5 and 30 ug/m^3.

Epiphytes. The park is famous for numerous species of orchids and bromeliads, species of vascular plants that grow on branches of trees in hammocks and pinelands. The epiphytes depend on the branches for support and some nutrients, but they depend entirely on precipitation for water and most nutrients. These species have a unique susceptibility to acid precipitation and dry deposition of SO_2 and metals on their foliage. A review of the literature has shown that anatomically, physiologically, and ecologically they are uniquely sensitive to air pollution (Benzing, 1981). A study on the sensitivity of epiphytes in Everglades National Park to air pollution (SO_2 and O_3) was initiated this year. In addition, these epiphytes and the sensitive lichen species have been placed in biomonitoring plots in the parks and other areas of south Florida. They will be studied and sampled every year for air pollution effects.

Other pollutants emitted by the proposed facility deserve special attention in the AQRV analysis. Fluoride is much more phytotoxic than SO_2, and lichens and orchids are hypersensitive to it at the parts per billion level. In addition, elevated levels of Hg and As have been found in invertebrates in the park (Ogden et al. 1974).

Due to currently high ozone levels in the park, reported ozone-like symptoms on slash pine, and the synergistic effect of ozone and SO_2, reduction of NO_x emissions from 5.0 to 3.0 lb/ton and SO_2 emissions by use of a flue gas scrubber, will minimize the impact on park resources. The use of a flue gas scrubber would also reduce fluoride emissions which are toxic to lichens and epiphytes, and it would help reduce H_2SO_4 and HCl which contribute to the acidity of rainfall.

Conclusions

The resources of Everglades National Park and Big Cypress National Preserve are unique, and many are sensitive to air pollutants. The area is a high growth area and there are presently applications pending for at least four resource recovery plants within 100 kilometers of these parks. Due to this high growth, the sensitivity of park resources, and the proposed NO_x, SO_2, and PM emission rates not reflecting BACT, the National Park Service requests that:

(1) The NO_x emission rate be reduced from 5.0 to 3.0 lb/ton;

(2) a flue gas scrubbing system be installed and the emission limitations for SO_2, F, H_2SO_4, HCl, and Hg be reduced to reflect the reductions achievable through the use of such a system; and

(3) an emission rate of 0.01 gr/dscf be specified as BACT for PM.

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Table 8-1. Maximum Predicted Concentrations Due to the Proposed NBCRR Facility Compared to Concentrations Known to Adversely Impact Vegetation

Pollutant	Average Period	Concentration (ug/m^3): Maximum Predicted Due to Facility	(ppm)	Concentration (ug/m^3): Background*	Concentration (ug/m^3): Total (Facility Plus Background)	Lowest Concentration Known to Impact Vegetation (ug/m^3)	Reference
SO_2	3-hour	34.6		27	61.6	260 for 6 hours 12 times in 12 weeks	Flagler and Younger, 1982
TSP	24-hour	0.71		63	63.7	32,000†	Thompson <u>et</u> <u>al</u>., 1984
NO_2	Annual	0.73		34	34.7	120	Thompson, 1970
	3-hour	35.2		**	35.2	188	Tingey, 1971.
CO	1-hour	11.0		7,000	7,011	Vegetation not impacted by CO	--
Pb	3-month	0.0026	$3.1x10^{-6}$	0.2	0.2	Unavailable to plants in high calcium and organic soils	Zimdahl and Skogerboe, 1977
	24-hour		$3.6x10^{-5}$				
F^-	24-hour	0.27	$3.5x10^{-4}$	**	0.27	1 to 3	McCune, 1969. Adams, 1956.
Be	24-hour	0.000014	$3.8x10^{-8}$	**	0.000014	Not known to be available to plants	Gough <u>et</u> <u>al</u>., 1979
Hg	24-hour	0.014		**	0.014	10 (Duration unknown)	Stahl, 1969
As	24-hour	0.0005	$1.5x10^{-7}$				

*Second highest 24-hour or highest annual average concentration measured within 10 km of the facility (see Section 5.2). The 3-hour concentration is not available with monitoring technique. The 3-hour background concentration was assumed equal to 2.25 times the 24-hour concentration of 12 $\mu g/m^3$ (DER, 1985).
†Assumes deposition velocity of 0.18 cm/sec.
**Ambient monitoring data not available in Broward County.

Source: ESE, 1986.

From – PSD Application – North Broward

BEST AVAILABLE COPY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET
ATLANTA, GEORGIA 30365

AUG 29 1984

DER
SEP 4 1984
BAQM

REF: 4AW-AM

Honorable Lawton Chiles
Federal Building
Lakeland, Florida 33801

RE: Broward County FAA Incinerator

Dear Senator Chiles:

This is in response to your letter of August 15, 1984, regarding correspondence from Mr. S. William Grassi concerning the proposed construction of a municipal solid waste incinerator near the Fort Lauderdale/Hollywood International Airport in Broward County, Florida.

The State of Florida Department of Environmental Regulation (FDER) has primary responsibility for issuing construction permits to any source applying for an air permit. When an application for an air permit is submitted to the FDER, the FDER reviews the application and determines if the source is subject to regulations for the Prevention of Significant Deterioration (PSD), New Source Performance Standards (NSPS), or National Emission Standards for Hazardous Air Pollutants (NESHAP). If the source is subject to PSD requirements, the FDER reviews the permit application, and prepares the preliminary determination and the draft construction permit. EPA reviews the preliminary determination, as well as the draft permit prepared by the FDER, to ensure that applicable PSD requirements are met. The preliminary determination and draft permit are subject to public comment. After the public comment period, the State prepares the final determination and construction permit, and forwards them to EPA. The FDER issues the PSD construction permit with the conditions contained in the final determination thereby granting a company authority to construct the source.

On August 22, 1984, the FDER was contacted in regard to the above referenced project. The project manager for this source (Mr. Ed Svec) stated that an application for construction was submitted on February 24, 1984, and was determined to be incomplete. According to the application, the source will be subject to PSD review for particulate matter, sulfur dioxide, nitrous oxides, carbon monoxide, lead, fluoride, beryllium, and mercury. In addition, the 1500 ton per day incinerator will be subject to NSPS and possibly power plant siting requirements for the State of Florida (if greater than 50 megawatts of power are generated in conjunction with the incineration). No additional information has been received by FDER since the April 20, 1984, meeting with the consulting firm handling the application. However, Mr. Svec stated that it is doubtful that the stack gas temperature would be increased to 3000°F as it is not economical.

DEPARTMENT OF ENVIRONMENTAL REGULATION

ROUTING AND TRANSMITTAL SLIP

ACTION NO	
ACTION DUE DATE	

1. TO: (NAME, OFFICE, LOCATION)	
~~Claire Fancy~~	Initial
	Date
2. Ed Svec	Initial
	Date
3.	Initial
	Date
4.	Initial
	Date

REMARKS:

if Steve needs to see this, send it back up.

INFORMATION	
	Review & Return
	Review & File
	Initial & Forward

DISPOSITION	
	Review & Respond
	Prepare Response
	For My Signature
	For Your Signature
	Let's Discuss
	Set Up Meeting
	Investigate & Report
	Initial & Forward
	Distribute
	Concurrence
	For Processing
	Initial & Return

FROM: Judy Rogers

DATE 9-4-84

PHONE

In summary, this source has not submitted a complete application as of this date. If you wish to obtain further information, you may contact the FDER at:

Bureau of Air Quality Management
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32301
904/488-1344

Sincerely yours,

Paul Traina
Acting for Charles R. Jeter
Regional Administrator

cc: Mr. Steve Smallwood, P.E., Chief
Bureau of Air Quality Management

DER
SEP 10 1984

Florida House of Representatives

Tallahassee

Anne Mackenzie
Representative, 95th District

Reply to:
☒ Suite 201
901 South Federal Highway
Fort Lauderdale, Florida 33316
(305) 524-1000

☐ 412 House Office Building
Tallahassee, Florida 32301
(904) 488-0245

Committees
Regulated Industries & Licensing
Finance & Taxation
Education, K-12

Growth Management (Select)

September 5, 1984

Claire Fancy
Department of Environmental Regulation
2600 Blair Stone Road
Tallahassee, Florida 32301

Ed Svec for permit file

Dear Claire,

Thank you for making the Broward County public information forum a great success. Your participation in this meeting reassured the residents of the area that D.E.R. officials are not the opposition but are willing to work together with them on this issue.

You now realize the many problems involved with the proposed resource recovery plant site. As expressed at the meeting, the concerned citizens are well-informed and willing to fight this proposal in every way possible. It is important that you maintain contact with Steve Simmons, the president of South Broward Citizens for a Better Environment, and with Larry Gore, the group's attorney, so that they fully understand the step by step permitting process. Hopefully, we can avoid any further misunderstanding or confusion.

I look forward to continue working with you to ensure the facility is placed at the proper location according to the appropriate regulations. Please keep me informed on what is happening at D.E.R. regarding this issue.

Again, thank you for all your help.

Sincerely,

Anne

Anne Mackenzie
Representative
District 95

AM/mi

P.S. thanks for all your help — Laud I did the bills 26% - 72% for Bing! Anne

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET
ATLANTA, GEORGIA 30365

SEP 19 1984

DER

SEP 25 1984

BAQM

REF: 4AW-AM

Honorable Lawton Chiles
Federal Building
Lakeland, Florida 33801

RE: Broward County FAA Incinerator, Lewis Druss

Dear Senator Chiles:

This is in response to your letter of September 5, 1984, regarding correspondence from Mr. Lewis R. Druss concerning the destruction of wetlands and the release of dioxins from a proposed resource recovery facility to be located near the Fort Lauderdale/Hollywood International Airport in Broward County, Florida.

In regard to the destruction of the wetland area, the Army Corps of Engineers has submitted applications to us for review regarding dredge/fill permitting of the Broward County Resource Recovery facility. We submitted comments regarding this application on April 6, 1984, stating that the permitting of this facility for dredge/fill is justifiable. However, to my knowledge, the Corps has not made a final decision on the issuance of the two dredge/fill permits for this facility. Any requests for a public hearing or additional information on dredge/fill permitting should be directed to Colonel Charles T. Myers III, District Engineer, or Mr. John Adams, Chief, Regulatory Division, Jacksonville District, U. S. Army Corps of Engineers, P. O. Box 4970, Jacksonville, Florida 32232. In addition to dredge/fill considerations, Mr. John Guidry of the Florida Department of Environmental Regulation (FDER), Southeast Florida District, was contacted regarding the proposed landfill and any possible leachates which may impact wetlands. Mr. Guidry stated that landfill leachates will be pumped to the Hollywood Sewage Treatment Plant from the resource recovery facility and that the sewage treatment plant has adequate capacity to provide for proper treatment of these wastes. It is, therefore, not suspected that leachates will have a detrimental impact on wetlands. Further information concerning landfill leachates or stormwater runoff retention/treatment may be obtained from Mr. Guidry at, P. O. Box 3858, West Palm Beach, Florida 33402, 305/689-5800.

In response to Mr. Druss's concerns regarding the release of dioxins from this project, the Environmental Protection Agency is conducting a National Dioxin Study in which a select group of combustion sources will be testing for levels of toxic dioxin. This Regional Office is participating in this study and has forwarded letters to our eight state directors to identify potential sampling site candidates. The results obtained from this

DEPARTMENT OF ENVIRONMENTAL REGULATION

ROUTING AND TRANSMITTAL SLIP

ACTION NO

ACTION DUE DATE

BARKER (2)		FANCY (1)		~~STARNES~~	
BLOMMEL		THOMAS		MARSHALL MOTT-SMITH	
MANNING		GEORGE		J. ROGERS	
DAVIS		ADAMS			

REMARKS

Ed Svec -
for permit file

INFORMATION
- REVIEW & RETURN
- REVIEW & FILE
- INITIAL & FORWARD

DISPOSITION
- REVIEW & RESPOND
- PREPARE RESPONSE
- FOR MY SIGNATURE
- FOR YOUR SIGNATURE
- LET'S DISCUSS
- SET UP MEETING
- INVESTIGATE & REPT
- INITIAL & FORWARD
- DISTRIBUTE
- CONCURRENCE
- FOR PROCESSING
- INITIAL & RETURN

FILE:

FROM:
STEVE SMALLWOOD

DATE

PHONE

effort will most likely be utilized in supporting the development of regulations for affected facilities which emit dioxins in quantities which impact the environment and are hazardous to ones' health.

If the EPA study concludes that dioxin emissions from municipal waste incinerators are of sufficient levels to warrant additional control, there are control technologies available to minimize those emissions. From our experience with hazardous waste incinerators, typically dioxins may be safely destroyed through incineration by maintaining high temperatures (1200° C or 1600° C), sufficient combustion time (2 secs or 1.5 secs), sufficient mixing amounts of waste feed, fuel and air, and maintaining an excess air ratio of 3% (@1200° C) or 2% (@1600° C) in the flue gasses.

In addition to the above study, a research scientist has completed a report entitled "Containment of Dioxin Emissions from Refuse Fired Thermal Processing Units: Prospects and Technical Issues" (PB# 84-217090), which is available from the National Technical Information Service, Springfield, Virginia 22161. This report states that dioxin molecules bind to fly ash and that these potentially hazardous emissions may be reduced through the control of fly ash (particulate) emissions. The current "state of the art" technology for control of particulate emissions from incinerators is the use of electrostatic precipitators (ESP's). These ESP's have been documented to achieve control efficiences for particulate matter as high as 99.97% at similar facilities.

If Mr. Druss wishes to obtain further information concerning the air emissions from the Broward County Resource Recovery project, he may contact the FDER at: Bureau of Air Quality Management, Twin Towers Office Building, 2600 Blair Stone Road, Tallahassee, Florida 32301, 904/488-1344.

If I can be of any further assistance, please feel free to contact me.

Sincerely yours,

Charles R. Jeter
Regional Adminstrator

cc: Mr. Steve Smallwood, P.E., Chief
Bureau of Air Quality Management

Ed Svec -
we should consider these as permit conditions

September 25, 1984

Mrs. Philip W. Beck
2536 Marathon Lane
Fort Lauderdale, Florida 33312

Dear Mrs. Beck:

Governor Graham has asked me to reply to your letter of August 30, 1984, about the proposed Broward County Resource Recovery Facility.

The department's Bureau of Air Quality Management is keenly aware of the local citizen's concern about potential dioxin emissions from the proposed facility. They are currently in the process of gathering and reviewing technical information on the subject from all sources available. We are in the process of checking with federal officials in the New York area to obtain the exact status of the Hempstead facility and are looking into participating in a study with several other states to determine dioxin emissions from such facilities.

Unfortunately, the testing for dioxin is very expensive (about $100,000 for the testing of one facility) and is also very complicated (only three laboratories in the country are capable of analyzing the samples). The State of Florida does not have the capability to do the tests or analyses. Consequently, we have to rely on information provided by the federal government and other sources. This multi-state effort appears to us the most practical and unbiased mechanism that we have to obtain good data.

The facility proposed for Broward County uses a mass burning technology similar to that used by Pinellas County. The other technology, the burning of refuse derived fuel, that is used by both Dade County and Hempstead appears to not be as environmentally acceptable as the mass burn technology.

The air pollution permits are being reviewed by our Central Air Permitting Section in Tallahassee. The applications are currently incomplete as all of the necessary information to adequately assess the air pollutant emissions has not been submitted to the department.

I assure you that we will thoroughly investigate the dioxin issue before any intent to issue the permits is made. Florida Statutes allow opportunity for interested parties to request a hearing on such intents before the permit is actually issued. If you have any additional questions please contact Clair Fancy at 904/488-1344.

Sincerely,

Stephen J. Fox, Director
Division of Environmental
Permitting

SJF/bs

State of Florida
DEPARTMENT OF ENVIRONMENTAL REGULATION

INTEROFFICE MEMORANDUM

For Routing To District Offices And/Or To Other Than The Addressee		
To:	Loctn.:	
To:	Loctn.:	
To:	Loctn.:	
From:	Date:	
Reply Optional [ ]	Reply Required [ ]	Info. Only [ ]
Date Due:	Date Due:	

TO: Victoria J. Tschinkel

THRU: Steve Alexander

FROM: Clair Fancy *Clair Fancy*

SUBJ: Contact with Legislature

DATE: August 2, 1984

About a week after our meeting with Representative Anne MacKenzie, of the 95th district, I receive a call from her assistant about setting up a public meeting to discuss the Broward County Resource Recovery Facility. That meeting has been scheduled for the evening of August 29. I suggested that they contact Ray Moreau, and either Roy Duke or Jim Williams, to also attend. That is what they plan to do.

Apparently there has been a considerable amount of public interest in this project and they anticipate in excess of 300 people at the public meeting. The purpose will be to discuss the technical aspects of garbage disposal and the air pollution emission and controls.

CHF/ks

Ed Svec
For Broward
County File.

7-13-84

Broward County

2 applications

Northern RR Facility (near Pompano) 1500 tpd

Southern RR " (near Ft. Lauderdale) 1500 tpd

rec'd 2/24/84 incomplete: no PE sig, no fee, not specified specific air poll equipment, no documentation on emission factors

Incompleteness letter written on 3/23

Had meeting on 4/20 with Phillis Korab & Tom Mills of Malcolm Pirnie. They were having problem with Northern facility. City had incorporated the property & re-zoned it so they couldn't build RR facility. County was going to take city court.

They were going to persue Southern facility. Was question about throughput in Southern & maybe Northern too. maybe up to 2500(?) tpd

Mills was going to send everything but vendor selection & PE stamp.

Swec called Korab on 7/11. Tom Henderson called back on 12th - He is now in charge. They resubmitted bid applications & a third vendor might be interested

One vendor suggested a 55 MW generator. Pirnie was still consultant, but might not be for long. Vendor selection could be near end of year.

Henderson will be in Tallahassee next month

Two letters from concerned citizens on Southern Site. Lauderdale Isles Civic Assn. generating campaign against project. Media pushing to not build it.

Subject: PSD, BACT

vendors: Waste Mngmt, Signal Resco, BFI
Talking ESP

821 tpy SO_2/unit at 3#/ton at 1500 tpd
312 " PM at .03 g/scf
38 " VOC at .14#/ton

Wednesday 8/02 - Ed Svec rec'd phone call from Mike Brandon - EPA Region IV - he rec'd a letter from Lawton Chiles (Senate) requesting date of application, major pollutants, significant pollutants. Svec brought him "up to date" on the application. Chiles' letter was prompted by a letter from S. William Grassi, ~~Et~~ Lauderdale Isles Civic Assn.

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

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

BOB GRAHAM
GOVERNOR

VICTORIA J. TSCHINKEL
SECRETARY

June 26, 1984

Mr. S. William Grassi
2530 Marathon Lane
Fort Lauderdale, Florida 33312

RE: Construction Permit Application,
Broward County Southern Resource
Recovery Facility

Dear Mr. Grassi:

The Department received an application to construct an air pollution source from Broward County on February 24, 1984. The application did not contain adequate information which would allow us to evaluate the request for a permit to construct this resource recovery facility. This information was requested on March 23, 1984 and we are still awaiting this information. I am enclosing a copy of this letter.

We will gladly provide you a copy of the incomplete application. However, we must charge you for its reproduction. You must send a check payable to the Department of Environmental Regulation for $26.62. The fee is five cents a page reproduced plus the clerical time.

There is a copy of this application available for inspection at the Air Office of the Broward County Environmental Quality Control Board. Their address is:

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

If I can be of any further assistance, please write to me at the above address.

Sincerely,

Edward J. Svec
Review Engineer
Bureau of Air Quality
Management

ES/agh
Attachment
cc: Gary Carlson, Broward County EQCD

601 Brentwood Rd.
Dearborn, Michigan 48124
June 30th, 1984

State of Florida Department of
Environmental Regulation
Twin Towers Building
2600 Blair Stone Road
Tallahassee, Fl. 32301

Dear Sirs: Re: Proposed Incinerator at 84 & 441
Fort Lauderdale, Fl.

We have owned our house at 2636 Key Largo Lane, Fort Lauderdale, 33312, since the subdivision was first built.

It is impossible to fathom the stupid reasons for allowing a perfectly nice and decent neighbourhood to be destroyed, as it will be if this site is used.

As taxpayers, I will expect you to write to me within ten business days citing your reasons for supporting this proposal. I especially ask this, as it is well known there is land available in an uninhabited region of south Florida.

Please write your letter to 601, Brentwood Rd., Dearborn, Mi.48124.

Very truly yours

Dorothy A. Sloss

(Mrs.) D. A. Sloss

RECEIVED
JUL 2 1984
DIV. ENVIRONMENTAL PERMITTING

BEST AVAILABLE COPY

DEPARTMENT OF ENVIRONMENTAL REGULATION

ROUTING AND TRANSMITTAL SLIP

ACTION NO

ACTION DUE DATE

1. TO: (NAME, OFFICE, LOCATION) Air Program — Initial — Date
2. Montgomery Bld. — Initial — Date
3.
4.

REMARKS:

DER
JUL 2 1984
BAQM

To Ed Seve
Date 7/1 Time

WHILE YOU WERE OUT

M Tom Henderson
of
Phone 305-375-6456
Area Code Number Extension

◯	TELEPHONED	☒	PLEASE CALL
	CALLED TO SEE YOU		WILL CALL AGAIN
	WANTS TO SEE YOU		URGENT
☒	RETURNED YOUR CALL		

Message (305) 357-6460
Broward County Resource Recovery | 115 So. Andrews Ave
RM 521
Ft Laud 33301

LG
Operator

FROM: Juan K. Buse
Bureau of Permitting
TLH

DATE 7-2-84

PHONE SC 278-0130

July 6, 1984

Dept. of Environmental Regulation
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32301

Attention: Mr. Edward J. Svec
Review Engineer

Re: Construction Permit Application
Broward County Southern Resource
Recovery Facility

Mr. Svec:

I wish to thank you for your letter dated June 26, 1984. Attached is my check in the amount of $26.62 which represents payment for photocopying of the application to construct an air polltion source for Broward County. Please send the complete application to my attention.

Sincerely yours,

S. William Grassi

S. William Grassi
2530 Marathon Lane
Ft. Lauderdale, FL 33312

RECEIVED
JUL 9 1984
EA, SOLID WASTE

DEPARTMENT OF ENVIRONMENTAL REGULATION

ROUTING AND TRANSMITTAL SLIP

ACTION NO.	
ACTION DUE DATE	

TO: (NAME, OFFICE, LOCATION)	
1 ~~Bill~~ F. Bs	INITIAL / DATE
2 Ed Svec	INITIAL / DATE
3	INITIAL / DATE
4	INITIAL / DATE

REMARKS:

yesterday, Malcom Pierce called about Broward County RR plant. There may be a third bidder (BFI) in addition to Signal Resco & Waste Mgmt. They may not have a vendor selected till years end. I guess it was felt that there may have been some hanky panky going on.

They may not have vendor selected until years end. They will answer March 23 letter fairly soon.

INFORMATION	
X	REVIEW & RETURN
X	REVIEW & FILE
X	INITIAL & FORWARD
X	

DISPOSITION	
X	REVIEW & RESPOND
X	PREPARE RESPONSE
X	FOR MY SIGNATURE
X	FOR YOUR SIGNATURE
X	LET'S DISCUSS
X	SET UP MEETING
X	INVESTIGATE & REPT
X	INITIAL & FORWARD
X	DISTRIBUTE
X	CONCURRENCE
X	FOR PROCESSING
X	INITIAL & RETURN

1287
1325

DATE 7/11

PHONE

Grassi

May 15, 1984

RECEIVED
MAY 22 1984
DIV. ENVIRONMENTAL PERMITTING

State of Florida
Dept. of Environmental Regulation
Koger Executive Center
2652 Executive Center, Circle E
Koger Center, Montgomery Bldg.
Tallahassee, FL 32304

Re: Broward County Rte. 441
Resource Recovery Project
Air Pollution Control
Plant and Landfill (App. No. AC06-83003)

Gentlemen:

I am a concerned citizen, a resident of Broward County, and a member of the Lauderdale Isles Civic Association. My residence is approximately 1000 feet from the perimeter of the dump and incinerator site. I am requesting photocopies of applications described above and your answers to Broward County regarding their applications.

If a permit was issued, I wish to have a copy of the detailed reasons for granting the permit, the in-depth studies of the environmental impact and the names and addresses of the federal and state agencies your organization ultimately reports to.

Since this is a high priority request, it is of the utmost urgency that you respond upon receipt of this correspondence.

Very truly yours,

S. William Grassi

S. William Grassi
2530 Marathon Lane
Ft. Lauderdale, FL 33312

DEPARTMENT OF ENVIRONMENTAL REGULATION

ROUTING AND TRANSMITTAL SLIP

ACTION NO	
ACTION DUE DATE	

1. TO: (NAME, OFFICE, LOCATION)	
1. Air — 6th floor	Initial / Date
2. ~~Clair~~	Initial / Date
3. ~~Bill T.~~, Ed S.	Initial / Date
4.	Initial / Date

REMARKS:

5/29 Make sure he gets copies as requested.

Clair

D.E.R.

MAY 25 1984

BAQM

Also draft a letter telling him who the contents are.

Call Nancy on this Request

INFORMATION	
	Review & Return
	Review & File
	Initial & Forward

DISPOSITION	
	Review & Respond
	Prepare Response
	For My Signature
	For Your Signature
	Let's Discuss
	Set Up Meeting
	Investigate & Report
	Initial & Forward
	Distribute
	Concurrence
	For Processing
	Initial & Return

FROM: J. K. Bess

DATE

PHONE

X copy for you

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

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

BOB GRAHAM
GOVERNOR

VICTORIA J. TSCHINKEL
SECRETARY

March 23, 1984

CERTIFIED MAIL - RECEIPT REQUESTED

Ms. Phyllis A. Korab
Project Director, Broward County
Courthouse - Room 248
201 Southeast - 6th Street
Ft. Lauderdale, Florida 33301

Dear Ms. Korab:

The Bureau of Air Quality Management has received your applications to construct a northern and southern resource recovery facility in Broward County, Florida. After reviewing these applications, the department has deemed these applications to be incomplete. Before the applications can be processed, all the requested information must be received by the department for each application.

1. The signature and seal of a Professional Engineer registered in the State of Florida is required for all applications.

2. General Project Information, Section II E, must be completed providing the requested power plant information.

3. Provide all information on the turbine generators including rating, manufacturer and efficiency for each resource recovery facility.

4. Will the Broward County Board of County Commissioners or the selected vendor operate these resource recovery facilities and be responsible for the maintenance and operation of these pollution control sources and pollution control facilities?

5. Section IV B, Best Available Control Technology: The EPA has declared the BACT for this class of source. Provide all the requested information.

6. An application fee of $1,000 is required for each permit.

7. How will the proposed units be fired during periods of startup and shutdown.

8. Will any auxiliary fuels be used during low Btu periods?

9. Provide documentation for the emission factors presented in Table 3-3 of Appendix C.

10. Items 2, 4, and 5 of Section V must be answered for the specific equipment that are proposed to be installed in these facilities.

11. Provide the manufacturer, date constructed and model number of the incinerator requested in Section IV.

When the requested information is received, we will resume processing your applications. If you have any questions on their status, please write me at the above address or call Edward Svec, Review Engineer, at (904)488-1344.

Sincerely,

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

CHF/ES/s

cc: Tom Tittle, DER SE District
Gary Carlson, Broward County EQCB
Ronald J. Mills, Malcolm Pirnie, Inc.
Cleve Holladay, DER

BEST AVAILABLE COPY

BROWARD COUNTY ENVIRONMENTAL QUALITY CONTROL BOARD

500 S.W. 14th Court
Fort Lauderdale, Florida 33315
(305) 765-5881

M E M O R A N D U M

DER
MAR 1 2 1984
BAQM

DATE: March 6, 1984

TO: James G. Williams, P.E.
DER, West Palm Beach

FROM: William P. Stone WPS

SUBJECT: Application File No. AC 06-83175
Broward County Board of County Commissioners

In a recent interview with the engineers regarding this project, we agree with Clair Fancy's opinion that the carbon monoxide emission calculations may be extremely low. We have requested additional information to verify their claims that their emission factor of .6#/ton is justified in the face of AP-42 stated factor of 35#/ton.

Therefore, we do not believe this application is complete.

WPS/mr

cc Clair Fancy 3/9/84

RECEIVED
'84 MAR 7 AM 9 22
FLA. DEPARTMENT OF
ENVIRONMENTAL REG.
WEST PALM BEACH

DEPARTMENT OF ENVIRONMENTAL REGULATION

ROUTING AND TRANSMITTAL SLIP

ACTION NO.

ACTION DUE DATE

TO: (NAME, OFFICE LOCATION)		
1.	Clair Fancy	INITIAL / DATE
2.	BAQM	INITIAL / DATE
3.	Tall.	INITIAL / DATE
4.	3/12 Bill Thomas	INITIAL / DATE

REMARKS:

BCBCC
applications
Resource Recovery
Memos from
Bill Stone

please handle.

INFORMATION
- REVIEW & RETURN
- REVIEW & FILE
- INITIAL & FORWARD

DISPOSITION
- REVIEW & RESPOND
- PREPARE RESPONSE
- FOR MY SIGNATURE
- FOR YOUR SIGNATURE
- LET'S DISCUSS
- SET UP MEETING
- INVESTIGATE & REPT
- INITIAL & FORWARD
- DISTRIBUTE
- CONCURRENCE
- FOR PROCESSING
- INITIAL & RETURN

FROM:

STATE OF FLORIDA
DEPT. OF ENVIRONMENTAL REGULATION
P.O. BOX 3858
WEST PALM BEACH, FL 33402

DATE 3/9/84

PHONE

BEST AVAILABLE COPY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET
ATLANTA, GEORGIA 30365

JAN 13 1984

4AW-RM

Mr. Robert W. McVety
Administrator
Solid and Hazardous Waste Section
Florida Department of Environmental
Regulation
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32301 - 8241

Dear Mr. McVety:

Enclosed is a copy of a memo and attachments from Michael Cook, the Agency's Dioxin Management Coordinator, on emission evaluations from a municipal waste combustion facility. Potential exposure levels of 2, 3, 7, 8 TCDD from this incinerator were approximately six times greater than any previously reported. However, the Agency has tentatively concluded that even these levels do not represent a significant health concern. A copy of the 1981 interim evaluation on five other incinerators is also enclosed. Both of these documents are in the draft stage, but may be shared with the public.

Sincerely,

James H. Scarbrough
Chief
Residuals Management Branch

Enclosures

16 DEC 1983

OFFICE OF
SOLID WASTE AND EMERGENCY RESPONSE

MEMORANDUM

SUBJECT: TCDD Emissions for Municipal Waste Combustors

FROM: Michael B. Cook
Dioxin Management Coordinator

TO: Addressees

We have recently completed an assessment of tetrachlorodibenzo-p-dioxin (TCDD) emissions from another municipal waste combustion (MWC) facility sampled early this year. This is the sixth MWC plant sampled by the Agency in its continuing program to evaluate the health risks associated with emissions of TCDD from combustion facilities.

EPA assessed TCDD emissions from the first five MWC facilities sampled in a report dated November, 1981, entitled "Interim Evaluation of Health Risks Associated with Emissions of Tetrachlorinated Dioxins from Municipal Waste Resource Recovery Facilities". The report concluded that ". . . the levels of TCDD's from the five municipal waste combustors . . . do not present a public health hazard for residents living in the immediate vicinity."

The emissions of TCDD from the sixth plant were higher than had previously been found. We have nonetheless concluded (p. 11) that ". . . in light of: . . . conservative assumptions . . . steps being taken . . ., the Agency does not believe that this most recently sampled MWC represents a significant health concern . . ."

I have attached a copy of the November 1981 interim evaluation and the recent assessment for your use. These assessments may be shared with interested members of the public.

Attachments

Addressees:

Regional Dioxin Coordinators
Regional Solid Waste Branch Chiefs
Regional Division Directors
Office of Pesticides and Toxic Substances
State of Virginia

ASSESSMENT OF EMISSIONS FROM A RECENT MUNICIPAL WASTE COMBUSTOR

Background

In the late 1970's concern was raised in the United States regarding the possible emission of trace amounts of highly toxic organic pollutants as a consequence of large scale combustion. Following suggestive findings in this country, which essentially confirmed reports from overseas where emissions testing had first identified the presence of chlorinated dibenzo-p-dioxins (CDDs), particular attention was directed to municipal waste combustors (MWCs).

In response, the Environmental Protection Agency (EPA) conducted a program which performed sampling and analysis at five separate MWCs. The focus of these studies was the emission of tetrachlorodibenzo-p-dioxins (TCDDs), with an emphasis on the specific isomer, 2,3,7,8tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD). This latter compound is known to be quite toxic, even at very low doses, as demonstrated in animal studies. Documented evidence of its presence in emissions evoked special concerns.

In November, 1981, the Agency published a report entitled "Interim Evaluation of Health Risks Associated with Emissions of Tetrachlorinated Dioxins From Municipal Waste Resource Recovery Facilities". (EPA, 1981). The report presented upper limit estimates of what the health risks might be to people living in the vicinity of the MWCs and concluded:

> "These estimates suggest that the present emissions levels of TCDDs from the five municipal waste combustors described in this report do not present a public health hazard for residents living in the immediate vicinity. In addition, the health risk estimates presented in the assessment indicate that as long as emission levels of TCDDs do not greatly exceed the emissions measured at the five US sites evaluated in this interim assessment, there should be no reason for concern. This conclusion is valid for all toxicological effects (including reproductive and cancer) for which the available animal and human data have been analyzed."

In the past few months, data have been generated by the Agency on the emission of TCDDs (and other pollutants) from a sixth MWC. These data and the supporting contractor report on the sampling and analysis are currently undergoing the normal review procedure within the Agency.

The existence of these data and their qualitative indication of the presence of TCDDs in the emissions from this MWC, however, have raised public concerns. Therefore, in order to give some perspective to these findings, the Agency is issuing this assessment employing the same procedures used in the November, 1981 document. These procedures incorporate a series of conservative assumptions which the Agency believes tend to overestimate the risks due to TCDD emissions. If this "worst case" assessment projects risks which are so low as to not present a health concern to people living in the vicinity, then there is additional assurance that the actual risk from the TCDD emissions should not form a health concern to nearby residents.

In sum, the purpose of this document is to project the results from a sixth MWC on the scale generated by the results from the five MWCs which were assessed in 1981, thereby providing a basis for interpreting the significance of the new data and the efforts already underway to modify conditions at the plant.

Note that the present document is being issued before the final report on the sampling and analysis that underlie this effort have been thoroughly reviewed. Consequently, the conclusions of this assessment are subject to changes that might be necessitated by changes in the final report.

Overview

This document presents an assessment of the health implications associated with the emission of TCDDs from a recently sampled MWC. The assessment is based on stack emission data which were used to estimate the level of exposure that people living near this facility might encounter, and on estimates of the health hazards that might be associated with these emissions.

Exposure information on the TCDDs was obtained by field sampling of stack emissions, followed by chemical analysis using gas chromatography and mass spectrometry (GC/MS). The actual amount of TCDDs from the stacks that would reach people living in the areas surrounding the plant was expected to be so small that it would not be detectable by available analytical techniques. Therefore, the Agency used a mathematical air dispersion model to estimate the ground level concentration levels of TCDDs to which people were likely to be exposed.

Estimates of the risk to human health from these TCDDs emission were obtained by extrapolating from animal data on the carcinogenic and reproductive effects of 2,3,7,8-TCDD. While the toxicity information on the other isomers of TCDD is limited, there is reason to believe that none of the other isomers are as toxic as 2,3,7,8-TCDD.

Hazard Assessment

The reader is referred to other sources which discuss the toxic properties of TCDDs in detail (Huff, 1980). The present document makes use of the same hazard assessment as was used in the November, 1981 document.

Dose-Response Assessment

The reader is referred to other sources for a discussion of the dose-response assessment that the Agency associates with 2,3,7,8-TCDD (EPA, 1980), based on a lifetime feeding study in rats (Kociba, et al, 1978). The present document makes use of the same dose-response assessment as was used in the November, 1981 document.

Exposure Assessment

Table I contains information on the MWC facility and the TCDD emissions detected there.

In the present estimates, the relation between the emission data and the maximum concentration to which people in the surrounding area are likely to be exposed has been obtained through a theoretical air dispersion model, PTMAX (EPA, 1977). This computer program calculates the location and magnitude of the maximum short term (1 hour) concentration in the area around the stack. The necessary input data are contained in Table I. In order to obtain a maximum annual average ground level concentration, a reasonable assumption was made that the maximum annual average concentration is 1/40 of the maximum hourly concentration (Tikvart, 1981). These results are found in Table II.

Toxicity and Exposure Assumptions

Ideally, there would be sufficient information compiled during the Hazard, Dose-Response, and Exposure Assessments to directly combine the data in a Risk Characterization step

(National Research Council, 1983). However, many unanswered questions relating to the toxicity of and exposure to these TCDD emissions remain. Since there are insufficient data to answer these questions definitively, and because some type of answers is needed in order to characterize the risk to people breathing the emissions, the Agency has adopted a series of assumptions which are designed to represent "reasonable worst cases". These are the same assumptions used in the November, 1981 document. Some of these unanswered questions and related assumptions are presented below:

<u>Question 1</u>

What are the toxicological properties of the 21 TCDD isomers, other than 2,3,7,8-TCDD?

<u>Assumption 1</u>

The carcinogenic properties and reproductive effects of all TCDDs are taken to be the same as that of 2,3,7,8-TCDD.

<u>Question 2</u>

How can the toxicological effects in humans be assessed in the absence of data in humans?

<u>Assumption 2</u>

The Agency has established methods (EPA, 1978) to address this question which include the following:

a. Use of the no-threshold assumption for carcinogenicity.

b. Use of the most sensitive, valid animal study.

c. Use of the linearized multi-stage model to generate an estimate of the upper limit of the excess cancer risk at low doses. The actual risk could be nearly any number between this upper limit and some lower number (possibly zero).

d. Conversion of animal dose to human equivalent dose by use of relative body surface area.

Question 3

Given the concentration and composition of TCDDs measured in emissions from the stack, what are the resulting air concentrations and compositions at ground level to which people would be exposed?

Assumption 3

The computerized PTMAX air dispersion model and the factor used to convert to the annual concentration is assumed to adequately represent the transport of the emissions to ground level. In lieu of a definitive analysis of atmospheric conditions, the result from the worst of six atmospheric classes modeled by the computer is assumed to be applicable. The composition of emission products found at ground level is taken to be identical to the composition (but not the concentration) in the stack.

Question 4

How do the TCDD contaminants in the air behave when they are breathed by humans? (The TCDDs in the stack gases are generally associated with particulate matter from which they are difficult to remove in the laboratory).

Assumption 4

Seventy-five percent of the inhaled particulates are assumed to be retained in the body (ICRP, 1968). Further, 100% of the TCDDs (gaseous or particulate-bound) are treated as being biologically available to exhibit a toxic response.

Question 5

How often, for how long, and at what level will people be exposed?

Assumption 5

People are assumed to be exposed continuously to the maximum annual average ground level concentration 24 hours/day, under the worst atmospheric conditions, for a 70 year lifetime.

Health Risk Characteration

Within the limitations of the assumptions discussed in the previous section, Table III contains the results of the health risk characterizations for the upper limit of excess cancer and for reproductive effects resulting from lifetime exposure to the maximum annual average concentration of TCDDs which are likely to be generated at the MWC. The details of these calculations are contained in the Appendix.

The cancer risk is characterized by an "estimated upper limit of excess cancer risk", which is expressed as a probability. For example, the upper limit of excess cancer risk for the MWC, based on maximum total TCDDs, is 4.6 x 10^{-6}. This figure can be interpreted as the upper limit of the excess cancer risk (probability) for an individual living at the point of maximum annual average concentration of TCDDs (resulting from emissions from the MWC) for 24 hrs/day, under the worst atmospheric conditions, for a 70 year lifetime. Alternatively expressed, this is a upper limit of risk of 46 in a 1,000,000 or 1 in 22,000. That is, based upon the assumptions above, the excess risk of contracting cancer is likely to be something less than 1 in 20,000. Again, this is not a prediction of the risk but simply a statement that the risk is not likely to exceed this level.

For comparison, the highest upper limit of excess cancer risk reported in the November, 1981 document for total TCDDs was 8 x 10^{-6}.

The reproductive effects risk is characterized in this assessment by a "confidence ratio", which is the ratio of the lowest level tested in animals divided by the anticipated exposure level in humans. Note that if this lowest dose tested is seen as a "no effect level" (this point is currently the subject of some scientific dispute), then the confidence ratio would become the more familiar "margin of safety".

For comparison, the lowest confidence ratio reported in the November, 1981 document was total TCDDs was 30,000.

Conclusion

The information in Tables I and II indicates that compared to the situations at the five MWCs evaluated in 1981, the most recently sampled MWC, when sampled, was emitting greater amounts of TCDDs, resulting in higher ground level exposures at the point of maximum impact (approximately .6 km from the stack under the worst atmospheric conditions). Table III shows that, under the conditions prevailing at the time of the test, the emissions represented a risk approximately 6-fold greater than that seen at any of the MWCs included in the 1981 survey.

A preliminary inquiry into the design and operation of this MWC has revealed a number of conditions that could be contributing to the increased level of emissions. Discussions are already underway with responsible parties in the public and private sectors to determine appropriate corrective measure that will likely lead to reduction into the emissions of TCDDs. In light of:

a. the conservative assumptions made in this current assessment,

b. the steps being taken to ameliorate the situation, and

c. the relatively short time span anticipated before these corrective measures are in place, the Agency does not believe that this most recently sampled MWC represents a significant health concern to people living in its vicinity.

The Agency will continue to work with all parties concerned to see to it that the planned changes in the facility and its operations are carried out expeditiously and that a subsequent re-sampling and analysis of the emissions is conducted effectively and efficiently.

TABLE I

PLANT PARAMETERS AND EMISSION RATES FOUND AT A MUNICIPAL WASTE COMBUSTOR IN 1983

<u>Parameters</u>	
Stack height	27.4 meters
Stack diameter	1.22 meters
Stack temperature	271 °C
Flue gas flow rate[(a)]	12 m^3/sec
Flue gas velocity	11.4 m/sec
Ambient temperature	4 °C
<u>Average Emission Rate</u>	
Total TCDDs	2.9×10^{-6} gram/sec

(2,3,7,8-TCDD constitutes 21% of the total)

(a) --- total from both stacks averaged over four tests

TABLE II

MAXIMUM ANNUAL AVERAGE GROUND LEVEL CONCENTRATION OF TCDDs CALCULATED[1] AT A MUNICIPAL WASTE COMBUSTOR (MWC) IN 1983.

Facility	Pollutant	Concentration
MWC	Total TCDDs	5.1×10^{-4} nanograms/m^3

1 --- These values were generated through the air dispersion model PTMAX (EPA, 1977) with a correction factor of 1/40 to convert to maximum annual average. [Acknowledgement of the assistance by OPTS (Kinerson) and OANR (McGinnity)].

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HEALTH RISK CHARACTERIZATION[1] AT A MUNICIPAL WASTE COMBUSTOR IN 1983, BASED ON TOTAL TCDDs IN STACK EMISSIONS.

FACILITY	UPPER LIMIT OF EXCESS CANCER RISK[2]	CONFIDENCE RATIO FOR REPRODUCTIVE EFFECTS[3]
Municipal Waste Combustor	4.6×10^{-5}(a)	9,100(b)

1 --- These results cannot be effectively interpreted independent of the underlying conservative assumption upon which they are based. (See text for further details)

a. All of the 22 possible TCDD isomers are assumed to have carcinogenic and reproductive effects properties equal to those of 2,3,7,8-TCDD.

b. The established procedures for extrapolating from high dose to low dose and from animals to man are assumed to be appropriate.

c. The air dispersion model (with worst atmospheric assumptions) is assumed to be an effective method for extrapolating from concentrations in the stack emissions to concentrations to which people will be exposed.

d. The majority of inhaled particulate matter is assumed to be retained in the body and all of the particulate bound TCDD is assumed to be bioavailable.

c. Exposure to the annual maximum average ground level concentration is assumed to occur continously for 70 years.

2 --- Using linearized multi-stage extrapolation model (EPA, 1978).

3 --- Confidence Ratio = $\frac{\text{Lowest dose tested}}{\text{Estimated human dose}} = \frac{1\ \text{ng/kg-d}}{\text{Estimated human dose}}$

a --- For comparison, the highest value from the five previously tested MWCs was 8×10^{-6}.

b --- For comparison, the lowest value from the five previously tested MWCs was 30,000.

APPENDIX

DETAILS OF CALCULATIONS
(using MWC maximum data as an example)

The PTMAX model was run using the input parameters in Table I. For general purposes, however, the emission rate entered into the model was 1 g/s. This permitted easy scaling to whatever specific emission rate might be of interest, since the model is linear in mass emission rate.

Specifically, for the MWC:

a. PTMAX showed that with 1 g/s the maximum hourly concentration of 7×10^{-6} g/m^3 was obtained for atmospheric stability class I (or A); that is, "unstable".

b. Applying the correction factor to estimate the annual maximum average concentration, we obtain

$$7 \times 10^{-6} \text{ g/m}^3 / 40 = 1.75 \times 10^{-7} \text{ g/m}^3$$

c. Table I indicates that a total of 2.9×10^{-6} g/s was the observed emission rate at the MWC. Applying the factor from b, we obtain as annual maximum average concentration:

$$(2.9 \times 10^{-6} \text{ g/s})\ (1.75 \times 10^{-7} \tfrac{\text{g/m}^3}{\text{g/s}}) = 5.1 \times 10^{-13} \text{ g/m}^3 = 5.1 \times 10^{-4} \text{ ng/m}^3$$

(See Table II)

The estimated upper limit of excess risk of cancer was obtained using the unit risk factor developed by the Agency's Cancer Assessment Group (CAG) for 2,3,7,8-TCDD (EPA, 1981).

d. Upper limit of excess cancer risk = (unit risk factor) (conc.)

$= [.091 \ (ng/m^3)^{-1}] \ [5.1 \times 10^{-4} \ ng/m^3]$

$= 4.6 \times 10^{-5}$ (See Table III)

The confidence ratio makes use of the data from the three-generation reproduction study in the rat conducted by Murray (Murray, 1979) and compares the lowest dose in that study (1 ng/kg-d) to the estimated human dose derived from breathing the dispersed emissions.

f. Estimated human dose =

(Conc) x (Breathing rate) x (75% retention) / (Body mass)

$= (5.1 \times 10^{-4} \ ng/m^3) \ (20 \ m^3/d) \ (.75) \ / \ (70 \ kg)$

$= 1.1 \times 10^{-4}$ ng/kg-d

g. Therefore, using results from f,

Confidence Ratio =

(Lowest dose in animals) / (Estimate human dose)

$= (1 \ ng/kg\text{-}d) \ / \ (1.1 \times 10^{-4} \ ng/kg\text{-}d)$

= 9,100 (See Table III)

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Interim Evaluation of Health Risks Associated with Emissions of Tetrachlorinated Dioxins From Municipal Waste Resource Recovery Facilities

November 1981

Background

Concern has been raised within the United States regarding the possible emission of trace amounts of highly toxic organic pollutants as a consequence of the large scale combustion of municipal wastes for recovery of energy. Such resource recovery facilities are also referred to as municipal waste combustors. The concern first came to a focus at the Hempstead Resource Recovery Corporation (HRRC) facility in Hempstead, Long Island, where in 1979 the owners and operators of the plant permitted EPA to sample its emissions. Subsequent analyses indicated that tetrachlorodibenzo-p-dioxins (TCDDs), including 2,3,7,8-TCDD, were present. However, due to the nature of the sampling method and the operating conditions of the plant at the time, only a qualitative statement could be made on the presence of these materials. Based on these findings the Agency concluded that more rigorous testing would be required in order to quantitate the results.

By the time this qualitative information was becoming available, the Exposure Evaluation Division (EED) of the Office of Pesticides and Toxic Substances (OPTS) had already initiated a pilot study of emissions from two other municipal waste combustors in the United States. In addition, the Office of Solid Waste (OSW) had begun a series of similar studies to determine whether or not potential problems existed at other municipal waste combustors. The analytical results from five plants are now available.

Even before the above data became available to the Agency, a considerable amount of information had been accumulated by scientists working on similar and related facilities outside the United States. In 1979 a report appeared on the analysis of a number of micro-pollutants, including TCDDs, in fly ash from five municipal incinerators in The Netherlands, Canada, and Japan (Eiceman, et al, 1979). This was followed in the next year by an investigation of fly ash and stack emissions from four municipal incinerators in Italy (Cavallaro, et al, 1980) and by an extensive review (Lustenhouwer, et al, 1980) on the amounts of micro-pollutants found in the fly ash of various municipal incinerators in Europe. Amplification of this information was provided in testimony presented during EPA's cancellation hearings on the herbicide 2,4,5-T (Hutzinger, 1980). Each of these investigators reported TCDDs in the emissions and fly ash of municipal incinerators.

The Agency's review of the foreign data did not suggest the existence of any problem that called for precipitous action due to the emission of TCDDs associated with the combustion of municipal wastes. The Agency continued its program of systematic testing at municipal waste combustors in order to assess the domestic situation more completely.

Now that the EPA-generated emissions data from American municipal waste combustors are available, it is appropriate to publish an interim assessment of the toxic effects which could conceivably be associated with TCDDs emissions from municipal waste combustors in this country.

Overview

The human health implications associated with the emission of TCDDs from five municipal waste combustors have been assessed. The evaluation was based on the information available on the estimated levels of the exposure that people living near municipal waste combustors are likely to experience, and on estimates of health hazards associated with TCDDs. The Hempstead, Long Island plant is not one of the five analyzed as the EPA data for this plant are not sufficient to support a quantitative evaluation.

Exposure information on TCDDs was obtained by field sampling of stack emissions from the five municipal waste combustors, followed by complex chemical analyses for TCDDs. To obtain an estimate of the amount of TCDDs that were emitted into the atmosphere, it was necessary to collect and analyze both the flue-gas and the particulate materials as TCDDs have a tendency to firmly adhere to small particles (Lustenhouwer, et al, 1980).

Computer modeling was used to derive approximate exposure levels experienced by the population as a result of the dilution and dispersion that takes place as the flue-gas and particulate material make their way to ground-level after stack emission.

Estimates of the risk to human health from these TCDDs emissions were obtained by extrapolating from animal data on the basis of an important assumption. The levels of exposure are far below those causing acute (short term, high dose) effects in animals. Therefore, this assessment focuses on chronic (long term, low dose) effects with an emphasis on the two most sensitive toxic effects seen in animals: reproduction and carcinogenicity.

The fundamental assumption that was made was that if TCDDs are a human carcinogen, or if they pose a health hazard due to adverse reproductive effects in humans, then these effects will be manifested at the same relative dose levels as observed in the reported animal studies, taking the relative body surface of animals and humans into account. The inclusion of this assumption is essential in the interpretation of the significance that animal data may have with regard to any human experience. The exposure data and the health hazard information on TCDDs were then combined in a number of mathematical models to estimate the risk associated with human exposure to TCDDs emitted from municipal waste combustors.

Toxicity Data

Although there are a total of 22 tetrachlorodibenzo-p-dioxin (TCDD) isomers, the 2,3,7,8-TCDD isomer has been subjected to the most extensive testing. While a variety of studies point to a range of effects produced by this material, the appearance of adverse reproductive and carcinogenic effects at very low doses in chronic feeding studies in animals has generated special interest and concern.

The effects of a combination of isomers is difficult to assess, but a conservative assumption is that all of the isomers are as toxic as 2,3,7,8-TCDD. There are biochemical reasons, supported by some experimental data (Poland, et al, 1979), to suggest that the mechanism of toxic action of 2,3,7,8-TCDD is associated with the chlorine atoms on the lateral ring positions (positions 2, 3, 7, and 8). In fact, there is no evidence to indicate that any of the isomers are more toxic than 2,3,7,8-TCDD.

Data on the other chlorinated dioxins were insufficient to be included in this interim assessment.

A. Reproductive effects of 2,3,7,8-TCDD

2,3,7,8-TCDD has been investigated and shown to have reproductive effects in numerous animal studies. In one of the most recent studies, a three-generation study in rats (Murray, et al, 1979), adverse reproductive effects appeared inconsistently in the different generations at the lowest dose tested (0.001 ug TCDD /kg /day), although this may be at or very close to the "no-observed -effect level" (NOEL). Human epidemiological studies in this area are limited in number and statistical power; those that have been conducted do not demonstrate clear exposure-related effects.

B. Carcinogenicity of 2,3,7,8-TCDD

Bioassays have demonstrated that 2,3,7,8-TCDD is an animal carcinogen in rats and mice (Kociba, et al, 1978; National Cancer Institute, 1980), under the test conditions imposed. The information with respect to human exposure is less conclusive. Epidemiological studies of cohorts of workers engaged in chlorophenol production and use, and their exposure to TCDDs in this country (Zack and Suskind, 1980; Cook, et al, 1980), suggest that any overall carcinogenic effect on humans is small. A significant excess of stomach cancer, however, has been reported in a similar cohort of German workers (Theiss, et al, 1981). In addition, a recent series of reports (Hardell and Sandstrom, 1979; Eriksson, et al, 1981; Honchar and Halperin, 1981; Cook, 1981) indicate that soft tissue sarcomas (a form of cancer) may be associated with long term exposure to phenoxy herbicides which contain 2,3,7,8-TCDD. The human information available from the Seveso, Italy explosion in 1976 has not indicated that the local populations have developed any excess of cancer. However, it may be too early to evaluate the long term effects from this exposure (Reggiani, 1980) in view of the short period of time that has elapsed since the Seveso incident and the generally longer latency period for cancer development. More definitive work to address this question has been initiated by the National Institute of Occupational Safety and Health (NIOSH) and the National Cancer Institute (NCI).

Exposure Data

There are about 40 municipal waste combustors in the country. A large number of additional units are under consideration for construction, some of them involving very different technologies. Consequently, the recently obtained emission data from the stacks of five municipal waste combustors cannot be said to characterize totally the industry today nor what the industry is likely to become (see Tables 1 and 2). However, the data can give some indication of current conditions and what might be expected in the future as data collection proceeds. In order to analyze these data more completely, information is needed on the interaction between the various factors that may affect the output of dioxins from municipal waste combustors. Included among these are the nature of the combustible materials, temperature, flow rate, process, stack heights, local topography, and/or combustion chamber design.

In the present estimates, the relation between the emission data and the maximum concentration to which people in the surrounding area are likely to be exposed has been obtained through a theoretical air dispersion model, PTMAX (EPA, 1977). This computer program calculates the location and magnitude of the maximum short term (1 hour) concentration in the area around the stack. Data from the five sampled sites provided the input. Basically, the results show the ground concentration to be a slowly varying function of stack height, temperature, diameter, and exit velocity. To obtain annual maximum average ground level concentrations, reasonable, if rough, estimates were made on the assumption that the maximum annual average concentration is 1/40 of the maximum hourly concentration (see Table 3) (Tikvart, 1981). While there is no guarantee that the results of future studies (some are already in progress and will continue through FY 82) will fall within these ranges, the current data can be used to suggest the range of variations that is expected to be encountered.

Toxicity and Exposure Assumptions

Emission data can be used with other data to estimate potential human exposure to TCDDs from municipal waste combustion sources. However, many unanswered questions relating to TCDDs' toxicity and exposure remain. Since there are insufficient data to answer these important questions and because this information is needed to assess the risk to people breathing emissions from the stack, the Agency has adopted a series of assumptions which are designed to represent the "worst case" possible. Some of these questions and related assumptions are presented below:

1. What are the toxicological properties of the different TCDD isomers? (There are considerable experimental data on the properties of 2,3,7,8-TCDD, but relatively little on the other 21 isomers. The evidence that does exist, however, suggests that they may be less toxic than 2,3,7,8-TCDD.)

   In the absence of data the assumption is:

   The carcinogenic properties and reproductive effects of all TCDDs are the same as that of 2,3,7,8-TCDD.

2. Given the concentration and composition of TCDDs measured in emissions from a stack, what are the resulting air concentrations and compositions at ground level to which people would be exposed? In the absence of data the assumption is:

   The PTMAX air dispersion model (EPA 1977) and the factor used to convert to the annual concentration, adequately represent the transport of the emissions to ground level. The composition of emission products found at ground level is identical to the composition (but not the concentration) in the stack.

3. How does the ground level concentration vary relative to the position from the stack? In the absence of data the assumption is:
<u>All of the exposed population is subjected to the maximum average annual concentration found at the point of concentration</u>.

4. How do the TCDD concentrations in the air behave when they are breathed by humans? (The TCDDs in the stack gases are generally associated with particulate matter from which they are difficult to remove in the laboratory). In accord with available data (ICRP, 1968) the assumption is:
<u>Seventy-five percent of the inhaled particles are retained in the body</u>.
In the absence of data the assumption is:
<u>All the TCDDs that are retained in the respiratory tract are biologically available to the organism</u>.

5. How often and for how long will people be subject to a given level of exposure? (The lifetime of municipal waste combustors is approximately 30 to 40 years.) Even given this approximation, the following is assumed:
<u>The population is exposed to this maximum average annual concentration from the source for 24 hours a day throughout a 70 year lifetime</u>.

6. What is the relative sensitivity of man versus the animals used in these studies?

   In the absence of data the assumption is:

   Man is of comparable sensitivity to animals for reproductive and carcinogenic effects, taking body surface areas into account.

Health Risk Estimates

The health risk estimates were calculated using a variety of mathematical models - linearized multi-stage (Crump, 1981); probit, logit, Weibull and gamma multi-hit (Food Safety Council, 1980) - which were applied to the rat carcinogenicity data (Kociba, 1978) and the TCDDs exposure data associated with the emissions from municipal waste combustors. The results from the models were consistent in estimating low risks.

Potential reproductive effects were assessed by comparing the calculated levels of exposure from TCDDs to the lowest level tested in animals (Murray, et al, 1979). The anticipated levels of TCDDs to which humans may be exposed are far below the level used in the animal study.

Summary

An evaluation of the public health considerations related to TCDDs emissions has been made by applying the various mathematical models to the data from the five US sites under the many combinations of assumptions that must be made in analyzing the data. These estimates suggest that the present emissions levels of TCDDs from the five municipal waste combustors described in this report do not present a public health hazard for residents living in the immediate vicinity. In addition, the health risk estimates presented in the assessment indicate that as long as emission levels of TCDDs do not greatly exceed the emissions measured at the five US sites evaluated in this interim assessment, there should be no reason for concern. This conclusion is valid for all toxicological effects (including reproductive and cancer) for which the available animal and human data have been analyzed.

This is an interim report and EPA intends to periodically monitor representative resource recovery facilities such as these for emissions of TCDDs. EPA will take steps to regulate TCDDs emissions if it appears necessary. However, at the present time, this need has not been demonstrated.

TABLE 1

RANGE OF STACK CONCENTRATIONS

Pollutant(s)	Range (ng/dscm[a])
2,3,7,8-TCDD	ND[b] - 3.5[c]
TCDDs[d]	ND - 8.5

a - ng = 10^{-9} grams; dscm = dry standard cubic meter

b - "ND" not detected at a detection limit of 0.25 ng/dscm.

c - The analytical method used could not distinguish 2,3,7,8-TCDD from several of the other TCDD isomers. It is recognized that some molecular forms may be co-eluting with the 2,3,7,8 isomer; therefore this value could be an overestimate of the amount of 2,3,7,8-TCDD actually present.

d - "TCDDs" includes any and all of the tetrachlorodibenzo-p-dioxin isomers present.

TABLE 2

RANGE OF STACK PARAMETERS

REPRESENTED BY THE FIVE COMBUSTORS TESTED

Parameter	Range
Stack Height (meters)	10 - 76
Stack Temperature (Centigrade)	139 - 232
Flue gas flow-rate (dscm/sec[a])	3.7 - 83.3

a - dscm = dry standard cubic meter; sec = second.

TABLE 3

RANGE OF ANNUAL MAXIMUM AVERAGE GROUND LEVEL CONCENTRATIONS OF DIOXIN ISOMERS ESTIMATED FOR FIVE US SOURCES SAMPLED TO DATE USING PTMAX COMPUTER AIR DISPERSION MODEL[a]

Pollutant (s)	Range (ng/m^3)[b]
2,3,7,8-TCDD[c]	up to 3.8×10^{-5}
TCDDs	up to 9.2×10^{-5}

a - Although sampling was conducted at only one stack at each site, the results have been adjusted to reflect the estimated contributions from all boilers present at each site.

b - The lower level of estimated concentration is an indeterminately small number based on the non-detectable amounts of the pollutant found in the stack emissions.

c - The analytical method could not distinguish 2,3,7,8-TCDD from a number of co-eluting isomers. Therefore, this could be an overestimate of the 2,3,7,8-TCDD actually present.

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FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION

APPLICATION TO OPERATE / CONSTRUCT AIR POLLUTION SOURCES

NORTHERN RESOURCE RECOVERY FACILITY

BROWARD COUNTY, FLORIDA

BROWARD COUNTY FLORIDA

AC 068299

FEBRUARY 1984

MALCOLM PIRNIE

ENVIRONMENTAL ENGINEERS, SCIENTISTS & PLANNERS

in association with Hazen & Sawyer, P.C. and William F. Cosulich Associates, P.C.

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MALCOLM PIRNIE, INC.
ENVIRONMENTAL ENGINEERS, SCIENTISTS & PLANNERS

February 21, 1984

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

Attention: Mr. C.H. Fancy, P.E.
Deputy Chief

Re: Broward County, Florida Resource Recovery Project/Prevention of Significant Deterioration Permit Applications

Gentlemen:

On behalf of the Broward County Board of County Commissioners, please find enclosed Prevention of Significant Deterioration (PSD) permit applications for the two resource recovery facility components of the subject project. We would like to acknowledge the efforts of Environmental Science and Engineering, Inc. in preparing Appendix C of the enclosed under subcontract to Malcolm Pirnie, Inc.

As noted in prior discussions and correspondence, each of the two resource recovery facilities (i.e., the northern or Copans Road facility and the southern or Route 441 facility) will utilize mass-burn technology. The mass burning with energy recovery technology represents the state of the art for solid waste disposal, and it has been proven through years of successful operation to be a demonstrated, reliable method of disposal. It is a mature technology with more than 350 plants worldwide, processing over 110,000 tons of refuse per day. The first modern mass burning system was built nearly 30 years ago in Berne, Switzerland, and is still operating successfully today.

As you are aware, Broward County is utilizing the full-service approach for implementation of the subject project. As a result, the enclosed applications are based on preliminary or conceptual design performed to date, and may therefore be subject to certain refinement following selection of a full-service vendor which is scheduled to occur in March or April, 1984. Because this conceptual design is based on conservative assumptions from a potential air quality impact viewpoint, we are confident that once a vendor is selected and this conceptual design is refined the predicted impact levels will be no more significant than those presented in the enclosed applications.

Broward County has received, and is currently reviewing, proposals submitted by two pre-qualified full-service vendors (Waste Management, Inc./Bechtel Civil and Minerals, Inc. and Signal RESCO, Inc.). Thus, in addition to the technical specifications contained in the County's Request for Proposals and imposed as minimum project requirements, we have also enclosed certain relevant information and data from these vendor proposals. Because final detailed facility design to be performed by the selected vendor must be consistent with the minimum project technical requirements as specified, we feel the predicted air quality impacts presented in the enclosed applications represent conservative projections regardless of which vendor is ultimately selected to enter into a long-term, full-service agreement with Broward County.

Your cooperation and assistance to Broward County on the timely implementation of an environmentally and economically sound program of municipal solid waste management is greatly appreciated. We look forward to working with you during your agency's review of these applications in order to meet the accelerated project schedule necessary to resolve the County's current municipal solid waste disposal situation. Should you have any questions or require clarification on the enclosed applications, please contact us at your convenience.

Very truly yours,

MALCOLM PIRNIE, INC.

Ronald J. Mills

Ronald J. Mills

RJM:hkh

enclosures

cc: P. Korab/Broward County
G. Carlson/Broward County EQCB
L. George/Florida DER
T. Tittle/Florida DER
R. McCann/Env. Science and Engineering, Inc.

STATE OF FLORIDA DER - APPLICATION TO OPERATE/CONSTRUCT
AIR POLLUTION SOURCES

TABLE OF CONTENTS

AC 06-82999

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

DER

FEB 24 1984

BAQM

BOB GRAHAM
GOVERNOR

VICTORIA J. TSCHINKEL
SECRETARY

ALEX SENKEVICH
DISTRICT MANAGER

APPLICATION TO OPERATE/CONSTRUCT AIR POLLUTION SOURCES

SOURCE TYPE: Resource Recovery Facility [X] New[1] [ ] Existing[1]

APPLICATION TYPE: [X] Construction [ ] Operation [ ] Modification

COMPANY NAME: Broward County Board of County Commissioners COUNTY: Broward

Identify the specific emission point source(s) addressed in this application (i.e. Lime Kiln No. 4 with Venturi Scrubber; Peaking Unit No. 2, Gas Fired) Stack(s)

SOURCE LOCATION: Street Intersection Copans Rd & Florida's Turnpike City Pompano Beach

UTM Zone 17 UTM: ~~East~~ X coord = 584.0 km ~~North~~ Y coord = 2904.7 km

Latitude 26 ° 15 ' 42 "N Longitude 80 ° 09 ' 32 "W

APPLICANT NAME AND TITLE: Ms. Phyllis A. Korab, Project Director

APPLICANT ADDRESS: Broward Cty Courthouse - Rm 248, 201 S.E. 6th St., Ft. Lauderdale, Florida 33301

SECTION I: STATEMENTS BY APPLICANT AND ENGINEER

A. APPLICANT

I am the undersigned ~~owner or~~ authorized representative* of Broward County Board of County Commissioners

I certify that the statements made in this application for a construction permit are true, correct and complete to the best of my knowledge and belief. Further, I agree to maintain and operate the pollution control source and pollution control facilities in such a manner as to comply with the provision of Chapter 403, Florida Statutes, and all the rules and regulations of the department and revisions thereof. I also understand that a permit, if granted by the department, will be non-transferable and I will promptly notify the department upon sale or legal transfer of the permitted establishment.

*Attach letter of authorization

Signed: Phyllis A. Korab

Phyllis A. Korab Project Director
Name and Title (Please Type)

Date: 2/22/84 Telephone No. (305) 765-5844

B. PROFESSIONAL ENGINEER REGISTERED IN FLORIDA (where required by Chapter 471, F.S.)

Refer to Attachment No. 1

This is to certify that the engineering features of this pollution control project have been designed/examined by me and found to be in conformity with modern engineering principles applicable to the treatment and disposal of pollutants characterized in the permit application. There is reasonable assurance, in my professional judgment, that

[1] See Florida Administrative Code Rule 17-2.100(57) and (104)

the pollution control facilities, when properly maintained and operated, will discharge an effluent that complies with all applicable statutes of the State of Florida and the rules and regulations of the department. It is also agreed that the undersigned will furnish, if authorized by the owner, the applicant a set of instructions for the proper maintenance and operation of the pollution control facilities and, if applicable, pollution sources.

Signed Refer to Attachment No. 1

Name (Please Type)

Refer to Attachment No. 1

Company Name (Please Type)

Mailing Address (Please Type)

Florida Registration No. Refer to Attachment No. 1 Date: ________ Telephone No. ________

SECTION II: GENERAL PROJECT INFORMATION

A. Describe the nature and extent of the project. Refer to pollution control equipment, and expected improvements in source performance as a result of installation. State whether the project will result in full compliance. Attach additional sheet if necessary.

Refer to Appendices A & C

B. Schedule of project covered in this application (Construction Permit Application Only)

Start of Construction October 1984 Completion of Construction See Note 1 below

C. Costs of pollution control system(s): (Note: Show breakdown of estimated costs only for individual components/units of the project serving pollution control purposes. Information on actual costs shall be furnished with the application for operation permit.)

Depending upon the vendor selected, the cost of each process train pollution control system may range between $1,500,000 and $3,600,000.

D. Indicate any previous DER permits, orders and notices associated with the emission point, including permit issuance and expiration dates.

None

Note: 1. Start of Operation - July 1987

E. Requested permitted equipment operating time: hrs/day 24 ; days/wk 7 ; wks/yr 52 ;

if power plant, hrs/yr N/A; if seasonal, describe: Not Applicable (N/A)

F. If this is a new source or major modification, answer the following questions. (Yes or No)

1. Is this source in a non-attainment area for a particular pollutant? Yes

   a. If yes, has "offset" been applied? No

   b. If yes, has "Lowest Achievable Emission Rate" been applied? No

   c. If yes, list non-attainment pollutants. ozone (See Note 2 below)

2. Does best available control technology (BACT) apply to this source? If yes, see Section VI. Yes

3. Does the State "Prevention of Significant Deterioriation" (PSD) requirement apply to this source? If yes, see Sections VI and VII. Yes

4. Do "Standards of Performance for New Stationary Sources" (NSPS) apply to this source? Yes

5. Do "National Emission Standards for Hazardous Air Pollutants" (NESHAP) apply to this source? No

H. Do "Reasonably Available Control Technology" (RACT) requirements apply to this source? No

   a. If yes, for what pollutants? N/A

   b. If yes, in addition to the information required in this form, any information requested in Rule 17-2.650 must be submitted. N/A

Attach all supportive information related to any answer of "Yes". Attach any justification for any answer of "No" that might be considered questionable.

N/A

Note:

2. Broward County is currently designated as an ozone nonattainment area. There are no other designated nonattainment areas for other pollutants within 100 kilometers of the proposed plant site.

SECTION III: AIR POLLUTION SOURCES & CONTROL DEVICES (Other than Incinerators) N/A

A. Raw Materials and Chemicals Used in your Process, if applicable:

Description	Contaminants		Utilization Rate - lbs/hr	Relate to Flow Diagram
	Type	% Wt		
NOT APPLICABLE				

B. Process Rate, if applicable: (See Section V, Item 1)

1. Total Process Input Rate (lbs/hr): N/A

2. Product Weight (lbs/hr): N/A

C. Airborne Contaminants Emitted: (Information in this table must be submitted for each emission point, use additional sheets as necessary)

Name of Contaminant	Emission[1]		Allowed[2] Emission Rate per Rule 17-2	Allowable[3] Emission lbs/hr	Potential[4] Emission		Relate to Flow Diagram
	Maximum lbs/hr	Actual T/yr			lbs/yr	T/yr	
NOT APPLICABLE							

[1] See Section V, Item 2.

[2] Reference applicable emission standards and units (e.g. Rule 17-2.600(5)(b)2. Table II, E. (1) - 0.1 pounds per million BTU heat input)

[3] Calculated from operating rate and applicable standard.

[4] Emission, if source operated without control (See Section V, Item 3).

D. Control Devices: (See Section V, Item 4)

Name and Type (Model & Serial No.)	Contaminant	Efficiency	Range of Particles Size Collected (in microns) (If applicable)	Basis for Efficiency (Section V Item 5)
	NOT APPLICABLE			

E. Fuels

Type (Be Specific)	Consumption*		Maximum Heat Input (MMBTU/hr)
	avg/hr	max./hr	
NOT APPLICABLE			

*Units: Natural Gas--MMCF/hr; Fuel Oils--gallons/hr; Coal, wood, refuse, other--lbs/hr.

Fuel Analysis:

Percent Sulfur: N/A Percent Ash: N/A

Density: N/A lbs/gal Typical Percent Nitrogen: N/A

Heat Capacity: N/A BTU/lb N/A BTU/gal

Other Fuel Contaminants (which may cause air pollution): N/A

F. If applicable, indicate the percent of fuel used for space heating.

Annual Average N/A Maximum N/A

G. Indicate liquid or solid wastes generated and method of disposal.

N/A

H. Emission Stack Geometry and Flow Characteristics (Provide data for each stack):

Stack Height: N/A ft. Stack Diameter: N/A ft.

Gas Flow Rate: N/A ACFM N/A DSCFM Gas Exit Temperature: N/A °F.

Water Vapor Content: N/A % Velocity: N/A FPS

SECTION IV: INCINERATOR INFORMATION

Type of Waste	Type O (Plastics)	Type I (Rubbish)	Type II (Refuse)	Type III (Garbage)	Type IV (Pathological)	Type V (Liq.& Gas By-prod.)	Type VI (Solid By-prod.)
Actual lb/hr Incinerated	REFER TO	APPENDIX F			None	None	None
Uncontrolled (lbs/hr)					None	None	None

Description of Waste Refer to Appendix F

Total Weight Incinerated (lbs/hr) 125,000 (See Note 3 below) Design Capacity (lbs/hr) 125,000

Approximate Number of Hours of Operation per day 24 day/wk 7 wks/yr. 52

Manufacturer To be determined following vendor selection.

Date Constructed N/A Model No. N/A

	Volume $(ft)^3$	Heat Release (BTU/hr)	Fuel Type	Fuel BTU/hr	Temperature (°F)
Primary Chamber	To be determined following vendor selection				
Secondary Chamber					

Stack Height: See note 4 below ft. Stack Diamter: See note 4 Stack Temp. See note 4

Gas Flow Rate: See note 4 ACFM See note 4 DSCFM* Velocity: See note 4 FPS

*If 50 or more tons per day design capacity, submit the emissions rate in grains per standard cubic foot dry gas corrected to 50% excess air.

Type of pollution control device: [ ] Cyclone [ ] Wet Scrubber [ ] Afterburner

[X] Other (specify) Electrostatic Precipitator See Note 4

Notes:

3. For the purposes of this submittal, 100 percent availability (worst case) is assumed; however, the actual average total weight incinerated will be 100,000 lb/hr.

4. Refer to Appendix C.

Brief description of operating characteristics of control devices:

Refer to Appendix C

Ultimate disposal of any effluent other than that emitted from the stack (scrubber water, ash, etc.):

Ash residue generated by the electrostatic precipitator units will be mixed with the incinerator bottom ash and deposited at the Northern Residue/Uprocessable Waste Landfill adjacent to the Resource Recovery Facility.

NOTE: Items 2, 3, 4, 6, 7, 8, and 10 in Section V must be included where applicable.

SECTION V: SUPPLEMENTAL REQUIREMENTS

Please provide the following supplements where required for this application.

*1. Total process input rate and product weight -- show derivation [Rule 17-2.100(127)]

*2. To a construction application, attach basis of emission estimate (e.g., design calculations, design drawings, pertinent manufacturer's test data, etc.) and attach proposed methods (e.g., FR Part 60 Methods 1, 2, 3, 4, 5) to show proof of compliance with applicable standards. To an operation application, attach test results or methods used to show proof of compliance. Information provided when applying for an operation permit from a construction permit shall be indicative of the time at which the test was made.

*3. Attach basis of potential discharge (e.g., emission factor, that is, AP42 test).

* 4. With construction permit application, include design details for all air pollution control systems (e.g., for baghouse include cloth to air ratio; for scrubber include cross-section sketch, design pressure drop, etc.)

* 5. With construction permit application, attach derivation of control device(s) efficiency. Include test or design data. Items 2, 3 and 5 should be consistent: actual emissions = potential (1-efficiency).

* 6. An 8 1/2" x 11" flow diagram which will, without revealing trade secrets, identify the individual operations and/or processes. Indicate where raw materials enter, where solid and liquid waste exit, where gaseous emissions and/or airborne particles are evolved and where finished products are obtained.

* 7. An 8 1/2" x 11" plot plan showing the location of the establishment, and points of airborne emissions, in relation to the surrounding area, residences and other permanent structures and roadways (Example: Copy of relevant portion of USGS topographic map).

* 8. An 8 1/2" x 11" plot plan of facility showing the location of manufacturing processes and outlets for airborne emissions. Relate all flows to the flow diagram.

Note: * Refer to Attachment No. 2

9. The appropriate application fee in accordance with Rule 17-4.05. The check should be made payable to the Department of Environmental Regulation.

10. With an application for operation permit, attach a Certificate of Completion of Construction indicating that the source was constructed as shown in the construction permit.

SECTION VI: BEST AVAILABLE CONTROL TECHNOLOGY

A. Are standards of performance for new stationary sources pursuant to 40 C.F.R. Part 60 applicable to the source?

[X] Yes [ ] No (Subpart (e))

Contaminant	Rate or Concentration
1. Particulate matter	0.08 grains per standard cubic foot
	dry gas, corrected to 50% excess air

B. Has EPA declared the best available control technology for this class of sources (If yes, attach copy)

[ ] Yes [X] No

Contaminant	Rate or Concentration

C. What emission levels do you propose as best available control technology?

Contaminant	Rate or Concentration
1. Refer to Appendix C	
2. Particulate matter	0.03 grains per standard foot dry gas,
	corrected to 12% CO_2.

D. Describe the existing control and treatment technology (if any). N/A

1. Control Device/System:
2. Operating Principles:
3. Efficiency:*
4. Capital Costs:

*Explain method of determining

Note: * Refer to Attachment No. 2.

5. Useful Life:

6. Operating Costs:

7. Energy:

8. Maintenance Cost:

9. Emissions:

Contaminant	Rate or Concentration

10. Stack Parameters

a. Height: ft.

b. Diameter: ft.

c. Flow Rate: ACFM

d. Temperature: °F.

e. Velocity: FPS

E. Describe the control and treatment technology available (As many types as applicable, use additional pages if necessary). Refer to Appendix C

1.

a. Control Device:

b. Operating Principles:

c. Efficiency:[1]

d. Capital Cost:

e. Useful Life:

f. Operating Cost:

g. Energy:[2]

h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

2.

a. Control Device:

b. Operating Principles:

c. Efficiency:[1]

d. Capital Cost:

e. Useful Life:

f. Operating Cost:

g. Energy:[2]

h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

[1]Explain method of determining efficiency.
[2]Energy to be reported in units of electrical power - KWH design rate.

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

3.

a. Control Device:

b. Operating Principles:

c. Efficiency:[1]

d. Capital Cost:

e. Useful Life:

f. Operating Cost:

g. Energy:[2]

h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

4.

a. Control Device:

b. Operating Principles:

c. Efficiency:[1]

d. Capital Costs:

e. Useful Life:

f. Operating Cost:

g. Energy:[2]

h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

F. Describe the control technology selected: Refer to Appendix C

1. Control Device:
2. Efficiency:[1]
3. Capital Cost:
4. Useful Life:
5. Operating Cost:
6. Energy:[2]
7. Maintenance Cost:
8. Manufacturer:
9. Other locations where employed on similar processes:

a. (1) Company:

(2) Mailing Address:

(3) City:

(4) State:

[1]Explain method of determining efficiency.
[2]Energy to be reported in units of electrical power - KWH design rate.

(5) Environmental Manager:

(6) Telephone No.:

(7) Emissions:[1]

Contaminant	Rate or Concentration

(8) Process Rate:[1]

b. (1) Company:

(2) Mailing Address:

(3) City: (4) State:

(5) Environmental Manager:

(6) Telephone No.:

(7) Emissions:[1]

Contaminant	Rate or Concentration

(8) Process Rate:[1]

10. Reason for selection and description of systems:

[1]Applicant must provide this information when available. Should this information not be available, applicant must state the reason(s) why.

SECTION VII - PREVENTION OF SIGNIFICANT DETERIORATION

A. Company Monitored Data N/A; Refer to Appendix E.

1. ____________ no. sites ____________ TSP ____________ ( ) SO2* ____________ Wind spd/dir

Period of Monitoring ______/______/______ to ______/______/______
month day year month day year

Other data recorded ____

Attach all data or statistical summaries to this application.

*Specify bubbler (B) or continuous (C).

2. Instrumentation, Field and Laboratory

a. Was instrumentation EPA referenced or its equivalent? [ ] Yes [ ] No

b. Was instrumentation calibrated in accordance with Department procedures?

[ ] Yes [ ] No [ ] Unknown

B. Meteorological Data Used for Air Quality Modeling Refer to Appendix C

1. 5 Year(s) of data from 01 / 01 / 70 to 12 / 31 / 74 (month day year to month day year)

2. Surface data obtained from (location) Miami, Florida

3. Upper air (mixing height) data obtained from (location) Miami, Florida

4. Stability wind rose (STAR) data obtained from (location) N/A

C. Computer Models Used Refer to Appendix C

1. Industrial Source Complex Model (ISC) - Modified? If yes, attach description.

~~2.~~ Only data output format modified Modified? If yes, attach description.

~~3.~~ ______ Modified? If yes, attach description.

~~4.~~ ______ Modified? If yes, attach description.

Attach copies of all final model runs showing input data, receptor locations, and principle output tables. Refer to Appendix C

D. Applicants Maximum Allowable Emission Data Refer to Appendix C

Pollutant	Emission Rate
TSP	______ grams/sec
SO^2	______ grams/sec

E. Emission Data Used in Modeling Refer to Appendix C

Attach list of emission sources. Emission data required is source name, description of point source (on NEDS point number), UTM coordinates, stack data, allowable emissions, and normal operating time.

F. Attach all other information supportive to the PSD review. Refer to Attachment No. 3

G. Discuss the social and economic impact of the selected technology versus other applicable technologies (i.e., jobs, payroll, production, taxes, energy, etc.). Include assessment of the environmental impact of the sources. Refer to Attachment No. 3

H. Attach scientific, engineering, and technical material, reports, publications, journals, and other competent relevant information describing the theory and application of the requested best available control technology. Refer to Attachment No. 3

BROWARD COUNTY FLORIDA

County Administrator's Office
Room 248, Broward County Courthouse
Fort Lauderdale, Florida 33301
(305) 765-5121

February 22, 1984

Attn: To Whom It May Concern

State of Florida
Department of Environmental Regulation
2562 Executive Center Circle East
Montgomery Building
Tallahassee, Florida 32301

Re: Application to Operate/Construct Air Pollution Source for Northern Broward County Resource Recovery Facility

I have designated Phyllis A. Korab, Director, Broward County Resource Recovery Office, as the authorized agent for Broward County's Application to Operate/Construct Air Pollution Source for the above referenced project. Ms. Korab is authorized to negotiate modifications and revisions when necessary, and accept or assent to any stipulation on our behalf.

Very truly yours,

Floyd T. Johnson
County Administrator

FTJ/bd

STATE OF FLORIDA, DER - APPLICATION TO CONSTRUCT/OPERATE
AIR POLLUTION SOURCES

ATTACHMENT NO. 1

SECTION I

STATEMENTS BY APPLICANT AND ENGINEER

B. Professional Engineer Certification

The engineering features of this pollution control project have been designed as minimum requirements which the vendor selected to design and construct the project must meet. Following vendor selection, a professional engineer registered in accordance with Florida State requirements will certify the actual vendor-designed pollution control project.

STATE OF FLORIDA, DER - APPLICATION TO CONSTRUCT/OPERATE
AIR POLLUTION SOURCES

ATTACHMENT NO. 2

SECTION V

SUPPLEMENTAL REQUIREMENTS

1. Not Applicable.

2. Basis of emission estimate and proposed methods to show proof of compliance with applicable standards - refer to Appendix C.

3. Basis of potential discharge - refer to Appendix C.

4. Design details for air pollution control systems will be dependent upon the vendor selected to construct the project. Minimum ESP design requirements are presented in Appendix B. Design detail information is presented in Table 1 for equipment to be provided by each potential vendor, Waste Management Inc.-Bechtel Civil & Minerals, Inc. and Signal RESCO, Inc. Typical specifications and detailed drawings of the air pollution system to be provided by Waste Management, Inc.-Bechtel Civil & Minerals, Inc. are included in Appendix D. Information from Signal-RESCO is not available at this time.

5. Not Applicable.

6. Flow diagram - A flow diagram identifying the individual operations of the resource recovery process is included as Figure 1. The process equipment depicted in the diagram is typical; the numbers and/or configuration of the units may vary from vendor to vendor.

7. The location of the resource recovery facility in relation to the surrounding area, residences, roadways, and other structures is shown on Figure 2. The source of airborne emissions at the facility is identified on the plan. The number of stacks at the facility will be one or two, depending upon the selected vendor.

8. The actual configuration of the resource recovery facility will be dependent upon the vendor selected to construct the project. Although the manufacturing processes are the same, each vendor proposes his own manufacturing layout. Plot plans for each potential vendor are included. Figure 3 illustrates the manufacturing process and airborne emissions outlets proposed by Waste Management, Inc.-Bechtel Civil & Minerals, Inc. The plant layout proposed by Signal-RESCO, Inc. is shown on Figure 4.

9. Not Applicable.

10. Certificate of completion of Construction-Not Applicable.

TABLE 1

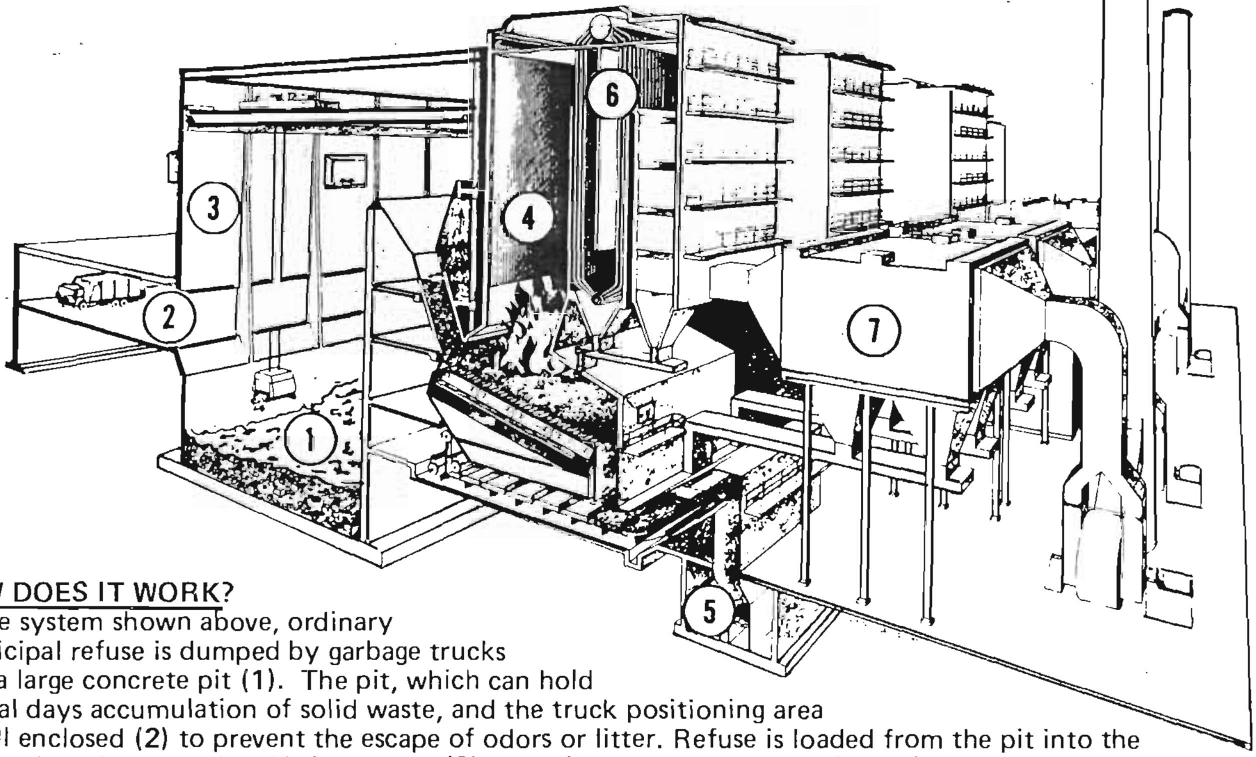
ELECTROSTATIC PRECIPITATOR DESIGN CRITERIA

	Waste Management, Inc.-Bechtel Civil & Minerals, Inc.	Signal-RESCO
1) Gas Flow		
a) Volume Flow Rate (per Section) (Max), cubic meters/second	58	82
b) Velocity, meters/second	0.81	15.24
c) Temperature (per Section), °C	200	212
d) Pressure, psi	0.21	See Note 1
2) ESP Design		
a) Electrical Length per Plate, meters	0.50	3.84
b) Wire to Plate Spacing, millimeters	150	152.4
c) Wire to Wire Spacing, millimeters	180/320	304.8
d) Wire Diameter, millimeters	2.7	See Note 2
e) Wires per Section, meters	864	768
f) Wire Length per Section, meters	3,365	7.022.6
g) Number of Electrical Sections	3	3
h) Plate Area per Section, square meters	1,440	2,330.6
i) Duct Width, meters	0.30	9.75
3) Electrical Design		
a) Applied Voltage per Section, volts	60,000	See Note 1
b) Total Current in Electrical Section	0.6	See Note 1
c) Roughness of Wire	0.8	See Note 1

Notes:
1. Information not provided by vendor.
2. Field No. 1 - Isodyne wires 2.29 mm x 4.82 mm with 5.33 mm spikes every 50.9 mm perpendicular to flow.
   Field No. 2 & 3 - Star shaped wires 5.79 mm diameters.

Broward County
RESOURCE RECOVERY PROGRAM
FLOW DIAGRAM

WHAT IS RESOURCE RECOVERY? It is a solid waste disposal method producing inert residue while recovering useful energy and/or materials. The resource recovery process chosen by Broward County is called mass-fired waterwall incineration.

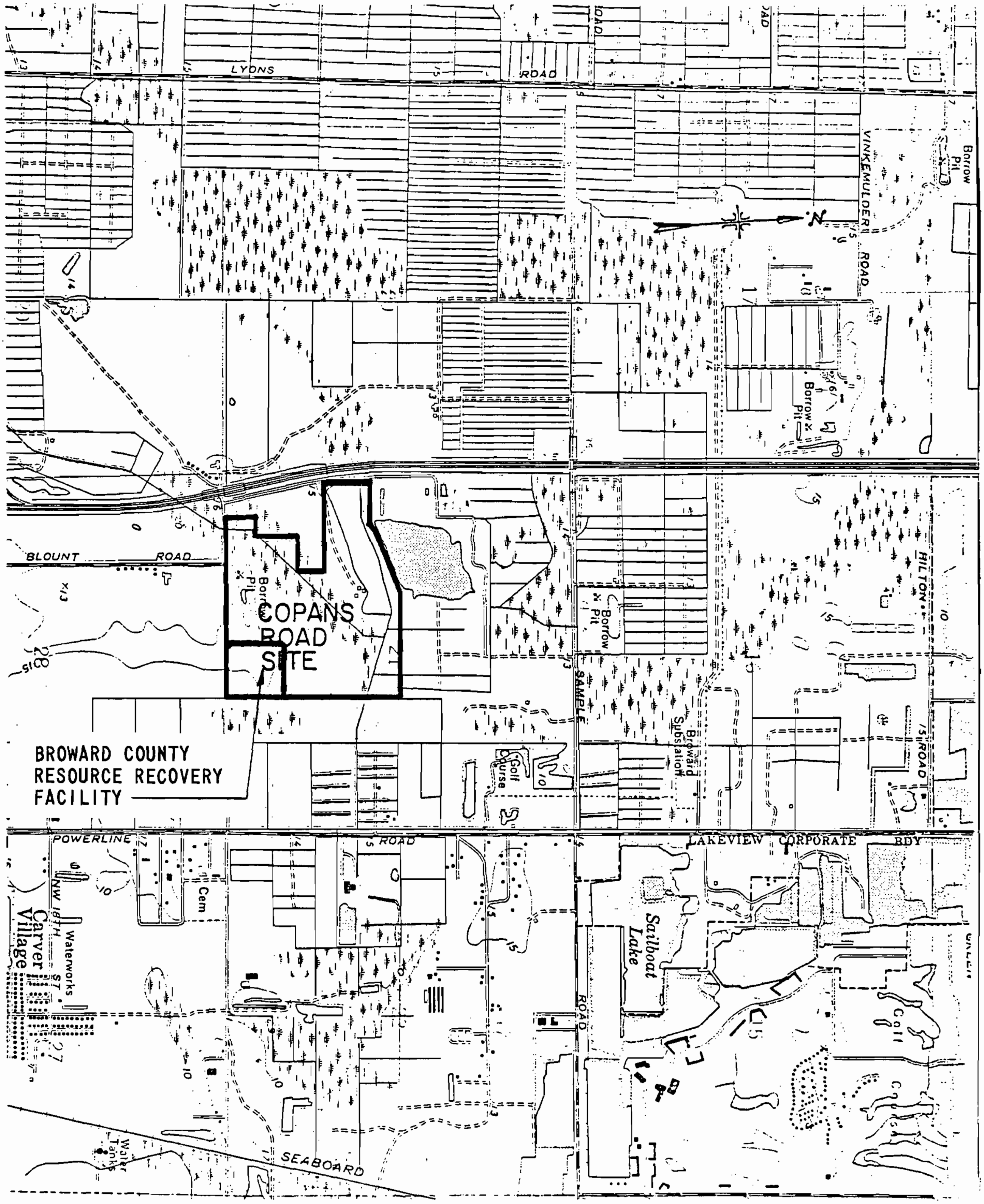


HOW DOES IT WORK?
In the system shown above, ordinary municipal refuse is dumped by garbage trucks into a large concrete pit (1). The pit, which can hold several days accumulation of solid waste, and the truck positioning area are all enclosed (2) to prevent the escape of odors or litter. Refuse is loaded from the pit into the furnace by a large overhead bridge crane (3). Oversized or unprocessible items (engine blocks, tree stumps, concrete rubble, etc.) which accidentally get into the pit can be removed at this point and either sent directly to the landfill, or put through a shredder for size reduction prior to being sent to landfill or sold.

In the furnace (4) the refuse is burned at high temperature and under controlled conditions of air and turbulence. The result is essentially complete destruction of organic material, (paper, plastic, wood, food wastes, etc.) leaving an ash residue (5) which contains the unburnable fraction (glass, metal, ceramics, etc.). This residue has a volume of five to ten percent of the original solid waste, thus lengthening the projected landfill lifetime by a factor of ten to twenty.

Hot gases from the combustion process pass up through the boiler portion (6) of the furnace where the heat is transferred to water-filled steel tubes. This heat is used to generate steam and ultimately electricity.

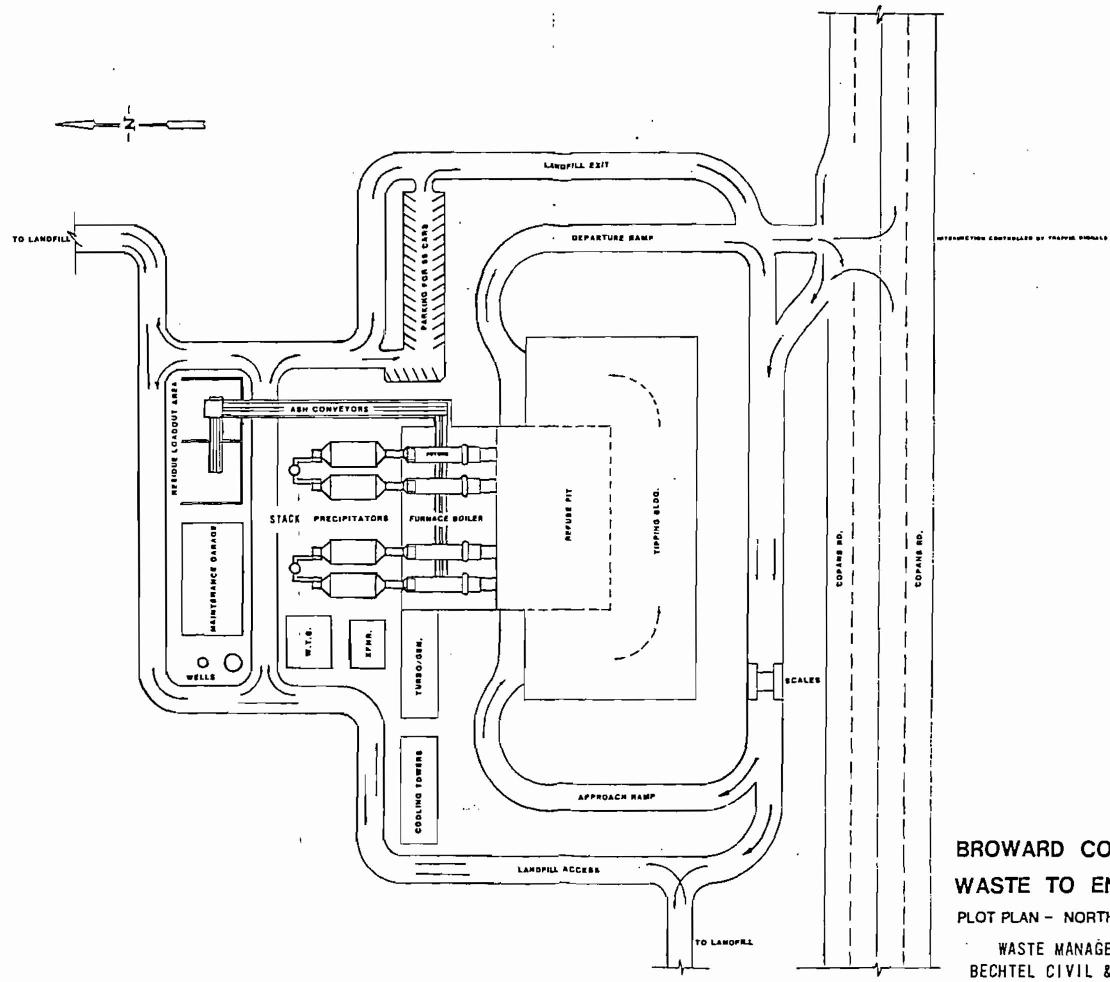
After passing through the boiler the hot gases pass through electrostatic precipitators (7) which act as giant filters removing the dust particles from the gas stream. The clean gases are then discharged at the stack.



BROWARD COUNTY RESOURCE RECOVERY

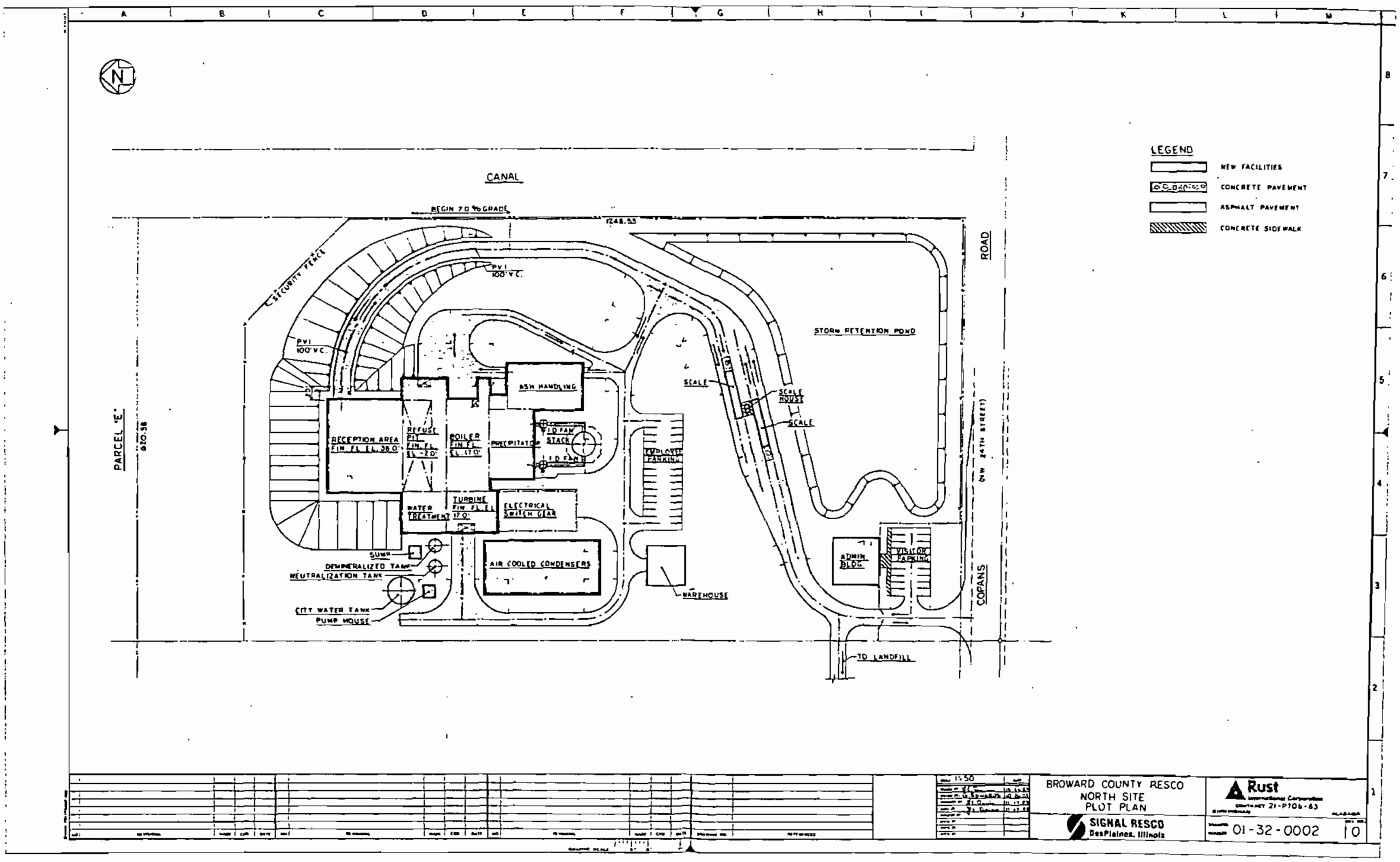
COPANS ROAD SITE

FIGURE 3



BROWARD COUNTY, FLORIDA
WASTE TO ENERGY PROJECT
PLOT PLAN - NORTH SITE
WASTE MANAGEMENT INC. -
BECHTEL CIVIL & MINERALS, INC.

FIGURE 4



LEGEND
NEW FACILITIES
CONCRETE PAVEMENT
ASPHALT PAVEMENT
CONCRETE SIDEWALK
CANAL
BEGIN 7.0 % GRADE
SECURITY FENCE
PVI 100' V.C.
STORM RETENTION POND
ROAD
ASH HANDLING
RECEPTION AREA FIN. FL. EL. 30.0'
REFUSE PIT
BOILER
PRECIPITATOR
I.D. FAN
STACK
SCALE
SCALE HOUSE
EMPLOYEE PARKING
WATER TREATMENT
TURBINE FIN. FL. EL. 17.0'
ELECTRICAL SWITCH GEAR
SUMP
DEMINERALIZED TANK
NEUTRALIZATION TANK
CITY WATER TANK
PUMP HOUSE
AIR COOLED CONDENSERS
WAREHOUSE
ADMIN. BLDG.
VISITOR PARKING
COPANS
TO LANDFILL
PARCEL "E"
1:50
BROWARD COUNTY RESCO
NORTH SITE
PLOT PLAN
SIGNAL RESCO
DesPlaines, Illinois
Rust
CONTRACT 21-P706-83
01-32-0002
0

STATE OF FLORIDA DER - APPLICATION TO CONSTRUCT/OPERATE
AIR POLLUTION SOURCES

ATTACHMENT NO. 3

SECTION VII

PREVENTION OF SIGNIFICANT DETERIORATION

F. The following materials are provided supportive of the PSD review:

Appendix A - Project Description

Appendix B - Project Technical Specifications

Appendix C - Technical Support Document for the Prevention of Significant Deterioration (PSD) Permits for Two Resource Recovery Facilities in Broward County, Florida

G. Social and economic impacts of the selected technology and assessment of the environmental impact of the air emissions source are discussed in Appendix C.

H. Additional relevant information describing the theory and application of the requested best available control technology - same as Item F above.

APPENDIX A

PROJECT DESCRIPTION

The northern Broward County Resource Recovery Facility (RRF) and residue/unprocessable waste landfill will be located on approximately 140 acres of land in the City of Pompano Beach (Figure 1). The site will be located on Copans Road between the North Broward Wastewater Treatment Plant and Florida's Turnpike. The facility will consist of two major elements, the RRF itself and a landfill for the disposal of RRF residue and unprocessable waste with accompanying buffer areas and stormwater retention ponds. The resource recovery facility (RRF) will be located on the southeastern portion of the project site (12 acres). The residue/unprocessable waste landfill will be constructed on approximately 80 acres north and west of the RRF. The remaining acreage is sufficient for development of the stormwater retention ponds and buffer areas.

The RRF is a mass burn system which will receive and process a minimum of 1,000 tpd of solid waste from northern Broward County with capability for future expansion of up to 1,400 tpd. Approximately 40 percent of the processable solid waste generated in Broward County is expected to be received by this resource recovery facility. Most of the solid waste coming to the RRF will be burned to reduce the original volume by 90 percent. Heat energy from the burning process will be recovered to generate electricity which will be sold to FP&L. Ash residue from the incineration process, consisting of less than 4.0 and 0.3 percent by weight of combustible and putrescrible matter, respectively, will be landfilled. Unprocessable wastes such as construction materials will also be landfilled directly. Ferrous metals may be salvaged and stored on site until they are sold by the operator.

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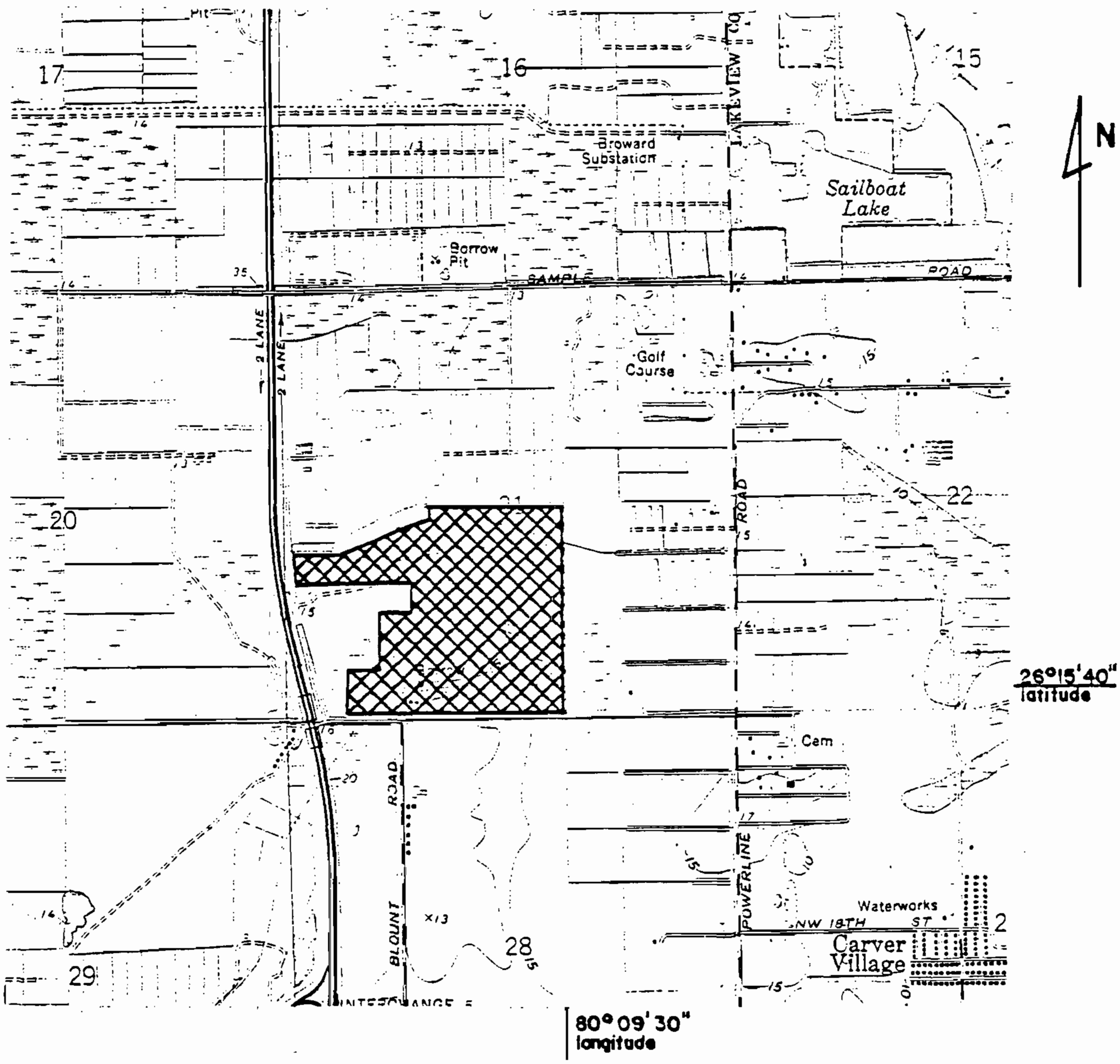
FIGURE 1



PURPOSE: RESOURCE RECOVERY FACILITY

DATUM: MEAN SEA LEVEL

SOURCE: USGS QUAD. N2615 WEST DIXIE BEND, FL

VICINITY MAP

SCALE: 1" = 2000'

IN: UNINCORPORATED BROWARD COUNTY

AT: COPANS RD. BETWEEN FL'S TURNPIKE & POWERLINE RD.

COUNTY OF BROWARD STATE FL

APPLICATION BY BROWARD COUNTY

DATE 8-19-83

The main features of the RRF will consist of material receiving and handling areas, storage pits, incinerators, boilers, turbine generators to produce electricity, and electrostatic precipitators for particulate removal prior to discharge through the stacks. Incinerator and fly ash residue will be cooled in the residue tank and conveyed to the residue disposal wing. Administrative and control facilities will include a scale house, offices and plant personnel facilities, and control room for observing and controlling facility operations.

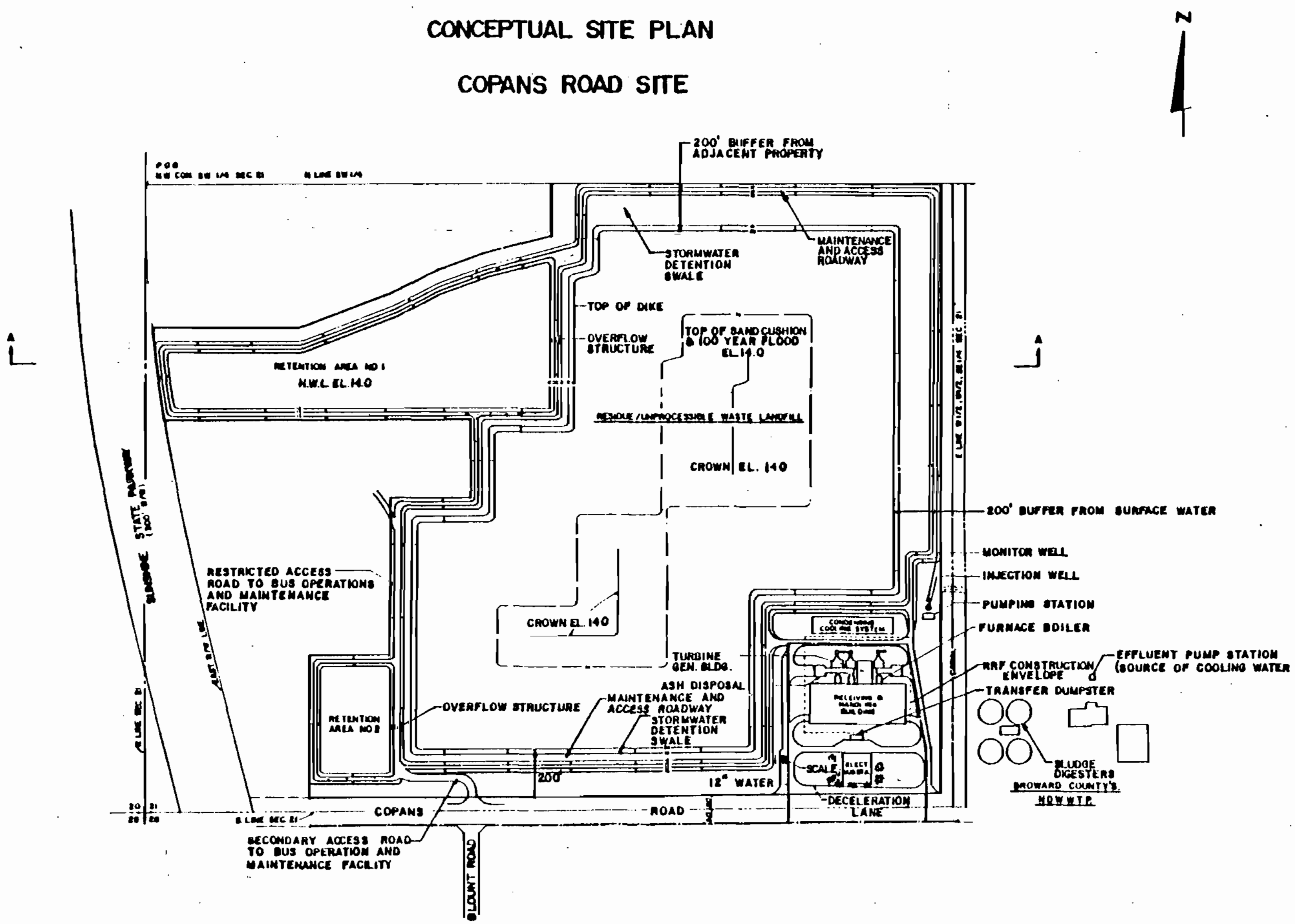
Ash residue from the RRF and unprocessble solid waste will be landfilled on site (Figure 2). At no time will the ash residue produced at the plants be greater than 25 percent of the weight of the incoming waste. Approximately 80 acres of the site will be used for the landfill and an estimated 9 million cubic yards of ash residue and unprocessable waste will be landfilled over the 20 year life expectancy of the project. The landfill will initially receive aproximately 250 tpd of residue and unprocessable waste with this total increasing to an estimated 800 tpd in later years.

The landfill will consist of a landfill cell, attendant facilities for water management, and 200-foot buffer zones from adjacent surface waters, properties, and raodways (Figure 2). The ash and unprocessable waste will be filled in a series of subcells within the landfill area. All material deposited in the fill will be placed at or above the 100-year flood elevation. Exposed (to public view) faces will be capped and landscaped as filling progresses. The final height of the landfill will be approximately 126 feet above grade, or elevation 140 feet above mean sea level (MSL).

When a landfill area is completed to design grades it will be closed in accordance with federal, state and local regulatory agency requirements. In addition, final cover will consist of a layer of impervious material having a perme-

CONCEPTUAL SITE PLAN

COPANS ROAD SITE



PAD / JMF / PER	HAZEN AND SAYER, P.C. ENGINEERS	BOARD OF COUNTY COMMISSIONERS BROWARD COUNTY, FLORIDA / SOLID WASTE DIVISION	RESOURCE RECOVERY PROGRAM / SITE PLAN
8-19-83 DREDGE & FILL PERMIT PER			DATE: JULY 8, 1983 / DRAWING: 8134-1

FIGURE 2

ability of 10^{-7} cm/sec or less, covered with sufficient top soil to support the growth of vegetative cover. Roadways will be extended to the crown of the landfill for long term maintenance.

The ash residue and unprocessable solid waste are stable inorganic and nonhazardous materials. Thus, the landfill mass will be a stable, inorganic material which will not be subject to the anaerobic decomposition processes with associated noxious end products common to the landfilling of organic solid wastes (garbage). Landfills of this type do not attract insects, rodents, and birds as do sanitary (garbage) landfills.

The surface water management system for the northern site will be designed to accommodate current and future site utilization. A phased development plan is envisioned in order to address such issues as the routing and treatment of runoff from active portions of a landfill cell and concerns regarding the quality and appropriate control methods for the disposal of surface runoff during rainfall periods. Collection and disposal of leachate and stormwater from active landfill subcell areas will be entirely separate from the stormwater management facilities. To ensure that all runoff and leachate are contained on-site, each landfill cell will have an impermeable membrane and underdrain system, and the landfill cell will be surrounded by a grassed perimeter swale system and perimeter access road which will serve as a dike. All leachate and stormwater runoff will be disposed of in an environmentally acceptable manner.

APPENDIX B

TECHNICAL SPECIFICATIONS

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APPENDIX B

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SECTION 1 - RESOURCE RECOVERY FACILITIES (cont'd)

APPENDIX B

TECHNICAL SPECIFICATIONS

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SECTION 3 - ACCEPTANCE TESTING REQUIREMENTS

APPENDIX B

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TECHNICAL SPECIFICATIONS

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APPENDIX B

TECHNICAL SPECIFICATIONS

SECTION 1 - RESOURCE RECOVERY FACILITIES

1.1 Introduction

The intent of these technical specifications is to set minimum guidelines and functional design requirements to insure comparable proposals of uniform quality and to establish specific standards for the construction and operation of the facilities. In no instance is there any intent to limit the Proposer from adding to these minimum requirements and guidelines, or to unfavorably affect the use of proprietary systems and subsystems developed by manufacturer-suppliers through their own research and development efforts.

If a Proposer desires a change in the functional design requirements described herein, the Proposer shall submit identification of the change by utilizing Form 5.3 contained in the RFP. As discussed in Section 1 of the RFP, these facilities shall include two resource recovery facilities and two final Residue/Unprocessable Waste disposal landfills. In this specification, unless the context otherwise requires, words imparting the singular include the plural and vice versa. Thus, these technical specifications will apply to each facility.

The Contractor shall provide the necessary facilities to dispose fully of all the municipal solid waste (MSW) delivered to the facilities.

The Contractor shall not receive or dispose of pathogenic or hazardous industrial wastes.

Each resource recovery facility shall process all processable waste delivered to the facilities as received and shall obtain the following outputs:

- o Electrical energy
- o Recovered materials (optional)
- o Ash residue

These technical specifications are based on a mass-burn system technology wherein the waste shall be burned continually in furnace-boilers under controlled conditions of air pressure and temperature. Steam, produced in the boilers, shall be passed through a turbine-generator set to generate electricity. The residue and siftings shall be cooled either by spray or quench, and eventually landfilled if no reuse can be found for them. Gas stream particulates and fly ash removed by electrostatic precipitators before the gases are discharged into the atmosphere may be conveyed to a common residue removal system, along with boiler ash or the fly ash and boiler ash may be removed by separate systems from the plant.

The Contractor shall supply, maintain and operate all necessary process equipment and machinery. All equipment shall be arranged in such a way as to insure safety, good housekeeping, accessibility, and ease of replacement and/or maintenance of the equipment. All equipment and machinery shall be new and of the latest proven design. The process design shall include adequate redundancy to meet the required availability and process requirements. In addition, the facilities shall be designed to accommodate future expansions that may be necessitated as a result of increased waste generation.

In accordance with Section 4 of the RFP, a minimum of two distinct and independent process lines shall be provided at the southern resource recovery facilities, and a minimum of two distinct and independent process lines shall be provided at the northern resource recovery facility. Each process line shall, as a minimum, include the following:

- A refuse-fired mass-burning furnace/boiler (steam generator) with appurtenances
- Residue conveyors with appurtenances

- An electrostatic precipitator with appurtenances
- An induced draft fan and related duct work
- Instrumentation

Common elements to each resource recovery facility shall include, but not necessarily be limited to:

- MSW/residue weighing system
- Enclosed tipping floor
- Refuse storage pit
- Refuse charging cranes and grapples
- Collecting residue conveyors
- Ferrous removal systems (optional)
- Condensers
- Water treatment equipment
- Steam extraction headers and controls
- Two turbine/generator sets or one set with one spare rotor provided
- Stacks
- Centralized process control system

1.2 General Requirements

1.2.1 Civil Engineering

The design of each facility shall take into account the existing site conditions with respect to soil conditions, site clearing and drainage. The Proposer shall be responsible for any site preparation including soil stabilization.

Site grading shall meet the requirements for necessary flood protection and be compatible with the general topography of the adjacent properties.

1.2.2 Image

It is important to the County that, because of the anticipated physical size and the activities that take place in and around these facilities, utmost care be paid to minimize any possible adverse impact of the presence of each facility to the public. In this regard, a sensitive and careful urban planning effort is required in the siting and architectural design.

The buildings and grounds of each facility should be designed to project a coherent image of each facility's function and value to the community. Exterior building materials and fenestration shall project an image of quality and functionalism. This architectural image should be contemporary in tone, visually low-key on the exterior, and embody current design for industrial buildings. Each facility should be perceived by the public as a resource and energy recovery industrial building and not as an incinerator or refuse dump. A good neighbor relationship is mandatory for each facility and the surrounding community.

The visual quality of each facility's stack design with regard to siting, material, and color options shall be considered.

1.2.3 System Availability

The facilities shall be designed using a modular approach with sufficient equipment redundancy to avoid shutdowns or outages. Each facility shall be designed to accept those quantities delivered by the County and the contract municipalities in accordance with their normal collection and delivery practices. The facilities shall be designed to process 765,000 tons of Processable Waste per year, 14,700 tons per week, 2,100 tpd, with allowances made for scheduled and unscheduled downtime.

The system designs shall provide for continuous performance.

Guaranteed availability shall be based on a proposed energy output for each ton of input at varying MSW heating values. The extent to which the guaranteed availability changes with changes in the heating value of the wastes shall also be guaranteed.

1.2.4 General Facility Process Design Requirements

The design of each facility shall incorporate the following requirements:

- Each facility shall be designed so that all the Processable Waste received will be processed in a highly reliable manner. The Proposer will clearly state and demonstrate the long-term reliability and availability of the systems proposed.

- Each Processable Waste storage pit shall be large enough to hold a minimum of four times the daily Nampelate Capacity of the facility.

- Each vehicle shall be weighed upon entering the site to determine the net payload of the MSW delivered.

- On-site MSW truck traffic flow shall be designed to minimize conflicts and to allow a maximum on-site time of ten minutes for any vehicle, even during peak traffic periods.

- Sufficient unloading bays shall be provided to meet the above stated time criteria in regard to the unloading of Processable Waste in a totally enclosed tipping area.

- Visitor accommodations shall be provided along with the appropriate walkways, galleries, conference rooms, and control room access.

- The Proposer shall incorporate the following check-list in the design of each facility:
  - Weighing station - automated, with one standby scale
  - No truck queuing on the ramps or public road-ways
  - Cranes - minimum of two each at one hundred percent of daily facility capacity, or three each at fifty percent capacity. The crane grapples shall have the capabilities to transfer the Processable Waste quantities at these crane capacities from the storage pit to the charging hoppers.
  - Manual overrides for all systems and equipment with automatic controls
  - Maximum furnace sizes - 750 tons/day
  - Turbine-generator units - two as a minimum or one with one spare rotor provided
  - Air Pollution Control - Electrostatic Precipitators, one per process line
  - Stack(s) height - at each facility a maximum of 200 feet above final grade elevation
  - Residue removal system - each one hundred percent nominal capacity conveyor systems

- Utility interconnection - as per the requirements of the Florida Power and Light Company (FP&L)
- Fire fighting system

1.2.5 <u>Applicable Codes and Standards</u>

The design and construction of all structures, along with all the equipment, component parts, and ancillaries, shall conform with all governmental and industry codes and standards. Without limiting the foregoing, <u>The South Florida Building Code</u> shall be followed, including requirements for:

- o construction classifications,
- o fire restrictive construction,
- o fire protection systems,
- o elevators.

In addition, the latest issues of the following codes and standards for construction and operation of each facility, shall be incorporated in the design.

- o American Association of State Highway and Transportation Officials (AASHTO)
- o American Institute of Steel Construction (AISC) Specifications
- o American Welding Society Code
- o Applicable codes and standards of the American National Standards Institute (ANSI)
- o American National Standards Building Code Requirements for Minimum Loads in Buildings and Other Structures (ANSI A58.1)
- o Instrument Society of America (ISA)
- o Applicable codes and standards of the American Society for Testing and Materials (ASTM)
- o Air Mixing and Conditioning Association (AMC)
- o ASHRAE Handbook and Standards
- o Tubular Exchange Manufacturers Association (TEMA)
- o American Society of Mechanical Engineers (ASME) - Boiler and Pressure Vessel Code

- Hydraulic Institute Code (HIC)
- Heat Exchanger Institute (HEI)
- American Concrete Institute (ACI)
- Steel Structures Painting Council (SSPC)
- All Standards Promulgated by the U.S. Secretary of Labor under Occupational Safety and Health Administration (OSHA)
- Institute of Electrical and Electronic Engineers (IEEE)
- National Electrical Code (NEC)
- National Electrical Manufacturers Association (NEMA)
- National Fire Protection Association Codes (NFPA)
- National Board of Fire Underwriting (NBFU)

In the event that any of the above codes or standards conflict with one another, the most stringent requirement shall be applied.

1.2.6 Utilities

General: It is the responsibility of the Proposer to inform the County of the quantities of all utilities required by each proposed facility. The Proposer shall indicate in the proposal if there is an insufficiency in utilities supplying the sites. Off-site costs associated with providing utilities capacity (exclusive of cooling water requirements) in excess of those immediately available shall be treated as "developmental costs" to be included in the Project financing.

The design and installation of all utility connections shall be in accordance with the requirements of the utility suppliers and will be considered as part of the design of each facility.

Water: The requirements of the South Florida Water Management District shall be met, including those for permits.

It is the Proposer's responsibility to include in the proposal, details on the treatment of the water as may be required for plant operations and any pretreatment requirements for industrial wastewater. In addition, the Proposer shall include stormwater drainage plans for the resource recovery facilities and Residue/Unprocessable Waste landfills.

The water quantities and pressures required for plant processing and other purposes, including fire protection, shall be included in the Proposal. If the County cannot provide the quantities and pressures required, auxiliary sources for obtaining same shall be included in the Proposal.

The Proposer shall consider for process water the use of non-potable well water, the recycling of plant wastewater, and the potential use of plant effluent. The Proposal shall include a complete description and estimates for each auxiliary source. Compliance with all applicable codes is mandatory.

Sanitary Sewer: The Proposer shall submit in the Proposal, design data on his projected water discharges, including quantities and qualities of discharge and pretreatment, if required, i.e., characteristics as defined by the rules of the County and/or the host municipality user charge/industrial cost recovery systems. The Proposal shall also include methods to handle discharge if the present systems cannot accept it. Applicable codes and requirements of the State and the County shall be complied with.

Storm Drainage: Storm drainage for the sites shall be developed to conform to all requirements of the South Florida Water Management District (SFWMD). The Proposer shall submit calculations showing the method for determining runoffs. On site retention lakes will be required for storm drainage control.

As part of the County's permit application procedure, preliminary storm drainage plans have been developed and submitted to the SFWMD. These plans include the use of injection well systems as a result of the limited acreage available at the project sites. Specifications for a typical injection well system are included in Appendix G of the RFP.

Storm drainage plans shall be reviewed with the County for conformance with code and other requirements of the SFWMD.

Electrical Power: Florida Power & Light (FP&L) will bring transmission power to the facility substations. Power requirements and the suggested operating compatibility for the electrical system for each facility during the construction, start-up and operation phases, and for backup, shall be provided in the Proposal. The electrical system includes the plant distribution system, the type of metering, the interconnection systems with FP&L and FP&L protection costs within the interconnection systems. The Proposer shall provide electrical power specifications to the County and shall make all arrangements for electrical service during construction and start-up through FP&L.

For utility interconnection, the design and installation shall be in accordance with the requirements and standards imposed by FP&L and shall be part of each facility. FP&L shall tie-in to electrical substations to be located within each facility site.

The mode of electrical energy distribution shall meet with the following:

- Each turbo-generator and associated power generation equipment shall have its own bus which is to be at the same voltage level as the generator. Synchronizing and protective relays shall be provided on each generator breaker.

- Interconnect transformers shall each be sized for the full output of the plant.

- Complete indoor relay and control switchboards shall be provided for each facility's electric systems.

The distribution systems at each facility shall have 4.16 KV and 400 volt systems with switchgear and related accessories housed in the processing section of each of the facilities.

The electrical output of the turbine-generator sets shall operate within the interconnection system established by FP&L. The turbine-generator sets shall be capable of operating in the full condensing mode, at maximum steam flow, even on the hottest day of the year, and still provide an efficient and adequate quantity of electrical energy.

In addition, payment to FP&L shall be required for interconnection and protection costs associated with the northern and southern facility electrical interconnections, and for the following additional costs:

- Monthly telephone company charge for FP&L dispatcher communication channel, which has been estimated by FP&L at $175 per month at each site.
- Maintenance and operation fee to FP&L for interconnections facilities.
- Metering costs.
- Suitable arrangements for termination of FP&L lines. The service points may be adjusted if desirable to provide suitable line terminations.
- Suitable right-of-ways and easements both on and off the sites for the transmission lines. Thirty-six foot minimum width, accessible easements are required. The right-of-ways must be cleared and finished to adequate grade. Costs of fees and permits, if applicable, shall also be paid.

1.2.7 Site Utilities

This subsection provides information on available utility service for the Route 441 and Copans Road Sites. However, it is the responsibility of the Proposer to verify and supplement this information where necessary.

Route 441 Site

Figure A-1 illustrates the known utility locations adjacent to the Route 441 site. The electrical interconnection proposed by FP&L is shown in Figure B-2.

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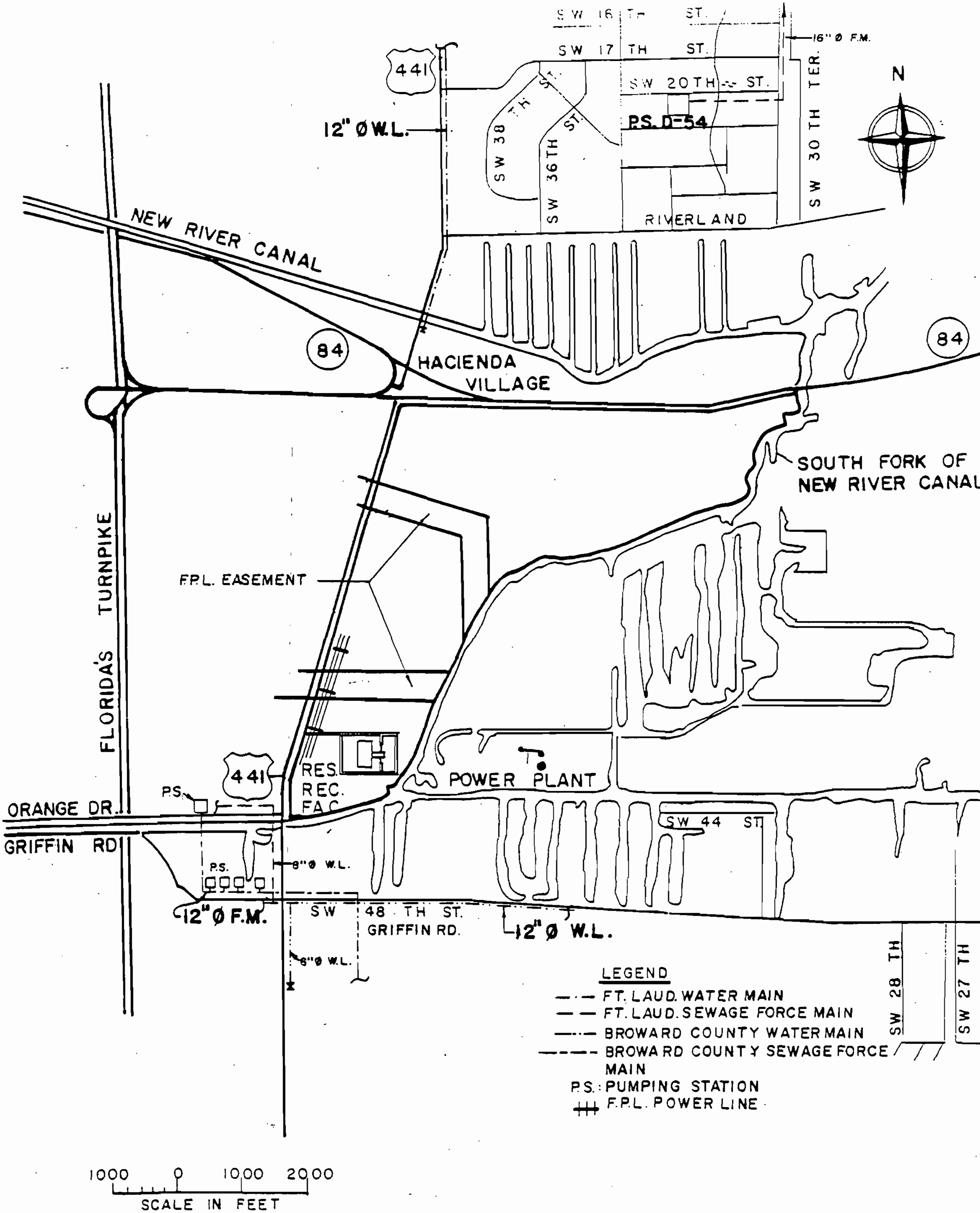
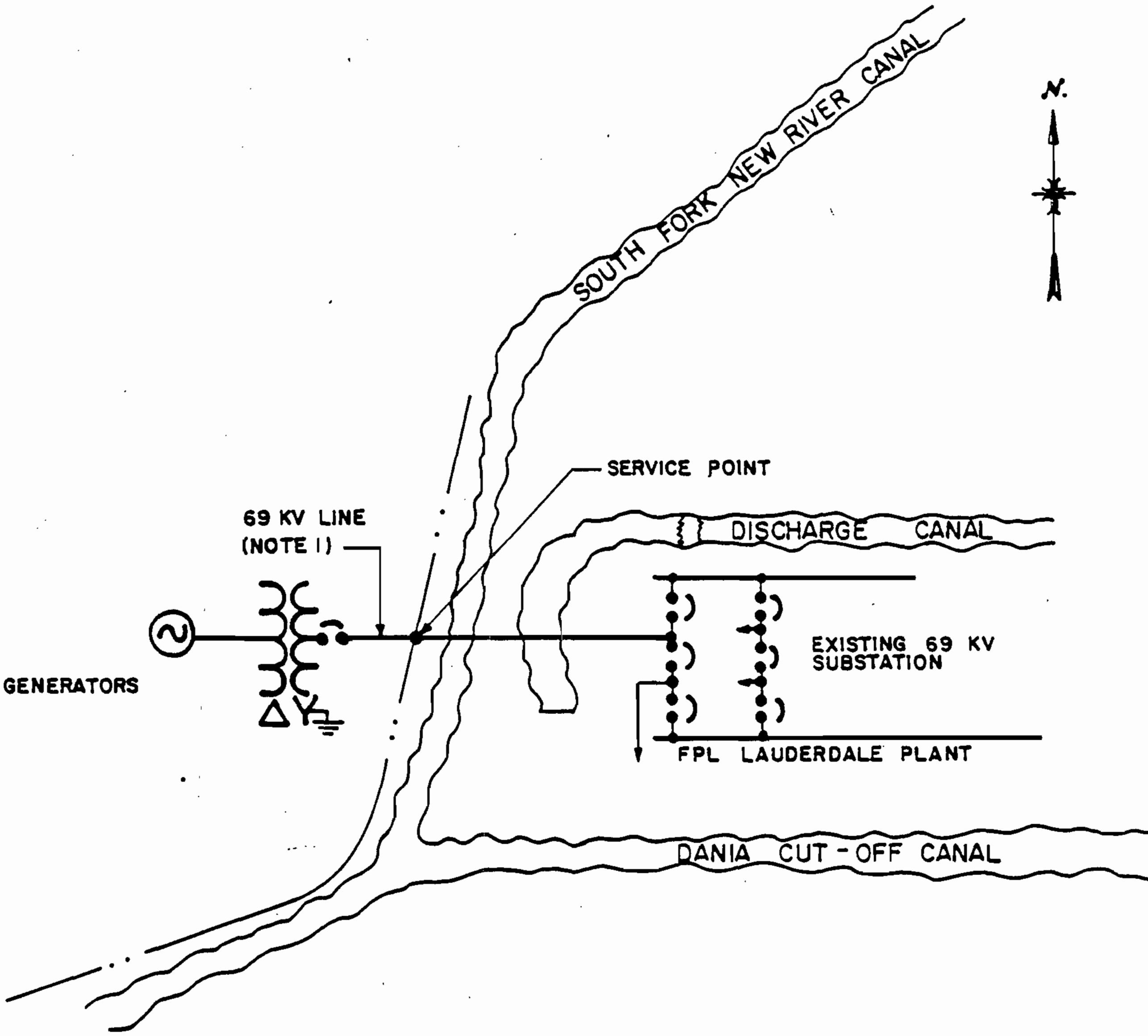
FIGURE B-1



BROWARD COUNTY
RESOURCE RECOVERY

UTILITY LOCATIONS
ADJACENT TO THE
ROUTE 441 SITE

FIGURE B-2



* GROSS OUTPUT MAY BE SUPPLIED BY TWO GENERATORS

NOTE 1

PROVIDE FOR FUTURE CONVERSION FROM 69 TO 138 KV

BROWARD COUNTY
RESOURCE RECOVERY

ELECTRICAL INTERCONNECTION SCHEMATIC
ROUTE 441 SITE

Electric Service: For the southern facility, FP&L indicates that a 69 KV transmission line will be extended westwardly across the South Fork New River Canal from FP&L's Lauderdale Power Plant Substation to the southern site's substation. The routing of this line will require coordination in the development of the resource recovery plant. The facilities at the southern sites should be designed to facilitate future conversion of the 69 KV service voltage to 138 KV.

Florida Power and Light has developed an interconnection cost estimate, including modifications to offsite substations and transmission lines, for the southern site. This estimate, based on the above assumptions is $300,000 which does not include the cost of the transformer, circuit breaker or protective equipment installed at the site.

The above cost, in current dollars, should be regarded as a budget estimate to provide feasibility guidance. Since the Project will pay on the basis of actual cost including appropriate overheads, rather than estimated cost, the estimates must be reviewed when specific designs become available.

Water Service: Water, exclusive of cooling water requirements, can potentially be provided by Broward County or the City of Fort Lauderdale. Broward County has an existing 12-inch diameter water main, which runs east-west along Griffin Road south of the project site. An 8-inch line extends north from that main to a point adjacent to the resource recovery facility site. Water quality data for the County water plant that would provide service to the southern site is provided in Table B-1. Preliminary information from the County indicates that approximately 100 gpm of water from the County water system may be available to this site.

Service by the City of Fort Lauderdale would require a main extension from the New River Canal, Route 441

TABLE B-1
1982 AVERAGE ANNUAL WATER QUALITY VALUES FOR
THE BROWARD COUNTY SYSTEM 3-A PLANT

Analytical Results	Raw Water	Finished Water
Water pH at the Plant	7.25 units	8.75 units
Water pH at the Field	-	8.50 units
Water Color at the Plant	63 CU	12.0 CU
Water Color at the Field	-	12.8 CU
Water Odor No. Dilutions	3 DIL	-
Water Turbidity	-	0.41 BTU
Water Free Carbon Dioxide	21 mg/l	0 mg/l
Calcium Hardness as $CaCO_3$	209 mg/l	63 mg/l
Magnesium Hardness as $CaCo_3$	18 mg/l	14 mg/l
Total Hardness as $CaCO_3$	227 mg/l	77 mg/l
Total Mo. Alk. as $CaCO_3$	198 mg/l	26 mgl
Non Carbonate Hardness as $CaCO_3$	29 mg/l	51 mg/l
Calcium as Ca^{+2}	83.6 mg/l	25 mg/l
Magnesium as MG^{+2}	4.4 mg/l	3.4 mg/l
Iron as Fe^{+2}	1.67 mg/l	0.03 mg/l
Sodium as Na^{+1}	23.2 mg/l	23.8 mg/l
Bicarbonate as HCO_3^{-1}	242 mg/l	31.7 mg/l
Chloride as Cl^{-1}	35 mg/l	52.4 mg/l
Sulfate as SO_4^{+2}	17.0 mg/l	18.0 mg/l
Fluoride as F^{-1}	0.19 mg/l	0.88 mg/l
Total Dissolved Solids	408 mg/l	173 mg/l
Total Res. Chlorine	-	2.9 mg/l
Total Free Chlorine	-	2.5 mg/l
Total Comb Chlorine	-	0.4 mg/l
Saturation Index	+0.00	+0.14 mg/l

intersection south to the site. This extension will necessitate crossing Route 84 and the proposed I-595 interchange. Preliminary information from the City of Fort Lauderdale indicates that approximately 100 gpm of water may be available from the City's Peele Water Plant. Water quality data for this plant is provided in Table B-2.

Sewer Service: As with water, sewer service can potentially be provided by either Broward County or the City of Fort Lauderdale.

The Broward County system consists of small submersible pump stations discharging through a 6-inch diameter force main located on Griffin Road. The possibility that increased flow through the Broward County system will significantly affect hydraulic conditions must be addressed.

The City of Fort Lauderdale operates pumping station D-54 on S.W. 20th Street to the north of the project site. This is a large station which would probably not be affected by increased flow from the resource recovery facility. However, the piping required to meet the City system must pass across Route 84 and proposed I-595.

Copans Road Site

Figure B-3 illustrates the location of known utilities, adjacent to the Copans Road Site. The electrical tie-in proposed by FP&L is shown in Figure B-4.

Electric Service: For the northern facility, FP&L indicates that a 138 KV overhead transmission line will be brought to the eastern side of the site. This pole line will enter the northern site at approximately the northeast corner and extend southward along the east property line to the northern site's substation.

Based on the above assumptions, Florida Power and Light has estimated the interconnection costs for this site, including modifications to offsite substations and transmission lines at $800,000. This estimate does not include the

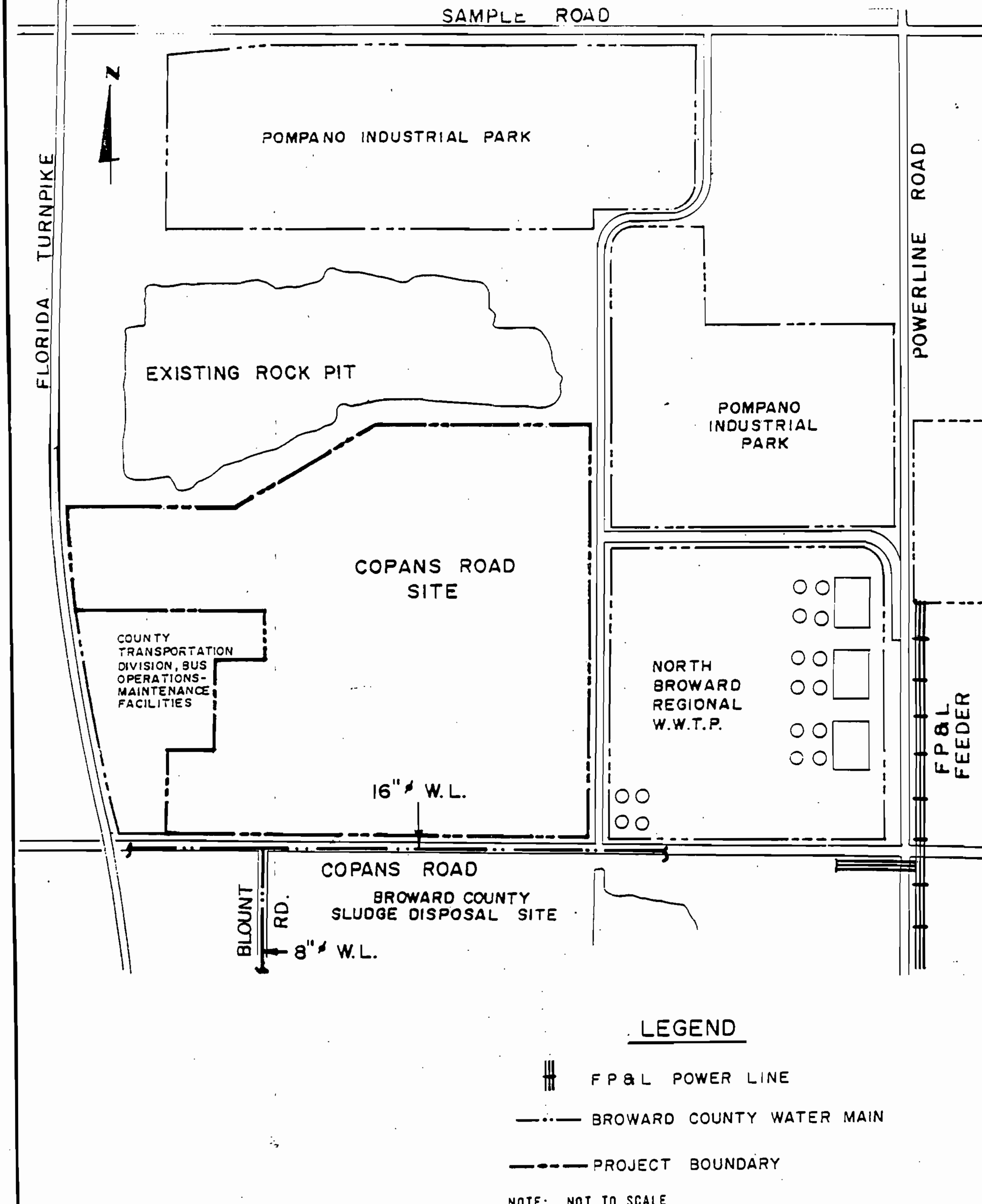
TABLE B-2

1982 AVERAGE ANNUAL WATER QUALITY VALUES FOR
THE CITY OF FORT LAUDERDALE'S

WALTER E. PEELE PLANT

Analytical Results	Raw Water	Finished Water
Water, pH	6.9 units	9.1 units
Water Color	3.65 CU	5.25 CU
Turbidity, NTUO	-	0.36
P Alkalinity	-	8.5 mg/l
M Alkalinity	-	39.7 mg/l
Total Mo. Alkalinity	224 mg/l	-
Calcium hardness as $CaCO_3$	254 mg/l	81 mg/l
Total Hardness as $CaCO_3$	165 mg/l	90.5 mg/l
CO_2 Calcium	54 mg/l	-
Iron as FE	1.85 mg/l	0.11 mg/l
Chlorides as Cl^{-1}	42 mg/l	53.7 mg/l
Residual Chlorine	-	2.5/3.4

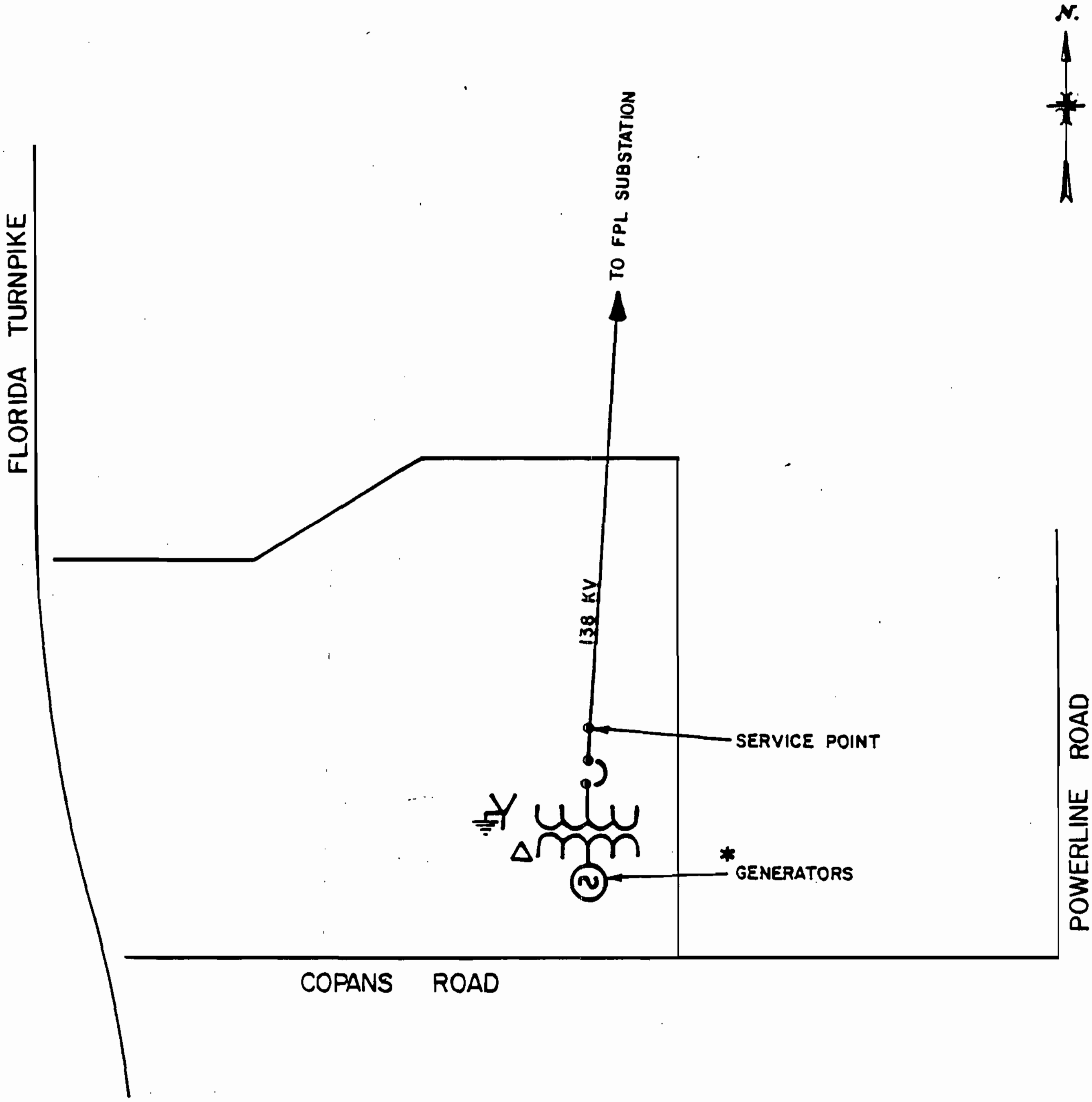
FIGURE B-3



UTILITY LOCATIONS ADJACENT TO THE COPANS ROAD SITE

BROWARD COUNTY RESOURCE RECOVERY

FIGURE B-4



* GROSS OUTPUT MAY BE SUPPLIED BY TWO GENERATORS.

BROWARD COUNTY
RESOURCE RECOVERY

ELECTRICAL INTERCONNECTION SCHEMATIC
COPANS ROAD SITE

cost of the transformer, circuit breaker, or protective equipment necessary to be installed at the facility.

The Contractor would be responsible for installation and operation of the step down transformers, interfacing circuit breakers and protective equipment.

The preceding cost, in mid 1983 dollars, should be regarded as a budget estimate to provide feasibility guidance. Since the Project will pay on the basis of actual cost including appropriate overheads, rather than estimated cost, the estimates must be reviewed when specific designs become available.

Water Service: Water, exclusive of cooling water requirements, may be provided from the Broward County water distribution system. Preliminary discussions with the County indicate that approximately 100 gpm of water may be available from the County water system to this site. Water quality data for the County water plant that would provide to the northern site is provided in Table B-3.

Sewer Service: The Copans Road site is located immediately west of the North District Regional Wastewater Treatment Plant which can provide sewer service to the resource recovery facility. Broward County owns and operates this plant.

TABLE B-3
1982 AVERAGE ANNUAL WATER QUALITY VALUES FOR
THE BROWARD COUNTY SYSTEM 1-A PLANT

Analytical Results	Raw Water	Finished Water
Water pH at the Plant	7.2 units	8.9 units
Water pH at the Field	-	8.6 units
Water Color at the Plant	82 CU	10.75 CU
Water Color at the Field	-	11.5 CU
Water Odor No. Dilutions	3.0 DIL	-
Water Turbidity	-	0.40 BTU
Water Free Carbon Dioxide	27 mg/l	0
Calcium Hardness as $CaCO_3$	235 mg/l	70 mg/l
Magnesium Hardness as $CaCo_3$	18 mg/l	9 mg/l
Total Hardness as $CaCO_3$	253 mg/l	79 mg/l
Total Mo. Alkalinity as $CaCO_3$	227 mg/l	29 mg/l
Non Carbonate Hardness as $CaCO_3$	26 mg/l	50 mg/l
Calcium as Ca^{+2}	94 mg/l	28 mg/l
Magnesium as MG^{+2}	4.38 mg/l	2.2 mg/l
Iron as Fe^{+2}	1.42 mg/l	0.03 mg/l
Sodium as Na^{+1}	32.6 mg/l	32.8 mg/l
Bicarbonate as HCO_3^{-1}	277 mg/l	35.4 mg/l
Chloride as Cl^{-1}	57 mg/l	82.0 mg/l
Sulfate as SO_4^{+2}	14 mg/l	14.0 mg/l
Fluoride as F^{-1}	0.14 mg/l	0.85 mg/l
Total Dissolved Solids	406 mg/l	275 mg/l
Total Res. Chlorine	-	4.1 mg/l
Total Free Chlorine	-	3.3 mg/l
Total Comb Chlorine	-	0.8 mg/l
Saturation Index	+0.06	+0.37 mg/l

1.3 Site Work

1.3.1 Subsurface Investigation

Data and information pertaining to the subsurface conditions at the southern site are provided in Appendix A of the "Route 441 Site Environmental Review Form Summary and Report" dated July, 1983. The Camp, Dresser, McKee report entitled "The Solid Residuals Disposal: Phase I Design" dated May 1980 and prepared for the Broward County Department of Utilities, Division of Water and Wastewater, contains information concerning subsurface conditions for an area adjacent to the northern site. Copies of these documents are available at the Office of the Project Administrator.

In addition, the County will conduct subsurface investigations at the northern and southern sites. These investigations will include a boring program at each site and subsequent laboratory testing. The subsurface data will be compiled into a report-type format which will be made available during the vendor selection process.

This data will be supplied for informational purposes only. The Contractor must assure itself that subsurface conditions are compatible with its facilities.

1.3.2 Survey

The Contractor shall furnish all labor, materials, tools, equipment, to perform all work and services necessary for or incidental to the performance and completion of survey work necessary for the construction of site work, buildings, new utilities, and other new facilities and establish and maintain bench marks, make measurements to verify location of completed construction, and survey alignment to existing property boundaries.

The following conditions shall be followed in making the above described survey:

- o A survey shall be made to establish the property site lines.

- o Copies of all the County's survey information will be made available at Contractor's expense.

- o The Contractor shall not disturb existing benchmarks or property line monuments. Work necessary to replace stakes and monuments as directed by the County shall be at the Contractor's expense.

1.3.3 Clearing, Grubbing and Site Preparation

Underground Void Areas: Such as tanks, cisterns, tunnels, or the like shall be removed or filled according to all pertinent codes and regulations.

Shoring: All temporary shoring required to support existing work, and adjacent areas and work shall be furnished and installed to prevent settlement or other damage to surrounding areas and structures and shall be provided with adequate means to compensate for any settlement in the shoring supports.

Debris: All materials removed shall become the property of the Contractor and shall be removed from the premises and disposed of by the Contractor.

Maintenance: All access roadways used by the Contractor shall be maintained in serviceable condition. The Contractor shall keep the surfaces of these roadways free from mounds, depressions and obstructions which might present a hazard or annoyance to traffic.

Signs, Signals and Barricades: All signs, signals and barricades shall be provided by the Contractor and shall meet or exceed all OSHA regulations for accident prevention.

Dust Control: The Contractor shall be responsible for all dust control at the site. The Contractor shall prevent the spread of dust during his operations. Moistening all surfaces with water or applying calcium chloride shall be used to prevent dust from becoming a nuisance to the public and neighbors. Contractor shall furnish all labor and equipment necessary for dust control including but not limited to tank trucks, hoses, calcium chloride spreaders, etc.

Burning: On-site burning shall not permitted.

Vermin and Rodent Control: During the course of construction and operation, a constant control of vermin and rodents shall be maintained by the Contractor. If necessary, the Contractor shall employ the services of a professional exterminator.

Explosives: The use of explosives shall at all times be in conformance with the conditions set forth in Section 3.5 of the RFP.

Disconnection of Utilities: Before starting site operations, the Contractor shall disconnect or arrange for the disconnection of all utility services required to be removed, performing all such work in accordance with the requirements of the utility company or agency involved.

Grubbing: The Contractor shall remove all surface rocks and all stumps, roots and other vegetation within the limits of construction.

Dewatering: The Contractor shall be responsible for performing all necessary site dewatering.

Site Drainage: The Contractor shall be responsible to install and maintain adequate drainage and prevent soil erosion at the site during construction.

1.3.4 Excavation, Filling, and Backfilling

The Contractor shall be responsible for furnishing all supervision, labor, tools, materials and equipment and performing all operations in connection with excavation of all materials regardless of character of material, and obtain fill and backfill material approved by a qualified soil engineer to produce final grade lines. All necessary arrangements for obtaining fill material and topsoil from off-site borrow areas shall be the responsibility of the Contractor.

The Contractor shall remove from the site all rubbish and debris found thereon to prepare the site for excavation.

The Contractor shall perform the required excavation of whatever materials encountered, as necessary for the construction of the Project.

Excavation for footings shall be made sufficiently wide for the installation of form work and to the depths required.

The Contractor shall prevent the foundation area from becoming unstabilized by the flow of water into the excavation or by cave-ins.

Deleterious soil not suitable for sustaining design loads must be removed entirely and controlled fill shall be placed in its stead. In areas other than under buildings unsuitable soil shall be removed to the depth required to sustain traffic loads with controlled fill placed in the area.

The Contractor's quality of work including excavation, fill, backfilling, dewatering, subgrade preparation and stabilization, shoring, drainage, for protection shall comply with soils engineer recommendations, the applicable American Society for Testing and Materials (ASTM) standards, and the Florida State Department of Transportation.

All existing utility lines, drains or other structures which are encountered or which are uncovered by excavation shall be carefully supported and protected from injury by the Contractor, and if damaged shall be restored by the Contractor at his expense to the same condition in which they were found.

Surplus excavated material over and above that required for backfilling shall be placed by the Contractor at points on the property consistent with the Contractor's landscaping plan.

Before backfilling, all excavated areas to be backfilled shall be cleared of all building rubbish, wood, lumber and dismantled from work, etc.

Backfill shall consist of suitable clean soil.

Backfill shall not be placed against walls until they have attained sufficient strength to withstand the pressure of the fill material safely.

1.3.5 Easements and Setbacks

Existing easements at the sites, such as those held by FP&L and as indicated on the site drawings in this RFP, must be observed and honored unless specific exceptions are obtained from the easement holder.

A discussion of the required buffer areas for the northern site is provided in Section 4 of the zoning ordinance for the Copans Road Site, while the Zoning and Land Use Section of the "Route 441 Site Environmental Review Form Summary and Report" dated July, 1983 contains information pertaining to setbacks and buffer areas for the southern site.

1.3.6 Site Maintenance

The Contractor shall be responsible for the maintenance of the sites. Maintenance shall include all watering, weeding, clean-up, repair of washouts, repairs to fences and all other necessary work associated with site maintenance.

The Contractor shall clean-up and remove from the site all rubbish and materials as they accumulate and shall not permit them to be scattered about the site. If the Contractor fails to attend to this clean-up promptly and satisfactorily, the County shall have the right to employ others for the work and charge the cost to the Contractor.

1.4 Architectural

1.4.1 Functional

General: The Proposer shall be responsible for developing site layouts which will meet all functional design requirements to provide for efficient operation of each facility.

Plans for each facility shall include an architectural program for all functional areas of the facility, identifying the designated use and capacity of these areas. Concepts for interior design and furnishings shall also be provided. An interior circulation plan shall be designed for efficient movement and functional operation of equipment and control by the crews of each facility. Personnel facilities should be placed in a central location to minimize walking distances.

Each complete facility, including buildings required to house process equipment and administrative functions, public areas, ancillary buildings, infrastructure such as roadways, parking areas and landscaping, shall be designed and constructed to meet all functional requirements of the Project. Each facility shall be designed and constructed of quality materials to ensure that with proper maintenance and repair the facility will remain in good condition both functionally and visually over the operating period. The selection of exterior materials should be made from the standpoint of durability, weather-resistance and easy maintenance.

The proposal shall include necessary systems for heating, ventilation, air conditioning, plumbing, lighting and power distribution, communication, fire protection, and provision for the handicapped in visitor and administrative office areas to facilitate proper operation of the process equipment and provide essential comfort for the personnel.

Each facility shall include all of the necessary equipment and their enclosures and conform to all applicable Federal, State and local codes.

Each facility shall be designed to facilitate repair and maintenance of process equipment by providing adequate space around and between equipment items.

<u>Main Process Buildings</u>: Each main process building shall house the refuse receiving and handling area, refuse storage area, water and waste handling systems, control room, machine shop and locker rooms. In addition, each main process building shall house an employee area, maintenance and storage areas, laboratory and the first aid center. The turbine-generator sets may be installed outdoors or may be housed within the main process building.

Exterior walls shall be durable, as well as providing noise abatement, and easily maintainable. Natural light shall be utilized throughout the main process buildings to the maximum extent possible.

Material that is easily cleaned, damage resistant against various maintenance activities, and tolerant of adverse conditions created by high humidity and equipment operation (e.g., vibration) shall be selected for the interior walls and partitions. Access stairs, ladders, platforms and elevators shall be provided in accordance with applicable sections of OSHA.

Administrative Office Spaces and Employee Areas: At each facility the administrative offices may be incorporated within the main process building or housed in a separate building. Each facility shall include suitable office space and furnishings to accommodate the facility staff and County representatives.

Conference rooms, a visitor reception area, employee locker room(s) with toilets, an employee lunch room, and toilets for staff and visitors shall also be provided at each facility. These spaces shall be furnished with all customary furniture and equipment.

Visitor Accommodations: Each facility shall provide for occasional visitors, both singly and in groups, and for on-site public educational programs.

In addition, controlled visitor viewing locations, in various process areas of each facility, shall be provided. These viewing spaces shall not be directly exposed to operating equipment to assure the safety of the public. Elevators shall be provided to facilitate visitor access and movement to all levels of each facility.

Maintenance and Storage: Each facility shall include a maintenance and machine shop and adequate storage for spare parts, equipment and rolling stock, sufficient to provide for a regular program of maintenance for all facility buildings and grounds.

The Contractor shall furnish equipment for the machine shop as part of each facility.

Each facility shall have storage spaces for all mobile vehicular equipment necessary to operate the facility and associated landfills. An enclosed vehicular garage/repair shop shall be provided at each facility.

Scale Houses: Each facility shall have a scale house as a separate building. Each shall contain, in addition to the weighing equipment, provisions for an office for the operator with the necessary furnishings and an area with toilets for truck drivers. Adequate lighting, heating, ventilating and air conditioning shall be provided. A security office shall also be located within each scale house.

Waste Sampling Areas: The enclosed tipping floors at each facility shall have provisions for use of an area on the floors for Processable Waste sampling on a selective or as-needed basis. Vehicular access shall be provided to the sampling areas. Ample space shall be provided to permit waste to be transferred from the receiving areas into a 1-cubic yard box using a small front end loader. These sampling spaces may be routinely used for other purposes and made available for test work on a coordinated basis.

Residue Handling Areas: The residue handling areas shall be enclosed to minimize the aesthetic impact of this operation, control the emission of noise and odor and to conceal the activities from the view of the public.

Laboratory: The facility shall include a fully equipped laboratory to conduct all routine testing of steam and feedwater. The detailed design of the laboratory shall be the responsibility of the Proposer.

First Aid Centers: The Proposer shall provide an area for a fully equipped First Aid Center within each facility.

Access Roads and Ramps: The access roads and/or ramps shall be designed to achieve the greatest efficiency, to minimize the use of space, to minimize the interaction of trucks with staff and visitor vehicles, and to prevent the queuing of trucks on ramps and public roadways.

Road System: The road systems shall include all roadways within the facilities. There shall be at a minimum at each facility a road from:

(1) The entrance and the exit to:
- o The weighing station
- o The main plant building
- o All auxiliary facilities

(2) The weighing station to and from:
- o The tipping area (truck ramp shall be constructed with a slope not to exceed five percent
- o The ash handling area
- o The residue/unprocessable waste landfill,

(3) The main plant building to and from:
- o All auxiliary facilities

Road Geometric Design: There shall be a minimum of two lanes for each traffic direction, one of which shall be a shoulder for breakdowns and traffic by-pass. The width of each lane shall be as a minimum the size of lane as per construction codes of the American Association of State Highway and Transportation Officials for street width for trucks. The radius or curvature of any roadway shall also be not less than the minimum curvature suggested by the same construction codes.

Road Drainage: Paved roads and surfaces shall be pitched so as to adequately drain all storm waters to drainage ditches or to catch basins connected to a subsurface drainage system.

Site Walkways: All walkways shall conform to applicable State and County requirements and the appropriate codes and standards. In addition, all walkways shall be adequately lighted, maintained and have provisions for the handicapped.

Site Outdoor Lighting: Sufficient outdoor lighting of roads, walkways and parking areas shall be provided to insure the safety and security of the operation of each facility, the safe movement of people and vehicles, and for security purposes.

Facility buildings shall be suitably illuminated to present the facility to the public.

Primary lighting shall be provided for the main roadways from each facility to the street gates; the gate house, if any; the refuse vehicle weighing areas (scale house); employees' parking lot; electrical substation; and pedestrian walkways. Primary lighting shall generally be of higher intensity than secondary lighting and shall utilize fixtures and post equipment of superior aesthetic and structural quality. Exterior light poles and fixtures shall be metal and shall be contemporary in design.

Secondary lighting shall cover areas where activity is more intermittent and, therefore, requires less intense lighting. These activities include storage areas, process water wells, outdoor tanks, service truck parking, residue and ash storage, etc. Special process equipment lighting shall also be provided to assure safe access and work illumination. Stacks shall be obstruction lighted in accordance with Federal Aviation Authority (FAA) regulations. All outdoor signs shall be illuminated.

Signage: Well-designed graphics should be used for directional and identification signing. These signs shall be properly located to achieve their purpose without constituting a hazard to vehicles or pedestrians.

Clear, concise graphic design of all directional and identification signs shall be incorporated into the design of each facility, in accordance with County standards and applicable codes of the County.

Erosion Control/Seeding and Planting: The Contractor shall establish an erosion control plan consistent with the State of Florida and Broward County erosion and sediment control requirements.

The Contractor shall establish grass and plant trees and shrubs in accordance with the Landscaping Plan as approved by the County.

Landscaping: Landscaping of each facility site will be used to control or screen views from adjacent roads.

Trees, shrubs, ground cover, planting, sculpture and use of building and paving materials, shall be integrated into the building arrangement, topography, parking and screening requirements.

Fencing, evergreens, shrubs, or bushes (or combinations), shall be located on the site perimeter to minimize the effect of vehicle headlights, noise, outdoor lighting glare and reflection, movements of people and vehicles, and to shield the site activities from adjacent properties where necessary.

Adequate landscaping shall be required to provide maximum screening for the sites. The landscaping plans shall address the following items:

- o Earth sculpturing to provide topographic relief and to aid in screening such areas as parking lots and blank walls.
- o Appropriate street tree plantings along access roads to the site.
- o Extensive use of plants indigenous to Florida to provide visual screening and local color.
- o Plantings to enhance the main entrance to each facility.

- o Appropriate plantings around employee outdoor sitting areas.
- o Preparation of soil stabilization plans for use during construction which utilizes plants and grass as stabilizers.

The selection of plant species should be based upon those plants which are tolerant of local conditions. Indigenous vegetation should be included in appropriate areas of the site. Planter boxes should be kept to a minimum. Lawn areas should be kept to a minimum with hardy ground covers utilized wherever possible. Top soil shall be provided in all planting areas and all plant pits.

A detailed landscaping plan for each facility site is a proposal requirement. Special attention in the plan should be given to the entrance and the visitors' area, as well as the view of each facility from the public streets serving it and/or from adjacent highways.

1.4.2 Detailed Architectural Requirements

Masonry: In addition to complying with all pertinent codes and regulations, the Contractor shall comply with the standards of masonry installation described in "Concrete Block Masonry Inspectors Manual" published by the Technical Committee of the California Concrete Masonry Manufacturers Association.

Concrete Curbing: All curbs shall be constructed of concrete with suitable expansion joints. The Contractor's quality of work shall conform to the requirements of the Florida State Department of Transportation, American Concrete Institute and the American Society for Testing Materials (ASTM).

Carpentry and Mill Work: Lumber, herein referred to, shall conform with the American Lumber Standard, Simplified Practice Recommendations, latest edition. Lumber shall conform to and bear the grade and trade mark for the Association under whose rules it is produced.

Wall Panels: Wall construction shall be fabricated and installed to withstand 100 MPH wind.

Wall panels shall satisfy the following requirements:

ASTM B-117 - Salt Fog Test
ASTM D-968 - Abrasion Resistance Test
Kesternich Pollution Resistance Test
ASTM D-2247 - Humidity Resistance Test
Color Variance - Not more than 0.5 NBS units

Ceramic Tile: All ceramic tile shall be quality certified by the Tile Council of America Inc. Floor tile shall have abrasive surface. Wall tile shall be glazed surface.

All tile work shall be set in accordance with the "Tile Handbook" superseding the Basic Specifications for Tile Work K-300.

Acoustical Tile Ceilings: Acoustical tile panels shall meet ASTM C523 for light reflectance and Underwriters Laboratories Noncombustible Class 25.

Insulation and Lagging (for Exterior Mechanical Equipment): The Contractor shall furnish and install insulation and lagging for the following equipment: furnaces, boilers, precipitators and inlet ducts and nozzles, precipitators and outlet nozzles, breechings and ducts, I.D. fans and I.D. fan outlet ducts to stack, precipitator hoppers and conveyors.

The exterior lagging shall consist of flat overlapping square panels with cross-brake pattern.

The lagging shall be fastened with non-corrosive studs or clips. Closure strips, flashing and counterflashing of the same thickness as the panels shall be provided as required.

All laps of lagging, flashing and openings which cannot be made waterproof with closure strips shall be filled with high temperatures caulking compound (I-C 405) or equal, so as to render the entire lagging system weathertight.

Any additional stiffeners, corner angles, clips and other fastening and supporting devices shall be supplied as an integral part of the lagging system.

Dissimilar metals shall be insulated from one another by means of dissimilar metals separators or suitable primer and aluminum paint methods in accordance with siding manufacturer's recommendations, subject to approval of the County.

Each precipitator roof shall be adequately insulated. The roof shall be sloped to prevent rain water accumulation and shall be completely weatherproof. The insulation shall be protected by sheet metal panels, supported on purlins and designed for at least a 50 pounds per square foot live load.

<u>Painting</u>: Painting shall include but not be limited to the following items:

- Structural steel shapes and members
- Ferrous metal furnace castings and supports
- Electrical motors
- Cranes
- Charging hoppers, chute extension, refuse chutes and gates
- Combustion air fans and ductwork
- Stokers and siftings chutes
- Furnace access doors and ports; boiler doors and appurtenances
- Conveyors, flap gates, discharge chutes, drives
- Boiler structures and supports
- Precipitator, breechings, ductwork and I.D. fan structures
- Stack and appurtenances

- Scale and enclosures
- Transport equipment
- All pipework, fittings, valves and supports
- Tanks, strainers, deaerator, steam piping, valves and pumps
- Conduit, panel boxes, pull boxes, meter boards and distribution boxes
- Partitions, doors, frames, stairs, railings, ladders, grilles, registers, air diffusers, and underside of exposed metal decking
- Wood staining of wood doors, trim, paneling, millwork and wood shelving
- Stripping of on-site road and parking lots

Galvanizing: Galvanizing shall be done by the hot dip process in accordance with the specifications of the AHDGA.

Fencing and Gates: It is the Contractor's responsibility to provide fencing along the entire perimeter of the project sites and to provide site security. Security fencing and gate controls shall be made attractive.

1.5 Structural

1.5.1 Structures Supporting Vehicular Traffic

The design, loadings, materials, allowable stresses, fabrication and construction of structures subject to vehicular traffic such as roads, ramps, underpasses, tunnels, culverts, elevated roadways and framed slabs shall conform to the current standard specifications of the American Association of State Highway and Transportation Officials (AASHTO), including all interim specifications of AASHTO, and all applicable design requirements of the County and the State.

1.5.2 Structural Steel

General Requirements: The current rules and practices set forth in the "Code of Standard Practice for Steel Buildings and Bridges" and the "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings" of the American Institute of Steel Construction (AISC) shall apply to the work performed.

Quality Criteria and Inspection Standards shall conform to the AISC publication "Quality Criteria and Inspection Standards" latest edition.

Materials: Structural steel shall conform to ASTM A 36. High strength bolts, with suitable nuts and washers, shall conform to ASTM A 325. Welding electrodes shall conform to AWS Code D1.1. Stud shear connectors shall conform to AWS Code D.1. The following list indicates the minimum requirements for specific steel items:

Mild Steel Plates: Special Shapes for structural quality - ASTM-A27.

Steel Sheets: Structural quality - ASTM A 245.

Steel Plate: ASTM A 120, fittings for steel pipe shall be standard malleable iron.

Bar Steel: Hot rolled including rounds and squares of all sizes, and flat 6 inches or less in width.

Fabrication: Fabrication shall be in accordance with the applicable provisions of the AISC Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings.

Connections: Standard type connections shall comply with the appropriate tables entitled "Framed Beam Connections" of the AISC "Manual of Steel Construction" and shall be used wherever possible to employ such connections.

Bolting: Assembly of structural joints using high strength steel bolts shall be in accordance with the RCRBSJ Specification for "structural joints using ASTM A325 or A490 bolts."

Welding: Welding of structural steel work and study shear connectors shall be in accordance with AWS Code D1.1.

Shop and field welding shall be performed only by certified welders qualified in accordance with AWS Code D1.1.

Field Erection: All members shall be aligned, leveled, and adjusted accurately prior to final fastening. Tolerances shall conform to the AISC "Code of Standard Practice".

1.5.3 Metal Roof Deck

Materials: Design and fabrication of metal roof deck shall be in accordance with the latest specifications of the Steel Deck Institute. Steel used in the fabrication of deck units shall conform to the requirements of the AISI "Light Gage Cold-Formed Steel Design Manual".

Field Erection: The complete metal deck, including all shaping, cutting, fitting, drilling, welding, accessories, closures, sump pans, fastenings and all other miscellaneous pieces necessary, shall be properly installed with weathertight construction. Metal deck shall be erected in accordance with the deck manufacturer's instructions.

Welding and Fastening: Welding shall be in accordance with the requirements of the AISI "Specifications for the Design of Cold-Formed Steel Structural Members" and the AWS "Structural Welding Code".

1.5.4 Miscellaneous Metals

Miscellaneous metals shall include such items as:

- o Gratings (aluminum, fiberglass and galvanized steel)
- o Metal Floor Plates
- o Railings
- o Loose Lintels and Miscellaneous Framing
- o Ladders

Galvanizing of miscellaneous metal after fabrication shall be in conformance with ASTM A-123 and A-153. Cadmium plating of miscellaneous metals shall be in accordance with ASTM A-165, Type TS.

Specific requirements for miscellaneous metals include the following:

Grating: Grating shall conform to the following standards:

- o ASTM A-123, zinc (hot-galvanized) coatings on products fabricated from roiled, pressed, and forged steel shapes, plates, bars and strip.
- o ASTM A-385, high quality zinc coatings (hot-dip) on assembled products.
- o ASTM A-569, steel, carbon (0.15 maximum, percent), hot-rolled sheet and strip, commercial quality.
- o NAAMM, Metal Bar Grating Manual and Metal Finishes Manual.
- o Standards of the Reinforced Plastic/Composites Institute.
- o National Bureau of Standards, PS15-69.
- o ASTM B-210, Aluminum-Alloy Drawn Seamless Tubes.
- o ASTM B-221, Aluminum-Alloy Extruded Bars, Rods, Wie, Shapes and Tubes.

Ladders: Vertical ladders and cages shall conform to applicable OSHA regulations.

Railings: All railings (posts, rails and toe plates) shall conform to applicable OSHA regulations.

Metal Floor Plate: All metal floor plate shall conform to the applicable provisions and accommodations of the following:

- o ASTM A-36, Structural Steel.
- o ASTM B-209, Aluminum-Alloy Sheet and Plate.
- o ASTM A-123, zinc (hot-galvanized) coatings on products fabricated from rolled, pressed and forged steel shapes, plates, bars and strip.

1.5.5 Concrete

General Requirements: The requirements of Part III of the American Concrete Institute, "Building Code Requirements for Reinforced Concrete", (ACI 318-77) shall govern the concrete work.

Materials: Portland cement shall conform to ASTM "Standard Specifications for Portland Cement", C 150, Type II.

High-Early-Strength Portland Cement shall conform to ASTM "Standard Specifications for Portland Cement", C150, Type III.

Aggregates for concrete shall conform to ASTM "Standard Specifications for Concrete Aggregates" C33.

Air-entraining admixture shall conform to ASTM C 260, and shall be used in all concrete exposed to the weather. Air entraining admixture shall be added in such quantities as necessary to produce an air content of 4 to 6 percent by volume, as determined by ASTM C 231.

Water-reducing and retarding admixture shall conform to ASTM C 494, Type D and shall be used in all concrete. The admixture shall be added to the proportions recommended by the approved manufacturer.

Water shall be clean and free from injurious amount of oil, acid, alkalies, organic materials, or other deleterious substances.

Metal reinforcement shall be deformed bars and wire mesh conforming to the following requirements:

Deformed bars - ASTM A615, Grade 60.

Wire Mesh - ASTM A 185

Testing and Inspection: Testing and inspection of concrete and materials shall be performed by an independent testing laboratory.

The Contractor shall make test cylinders of the concrete placed at the job in accordance with applicable ASTM standards. Concrete cylinder testing shall conform to the standard Method of Making Compression Test of Concrete, Serial Designation C39.

Test cylinders shall be properly cured and aged before testing. Copies of all test reports shall be retained by the Contractor for record. Cost of all tests shall be borne by the Contractor.

Proportioning and Mixing Cast-in-Place Concrete: All structural concrete shall have a minimum compressive strength of 4000 psi in 28 days. One brand of cement only shall be used to prevent different shading of finished concrete or mortars.

Ready mixed concrete shall be mixed and delivered in accordance with the Standard Specifications of the ASTM C-94 latest edition.

Temperature: Hot weather - All methods and materials used for hot weather concreting shall be in accordance with the requirements of "Recommended Practice for Hot Weather Concreting" (ACI 605).

Lightweight Insulating Roof Fill: All work shall conform with the requirements of the prevailing Building Code in addition to the requirements or qualifications of these specifications.

Lightweight insulating roof fill shall meet all requirements as detailed in:

ASTM C-332-66(71) Group I
ASTM D-312-71
Factory Mutual 69-209.20

1.5.6 Light Poles, Mast Lighting, Sign and Signal Supports

The design, loadings, materials, fabrication and construction of light poles shall conform to standard specifications for structural supports for highway signs, luminaries and traffic signals of the American Association of State Highway and Transportation Officials, and all the design requirements of the County and the State.

1.5.7 Stacks

Stacks shall be designed and erected in accordance with all applicable codes and regulations. The maximum stack height, at each site shall be 200 feet above final grade elevation. The stacks can be of a radial brick, concrete, or steel type with acid resistant high temperature liners. In all cases the stacks shall be of a design providing sufficient draft to exceed by at least twenty percent all losses due to I.D. fan outlet breeching gas velocities, in stack gas velocities and friction and stack outlet velocities. In no case shall the stack designs result in positive pressures at the base of the stacks under normal operating conditions.

The design loading for stacks or chimneys shall conform to the minimum building code requirements of American National Standards Institute (ANSI A58.1). The wind pressure shall be based on a fastest mile speed of 100 miles per hour at 30 feet above ground and Exposure C with consideration given to gusts and vibration response.

The design, materials, fabrications, and construction of concrete chimneys shall conform to the standard specification for design and construction of reinforced concrete chimneys (ACI 505).

The design, materials, fabrication, and construction of steel chimneys shall conform to the specifications of American Institute of Steel Construction and American Iron and Steel Institute with design considerations given to cable deflections.

Masonry chimneys shall be constructed with radial bricks with type "M" mortar conforming to ASTM C-270.

1.6 General Mechanical

1.6.1 Plumbing/Piping

City Water Piping: The Contractor shall furnish and install City water supply piping as required.

Hydrostatic testing for water piping shall conform to AWWA Specification C-600-64 Section 13.0.

All ductile iron pipe and fittings shall be cement lined. Linings shall conform to ANSI Spec. A 21.4. All piping and fittings shall be shop coated with standard bituminous coating on the exterior.

Reinforced Concrete Piping: Reinforced concrete pipe shall be Class IV Reinforced Concrete ASTM C-76 (Steel Area 0.07).

The installation of all pipe shall conform to the applicable requirements of AWWA Standard C600. All accessories for making mechanical joints shall meet the requirements of ANSI Specification A 21.11.

Polyvinyl Chloride Piping (PVC): All piping and fittings shall be Type 1, Grade 1, virgin unplasticized PVC Schedule 80 conforming to ASTM Des. D 1784, D 1785, D 2241, D 2264 and D 2467.

All assembly shall be done strictly in accordance with the manufacturer's specifications.

Miscellaneous Piping Requirements: Bronze gate and globe valves shall conform to ASTM B 62.

All backflow preventers shall conform to local code requirements. Air release valves shall be installed where required. All required accessories, such as gate valves, globe valves and check valves shall be installed as recommended by the air release valve manufacturer.

Wherever dissimilar metals come in contact, dielectric couplings shall be installed in the lines to separate the metals and prevent galvanic action.

The Contractor shall conduct testing of all pipelines leakage. All pipelines shall be tested to not less than one hundred fifty percent of the working pressure. All visible leaks and defects shall be promptly repaired and the line re-tested.

Drain lines on the process piping system shall be tested as per plumbing standards.

Painting: All pipelines shall be painted in conformance with latest ANSI Standards.

Temporary Water: The installation and cost of temporary water shall be provided and borne by the Contractor.

Water Meters: Water meter(s) shall be furnished and installed by Contractor. Water meter(s) shall conform to local code requirements.

1.6.2 Heating, Ventilation and Air Conditioning

Rules and Regulations: The Contractor shall conform to the rules and regulations of the BOCA Basic Building Code having jurisdiction in this State, and to all County and Local laws, ordinances and regulations affecting the erection and completion of the Heating, Ventilation and Air-Conditioning work.

Piping Installation: Piping shall be erected with proper provision for expansion and contraction, as required.

Dampers: In addition to volume control dampers, fire dampers shall be installed as required by insurance underwriters, and local codes.

Thermal Insulation for Ducts and Piping: All components of the insulation for both piping and ductwork, including facings, mastics and adhesives shall have a fire hazard rating not to exceed 25 for flame spread and 50 for fuel contributed and smoke developed. Ratings shall be as determined by Underwriters Laboratories, Incorporated, or other approved testing laboratory.

Belt Guards: Belt guards shall be installed on all equipment equipped with belt drives.

Vibration Isolation: Vibrating equipment such as pumps, fans, etc., shall be isolated from the building structure in a manner such that sound and vibration will not be transmitted through the building.

1.7 Electrical

1.7.1 Scope of Work

The scope of this section is to cover the work consisting of designing, furnishing, and installing all necessary equipment for the following:

- The interconnection system between each facility and FP&L, which shall include the outdoor switching substation consisting of circuit breakers, metering and power transformers and equipment, and all associated protection and synchronizing equipment, as well as the transmission feeders and terminating potheads between switching station and the FP&L transmission line.

- The step-up/step-down power transformers, interfacing circuit breakers and protective equipment at the switching station to meet facility and FP&L requirements. If load tap changers are required, they shall be provided in separate enclosures. Interconnect transformers shall each be sized for the full output of the plant.

- Three-phase current limiting reactors, one for each generator. The reactor shall limit the three-phase short circuit power on FP&L to FP&L requirements. The exact rating of the reactor shall be calculated by the Contractor and coordinated with the characteristics of the other equipment (i.e., transient reactance of the generators, independence of power transformers, FP&L available short circuit, etc.).

- 4.16 KV system for auxiliary services consisting of 4.16 KV switchgear, 4.16 KV motors and associated starters, and all other necessary equipment and materials required for the proper operation of the 4.16 KV system.

- 480 volt system consisting of the 480 volt switchgear, the 4.16/0.48 KV power transformers, all necessary motor control centers, energy saver type electrical motors, all necessary relaying protection with an emphasis on a properly coordinated ground fault protection system and all necessary equipment and materials required for the proper operation of the 480 volt system.

- Complete indoor relay and control switchboards for all the facility's electric systems.

- o Indoor and outdoor lighting systems comprising all necessary equipment and materials required for the proper illumination of the plant and site, at the required illumination levels for each specific task.

- o 125 volt DC system consisting of 125 volt DC battery, the required charger and the appropriate DC distribution switchboard.

- o Cable and wiring system with all necessary raceways for all power distribution systems, including reinforced, concrete encased, underground duct banks, and exposed AC and DC conduit system with rigid galvanized steel conduits and approved fittings. This shall include excavating, dewatering and backfilling. All cable and terminations shall be in accordance with the manufacturer's specifications.

- o Control, security and communication systems, Telephone, Fire Alarm, Smoke Detection, Sprinkler, Halon, Lighting, Local Automatic Shutdown, Local Manual Control, Central Automatic Control, Security, and HVAC for all plant and auxiliary operations, all as described elsewhere in these specifications.

1.7.2 General Electrical Requirements

The following items of equipment covered by this specification may be installed either indoors or outdoors in the open atmosphere:

- Turbogenerators and associated power generation equipment.
- 4.16 KV A.C. switchgear and accessories.
- 480 volt A.C. switchgear and accessories.
- 124 volt D.C. battery system.
- Interconnection bus structure, insulators, bus switches, etc.
- Interconnection oil circuit breakers.
- Interconnection power transformers.

The Contractor shall furnish, install and connect any additional components, parts, items and devices not specifically mentioned herein, but necessary for the proper operation of the equipment.

The systems shall be provided in accordance with all local and federal code requirements and shall provide the functional features described. Each system shall be furnished and installed complete with all appurtenances necessary to be fully operational.

1.7.3 Standards

All equipment to be furnished by the Contractor shall be in accordance with the latest applicable standards of NEMA, IEEE, ANSI, AAR, IPCEA, latest OSHA, UL, National Electrical Code, National Electric Safety Code, Florida Electrical Code, and all applicable local codes and/or ordinances with regard to Material, Design, Construction, Testing and Installation except for variations as specified herein.

1.7.4 Temporary and Interim Electric Work

The Contractor shall provide temporary, electrical services required for construction of the Project, including all fees to FP&L for their work associated with such electrical services and connections. FP&L energy use charges shall be paid for by the Contractor.

The installation shall conform to the requirements of FP&L and shall include poles, post, fences, grounding, terminations, meter cabinets, meter and secondary feeder and branch wiring and conduits, circuit breakers, panelboards, lights, wiring devices, wiring, motor connections and supports.

1.7.5 Cutting and Patching

The Contractor shall furnish chases and openings in the floors, walls, and partitions before they are built. The Contractor shall install sleeves or boxes in the forms of floor slabs and/or walls before they are poured.

1.7.6 Fire Alarm System

The Contractor shall equip each facility with a fire alarm system, including all necessary manual stations, bells, control panel and annunciator, wiring and conduit.

1.7.7 Fail-Safe Systems

The Contractor shall install Fail-Safe Systems for all key equipment, including, but not limited to the furnaces, the boilers, turbine-generator set, the electric substation and the electrostatic precipitators. The Fail-Safe Systems of each key equipment item shall be so designed that if any one piece of equipment fails, other equipment will not be damaged by this failure.

1.8 Facility Access and MSW Delivery Requirements

1.8.1 Functional Design

Each facility site design shall provide adequate ingress and egress roads and maintain continuous control of all traffic movements during facility operating hours. Each facility design shall also include adequate on-site roadways, parking, and maneuvering areas to accommodate, efficiently and safely, anticipated traffic levels during normal and emergency periods, in order to minimize the impact of traffic on noise and air quality levels and to prevent the queuing of disposal vehicles on public roads adjacent to the facilities.

1.8.2 Traffic Flow

The MSW will be delivered to each facility by collection trucks that are either municipally or privately operated.

On-site traffic shall be directed generally using one-way roads either to the weighing stations (MSW trucks), the ash handling areas (residue truck), and/or to the administration areas and process buildings (staffs, visitors and all other vehicles). This one-way flow of traffic shall help ensure congestion-free operations and smooth-functioning facilities.

MSW trucks shall proceed from the entries to the weighing stations, establish the weight of the refuse, proceed to the tipping areas for unloading, stop at the weighing stations again, if necessary, and then exit the facilities.

Trucks hauling Unprocessable Waste shall proceed from the entries of the resource recovery facilities to the weighing stations, establish the weight of the Unprocessable Waste, proceed to the Residue/Unprocessable Waste landfill dumping areas for unloading, stop at the weighing stations again if necessary, and then exit the facilities.

Two-way roads may be planned for on-site roads at the resource recovery facilities to the Residue/Unprocessable Waste landfills.

Maintenance and delivery vehicles shall be directed to the plant office or to service areas within each facility.

Paving and drainage of parking areas shall be in accordance with accepted standards. Staff and visitor vehicles shall be directed to parking adjacent to the administration area immediately upon entering each facility to prevent any traffic conflict with truck flows.

Roadways for trucks shall serve the scale house areas, the tipping floors and other functional areas of the facilities. Roads within each facility shall be designed to allow proper traffic flow to prevent the queuing of waste-handling vehicles, both during normal operation and in the event of mechanical failure of vehicles or at the scale house. Access to the sites from adjacent roads shall be designed to minimize interference with exiting traffic flow and permit vehicles rapid and safe ingress and egress to and from the sites. Sufficient on-site roadways shall be provided to ensure that traffic backups will not extend out to the local streets or highways.

The traffic design for each facility shall be based on the following criteria:

- A daily quantity of delivered MSW determined by the following formula:

$$DW = \frac{AFT \times AF_1 \times AF_2 \times AF_3}{365}$$

Where:

DW = Quantity of delivered MSW (processable and unprocessable waste) per day in tons

AFT = Annual guaranteed facility throughput in tons of Processable Waste

AF_1 = MSW Delivery Adjustment Factor = 1.17

$$\left(\frac{\text{7 days per week operation}}{\text{6 days per week delivery}} = 1.17 \right)$$

AF_2 = Broward County seasonal MSW generation rate Adjustment Factor = 1.11

AF_3 = Broward County Peak Daily MSW Delivery Adjustment Factor = 1.43

- The estimated number of trucks delivering garbage shall be based upon 55 percent of DW as determined above and an average net load of 9.0 tons per truck.

- The estimated number of trucks delivering processable trash shall be based upon 23 percent of DW as determined above and an average net load of 5.0 tons per truck.

- An estimated quantity of residue based upon such residue containing not more than 4 percent combustibles and 0.2 percent putrescibles of the incoming MSW.

- The estimated number of trucks delivering unprocessable trash shall be based upon 22 percent of DW as determined above and an average net load of 5.0 ton per truck.

- An estimated volume of 75 employee and visitor cars per day. Visitors arriving by bus shall also be accommodated.

- Maintenance and delivery vehicles as required.

Proper access shall also be provided for fire fighting apparatus. There shall be a bypass road around each scale house area for fire fighting, passenger and other designated vehicles.

All access roads used by refuse vehicles shall be constructed and paved in accordance with standards for heavy truck usage.

The Contractor shall maintain weighing, receiving, and queuing areas which are capable of:

- o Accepting the refuse in the quantity proposed and assumed transport mix.
- o Completing the functions of the MSW delivery (entering the plant, weighing, unloading, and exiting the plant) within ten (10) minutes of each truck arrival at the site; even during peak arrival periods.
- o Receiving, holding, or processing normal MSW quantities during scheduled downtime.

Adequate parking and maneuvering areas shall be provided for both facility staff and visitors. Provisions for the handicapped shall also be made for parking and sidewalk access.

The design and operation of all vehicular activities and traffic flow patterns associated with the construction and operation of each facility will be subject to the regulations of state and local Traffic and Highway Departments.

1.8.3 Traffic Control

The traffic flow within each facility site shall be controlled by stop signs except at the plant entrances, the weighing stations, and the tipping floor area where traffic lights shall be installed. All routine traffic shall be directed utilizing one-way roads. There shall be a minimum of mixing of truck traffic with staff and visitor traffic. There shall be exclusive truck routes to handle the estimated number of trucks per day including all refuse trucks, residue trucks, unprocessable waste trucks, maintenance and delivery vehicles.

The traffic pattern at each facility shall be designed to provide for efficient operation and use of space. The weighing systems and storage facilities may be of whatever design is most applicable to the process needs, while meeting the efficiency and safety specification.

Identification signs at the entrance and appropriate directional signs which are approved by the County shall be provided. Fences, gates, metal doors with locks, card controlled gates, or other adequate security measures must be provided to control access to each facility.

1.8.4 Weighing Station

General Information: The intake of waste to each facility shall be regulated and controlled by its weighing station's operation. MSW will be transported to the facilities either in municipal collection vehicles or private carter trucks. The facilities will not accept hazardous waste, and private automobiles will not be permitted to dump MSW at the facilities. After weighing, Unprocessable Waste shall be directed to the Residue/Unprocessable Waste landfill. In the event Unprocessable Waste is inadvertently unloaded at the resource recovery facility, the Contractor shall be responsible for cost of transporting such waste to the Residue/Unprocessable Waste landfill.

Deliveries shall be made in accordance with the County's normal collection and delivery practices as now or hereinafter may exist. Safe and adequately-sized areas must be provided for queuing incoming trucks and to prevent traffic back-up from interfering with local street and local highway traffic flows.

Each facility shall have the capacity to unload the Processable Waste from the vehicles, in a totally enclosed tipping area, with a total on-site unloading time of ten (10) minutes for mechanically unloaded vehicles. The unloading time is defined as the time a vehicle first enters the site to the time the vehicle leaves the site.

The Contractor shall maintain an identification system, including scales for weighing and recording deliveries. The scales shall be of a type approved by the State Sealer of Weights and Measures and shall be equipped with automatic printers which shall record the time, date, and scale weight in accordance with the Contractor's identification and accounting procedures.

The number of scales at each weighing station shall be determined using the information for truck flow; queuing space determined by the Proposer, the ten minute time per vehicle as defined above; and the inclusion of one standby scale.

Each weighing station shall be fully automatic with manual override systems. Each weighing station operator shall serve as the equipment operator as well as the traffic flow controller to the tipping area, and also maintain a level of security.

Each weighing station shall consist of as a minimum, but not be limited to, truck scales, scale pit or foundation with understructure and weighbridge, scale house, truck identification system, scale house equipment, approaches, entrance and exit gates and traffic control signal system.

Approach Road: The approach road to the weight station shall be wide enough to "fan" out the incoming flow of traffic as well as serving as a by-pass should any vehicle breakdown.

A deceleration lane shall be provided to ensure that traffic will not back up onto public streets.

The by-pass road for vehicles not having to be weighed (employee, visitor, delivery and maintenance vehicles) shall be controlled by a gate, which shall be manually operated by the weigh scale operator.

Scale Design: The truck scales shall have, as a minimum, a capacity of 40 tons and shall automatically print out vehicular weights on scale tickets. Each scale shall be equipped with an indicating and recording system.

Upon entering each facility, each delivery vehicle shall be weighed. If tare weights have not been established for particular vehicles, these vehicles shall be unloaded and weighed upon leaving the site. Therefore, provisions for scales to be used upon exit shall also be provided.

Scale Houses: The scale houses shall include all equipment which is auxiliary to the scales, such as the digital indicators, card printers with printout of gross, tare and net weights, and an accumulator for daily totals of net weights. These facilities shall include restrooms for truck drivers and employees, as well as visitors' observation spaces.

1.8.5 Tipping Area

General: The Processable Waste tipping process shall take place in totally enclosed tipping areas, which shall have a minimum length equal to the Processable Waste receiving and storage pit, and which shall be kept under negative pressure.

Ventilation systems shall provide for the control of dust, and shall meet all applicable Occupational Safety and Health Administration (OSHA) requirements for ventilation. In addition, sound proofing shall be provided within the tipping floor areas to limit the maximum noise level to 80 decibels (dba).

Truck Tipping Bays: At each facility there shall be an adequate number of tipping bays (to be determined by the Proposer) to handle the peak flow of waste trucks at all times. The number of bays should be based on the maximum vehicle size; peak truck flow; the coordination of queuing space at the weigh station, and the ten minute on-site time from entering the facility at the gate to exiting at a gate.

Safety and Hazard Controls: Safety measures shall be provided to minimize noise, dust, odors and general hazards, such as fire, in the tipping areas. Efforts shall be made in the design of each facility to maximize safety. All applicable requirements of OSHA shall be met with regard to the tipping area.

1.9 Processable Waste Storage and Handling System

1.9.1 General Description

At each facility, Processable Waste shall be stored in a pit large enough to hold, as a minimum, the quantity of Processable Waste equal to four times the daily Nameplate Capacity of the facility, without spilling onto the tipping floor. "Dedicated floor area" in lieu of a storage pit will not be acceptable.

At each facility, Processable Waste shall be moved from the storage pit and fed or charged into the furnaces by means of an overhead crane and grapple system. The cranes and grapples will also be used to mix Processable Waste in the pit to produce a homogeneous mass and shall be capable of removing large, bulky combustible trash items from the storage pit and feeding same to the crusher/shears. The crusher/shears, located at one end of the storage pit, shall be used for size reduction of the oversized processable trash prior to charging into the furnaces. Provisions shall also be made for removal of salvageable oversized non-combustible trash from the storage pit, utilizing the overhead crane and grapple system.

1.9.2 Processable Waste Storage

Construction: The pits shall be constructed of reinforced concrete and take into account soil, groundwater and flood-prone conditions of the sites. The crane parking areas shall be of prestressed concrete with steel reinforced outer perimeters.

The foundations of the pits shall be isolated and the independent of the foundation of the process buildings.

Dust and Odor Control: The pit areas shall be totally enclosed to limit the spread of any odor and dust. The areas shall be kept under negative pressure by drawing combustion air from the pit areas using the combustion air fans.

Ventilation Systems: The ventilation of the tipping areas as well as the pit areas shall be accomplished by the combustion air fans used for all the furnaces. Make-up air louvers, with broad screens shall be provided as required.

Fire Protection: There shall be at least two types of firefighting equipment for control of both chemical and non-chemical fires (water cannon and standpipe system). There shall also be fire alarms provided which shall be tied directly to the local fire departments in the event of any pit fires.

1.9.3 Crushers/Shears

At each facility a crusher/shear is to be provided for size reduction of oversized combustible bulky waste down to a size which shall minimize bridging or clogging in the furnace charging hoppers and assure complete incineration as fired with processable waste. Shredders shall not be used.

1.9.4 Crane and Grapple Systems

Scope: At each facility there shall be two 100 percent or three 50 percent capacity (one spare) heavy duty electric overhead traveling cranes suitable for continuous service handling Processable Waste.

The cranes shall be remote controlled from a stationary pulpit. "Cab-on-Crane" arrangements will not be permitted. Radio controlled cranes will be permitted.

Codes and Specifications: Unless otherwise specified, the cranes at each facility shall be designed and manufactured in accordance with applicable codes, manuals, specifications and requirements for Severe Duty Cycles and Steel Mill Type of Service:

(a) American Gear Manufacturers Association (AGMA)

(b) American Institute of Steel Construction (AISC)

(c) American National Standards Institute (ANSI)

(d) American Welding Society (AWS)

(e) Anti-Friction Bearing Manufacturers Association (AFBMA)

(f) Crane Manufacturers Association of America (CMAA) - Specification No. 70 (Electric overhead traveling cranes, Class "F", Severe Duty Cycles.)

(g) Insulated Power Cable Engineers Association (IPCEA)

(h) National Electrical Manufacturers Association (NEMA)

(i) National Fire Protection Association (NFPA)

(j) Occupational Safety and Health Administration (OSHA)

(k) Steel Structures Painting Countil (SSPC)

(l) American Society for Testing and Materials (ASTM)

(m) Association of Iron and Steel Engineers (AISE) - Standard No. 6 (May 1969) Specification for electric overhead traveling cranes for Steel Mill Service

In case of conflict between various applicable codes, standards and regulations outlined in this paragraph, the "Specification for Electric Overhead Traveling Cranes for Steel Mill Service" AISE Standard 6 of May, 1969 shall govern.

Rated Capacity: Each crane capacity shall be based on the weight of the grapple including lifting cables, plus material with a density of 540 pounds per cubic yard, with a heap factor. The feeding cycle calculation shall be based on an average material density of 400 pounds per cubic yard with a heap factor of 1.33.

Design Stresses: The cranes shall be mechanically and structurally designed and fabricated in accordance with AISE specifications for steel mill service. Unless otherwise specified, the design stress conditions shall be those required under codes and specifications above.

Duty Cycle: Duty cycle computations shall be based on:

Furnace Feeding	43%
Restocking	17.0%
Fatigue	10%
Total Active Time	70.0%

The cranes shall be capable of performing continuously, the feeding and rehandling cycles with full load, with motor temperature rises not exceeding the specified rating of the motors. The following crane/grapple motions may take place simultaneously:

- Hoisting and bridge travel with grapple at any level.
- Lowering and bridge travel with grapple at any level.
- Trolley and bridge travel with grapple in high position.

In addition to the simultaneous motions outlined above, the normal crane operations shall permit the following functions:

- Grapple open and close at any level.
- Trolley and/or bridge travel with grapple at any level.

Environment: The cranes shall be designed for an indoor dusty environment.

Crane Parking: The crane runways shall be designed to allow for parking of one crane at each end of the pit when out of service for repairs or for inspections. The roof above the crane runway shall include a penthouse with service platforms for each additional crane over and above the two cranes that can be parked at each end of the runway. The penthouse(s) shall include electric hoists to lift an inactive crane from the runway for parking or maintenance.

Operator's Pulpit: There shall be a minimum of one remote, stationary operating station (operator's pulpit) located above the pit on either the tipping floor or hopper side, which allows full view of the storage pit and of the furnace charging hoppers. The operating station shall contain one operator's control chair for each crane installed.

All station access corridor enclosures, separating station corridors from the refuse storage pit, shall be dust tight. The stations shall be equipped with an independent heating, ventilating and air conditioning system in accordance with the applicable building code requirements.

The pulpit shall be equipped with fire alarm systems, indicating panels and fire fighting control capabilities. There shall be a direct phone line to the local fire department from the operator's pulpit.

The normal crane operation shall provide for automatic loction of the trolley and bridge over the selected charging hopper after the grapple has picked its load and ahieved its lift to the top elevation.

Each crane shall be operable from either control pulpit on demand except when in use by one of the operators. A traverse switch shall be provided which will enable any one crane to be operated from any operator's station. Interlocks shall be provided to prevent interference and attempts for simultaneous operation.

Grapples: Orange peel or clam shell tine type electrohydraulic grapples shall be provided for each crane with one spare at each facility, in addition to the one on the spare crane.

Electrical Motors: All motors shall be capable of starting and operating under any conditions within the design capacity of the crane and with any voltage within plus or minus ten percent of the rated voltage.

All motors shall be totally enclosed, air over housing fan cooled.

1.9.5 Charging Hoppers and Chutes

Charging Hoppers: Charging hoppers shall be designed to withstand the weight of the refuse as well as the vertical and horizontal impact of the fully loaded crane grapple.

Charging hoppers shall be independently supported by the charging floor structure and shall be arranged so as to mnimize spillage onto the charging floor. Spill plates shall be incorporated between the charging hopper and refuse pit wall.

Charging hopper discharge throat (exit) shall be smaller than furnace feed chute entrance to furnace/boiler to prevent clogging (bridging) a furnace/boiler entrance, and shall be adequately sized to accommodate individual furnace/boiler rated throughput capacity.

Chutes and Cut-Off Gates: Chutes connecting charging hoppers and furnace/boiler feed throat shall be either water cooled or refractory lined.

Chutes shall be of the inverse taper type to preclude clogging (bridging) in chute.

Between each charging hopper discharge and chute entrance there shall be a cut-off gate to prevent burnback during furnace/boiler shutdown.

1.10 Combustion Systems

1.10.1 General Design

The combustion systems and all related equipment for each facility shall be supplied by the Contractor. The minimum combined total nameplate rated capacity of the two facilities shall be 2,600 tons of Processable Waste per day. The combustion units proposed shall be of proven design with a minimal successful operating experience of one year. Scaling up of components shall not exceed 25 percent. In view of the documented history on high temperature corrosion on superheaters, the Proposer's base proposal shall be with steam parameters of 750°F and 650 psia. Proposals based on higher quality steam parameters will be accepted, where the proposer can demonstrate, through supporting documentation, furnace/boiler on-line reliability equal to that of the base proposal.

The Contractor shall furnish and install a minimum of three combustion units at the southern facility and two combustion units at the northern facility, each with the capability of operating five percent above its rated Nameplate Capacity. The use of multiple units is intended to provide for system redundancy and the capability of selling additional energy to the utility during peak hours of operation. The Proposer shall provide a firing diagram and additional information indicating how the boilers will be capable of handling fluctuations in BTU content and moisture content as well as proximate and ultimate analysis.

The Contractor shall provide the turndown ratio such that the boiler efficiencies do not drop below 85 percent of the boiler design efficiencies.

All furnace equipment and auxiliary equipment shall be manufactured and constructed in accordance with ASME boiler and furnace construction codes except where otherwise stated, and shall be so stamped on the equipment.

The individual units shall each be designed to operate at the minimum excess air level and exhaust the combustion flue gases from the electrostatic precipitator at a minimum of 40°F above dewpoint.

The minimum combustion temperature shall be 1,500°F and temperature shall be controlled to a maximum of 1,800°F.

1.10.2 Furnace Design

General: Furnace design shall be of the mass-burn stoker-fired, or stoker/rotary kiln tandem type, capable of firing as-received Processable Waste (without auxiliary fuel burning) on a continuous feed basis.

Each combustion train shall be equipped with an individual multiple pass waterwall type boiler of a configuration which has been successfully demonstrated for a minimum of three years.

Refractory Enclosures: The refractory linings of the furnaces, where applicable, shall be of super duty quality, laid in high temperature mortar. The refractory walls (other than rotary kiln) and arches shall be of the sectionally supported type, anchored with high temperature alloy anchors and insulated with an adequate amount of insulation.

The refractory enclosure materials shall conform or be equal to the latest of the following minimum requirements and classification:

- Super duty fire brick - ASTM C-27
- Silicon carbide walls - ASTM C-106
- Insulating brick (where applicable) - ASTM C-15
- Insulating castable - ASTM C-401, Class Q
- Expansion joint filler - Fiberfrax, Kaowool or equal
- Sectionally supported wall and arch mortar--Super-duty Fireclay
- Insulation - Mineral wool block

- Tile engaging castings or anchors - ASTM A297-74A

All sectionally supported walls and arches shall be supported on a steel structure independent of stoker supports and assemblies. The exterior surfaces of the wall shall be protected by suitably reinforced steel or aluminum casings.

All structural steel framing shall be designed, fabricated and erected in accordance with the AISC Steel Construction Manual (latest edition), and in accordance with applicable local code requirements, including seismic, impact, lateral, vertical and longitudinal loading.

Grates (Stokers): The grates shall be of manufacturer's design and shall be of a design used in successful operation for a minimum of three years.

The design of mechanical components and selection of construction materials shall be such as to yield ninety percent availability under normal operating conditions. Routine repairs and adjustments shall not require more than 200 man-hours with major overhauls required at a maximum of every three years (or 20-30,000 hours).

All grate operations (speed, cycle frequency, etc.) shall be arranged for remote operation from a central control room with local manual override. Grate drive shall be by hydraulic motor controlled by a variable volume pump. The degree of burnout on the grate sections shall be established and guaranteed by the Contractor. The combustion efficiency of the stokers shall yield a residue containing not more than 4.0 percent combustibles and 0.2 percent putrescibles.

The stoker surface materials shall conform to the following minimum requirements:

- Reciprocating stokers shall be of precision ground cast chromium alloy steel grate bars.
- Feed sections not exposed to burning fuel bed - MEEHANITE HS type cast iron or equal.

- o Circular grates may be cast iron.
- o Parts designed to prevent erosion of side walls (if applicable) extending not more than six inches above stoker surface-MEEHANITE HS type cast iron or equal.
- o Burning section castings exposed completely or in part to burning fuel bed not more than forty five percent of operating cycle time, each cycle not exceeding five minutes - MEEHANITE HS type cast iron or equal.
- o All other surface castings - heat resistant alloy conforming to ASTM A 297-74a Grade HF designation.
- o Alloy (weldable stainless steel) steel grates shall have a minimum of four percent nickel composition.
- o Wear plates shall be "NT" (high density forged steel plate).

Waterwall Enclosures: Waterwall enclosures shall be of gas-tight fully-welded membrane type, backed by mineral wool block insulation. The cold face of the insulation shall be protected by steel or aluminum casing.

Where the waterwalls are expected to be exposed directly to direct flame or alternate reducing and oxidizing atmosphere, the tubes shall be protected with silicon carbide low oxidizing grade castable refractory, anchored to the tubes with welded studs of high temperature alloy steel.

The tube arrangements shall be of an in-line pattern (staggered tubes are not acceptable). Each boiler shall be equipped with a tube-cleaning system to provide and ensure high operating efficiency.

The walls adjacent to the stoker surfaces shall be of watercooled silicon carbide tile extending a minimum of four feet above the grate surfaces.

1.10.3 Combustion Air System

The combustion air systems shall be designed to control automatically the furnace temperatures within +50 degrees Fahrenheit of the set-point temperature selected by the Proposer while firing Processable Waste with higher heating values (HHV) varying from 3,500 to 6,000 BTU/lb. The Proposers should note the wide range of HHV for the Processable Waste as fired. Sampling conducted on Broward County's Processable Waste indicates that the minimum and maximum extremes of the range may be realized on a sustained seasonal basis (e.g. November through April at upper range and May through October at lower range) as a result of significant variation in moisture content associated with extremes in rainfall.

The distribution of the primary and secondary air, including secondary air jets, shall yield a combustion efficiency resulting in dry gas carbon monoxide (CO) content not exceeding 0.1 percent by volume, measured upstream of boiler convection sections.

Separate fans for primary and secondary air shall be used (minimum two combustion air fans per boiler). Each fan shall be motor driven. All combustion air fans shall be mounted on vibration elimination bases with non-combustible flexible connections at the inlets and outlets of the fans. Either system shall be automatically controlled by a furnace temperature control system. The control of the primary and secondary air flow shall be automatic with a manual override system in the plant control room.

The combustion air ductwork inlets shall be arranged to use selectively air from the refuse storage area, tipping area, or from outside atmosphere, or any combination of the above. Each primary and secondary air inlet duct shall be fitted with venturi type or similar non-plugging type flow measuring device with remote output readout instruments.

The combustion air ductwork shall be manufactured of sheet metal or steel plate two gauges thicker than required by ASHRAE code for air conditioning and ventilating systems for a similar air capacity and pressure. Section joints shall be flanged and gasketed; access doors or panels shall be provided at each bend; the ductwork system shall be essentially air tight with leakage not exceeding one percent of the maximum design air flow.

The fan drives shall be selected for a minimum of 125 percent of the maximum design brake horsepower (BHP).

1.10.4 Energy Recovery Systems

The steam parameters for the boiler system shall consist of the following:

- o Stream Pressure - 650 psia ±5%
- o Steam Temperature - 750°F ±5°F

Boilers: The boiler design and manufacture shall conform to the ASME boiler code and approved quality assurance program, and, if required by applicable codes, shall bear the ASME stamp.

The boilers shall be designed with in-line tubes and drum(s) perpendicular to the gas flow. Boiler tubes shall be of an adequate tube thickness and diameter with proper spacing provided between the tubes. Adequate air circulation near the convection tubes shall be provided. Gas temperatures coming into contact with the external tubes should not exceed 1,600°F.

Single pass boilers with vertical tubes shall have an arch or stainless steel baffle to redirect the air flow and prevent excessive corrosion of the boiler side tubes. Properly sized valves with welded packing shall be provided.

The tube and drum configuration shall be the option of the Contractor, but shall conform to general requirements specified herein. The drums shall be Class 1 fusion welded construction, tested before shipment. The steam drums shall be fitted with steam separation baffles yielding dry steam with a purity of one parts per million (ppm) solids at maximum continuous steaming conditions, at the design pressure and temperatures, when the boiler water concentrations do not exceed standard ABMA limits. Each drum shall have two manhole openings fitted with hinged steel manhole covers complete with necessary bolts, grabs, and gaskets.

Proper provisions shall be made for thermal expansion of the drums so that abnormal stresses are not produced on either the pressure parts or in the supporting members. The boilers shall be designated with either a soot blowing system or tube rapping system for the cleaning of both the external and internal surfaces. An access door allowing for inspection and maintenance of the tubes and the tube rapping system shall be provided.

Superheaters: Superheaters shall be manufactured out of the alloy best suited to resist thermal corrosion as well as chlorine, fluorine and sulphur corrosion. The Contractor shall specify whether the superheater tubes will be provided with clamp protective metallic shields on the tubes at the vulnerable locations or if the tubes will use plasma-gun coating by metallic or ceramic materials.

The superheaters shall be designed with proper provisions for thermal expansion and with attemperators between the stages of the superheater. The superheater bundle shall be placed away from the primary radiant section.

Economizers: Each boiler unit shall be provided with the proper tubular economizer. The economizers shall be the bare tube type (no finned tubes).

The economizers shall be designed for forced circulation, which is provided by the boiler feed pumps, using at a minimum, a feed water temperature of 250°F. The economizer design pressure shall be at a minimum of 125 percent of the boiler design pressure. The economizers shall conform, as a minimum, in all respects to the ASME boiler codes.

1.10.5 Boiler Auxiliary Systems

Boiler Auxiliaries: The Proposer shall provide all required auxiliary systems to make the boilers complete, operable and maintainable. All boiler appurtenances shall be designed to operate and support each facility at its maximum continuous rating.

Boiler auxiliary systems, including, but not limited to all steam circulation and distribution piping, boiler feed water pumps, treated water pumps, raw water pumps, condensate pumps, tanks and accessories, water treatment and deaeration systems, boiler feedwater heaters, process piping systems, etc., shall be designed and furnished by the Contractor in accordance with:

- ASME boiler construction codes.
- Report on the identification of power house piping.
- U.S. Environmental Protection Agency (USEPA) - noise level of vent, etc.
- Maximum boiler water concentrations, recommended by American Boiler Manufacturer's Association (ABMA) chemical feed system.
- ABMA boiler standards.
- AISC manual on steel construction.
- ASHRAE standards.

<u>Boiler Trim</u>: Each boiler unit shall be furnished with boiler trim, in accordance with the ASME code requirements as well as conforming to the best standards of power plant practice. Trim shall be designed for a minimum of 125 percent of the nominal operating pressure (PSIG). Each boiler unit shall have manual override systems, which also overrides the boiler auxiliary equipment, located and operated from the plant central control room.

The following list of accessories, at a minimum, are required. The final number and type of accessories shall be determined by the Contractor based on the water circulation and steam distribution designs.

- Safety valves as per ASME code.

- Water column, feed water regulator, gauge and glass drain valves.
- Reliance water column with high and low alarm and water gauges.
- Low-water cutoff.
- Water column drain valves and water gauge drain valves, rated for twice the operating pressures.
- Feedwater regulatory by-pass and drain valves.
- Feedwater stop and check valves.
- Drum blow off valves.
- Boiler air vent valves.
- Chemical feed valves.
- Continuous blowdown stop and check valves.
- Tube rapping - elements, supply and drain valves (if required).
- Steam and water flow transmitters.
- Differential level transmitters.
- Computing relays.
- Auto-manual set point control station.
- Air sets.
- Main steam non-return valves.
- Feedwater control valves.

Superheater Steam Piping Systems: The high pressure superheated steam piping systems shall be designed in such a way that the pressure drop between the main steam valve of the boilers and the main valves of the turbine, does not exceed ten percent of the nominal boiler pressure and that the drop in temperature does not exceed 10°F. A loop header shall be provided to insure the most flexible mode of operation as well as maintenance.

Reducers and coolers of steam pressure shall be installed so that each facility can bypass the turbines. There shall be no steam released directly into the atmosphere except where silencers are installed to reduce the noise level below 80 decibels (dba). The condensate drainage system of the high pressure superheated piping system shall be designed such that the condensate is recovered.

<u>Feedwater Systems</u>: The feedwater treatment systems shall be capable of handling a minimum of 100 percent of each facility's make-up water requirements. The systems will treat water to meet each facility's boiler water quality requirements.

There shall be one high pressure boiler feedwater pump for each boiler and one standby (backup) pump for every two boilers installed. High pressure boiler feedwater pumps shall be equipped with dual (electric and steam) drives. The feedwater system shall be designed in such a manner that achieves the maximum flexibility within the system.

The pumps shall be designed for operation at a maximum water temperature of 350°F, unless the Contractor's designed thermodynamic cycle demands otherwise.

<u>Deaerator Systems</u>: The water deaerator systems shall be designed in accordance with the applicable ASME codes. The deaerator storage tanks shall have a minimum ten minutes of storage of the plant's full load. The working pressure shall be suitable for the designed thermodynamic cycle of the facility. There shall be two, 100 percent capacity deaerators. The Contractor shall specify and guarantee the oxygen and carbon dioxide (CO_2) removal at any load between five percent and one hundred percent of the rated capacity. The Contractor shall also specify the amount of steam loss while the oxygen and CO_2 is being released through the deaerators. The Contractor may supply and install steam accumulator systems in order to avoid a severely fluctuating steam flow caused by the variation in the Processable Waste Btu/lb content.

Condensate System: Surge tanks for receiving the returnable condensate from the process shall be provided by the Contractor. The size and number of surge tanks depend on the amount of condensate returned and shall be determined by the Contractor. The returnable condensate is that condensate which can be reused without any major form of treatment.

Special Requirements: Boiler auxiliary equipment items shall have as a minimum the same degree of availability and reliability as the facility. Where necessary redundancy of any auxiliary equipment is required, it shall be supplied in the form of spare units.

All auxiliary equipment shall be automatically controlled with manual override systems, all of which shall be controlled from the facility's central control room.

Water Usage, Quality and Treatment: This section pertains to water that is to be used as:

- o Make-up water for steam generating systems.
- o Internal facility consumption (domestic and process uses).

Boiler water for the northern facility may be supplied by water lines from the Broward County water system. Table B-3 in Section 1.2.7 of this appendix, presents the 1982 annual average for water quality values for the County's System 1-A.

Water service by either Broward County or the City of Fort Lauderdale to the southern site may be possible. Tables B-2 and B-1, also in Section 1.2.7 of this appendix, provide annual average water quality values for the System 3-A plant (Broward County) and Walter E. Peele Plant (City of Fort Lauderdale), respectively.

1.10.6 Combustion Controls

At each facility controls shall be provided to monitor water level, furnace combustion temperature, steam flow, and exhaust gas temperature and volume. Combustion air modulation shall also be provided.

Controls shall consist of systems for Remote Automatic, Local Manual, and Remote Manual modes.

1.11 Residue Handling Systems

1.11.1 General

The solid residues from each facility must be managed and disposed of according to Federal and State standards for resource recovery facilities. The Proposer shall indicate the quantity and composition of residue ash expected to be produced at each facility from the furnace/boiler and air pollution control systems. The Contractor shall be responsible for ensuring that this residue ash, will not be considered hazardous based on applicable Federal and State regulations and requirements.

The Contractor will also be responsible for residue removal, transportation and landfilling, and all testing necessary to determine whether the residue is hazardous according to the applicable Federal and State regulations.

1.11.2 Description

The purpose of the residue handling systems is to collect the post-incineration bottom ash and fly ash while separating any recyclable materials in a dust free manner. The systems shall have two, one hundred percent capacity ash conveyors to transport the ash to the handling areas at each facility.

Provisions for tractor-trailer loading in an enclosed area, with ventilation and dust control shall be incorporated into the design. A clamshell-type bucket for loading ash onto trucks from an ash storage pit may be provided.

The Proposer shall indicate the marketability of ash, if any. The residue ash shall contain less than 4.0 percent combustibles, and less than 0.2 percent putrescibles. The residue shall be such that it will not support any type of animal or vermin life and will not sustain combustion.

1.11.3 Bottom Ash

The Contractor shall design the furnace connection of the ash discharge chute to be the full width of the final grate section to prevent blocking of the chute from the burn-out grate section. The distance from the end of the stoker to the furnace rear wall shall be at least equal to the height of the boiler feed throat lintel above the stoker feed section.

The bottom ash or residue shall be water cooled by spray or quenched in tanks or sumps before it is handled by the conveyors. The cooled bottom ash handling systems shall consist of drag or vibrating conveyors designed to handle the total plant load.

The Proposer shall specify water usage for residue quenching. Boiler blowdown may be used for ash quenching.

After removal of the residue ash from the water cooling system by the conveyors, the residue ash may be moved from the furnace/boilers to the ash storage area by either drag, belt, or vibrating conveyors designed for heavy duty service.

The drag conveyors, if included in the proposer's design, shall be extra heavy duty type with double strands (chains), steel flights, and with drives of the hydraulic infinitely variable speed type.

The vibrating conveyors, if included in the proposer's design, shall be natural frequency, balanced type, not requiring special foundations.

The belt conveyors, if included in the proposer's design, shall be of a trough type.

All conveyors shall be equipped with safety devices and zero speed switches.

1.11.4 Fly Ash

The fly ash may be combined with quenched bottom residue ash removed by the residue ash conveyors. Separate collection of the fly ash may be utilized should the Proposer wish to market the fly ash for re-use.

The fly ash handling systems include, but are not limited to, screw conveyors inside precipitator hoppers, rotary or double flap air lock valves, and dry drag type transfer conveyors.

1.12 Air Pollution Control Systems

Except as may be required under applicable law, the air pollution control systems at each facility shall consist of one electrostatic precipitator and one induced draft fan per combustion line.

1.12.1 Electrostatic Precipitators

Each combustion line shall be equipped with an electrostatic precipitator (ESP) including all appurtenances, structural supports, foundations, external and internal walkways, platforms access stairways, fly ash hoppers with discharge air lock valves, power and control wiring, and other accessories for a complete operation system.

Each ESP shall be a multi-field type with the output of each ESP's flowing into a single flue. The fields shall be sized adequately considering both the volume of gases and amount of excess air. The temperature of flue gases entering the ESP must be below 600°F and at least 40°F above the dew point temperature.

The U.S. Environmental Protection Agency's (USEPA) best available control technology (B.A.C.T.) shall define the minimum efficiency of the ESP's. The Contractor shall guarantee ESP performance. For the purpose of proposal submission, Proposers shall assume that the ESP outlet gases shall not exceed 0.03 grams per cubic foot of air. The actual required removal rate shall be determined during the permit negotiation process with the appropriate regulatory agencies.

Each ESP design submitted shall have been successfully operated in a facility firing Processable Waste for a minimum of three years. The proposed ESP shall not have been scaled up more than 25 percent over previous installation.

Casing and hoppers of each ESP shall be enclosed with weather resistant materials.

ESP structural design shall be based on all applicable codes as to dead, live, wind and seismic loads, using all external structural members, rigid frames, etc. Internal bracing exposed to the gas flow is not allowed. All design, fabrication and installation shall be in accordance with all applicable design codes and standards.

ESP internal walkways shall be provided at the inlet and outlet nozzles and between fields.

All ESP induction motors shall be extra severe duty high efficiency type, with a minimum guaranteed efficiency value which shall be confirmed by NEMA test standard MG-1-12.53a, (IEEE test procedure 112. Method B) using accuracy improvement by segregated loss determination including stray load loss measurement. All motors shall be labeled with the NEMA efficiency.

All ESP steel casing in contact with the flue gas shall be of ASTM A 242 steel; external structural members shall be ASTM A36 steel.

ESP gas distribution shall be accomplished via a low velocity, multiple vane system or a perforated plate system. It should be noted that as part of the contractual requirements of the selected Contractor, model studies of geometrically similar units shall be submitted for evaluation.

ESP collection systems shall consist of formed rolled ASTM A242 sheet of manufacturer's standard design.

ESP collecting surface rapping shall be by shaft-driven rotary hammers. Solenoid impact or vibration rapping is not acceptable.

ESP high voltage systems shall have star shaped, spiked stainless steel electrodes, rigid mast mounted; and high alumina refractory type insulators. Weighted wire systems will not be acceptable.

ESP discharge electrode rapping shall be accomplished by shaft mounted rotary hammers; solenoid impact or vibrating rapping is not acceptable.

ESP electrical systems shall be in accordance with ASA, AIEE, MENA and National Electrical Code requirements, designed by manufacturer. All operational functions controlled remotely from central control room. High voltage field control panel shall include all solid state, full wave bridge, thyristor type regulated D.C. supply with protective reactances. Saturable reactor systems are not acceptable. Key-type safety interlocks with sequential key arrangements shall be included on all precipitator access doors, rectifier enclosure access doors, high tension switching, and control units circuit breakers.

Minimum ESP remote control functions shall include:

- o Transformer overload alarm.
- o Precipitator failure alarm, if field ceases to operate, or if a long-term precipitator under voltage condition exists, while precipitator control is in on position.
- o Isolated contact for precipitator field.
- o Remote on-off switching.
- o Hopper and insulator heaters failure alarm.
- o Rapper start-stop-failure alarms.
- o Flyash conveyor start-stop failure alarms.
- o Flyash discharge air lock valves start-stop failure alarms.

ESP insulation (nozzles, sides, roof and hoppers) shall be mineral wool block or fiberglass blanket, applied directly onto the precipitator casing. Stiffeners and other structural members attached to the casing shall be wrapped with an insulating blanket.

ESP lagging shall be aluminum panels, except for the roof of the precipitator. Roof insulation shall be protected by purlins and metal panels which shall be designed for appropriate loads.

ESP flyash hopper heaters shall be the resistance type extending two thirds of the ash hopper height from the bottom of the hopper (to prevent blockage).

1.12.2 <u>Induced Draft Fan Systems</u>

Each furnace-boiler shall be equipped with an induced draft fan, an induced draft fan drive, an induced fan inlet damper, and appropriate breechings.

<u>Induced Draft Fans</u>: Induced draft fans shall be centrifugal, backward curved inclined blade, treated-radial tip type, designed for continuous operation at 600°F, in a dusty environment.

The fans shall conform to the following minimum requirements:

- Fan speed not to exceed 750 RPM.
- Equipped with access doors.
- Insulation and lagging in accordance with that required for the ESP's.
- Test block capacity factor: 1.15.
- If erected on an elevated structure, the I.D. fans shall be mounted on spring-loaded inertia bases.
- Fan blades shall be lined to withstand corrosion.

<u>Induced Draft Fan Drives</u>: The induced draft fans shall be coupled to electric variable speed drive systems consisting of either direct current drive motors with AC/DC

converter or AC variable speed motors and operator control stations, as required.

The drive HP shall be a minimum of 115 percent of the fan test block BHP. The control system shall include positive acceleration on demand and deceleration by inertia.

Induced Draft Fan Inlet Dampers: The induced draft (I.D.) fan inlet houses shall be fitted with parallel blade type inlet dampers designed and manufactured for 600°F continuous operation. The dampers shall conform to the following minimum requirements:

- Blades - ASTM A242 steel plates, air foil type.
- External blade linkages.
- End shaft connection with a universal joint (rigid jack shaft coupling not acceptable).
- Damper operators - Worm gear reducers with beveled gear attachments and AWWA limit stops.

Induced Draft Fan Breechings: All breechings shall be of ASTM A-242 steel plate, reinforced as required. I.D. fan inlet and outlet breechings shall be connected to the I.D. fans via flexible joints and supported independently of the I.D. fans housings.

Shaft extension shall be fitted with a manual handle and a locking arrangement.

All breechings shall be insulated and lagged in accordance with that required for the ESP's.

I.D. fan outlet breechings shall be designed to enter stack(s) at not less than a 45 degree angle.

1.12.3 Stacks

The height of stacks at both sites is to be limited to 200 feet above final grade elevations.

The stacks shall include access ladders, a test platform located at the point required by testing procedures, test ports, access doors at the base of the stack, lightning protection system, and obstruction warning light system. Structural designs shall take into consideration all dead, wind and seismic loads, and shall include natural frequency vibration analysis where applicable.

Heights of the stacks shall be based on draft considerations and residual pollutant dispersion analysis in accordance with latest USEPA regulations along with Federal Aviation Authority (FAA) requirements since the sites are near commercial airports.

The stacks shall have one flue per combustion line and shall include provisions for a possible additional line.

1.13 Turbine-Generator Sets

1.13.1 System Design

At each facility the turbine-generator set shall consist as a minimum of the following component items:

- Turbine
- Generator
- Cooling Systems
- Operating Controls

At each facility, the Contractor may provide one multiple stage turbine generator set sized at 100 percent of the maximum generation rate.

Proposers should be aware that the Florida Public Service Commission's proposal rules and regulations, for qualifying alternative energy generation facilities, does contain provisions for minimum on-line generating reliability. Consequently, the Proposer may wish to consider incorporating more than a single turbine generator set at each facility. Should a Proposer wish to consider two turbine generator sets at either, or both, facilities, the Proposer shall be aware that Florida Power and Light may have limitations on the minimum size turbine generator installed.

Design of the turbine-generator sets shall also take into consideration the installed capacity, the available power and the spinning reserve power of the turbines.

The turbine-generator sets shall be designed such that no loss of energy production, either thermal or electrical, occurs throughout the lifetime of each facility. Each facility shall be able to process Processable Waste at full capacity even during scheduled and unscheduled outages of the turbine-generator sets.

The spinning reserve power of the turbines shall be such that variations in the steam mass flow from the boilers can be accepted without overloading the turbines.

1.13.2 Turbines

The turbines shall be radiographically tested, magnetic particle inspected, and sonic tested, as outlined in the currently applicable ASTM specifications.

The turbines, which shall be rated in accordance with the requirements of these specifications, including boiler steam output at 650 psia and 750°F, shall rotate at 3600 rpm, and shall be directly connected to the generator and shall drive the generator described herein as an integrated unit.

The turbines shall be designed for continuous operation, even if pressure at the turbine main steam stop valve rises to, but does not exceed, 105 percent of turbines rated pressure.

The average steam mass flow into the turbines shall be based on a boiler steam output of 650 psia and 750°F.

1.13.3 Generators

The generators shall be alternating current synchronous generators rated in accordance with the requirements of these specifications and shall be directly connected to and driven by the turbines described herein.

The generators shall be of the nonsalient pole revolved field type.

The telephone influence factors of the generators shall be in accordance with the latest ANSI Standards.

The deviation factor of the open circuit terminal voltage wave of the generators shall not exceed ten percent (as defined by ANSI standards.

The generator armatures shall be capable of operating at 130 percent of rated armature current for at least one minute, starting from stabilized temperatures at rated conditions.

The generator field windings shall be capable of operating at a field voltage of 125 percent of rated load field voltage for at least one minute starting from stabilized temperatures at rated conditions.

The generator will be capable of withstanding, without injury, the thermal effects of unbalanced faults at the generator terminals, including the decaying effects of field current (where protection is provided by causing field current reduction, such as with a field breaker or equivalent) and the DC component of the stator current, for times up to 120 seconds, provided the integrated product (It) of generator negative phase sequence current (I) and time (t) does not exceed 30 seconds.

The generator shall be capable of withstanding, without mechanical injury, and type of short circuit at its terminals for times not exceeding the short time thermal capabilities, when operating at rated KVA and power factor and five percent overvoltage, provided the maximum phase current is limited by external means to a value which does not exceed the maximum phase current obtained from the three-phase fault. In the case of stator windings, the criterion for no injury is that the windings will satisfactorily withstand a normal maintenance high-potential test. There will also be no visible abnormal deformation or damage to the winding coils and connections resulting from this test.

The generator shall be suitable, for operation at rated KVA, power factor, and frequency at any voltage not more than five percent above or below rated voltage, but not necessarily in accordance with the standards of performance established for operation at normal rating.

The generator shall be capable of operating continuously at full rated load under usual service conditions. The total temperatures as determined by any of the methods given in ANSI standards shall not exceed 110°C for the stator coils and 125°C for the field when operating at full load or below.

1.13.4 Cooling Systems

General: The following information pertaining to cooling systems is included to provide Proposers with the appropriate systems and project site constraints that may impact upon the actual implementation of a cooling system at the selected sites. The cooling method at each facility may eventually be:

- o Once through cooling (surface condenser).
- o Evaporative cooling (evaporative cooling tower).
- o Air cooling (air cooled condenser).

The final determination of the actual cooling system that will be utilized will be made prior to the approval of the final Contract Agreement.

For the purposes of this proposal submission, however, proposals shall be based upon the utilization of an air cooled system at both sites.

At each facility the steam turbine(s) condenser(s) shall be designed to meet maximum boiler ASHRAE output without any steam being extracted for process, for the hottest day in the year, as per the Florida Weather Bureau, for the Broward County area.

The Proposer shall provide cooling systems sized to condense the exhaust steam for the turbine(s) assuming all boilers are in operation. Reducers and coolers of steam pressure shall be installed so that the facility can also bypass the turbine(s) and condense the total output of all boilers under maximum steam generation. Sustained venting of steam shall be avoided. The condensing system shall be valved and piped to increase operation and maintenance flexibility.

The following sections provide information to acquaint Proposers with the conditions that may impact on the final selection of the cooling systems at each of the selected sites.

Northern Facility (Copans Road Site): For consideration of a once through cooling systems, Contractors should be aware that the North Broward Regional Wastewater Treatment Plant lies just to the east of site selected for the Northern Resource Recovery Facility. The following information is provided for the period of August, 1982 through May 1983, on effluent from this facility.

	Min.	Max.
Daily Flow (MGD)	-	64.21
Minimum Hourly Flow [1]	10.0	-
Chlorine Residual (ppm)	0.5	2.4
BOD (mg/l)	2.0	13.0
TSS (mg/l)	3.0	22.0
pH	6.7	7.4
Fecal Coliform	<10.0	160.0
Temperature (°F)	78.0	86.0

(1) MGD basis occurred in August, 1982.

The effluent from this facility is currently discharged through an ocean out-fall with a maximum temperature discharge limitation of 97°F.

In order to consider once through cooling using closed loop surface condensing (evaporative cooling is unacceptable using wastewater treatment plant effluent) the following additional costs must be investigated:

- o Cooling water supply and return system remote controlled variable speed pumps (one on, one standby); supply and return piping; power and control wiring; hyperchlorination and straining system.

- o Modifications and/or alternations required to the wastewater treatment plant.

- o Satisfying wastewater treatment plant environmental permit conditions established by the State of Florida DER, including any ocean out-fall limitation on effluent discharge temperature.

For consideration of evaporative cooling at this site, the sources of water are limited to County water, as supplied by the County System 1-A plant, or ground water. With respect to County water, average annual water quality values are presented in Table B-3 of this Appendix. The Contractor will be responsible for determing makeup water requirements and County water availability to satisfy such requirements. With respect to utilization of groundwater, Appendix B, Environmental Specifications, of the RFP contains data regarding the underlying aquifers in this area.

Southern Facility (Route 441 Site): Steam pluming is of major concern at this site due to the proximity of Fort Lauderdale International Airport. Consequently, the consideration of evaporative cooling tower(s) at this site, such towers would be limited to a wet-dry type to eliminate visible plume formation which would occur under certain wet bulb and relative humidity conditions.

City and County water (refer to Tables B-2 and B-3) or ground water may be considered for evaporative cooling use. As in the case for the Northern Facility, the Contractor shall be responsible for determining make-up water requirements and city water availability to satisfy such requirements.

Summary: The data presented above regarding cooling systems is provided for informational purposes and for future reference only. All proposers are required to base their proposals on air cooled systems for comparison purposes. The actual cooling systems utilized at the selected sites will be determined during contract negotiations.

1.14 Process Control Systems

1.14.1 Local Automatic Control Systems

At each facility these systems shall provide for automatic shutdown of certain critical operations in the processes. This shall include, but not be limited to:

- o Turbine Generator(s)
- o Electrostatic Precipitators
- o Conveyors
- o Induced Draft Fans
- o Pumps
- o Stokers

These local control systems shall identify their actions to the remote central control systems.

1.14.2 Remote Automatic Control Systems

These on-line, real time systems shall provide automatic operation, control monitoring and data trending and logging of all plant process from the Central Control Room (CCR) of each facility, by means of a computer based central processing units (CPU).

The CPU's shall continually monitor the parameters of all the plant's process systems. The monitored data shall be used by the CPU's to determine whether the process lines are operating correctly, to identify any alarm conditions to the CCR operator that arise, and to generate operating and management reports.

The CPU's shall automatically control the operations of all process line component systems. Such control shall be in conjunction with any local control systems specified elsewhere in the RFP.

At each facility the systems shall provide to the CCR operators an interactive control station from which the operators shall institute process system startups and shutdowns, and affect modifications to all operating parameter setpoints.

The systems shall automatically optimize the operation of each process line by the proper coordination of the line's component systems, including, but not limited to: furnace grate speed control, under and over fire air feed control, temperature control, and boiler feed water control systems to provide maximum efficiency in steam generation.

The ratio of under and over fire air shall be automatically adjusted to compensate for the Processable Waste's moisture content so that a selected furnace temperature is maintained and complete burnout is obtained. The Processable Waste feed rate, grate speed and combustion air volume shall be adjusted to maintain optimum steam generation and complete burn-out.

The CPU's shall provide data logging and trending of all process parameters, including operator inputs to the system.

The systems shall be computer based and shall have a minimum of two CRT/keyboard operator stations and one printer for logging at each facility.

The mainframe processor (CPU) shall have sufficient memory capacity to contain all software operating systems and shall use, and be furnished with, mass storage devices of the rigid disk type for maintaining event data files, etc. Two magnetic tape drives shall also be furnished with each CPU and used for recording event data for off-line processing. Each CPU shall have a real time clock.

The CPU's shall perform an auto restart after a power failure and restoration of power. Floppy disks may be used for system initialization and restarts requiring software reloads. However, Floppy disks shall not be used for any continuous system function.

At each facility a priority software interrupt system shall be furnished and all high priority alarms shall be individually hand wired into this sytem, e.g., high steam pressure, malfunction of boiler feed water pump, etc. The CPU's shall instantly respond to all priority interrupts received and indicate appropriate action.

In the event of system malfunctions and/or alarms, the CPU's shall identify the event to the operator in fully description English text and shall also "prompt" the operator with a complete list of the actions to be taken in response to the specific event.

The CPU's shall monitor all process operating parameters and shall maintain and store the same for a minimum period of 30 calendar days.

The CCR operators shall have access to this stored data and be provided with requested hardcopy printouts of a specified parameter over a specified period of time.

1.14.3 Local Manual Control Systems

At each facility these systems shall provide manual on/off and lock-out controls for all moving equipment in the processing systems, i.e., electric motors, hydraulic or steam driven devices, etc. The manual control systems are required specifically for the safe performance of maintenance operations and for equipment testing and startup operations. The remote control systems shall monitor the status of these local manual controls and take appropriate action in response to the status indicated.

1.14.4 Remote Manual Control Systems

At each facility these systems shall provide for the manual operation of the plant's process lines from the plant's central control room. The systems shall be operated from a control and information display board which shall contain start/stop controls for all process operations, instrumentation indication of all critical and necessary parameters associated with the process operations, and alarm and status indication lights for all process operations. The alarm lights shall be provided in addition to an audible indication of a change in their status, to be sounded both in the central control room (CCR) and the plant floor, to cover the event of the CCR being unoccupied. This audible indication to the plant floor areas shall be a unique sound unlike any other audible indications in the facility.

The control/display boards shall be laid-out as a semi-graphic representation of the plant and its process lines. There shall be a fixed graphic display of each plant process line, from chute to stack, and all controls, alarms and instrumentation shall be located and identified such that they are immediately identifiable with their associated process components. A separate section of the control display (C/D) board shall be utilized for the steam and electricity distribution systems.

1.14.5 Control System Priorities

At each facility the local manual "on-off-auto" type controls shall take precedence over all types of controls. The next highest priority shall be that of the local automatic controls. The next priority shall be to the remote manual control board and lastly to the remote automatic computer controls.

1.14.6 System Requirements

All systems shall be comprised of the latest generation of electronic components and the computer software programs shall be written in a high order language.

Maintenance forces for the electronic systems selected shall be available in the Broward County area in sufficient quantity to guarantee 24-hour on-site response to maintenance calls.

1.14.7 Uninterruptible Power Supplies

At each facility an uninterruptible power supply system (UPS) shall be provided to supply power in an emergency to the remote automatic control system and to other facility equipment requiring UPS for its protection in an emergency.

This UPS shall include a converter and a battery storage system. The converter shall have, but not be limited to, a separate isolation step-down transformer, a solid state inverter bypass switch, an automatic transfer switch, input and output circuit breakers, meters, pilot status lights, low alarm, output frequency meter, manual TS control and fault alarm.

The battery storage system shall include lead-calcium batteries, tiered storage racks with interconnecting metal straps, and battery charger. The capacity of the UPS systems shall be twelve hours and shall be rated at not less than 50 KVA for the northern facility and 100 KVA for the southern facility, 120 volt, single phase outlet with one-hour battery reserve power.

1.14.8 Process Alarms

At each facility alarm annunciators shall be provided to alert the control room operators or other operators/attendants to abnormal process conditions of particular importance. These alarm systems will sound until acknowledged by the operators, and the status lights for the alarms will continue to be "on" until the abnormal conditions are attended to.

The various alarms shall be organized on annunciator panels located in the central control room. In addition, duplicate alarms shall be located at local alarm stations, such as the stoker panels, the turbine-generator rooms, the water treatment system rooms and the precipitator control consoles.

1.14.9 HVAC

All central computer system areas and all UPS battery storage areas shall be provided with the special air conditioning required for each area's proper operation.

Each battery storage area shall have a continuous exhaust of air to prevent hydrogen buildup and the area's temperature shall not exceed 85°F to prevent shortening of the batteries' life.

Each computer room shall have a floating floor which shall be utilized for all cable entry to the equipment and for forced air ventilation of the equipment cabinets. The ambient temperature in each room shall be maintained at 70°F, but in no case shall the temperature within any equipment cabinet be allowed to exceed 85°F.

1.15 Facility Security and Communication Systems

1.15.1 Facility Security

The Contractor shall be solely responsible for providing adequate security at each site, both during construction and operation of the facility.

Security during operation of the facility may include personnel, video, lighting, as well as electronic alarms. One, or a combination, of the methods shall be instituted at the Contractor's discretion.

1.15.2 Communications

The communications systems shall include the following services at each facility: telephone, intercom, public address, and two-way radio.

1.15.3 Security Lighting

Security lighting shall be provided on the exteriors of all facility buildings, in the vehicle parking lot(s), and on the entire perimeter fence. The type of light fixtures and the footcandle level of the illumination shall, as a minimum, be high pressure sodium and 2.5 foot candles.

SECTION 2

LANDFILL TECHNICAL SPECIFICATIONS

2.1 Introduction

As with the preceding technical specifications for resource recovery facilities, the purpose of these landfill technical specifications is to set minimum guidelines and functional design requirements to insure comparable proposals of uniform quality.

In addition, the County has initiated the permit application process with the appropriate government agencies, for the Residue/Unprocessable Waste landfills. As part of this activity, the County has and will continue to develop permit submittals containing landfill plans. The Proposals developed by the Proposers must conform to the plans and requirements contained in these permit submittals. As an example, a landfill liner, leachate control system and stormwater drainage system will be required at each of the landfills as part of the permit conditions. As a result, these items must be treated as required in each Proposal.

The Proposer is not limited to these minimum requirements and guidelines, however, should the Proposer desire to change the functional design requirements described herein, the Proposer shall utilize Proposal Form 5.3 of the RFP to describe the change.

The Proposer shall provide for the design, construction and operation of separate Residue/Unprocessable Waste landfills, together with the associated landfill facilities at the northern and southern resource recovery sites. Descriptions of these sites are provided in section 4.7 of the RFP. More specifically, development of these landfills shall include but not be limited to the following at each landfill:

1. Construction and maintenance of access roadways and parking areas.

2. Furnishing, installation and maintenance of a site security system.

3. Furnishing, installation, operation and maintenance of a truck weighing scale.

4. Furnishing, construction and maintenance of a scale building.

5. Furnishing, construction and maintenance of an equipment shed.

6. Furnishing, installation, and maintenance of land-fill liners.

7. Furnishing, construction, operation and maintenance of leachate collection and disposal systems.

8. Construction and maintenance of storm water drainage systems, including installation, operation and maintenance of injection well systems.

9. Clearing and grubbing of trees, brush, shrubs, and stumps within the limits of the site.

10. All excavating, backfilling and disposing of all materials, including unsuitable muck material, encountered at the site as required for the purpose of constructing structures, conduits, pipelines, roads, grading and other facilities required to complete development of the site.

11. Provisions for water, sewage, fire protection, and other utilities.

12. Furnishing, installation, operation and maintenance of a gas control system.

13. Furnishing, installation, and maintenance of ground-water monitoring wells.

14. Placement and compaction of select fill, as required, to increase site elevations to 100 year flood elevations prior to placement of solid waste.

In all cases, the above described work, and any other work required to complete the design, construction and operation of the Residue/Unprocessable Waste landfills, shall be in compliance with all applicable federal, state, county and local rules and regulations.

In addition to the development and construction of the Residue/Unprocessable Waste landfills, the Proposer shall be responsible for the operation, maintenance and final closure of these landfills.

2.2 General Design and Construction Requirements

In addition to the specific design requirements described in the site work section, the Contractor shall meet the following general design requirements:

- o The bottom of the landfills must be at least 5 feet above the groundwater table. To provide a suitable base for constructing the landfills it will be necessary to remove all unsuitable materials and to place clean fill on the site to establish the 5 foot separation of the groundwater table and the landfill bottom. If excavation uncovers an unexpected water table that cannot be lowered the excavated area must be backfilled to a point that will provide the necessary 5 foot separation.

- o Select fill must be placed and compacted wherever necessary to increase grade elevations to 100 year flood elevations. This will insure that solid waste will not be placed in future flood waters.

- o The top slope of completed landfill sections must be maintained at 2 percent or greater for drainage and the slopes at the sides of the fill should not be steeper than 3 horizontal to 1 vertical.

- o All materials and equipment used in the construction of the landfill should be handled, stored and installed in accordance with the manufacturer's recommendations.

- o All concrete structures, including drainage ditches, shall be constructed on a 12-inch layer of clean, fill. Backfill structures shall be backfilled with 12-inch thick layer of clean fill all around and tightly compacted.

- o Erosion control measures such as straw bales, silt fences and temporary seeding must be utilized to keep erosion of soil to a minimum.

- o A sufficient number of ground water monitoring wells shall be provided to determine ground water flow direction, background ground water quality and sub-surface geology, as required by the appropriate regulatory agency(ies).

- A landfill liner system shall be installed and maintained to contain infiltrated rainfall in accordance with the requirements of the Florida Department of Environmental Regulation (DER) and Broward County Environmental Quality Control Board (BCEQCB).

- A leachate collection system shall be installed, operated and maintained to collect and remove leachate from the landfill in accordance with the requirements of the Florida DER and BCEQCB.

- A storm water drainage system shall be installed, operated and maintained in accordance with the requirements of the South Florida Water Management District. As part of this system, injection wells will be required. Typical specifications for injection wells are provided in Appendix G of the RFP for informational purposes.

Conceptual layouts of the northern and southern landfills are included in the RFP as Figures 2 and 3, respectively.

2.3 General Operational Requirements

As part of the operational requirements, the Contractor shall develop operational procedure and maintenance manuals, which shall include, but not be limited to, the following items:

- Operation hours;
- Weighing procedures;
- Vehicle flow and unloading;
- Waste handling procedures;
- Placement of cover;
- Maintenance procedures;
- Operating procedures for various weather conditions;

- Fire prevention procedures; and
- Salvage and screening policy and procedures.

In addition to the development of operations and maintenance manuals, the general operational requirements for the Residue/Unprocessable Waste landfills include:

- All of the permanent facilities that will impact on the proposed landfill must be constructed prior to placement of waste in a new area. This includes such items as storm drainage lines and ditches, liner and leachate collection system, monitoring wells, haul roads and gas vents.

- Temporary measures that must be pursued on a continuous basis include temporary surface water diversion ditches, erosion control measures, and fencing to control blowing paper.

- The solid waste shall be covered according to the requirements of the applicable regulatory agency(ies). Final cover, however, shall consist of a layer of impervious material having a permeability of 10^{-5} cm/sec or less, topped with sufficient topsoil to support the growth of vegetative cover. Vegetative cover must then be established to prevent erosion.

- Burning of waste shall not be allowable and hazardous waste shall not be acceptable for disposal at the sites.

- A minimum 100 foot separation distance shall be maintained between fill areas and property boundaries. (Zoning Ordinances and permit requirements may necessitate larger separation distances).

- Initially, gas monitoring wells shall be tested once a month. If explosive limits of gas are detected, then a more extensive monitoring program should be developed. This more extensive monitoring program could involve additional monitoring wells as well as mitigating measures to stop the migration of gas.

- Ground water samples shall be taken in accordance with regulatory requirements and guidelines and shall be tested for those parameters required by the applicable regulatory agencies.

- After an area of the landfill is completed and final cover is applied, regular checks of the area will be made to determine if any erosion is taking place. Any eroded areas will be filled and a dense stand of grass established. An active ground water and gas monitoring program meeting the requirements of the Florida Department of Environmental Regulation will be carried out to make sure the landfill does not have an adverse effect on the environment.

2.4 Environmental

The Proposer shall assume and provide that, the design, construction, and operation of the Residue/Unprocessable Waste landfills shall comply with all applicable federal, state, county and local environmental regulations and standards in effect as of the proposal submission due date, unless otherwise advised in writing by the County. These environmental requirements will cover all air quality, water quality, traffic, noise, odor/vector control, residue, and community impacts. In particular, the design, construction and operation of the Residue/Unprocessable Waste landfills shall at all times be in compliance with the rules and regulations of the Florida Department of Environmental Regulation, specifically Chapter 17-7 Resource Recovery and Management; Part I: Solid Waste Facilities. Specific mitigating measures will be necessary at the southern site to minimize the environmental input on the South New River Canal. A discussion of these measures is provided in the "Land Use and Environmental Overview of the Route 441 Site" dated February 1983. Copies of this report are available at the office of the Project Administrator.

The Proposer shall itemize the measures by which all adverse environmental impacts will be mitigated including design features, construction procedures, operating procedures, and control hardware.

Attendance and participation at meetings and hearings will also be required of the Proposer and others retained by the Proposer in connection with the permit approval, and certification process. A listing of the environmental permits and regulations that may be applicable to these landfills is provided in Appendix B of the RFP.

Information pertaining to the Proposer's Residue/Unprocessable Waste landfills is to be provided in the proposal on Form 5.4- Technical Data; Section 5.4.5 Residue/Unprocessable Waste Landfills. Specifically this section requests information concerning the following:

- o Development plan.
- o Type of security system.
- o Operations plan.
- o Liner system.
- o Leachate system.
- o Closure cover.

The Proposer may provide additional information by attaching supplemental sheets to the proposal.

The following sections are intended to provide an overview of the environmental requirements for the residue/ unprocessable waste landfills. These requirements include but are not limited to:

2.4.1. <u>Design and Construction Requirements</u>

During construction of the landfills, the Contractor will be required to:

- o Control or prevent fugitive dust emissions.
- o Prevent the depositing of dirt and construction debris on neighboring streets and properties.
- o Provide for control of soil erosion and sedimentation of existing water courses.
- o Provide appropriate disposal for any water removed through dewatering.

2.4.2. <u>Operations Requirements</u>

During operation of the landfills, the Contractor will be required to:

- Train special environmental personnel.
- Prepare operational procedure and maintenance manuals.
- Develop practices to define the nature and quality of waste input to prevent the processing of obnoxious, undesirable, and hazardous material at the landfills.
- Prevent dirt and debris from being deposited on neighboring streets.
- No solid waste shall be disposed of:
  - within 200 feet of any natural or artificial body of water, except canals used to lower site water tables or bodies of water, contained completely within the site, which do not discharge from the site.
  - within 10,000 feet of the closest point of any runway at any airport licensed by the State of Florida, owned or operated by the United State, or subject to regulation by the Federal Aviation Administration which may be used by turbo-jet aircraft; or within 5,000 feet of any runway at any such airport used only by piston engine type aircraft unless it has been determined by the Federal Aviation Administration, or other appropriate federal or state agency charged with preventing airport hazards, that the proposed solid waste facility poses no safety hazard to aircraft in the vicinity.

2.4.3. Water Quality Requirements

No substance shall be discharged into the surface waters, groundwaters, storm or sanitary sewer system without the approval of the applicable agency(ies) regulating that discharge.

Proposers shall provide sufficient information and data on the proposed landfills including any necessary leachate pretreatment process, to show how compliance with these regulations and standards would be achieved.

2.4.4. Noise Impact Requirements

The proposal shall indicate, among other things, the methods to be used to safeguard both people working at the landfills and in neighboring areas from exposure to noise levels, greater than allowable thresholds, during both construction and operation.

The design and selection of equipment and construction materials should be made with consideration to the minimizing of noise generation within the site property lines and the transmission of noise beyond the property lines, and shall incorporate any design or operation measures requested by the County. The prevention of community nuisances due to excessive noise during construction and operation is extremely important to assure that the landfills are "good neighbors".

2.4.5. Odor/Vector Control Requirements

The Proposer shall provide sufficient controls to insure that the landfills will not constitute a hazard to public health, safety, or property both on-site, and in neighboring communities.

The design of the Residue/Unprocessable Waste landfills and associated facilities shall include all necessary provisions as required by Federal, State and local laws and regulations to eliminate any potential problems with odor or vector control.

SECTION 3
ACCEPTANCE TESTING REQUIREMENTS

3.1 Acceptance Testing

3.1.1 Pre-Acceptance Test Responsibilities of the Contractor

Each Proposer shall prepare, and submit to the County as part of their Proposals, a Preliminary Acceptance Test plan detailing the protocol to be followed for Acceptance Testing at each facility. It is understood that reference to an individual Acceptance Test implies and includes reference to both Acceptance Tests, unless expressly stated otherwise. The final Acceptance Test plan shall be submitted for County approval at least four months prior to the planned start of Acceptance Testing. The plan shall be a detailed test procedure. The plan shall include the methodology for monitoring facility processing capacity, residue quantity and quality steam generation, gross and net electrical generation, stack emissions, water discharges, traffic impacts and noise and odor during Acceptance Testing. The Contractor shall notify the County at least two weeks prior to the commencement of the Acceptance Test. The County will monitor the Acceptance Test to verify that the contractually agreed upon methods and procedures are being met.

3.1.2 Requirements for the Acceptance Testing

The Contractor shall provide all personnel, services, utilities, supplies, other than the County's committed Processable Waste, required to operate the Facility in accordance with the approved Facility Acceptance Test plan.

The Acceptance Test will determine if the Facility meets the specific performance requirements of the Construction Contract. During this testing period, the Facility shall be operated by operating personnel of the Contractor. Compliance with full scale operational performance guarantees shall be determined by the Acceptance Test which will be conducted at the expense of the Contractor.

The Acceptance Test Procedure, provided below, shall be utilized to determine whether the Facility meets all of the environmental requirements and performance guarantees set. The County reserves the right to have its staff present for any or all testing.

All operations during Acceptance Testing shall be conducted in conformance with applicable Federal, State and local laws, standards and regulations.

3.1.3 Acceptance Test Procedure

Acceptance of the Facility shall be contingent on a successful Acceptance Test run comprised of the following:

- Demonstrating the Facility's capability to meet all applicable environmental requirements as of the date of acceptance for stack emissions, residue quality and water discharges.

- Demonstrating the capability of the Facility to receive and process the guaranteed tonnage (nameplate capacity) of Processable Waste for a continuous period of not less than 28 consecutive days.

- Demonstrating the Facility's capability to produce the guaranteed plant throttle steam and net electrical energy output and the recovered materials output (if any).

- Demonstrating the Facility's capability to prevent traffic from backing onto public roadways and to provide, at a maximum, vehicle turn-around time of 10 minutes.

- Demonstrating the capability of the Facility to meet all other guarantees with respect to noise and odors.

Prior to any test run, all operating conditions shall be established and stabilized, the waste storage pits shall be emptied of all wastes, and the County shall be notified 14 calendar days in advance in writing when the test run shall occur. The County shall be supplied with all test data forms. During the test run, all operating conditions which might affect the results of the test run, will be maintained as constant as possible recognizing the heterogeneous nature of the Processable Waste. All equipment and accessories shall perform in their normal mode of operation.

For the Facility to be accepted, there shall be no major scheduled or unscheduled outages during the consecutive four week, 28 day Acceptance Test period. Routine preventive maintenance shall be scheduled as presented in the Contractor's operating plan. Operations during the Acceptance Test run shall be of a routine nature.

3.1.4 Environmental Testing

The Contractor will be required to retain the services of an independent consultant or laboratory subject to final approval by the County, for the purpose of conducting the following tests. The test protocol for the Environmental Testing shall be included with each Proposer's proposal responding to the RFP.

Stack Emissions Testing: Stack emissions testing shall be performed during the Acceptance Test period. Test protocol (methodology) for particulate and gaseous emissions testing shall be as approved by the Federal and/or State agencies having jurisdiction.

The Contractor shall be responsible for notifying apropriate jurisdictional agencies of the stack emissions testing schedule.

The testing results shall demonstrate conformance with the standards of the Federal and/or State agencies having jurisdiction as of the date of Acceptance.

Water Effluent Discharge Testing: Water effluent discharge testing shall be performed during the Acceptance Test period. Test protocol (methodology) for pH, BOD, COD, solids, temperature, flammability, corrosiveness and toxicity, shall be as approved by the Federal, State and/or local agencies having jurisdiction.

The Contractor shall be responsible for notifying appropriate jurisdictional agencies of the water effluent discharge testing schedule.

The testing results shall demonstrate conformance with the standards of the Federal and/or State agencies having jurisdiction as of the date of Acceptance.

Residue Quality Testing: Residue quality testing shall be performed during the Acceptance Test period.

A. Combustible and Putrescible Content Test

Under this test, residue quality shall be demonstrated to be less than 4.0% combustible content and 0.2% putrescible content (dry weight basis).

If the Contractor's system combines the fly ash from the boiler hoppers and/or air pollution control system hoppers with furnace bottom ash, then the definition of residue quality shall apply to the combined ash.

If the Contractor's system segregates fly ash from the boilers and air pollution control systems for direct marketing as a recovered secondary material, then the definition for residue quality shall apply to furnace bottom ash only.

The proposed test protocol (methodology) for residue sampling and quality analysis shall be included with each Proposer's proposal responding to the RFP. The actual test protocol utilized during the Acceptance Test shall be as negotiated between the Contractor and County and included in the Construction Contract.

B. Hazardous/Non-Hazardous Test

Under this residue test, the Contractor shall perform tests in accordance with RCRA regulations and applicable Florida DER requirements to demonstrate that the residue complies with standards set forth therein determining whether the residue is non-hazardous.

Noise Testing: Noise testing shall be performed during the Acceptance Test period. The Facility will be required to meet the Broward County Noise Regulations established under Chapter 27-7 of the Code of Regulations of the Broward County Environmental Quality Control Board. A copy of Chapter 27-7 of these regulations is provided as Appendix H of the RFP.

Odor Testing: Odor testing shall be performed during the Acceptance Test period. The Facility shall be designed to minimize odors resulting from the handling, storage and processing of solid waste so as not to create a health hazard or public nuisance. Since odors represent air pollutant, the following criteria have been established. These criteria utilize odor concentration units which are defined as the number of standard cubic feet of odor-free air needed to dilute each cubic foot of contaminated air such that at least 50 percent of an odor concentration test panel appointed by the County does not detect any odor in the diluted mixture. The Project shall meet the following criteria:

- o Odors emitted from well-defined stacks 50 feet or more above grade evaluation and with adequate dispersion characteristics as determined by the County shall not be greater than 150 odor concentration units.

- o Odors emitted from sources less than 50 feet above grade elevation or otherwise failing to create good dispersion conditions ad determined by the County shall not be greater than 25 odor concentration units.

- o No source shall emit odors in excess of 1,000,000 odor concentration units per minute.

- o No source shall emit air contaminants into the ambient air which cause odors outside the boundary line in excess of one odor unit.

3.1.5 Facility Capacity Testing

Total facility, as well as individual process line (furnace) Nameplate Capacity shall be tested during the

Acceptance Test period. In order to pass the Capacity Test, the facilities and the individual process lines must operate at their nameplate capacities for the testing period of 28 consecutive days.

The proposed test protocol (methodology) for facility and individual furnace nameplate capacity testing shall be included with each Proposer's proposal responding to this RFP. The actual test protocol utilized during the Acceptance Test shall be as negotiated between the Contractor and the County and included in the Construction Contract.

Prior to the initiation of the Capacity Test, the storage pits shall be empty to ensure that the quantity of Processable Waste that is processed during the Test is accurately recorded.

During performance of the Capacity Test, Processable Waste shall be sampled from the Facility receiving and storage pit, by an independent testing laboratory, approved by the County. Processable Waste samples shall be analyzed for proximate and calorific values for an as received/as fired basis.

3.1.6 <u>Energy Recovery Testing</u>

The Energy Recovery Test, as described herein shall be performed when the boilers have had a minimum of two weeks operating time to allow the boilers to become fouled to a normal operating mode. This two week period can take place during the inception of the Acceptance Test period.

The Energy Recovery Test shall be performed in accordance with the Performance Test Code for Large Incinerators, ANSI/ASME PTC 33. During the Energy Recovery Test period, pertinent information shall be recorded at appropriate intervals and in accordance with the Test Code. Test measurements shall be taken from the installed plant instruments which have been previously calibrated, by an approved independent testing laboratory, and approved by all concerned, including the County. Special portable instrumentation may also be used where required by the Contractor and agreed upon by the County.

Utilizing the test data and measurements, calculations shall be made in accordance with the Test Code for the determination of all boiler heat losses, heat outputs, and heat credits. All data and measurements from the test shall be presented for each combustion train (furnace) and then averaged for the sum total of all the combustion trains. Processable Waste fuel composition will be determined by independent laboratory analysis for higher heating value and proximate analysis, (percent moisture, percent volatiles, percent ash, and percent fixed carbon) performed under Capacity Testing, which shall in turn be performed simultaneously with the Energy Recovery Testing.

Installed plant instruments shall be utilized for measuring and recording throttle steam flow, gross facility electrical generation and net electrical generation being delivered to FP&L.

The results of the Energy Recovery Test shall meet the Energy Production Guarantees provided by the Contractor on Form 5.7 of the RFP, which shall be included in the Construction Contract.

3.1.7 <u>Materials Recovery Testing</u>

Materials recovery (if any) testing shall be performed during the Acceptance Test period. The proposed test protocol (methodology) for materials recovery testing shall be included with the Proposer's proposal responding to this RFP, if said proposal also includes material(s) recovery. The actual test protocol utilized during the Acceptance Test shall be as negotiated between the Contractor and the County and included in the Construction Contract.

The test protocol shall provide for the determination of:

- Efficiency of material(s) recovery system.
- Actual recovered material quality compared to quality specifications of the Contractor's recovered material market.

3.2 Supply of Waste During the Acceptance Testing

The Contractor shall notify the County, at least two weeks in advance, of the quantity of Processable Waste required for the Acceptance Test. The County will arrange for the delivery of that quantity of Processable Waste to the Facility in accordance with the County's responsibility under the approved Acceptance Test Plan.

The Contractor shall be responsible for any additional Processable Waste required.

3.3 Residue and Unprocessable Waste Removal

The Contractor shall be responsible for the removal and transport of all Residue and Unprocessable Waste to the disposal site, during the Facility Acceptance Testing. Residue and Unprocessable Waste removal shall be in accordance with the Contractor's Facility Acceptance Test plan.

For Residue and Unprocessable Waste removal, the Contractor must complete the initial development of the Residue/Unprocessable Waste landfills, and all necessary permits to construct and operate these landfills must be obtained from the applicable Federal, State and local regulatory agencies.

3.4 Energy Generation During the Facility Acceptance Testing

The Contractor will arrange with Florida Power and Light to accept electrical energy generated during the Acceptance Testing.

3.5 Preparation of Acceptance Test Report

The Contractor shall prepare and submit to the County the written test results and performance data, within four weeks after completing each Facility Acceptance Test. The Contractor shall submit to the County copies of the test report, for the County's full review, along with copies of the original test data sheets and log sheets.

Test and performance data shall be compiled and certified by an independent consultant engineering firm and/or certified testing laboratory selected by the Contractor and approved by the County. The independent firm will indicate whether the Acceptance Test was conducted in accordance with the Acceptance Test Plan and whether the Acceptance criteria have been met.

The County will observe the Acceptance Test and, upon request, have access to all raw data and calculations. The County reserves the right to Accept or Reject the Facility.

3.6 <u>Facility Acceptance</u>

Facility acceptance will be made by the County, only after the following conditions have been satisfied:

- o All environmental testing must meet compliance requirements for stacks emissions, water effluent discharges, residue quality, traffic impact, noise and odor.

- o All permits-to-operate must be issued by Federal, State and local agencies having jurisdiction.

- o The Acceptance Test report has been delivered to the County by the Contractor and has been approved by the County.

- o The County's consulting engineer has verified that all Acceptance criteria and performance guarantees have been met, and that the Acceptance Test was conducted in conformance with the approved Acceptance Test Plan.

- o A current system configuration description has been delivered to the County by the Contractor. The system configuration shall include, but not be limited to utility and construction record drawings.

- o The facilities are constructed in compliance with the negotiated specifications and with all applicable codes and regulations, and all punch list items have been completed.

- o A Certificate of Occupancy has been issued for the facilities.

- A Notice of Final Completion under the Construction Contract has been issued to the Contractor by the County.

The County may consider partial acceptance of the Facility should Waste Processing and Energy Production Performance Guarantees not be met under the Facility Acceptance Testing. Consideration, by the County, of partial acceptance would be limited to actually demonstrated Facility Processable Waste capacity, throttle steam production, as well as gross and net electrical energy, with all other Construction Contract and Facility Acceptance Test conditions satisfied by the Contractor.

The County's rights and recourse under partial Facility acceptance considerations are set forth under Section 4.14 of the RFP.

TECHNICAL SUPPORT DOCUMENT FOR THE PREVENTION OF SIGNIFICANT DETERIORATION (PSD) PERMITS FOR TWO RESOURCE RECOVERY FACILITIES IN BROWARD COUNTY, FLORIDA

Prepared for
MALCOLM PIRNIE, INC.

Prepared by
ENVIRONMENTAL SCIENCE AND ENGINEERING, INC.
Gainesville, Florida

December 1983

ESE NO. 83-156-100

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1.0 INTRODUCTION

This report presents the results of a comprehensive air quality dispersion modeling analysis and study performed by Environmental Science and Engineering, Inc. (ESE) for the proposed Broward County Resource Recovery (BCRR) facilities. The proposed plants will be located in the north and south portions of Broward County and, therefore, are referred to as the north and south BCRR facility, respectively. They will be owned by Broward County and operated by a vendor selected by Broward County. Because a vendor will not be selected until March 1984, a conceptual design has been specified by Malcolm Pirnie, Inc. based on conservative, or worst-case, assumptions from a potential air quality impact viewpoint. Once a vendor is selected and the conceptual design is finalized, the predicted impacts are not expected to be significantly different (i.e., not significantly higher) than those presented in this report. Therefore, for this analysis, each facility is assumed to be capable of charging 1,500 tons per day (TPD) of municipal solid waste (MSW) at a 100-percent annual availability factor. Solid waste will fuel steam generation boilers at each facility for the purpose of reducing waste volume and generating electricity.

In accordance with the Clean Air Act (CAA) Amendments of 1977, this report addresses the requirements of the Prevention of Significant Deterioration (PSD) review which will be submitted to the Florida Department of Environmental Agency (EPA) Region IV for their approval. This review includes an emission control technology evaluation, an air quality modeling and monitoring assessment of expected air pollutant emissions and background sources, and an assessment of the impact of the proposed facilities on soils, vegetation, and visibility.

As part of the air quality modeling assessment, incremental and total ambient pollutant concentrations were simulated for comparison to the national and Florida Ambient Air Quality Standards (AAQS) and PSD increments in the area surrounding the proposed plants. Air quality dispersion modeling was conducted using the EPA Industrial Source Complex (ISC) model for estimating concentrations.

The air quality regulatory requirements pertaining to the proposed BCRR facilities are presented in Section 2.0. The facility design description and control technology review are presented in Sections 3.0 and 4.0, respectively. The air quality modeling procedures and assumptions are presented in Section 5.0. The results of the modeling analyses that compare the predicted impacts of the BCRR facilities to the national and Florida AAQS and the PSD Class I and II increments are discussed in Section 6.0. An evaluation of the predicted impacts on soils, vegetation, and visibility is presented in Section 7.0. A summary of the results of this analysis and the conclusions are presented in Section 8.0.

2.0 AIR QUALITY REVIEW REQUIREMENTS AND APPLICABILITY

The following discussions pertain to the general project description and regulatory requirements that must be met for the construction and operation of the proposed resource recovery facilities, as required by federal and state PSD regulations and other air quality regulations.

2.1 Project Description

Broward County occupies an area of approximately 1,200 square miles (mi^2) and is located in the southeastern portion of the State of Florida. Broward County is bounded on the north by Palm Beach County, on the east by the Atlantic Ocean, on the south by Dade County, and on the west by Hendry and Collier Counties.

In 1981, Broward County generated approximately 2,700 TPD of solid waste (Malcolm Pirnie, Inc., 1983a). Currently, the County's waste is disposed of at two landfills. One of these landfills, the county landfill at Davie, is projected to reach capacity in 1986. The other landfill, the central disposal landfill located at Pompano Beach, is owned and operated by Waste Management, Inc. It is estimated that this landfill will reach capacity in the early 1990's.

The capacity limitations of these landfills necessitate the development of a long-term countywide disposal plan. Recognizing this need, Broward County authorized the investigation of solid waste management alternatives. A policy decision was made by Broward County not to rely on landfill as a primary long-term disposal solution and to concentrate on alternatives that involve the recovery of materials and/or energy as valuable resources.

Originally, Broward County pursued the development of two separate resource recovery projects. A northern project involving a 600-TPD co-disposal waste-to-energy facility was planned for a site located at Powerline Road. In addition, a southern, mass-burning waste-to-energy project at the intersection of Route 441 and State Road 84 was planned to accommodate the remaining county wastes. On October 12, 1982, Broward County suspended all activity on these previous projects and authorized the preparation of Request for Proposals (RFP) for long-term full-service waste disposal. The project included the design, construction, startup, and operation of two resource recovery facilities to be located in northern and southern Broward County, each with an accompanying disposal landfill site. The engineering firm of Malcolm Pirnie, Inc., in association with W.F. Cosulich and Associates, Inc. and Hazen and Sawyer, Inc., was retained by the County to assist representatives from applicable county agencies in developing this full-service RFP.

The BCRR project will utilize two sites to locate the necessary facilities. Figure 2-1 illustrates the general locations of the northern and southern sites. A resource recovery facility and landfill area will be located at each site. Broward County is currently in the process of acquiring and rezoning these sites. Negotiations have been initiated with the appropriate property owners, and the rezoning applications have been submitted.

The northern site location is shown in Figure 2-2. This site is accessible by Powerline Road to Copans Road. Powerline Road is a 4-lane paved roadway with current development in the vicinity of the site limited to industrial activity. Copans Road is a 2-lane paved roadway extending westward from Powerline Road to Blount Road.

At the northern site, approximately 130 acres will be available for siting the resource recovery facility and accompanying landfill and to provide buffer and stormwater retention ponds. Acreage requirements for the resource recovery facility, stormwater retention ponds, and buffer

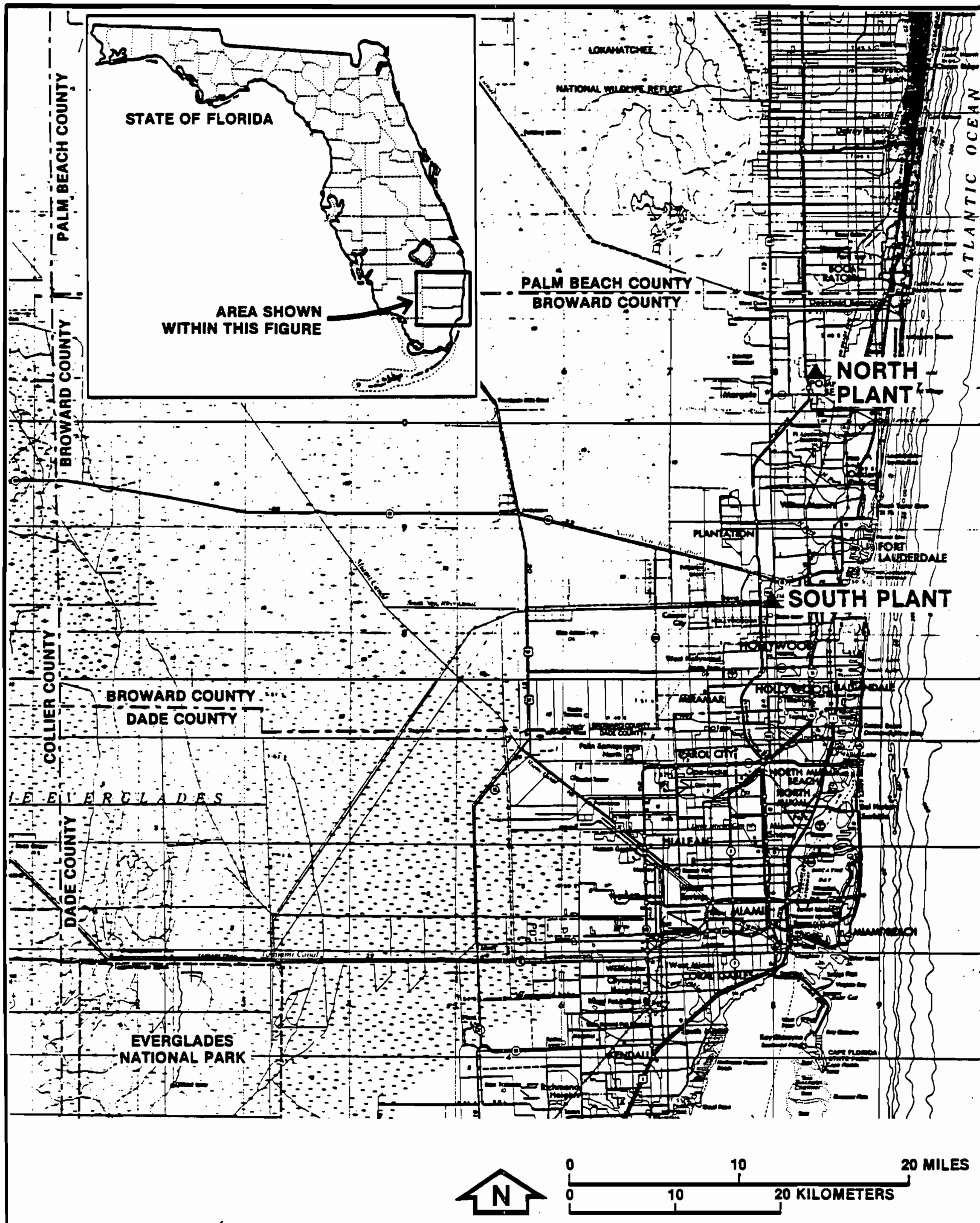

Figure 2-1
LOCATIONS OF THE PROPOSED NORTH AND SOUTH RESOURCE RECOVERY FACILITIES IN BROWARD COUNTY

SOURCE: ESE, 1983.

MALCOLM PIRNIE, INC.

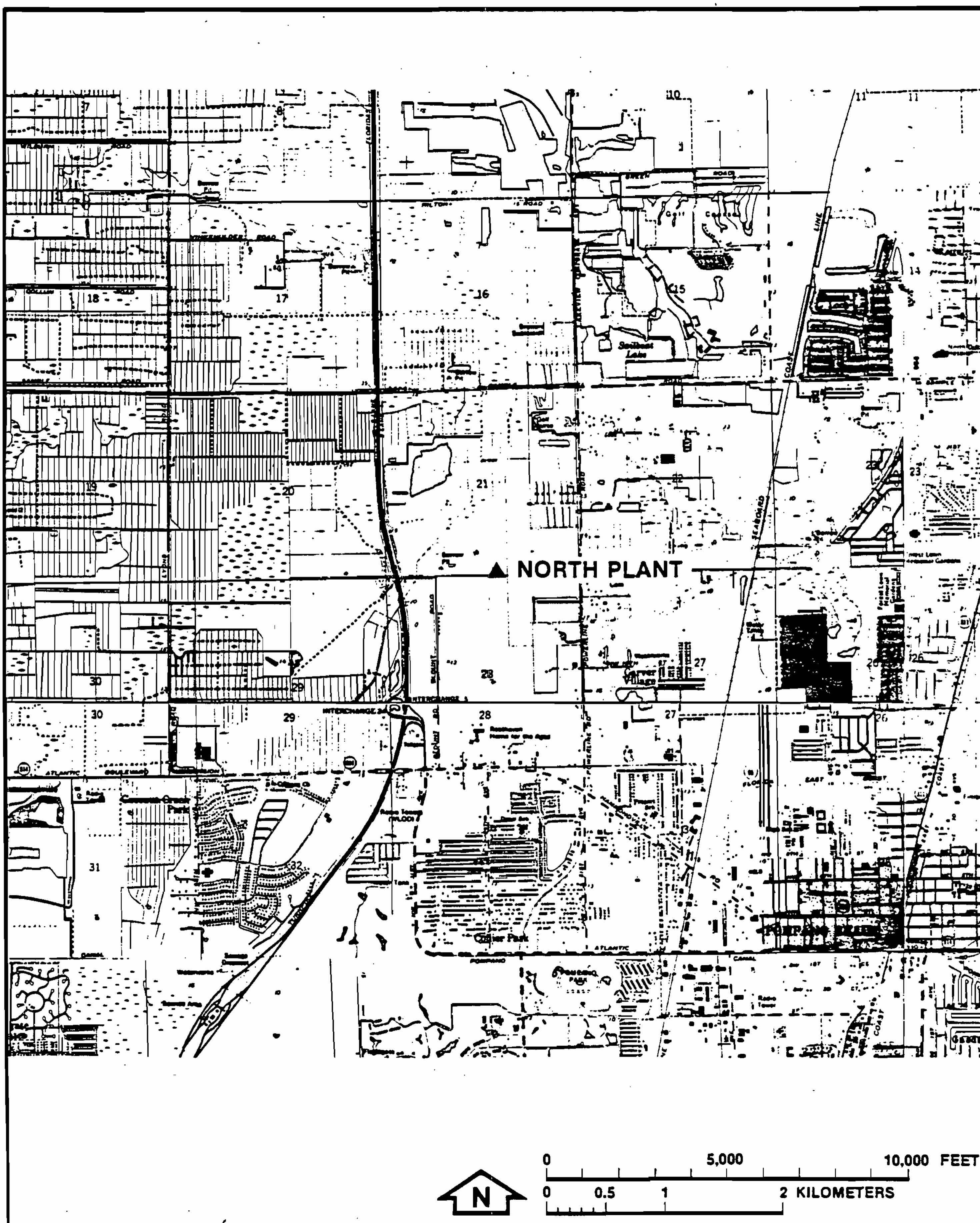

Figure 2-2
LOCATION OF PROPOSED NORTH RESOURCE RECOVERY FACILITY

MALCOLM PIRNIE, INC.

SOURCE: ESE, 1983.

areas are estimated to be approximately 50 acres. Approximately 80 acres will be available at this site for landfill development. The southern site, shown in Figure 2-3, will be located about 1.5 km southeast of the intersection of US Route 441 (State Road 7) and State Road 84. The southern and eastern site boundaries are formed by the South New River Canal. This site is accessible from an easement off US Route 441, which is a 4-lane undivided highway and a major roadway in the area.

2.2 National and State AAQS

As a result of the requirements of the 1970 CAA Amendments, EPA enacted primary and secondary national AAQS (Federal Register, 1971) for six air pollutants. Primary national AAQS are required to protect the public health, and secondary national AAQS are required to protect the public welfare from any known or anticipated adverse effects associated with the presence of pollutants in the ambient air.

The existing applicable national and Florida AAQS are presented in Table 2-1. Since the original standards were issued in 1971, the following changes have been made to national AAQS:

1. EPA eliminated the 24-hour and annual secondary AAQS for SO_2;
2. AAQS for photochemical oxidants was redesignated as ozone, the concentration limit was increased, and the method for determining compliance was changed;
3. A new national AAQS for lead was promulgated; and
4. AAQS for hydrocarbons, used as a guide in achieving the AAQS for photochemical oxidants, was eliminated.

Prior to these changes, the State of Florida promulgated the secondary national AAQS for SO_2 as the state AAQS. Since states have the authority to adopt AAQS more stringent than those established by EPA, the STate of Florida has chosen to

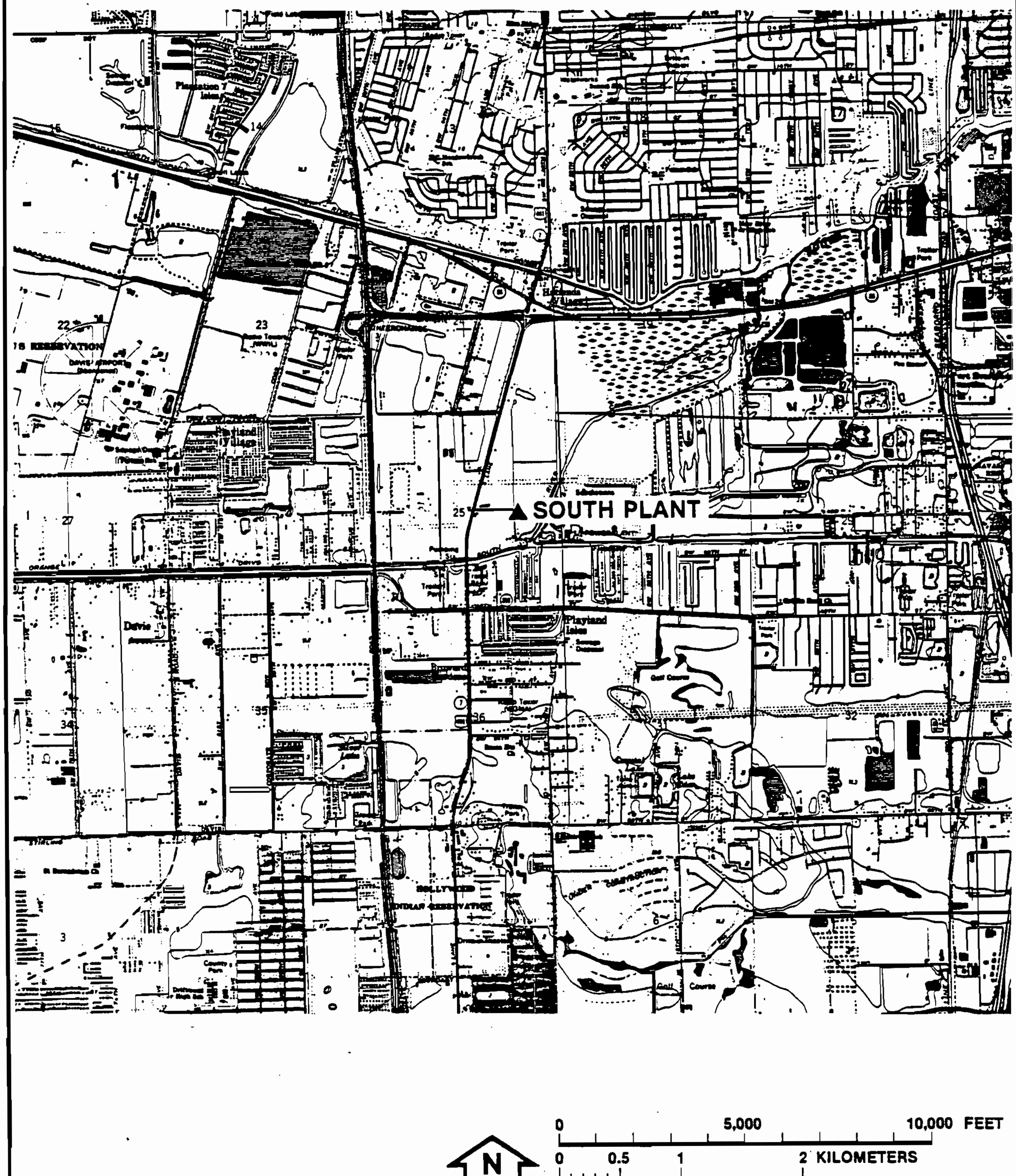

Figure 2-3
LOCATION OF PROPOSED SOUTH RESOURCE RECOVERY FACILITY

MALCOLM PIRNIE, INC.

SOURCE: ESE, 1983.

TABLE 2-1

National and Florida AAQS

Pollutant	Averaging Time	National* AAQS (ug/m3) Primary	National* AAQS (ug/m3) Secondary	PSD Increments (ug/m3) Class I	PSD Increments (ug/m3) Class II
Suspended Particulate Matter	Annual Geometric Mean	75	60	5	19
	24-Hour Maximum†	260	150	10	37
Sulfur Dioxide	Annual Arithmetic Mean	80	N/A	2	20
	24-Hour Maximum†	365	N/A	5	91
	3-Hour Maximum†	N/A	1,300	25	512
Carbon Monoxide	8-Hour Maximum†	10,000	10,000	NA	NA
	1-Hour Maximum†	40,000	40,000	NA	NA
Nitrogen Dioxide	Annual Arithmetic Mean	100	100	NA	NA
Ozone	1-Hour Maximum**	235	235	NA	NA
Lead	Calendar Quarter	1.5	1.5	NA	NA

* Florida AAQS are identical to the secondary national AAQS except for the following sulfur dioxide concentrations: 60 ug/m^3, annual average, and 260 ug/m^3, 24-hour average.

† Maximum concentration not to be exceeded more than once per year.

** Maximum concentration not to be exceeded more than an average of 1 calendar day per year.

ug/m^3 = micrograms per cubic meter.
N/A = Not applicable.

Source: 40 CFR, Parts 50 and 52.

retain the secondary AAQS for SO_2 which were eliminated by EPA. Pollutants for which AAQS have been established are called "criteria" pollutants.

Areas of the country in violation of AAQS are designated as nonattainment areas, and new sources to be located in or near these areas may be subject to more stringent air permitting requirements. Broward County is currently designated an ozone nonattainment area. There are no other designated nonattainment areas for other pollutants within 100 kilometers (km) of the proposed plant sites.

2.3 PSD Requirements

2.3.1 General Requirements

Under federal PSD review requirements, all major new sources of air pollutants regulated under CAA must be reviewed and approved by EPA (in this case, reviewed and approved by DER since PSD review authority has been delegated to the state). A "major stationary source" is defined as any one of 28 named source categories which has the potential to emit 100 tons per year (TPY) or more, or any other stationary source which has the potential to emit 250 TPY or more, of any pollutant regulated under CAA. "Potential to emit" means the capability at maximum design capacity to emit a pollutant after the application of control equipment.

PSD review is used to determine whether significant air quality deterioration will result from the new or modified source. PSD requirements are contained in 40 CFR 52.21, Prevention of Significant Deterioration of Air Quality. Major sources are required to undergo the following reviews related to PSD for each pollutant emitted in significant amounts:

1. Control technology review,
2. Source impact analysis,
3. Air quality analysis (monitoring),

4. Source information, and

5. Additional impact analyses.

"Significant" is defined as any increase in emissions in excess of specified levels (Table 2-2).

The control technology review includes determination of Best Available Control Technology (BACT) for each applicable pollutant. BACT emission limits cannot exceed applicable emission standards (e.g., New Source Performance Standards (NSPS) or state emission limits) promulgated under 40 CFR 60. The source impact analysis requires demonstration of compliance with federal and state AAQS and allowable PSD increment limitations. Projected ambient impacts on designated nonattainment areas and federally promulgated Class I PSD areas must also be addressed. The air quality analysis (monitoring) portion of PSD review requires an analysis of continuous ambient air monitoring data to be performed for the impact area of the proposed source. Source information, including process design parameters and control equipment information, must be submitted to the reviewing agencies. Additional analysis of the proposed source's impact on soils, vegetation, and visibility, especially pertaining to Class I PSD areas, must be performed, as well as analysis of impacts due to growth in the area associated with the proposed source.

2.3.2 Increments/Classifications

In promulgating the 1977 CAA Amendments, Congress specified that certain increases above an air quality "baseline concentration" level of sulfur dioxide (SO_2) and total suspended particulate (TSP) concentrations would constitute significant deterioration. The magnitude of the increment that cannot be exceeded depends on the classification of the area in which a new source (or modification) will have an impact. Three classifications were designated based on

TABLE 2-2

PSD Significant Emission Rates and De Minimis Impact Levels

Pollutant	Regulated Under	Significant Emission Rate (TPY)	De Minimis Air Quality Impact (ug/m^3)
Sulfur Dioxide	NAAQS, NSPS	40	13, 24-hour
Particulate Matter	NAAQS, NSPS	25	10, 24-hour
Nitrogen Oxides	NAAQS, NSPS	40	14, Annual
Carbon Monoxide	NAAQS, NSPS	100	575, 8-hour
Volatile Organic Compounds (Ozone)	NAAQS, NSPS	40	100 TPY*
Lead	NAAQS	0.6	0.1, 24-hour
Sulfuric Acid Mist	NSPS	7	†
Total Fluorides	NSPS	3	0.25, 24-hour
Total Reduced Sulfur	NSPS	10	10, 1-hour
Reduced Sulfur Compounds	NSPS	10	10, 1-hour
Hydrogen Sulfide	NSPS	10	0.04, 1-hour
Asbestos	NESHAP	0.007	†
Beryllium	NESHAP	0.0004	0.0005, 24-hour
Mercury	NESHAP	0.1	0.25, 24-hour
Vinyl Chloride	NESHAP	1	15, 24-hour
Benzene	NESHAP	0	†
Radionuclides	NESHAP	0	†
Inorganic Arsenic	NESHAP	0	†
Any Regulated Pollutant	—	Class I Impact**	

* Increase in volatile organic compounds (VOC) emissions.
† No ambient measurement method.
** Any emission rate for a source located within 10 km of a Class I area which causes impacts of 1 ug/m^3, 24-hour average, or greater.

Notes: Ambient monitoring requirements for subject pollutants may be exempted if the impact of the increase in emissions is below air quality impact de minimis levels.
TPY = Tons per year
NAAQS = National Ambient Air Quality Standards.
NSPS = New Source Performance Standards.
NESHAP = National Emission Standards for Hazardous Air Pollutants.

In February 1981, the Ambient Monitoring Guidelines for PSD (EPA-450/4-80-012) were revised to reflect the following changes in the de minimis levels: lead--0.1 ug/m^3, calendar quarter; hydrogen sulfide--0.2 ug/m^3, 1-hour; and beryllium--0.001 ug/m^3, 24-hour. These revisions have not been published in the Federal Register or incorporated into the Code of Federal Regulations.

Sources: 40 CFR 52.21.
Lutz, 1981.

criteria established in the CAA Amendments. Initially, Congress promulgated areas as Class I (international parks, national wilderness areas, and memorial parks larger than 2,024 hectares (ha) 5,000 acres), and national parks larger than 2,428 ha (6,000 acres)] or Class II (all other areas not designated as Class I). No Class III areas, which would be allowed greater deterioration than Class II areas, were designated. However, the states were given the authority to redesignate any Class II area to Class III status, provided certain requirements were met. EPA then promulgated as regulations the requirements for classifications and area designations. The State of Florida has adopted the EPA class designations and allowable PSD increments (Table 2-2). The nearest Class I area is the Everglades National Park, located about 75 and 57 km from the north and south BCRR facility, respectively.

The term "baseline concentration" evolved from federal and state PSD regulations and denotes a fictitious concentration level corresponding to a specified baseline date and certain additional baseline sources. By definition in the PSD regulations, as amended August 7, 1980, baseline concentration means the ambient concentration level which exists in the baseline area at the time of the applicable baseline date. A baseline concentration is determined for each pollutant for which a baseline data is established and shall include:

1. The actual emissions representative of sources in existence on the applicable baseline date; and

2. The allowable emissions of major stationary sources which commenced construction before January 6, 1975, but were not in operation by the applicable baseline date.

The following will not be included in the baseline concentration and will affect the applicable maximum allowable increase(s) (allowed increment consumption):

1. Actual emissions from any major stationary source on which construction commenced after January 6, 1975; and

2. Actual emissions increases and decreases at any stationary source occurring after the baseline data.

"Baseline date" means the earliest date after August 7, 1977, on which the first complete application under 40 CFR 52.21 is submitted by a major stationary source or major modification subject to the requirements of 40 CFR 52.21.

2.3.3 Control Technology Review

CAA mandated that EPA promulgate NSPS, which are a set of national emission standards for stationary sources of air pollution. These standards are applicable to specific categories of sources and apply not only to new sources, but also to modified or reconstructed existing sources of air pollution. Consequently, EPA promulgated NSPS for incinerators in June 1974 (40 CFR 60, Subpart E). NSPS for incinerators impose an emission limitation on particulate matter (PM) only. Specifically, incinerators with a charging rate in excess of 50 TPD of solid waste may not discharge to the atmosphere flue gases that contain PM in excess of 0.08 grain per standard cubic foot dry gas (gr/dscf), corrected to 12-percent carbon dioxide (CO_2).

DER has promulgated pollutant emission limitations to attain and preserve ambient air quality. The only emission regulation that applies to the proposed BCRR facilities is a PM standard. Particulate emissions from a new incinerator with a charging rate equal to or greater than 50 TPD are limited to 0.08 gr/dscf corrected to 50-percent excess air. Opacity is limited to 20 percent.

Under EPA's implementation of the CAA Amendments, the basic control technology requirement is the application and evaluation of BACT. BACT is defined as follows (40 CFR 52.21(b)(12)):

> An emission limitation...based on the maximum degree of reduction for each pollutant...which would be emitted from any proposed major stationary source or major modification which the Administrator, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable...for control of such pollutant.

In December 1978, EPA's Office of Air, Noise, and Radiation published Guidelines for the Evaluation of BACT to assist states and EPA Regional Offices in making BACT determinations. The BACT requirements are intended to ensure that the control systems incorporated in the design of a proposed facility reflect the latest in control technologies used in a particular industry and take into consideration existing and future air quality in the vicinity of the proposed facility. BACT must, as a minimum, demonstrate compliance with NSPS for this source, if applicable. An evaluation of the air pollution control techniques and systems, including a cost-benefit analysis of alternative control technologies capable of achieving a higher degree of emission reduction that then proposed control technology, is also required. The cost-benefit analysis requires the documentation of the materials, energy, and economic penalties associated with the proposed and alternative control systems as well as the environmental benefits derived from these systems.

2.3.4 Air Quality Analysis

In accordance with requirements of 40 CFR 52.21(m), any application for a PSD permit must contain, for each pollutant regulated under CAA, an analysis of continuous ambient air quality data in the area affected by the proposed major stationary source or major modification. For a new major source, the affected pollutants are those that the source would potentially emit in a significant amount.

According to CAA, ambient air monitoring for a period of up to 1 year generally is appropriate to complete the PSD requirements of CAA. Existing data from the vicinity of the proposed source may be utilized if the data meet certain quality assurance requirements; otherwise, additional data may need to be gathered. Guidance in designing a PSD monitoring network is provided in EPA's Ambient Monitoring Guidelines for Prevention of Significant Deterioration (EPA, November 1980).

The regulations include an exemption which excludes or limits the pollutants for which an air quality analysis is conducted. This exemption states that the Administrator may exempt a proposed major stationary source or major modification from the monitoring requirements of 40 CFR 52.21(m) with respect to a particular pollutant if the emissions increase of the pollutant from the source or modification would cause, in any area, air quality impacts less then the *de minimis* levels presented in Table 2-2.

The State of Florida has passed similar PSD air quality analysis requirements. EPA and State of Florida *de minimis* air quality impact levels are currently identical. In February 1981, EPA revised the *de minimis* levels and averaging times for three of the pollutants (Lutz, 1981). The averaging period for the *de minimis* level for lead was changed to 3 months, and the *de minimis* impact levels for beryllium and hydrogen sulfide were changed to 0.001 microgram per cubic meter (ug/m^3) and 0.2 ug/m^3, respectively.

2.3.5 Source Impact Analysis

A source impact analysis must be performed by a proposed major source subject to PSD for each pollutant for which the increase in emissions exceeds the significant emission rates (Table 2-2). The PSD regulations specifically require the use of atmospheric dispersion models in performing impact analysis, estimating baseline and future air quality levels, and determining compliance with AAQS and allowable PSD increments. Designated EPA models must normally be used in performing the impact analysis. Specific applications for other than EPA-approved models require EPA's consultation and prior approval.

Guidance for the use and application of dispersion models is presented in the EPA publications, "Guideline on Air Quality Models" (EPA, 1978) and "Regional Workshops on Air Quality Modeling: A Summary Report" (EPA, 1982a). Criteria pollutants may be exempt from the source impact analysis if the net increase in impacts due to the proposed source is below significant impact levels, as presented in Table 2-3.

Various lengths of record for meteorological data can be utilized for impact analysis. A 5-year period can be used with corresponding evaluation of highest, second-highest short-term concentrations for comparison to AAQS or PSD increments. The term "highest, second-highest" refers to the highest of the second-highest concentrations at all receptors (i.e., the highest concentration at each receptor is discarded). The second-highest concentration is significant because short-term AAQS specify that the standard should not be exceeded at any location more than once a year. If less than 5 years of meteorological data are used, the highest concentration at each receptor must be used.

2.3.6 Additional Impact Analyses

In addition to air quality impact analyses, federal PSD regulations require analyses of the impairment to visibility and the impacts on soils and vegetation that would occur as a result of the proposed source. These analyses are to be conducted primarily for PSD Class I areas. Impacts due to general commercial, residential, industrial and other growth associated with the source must also be addressed. These analyses are required for each pollutant emitted in significant amounts.

2.4 Source Applicability

The estimated emissions of regulated pollutants from the BCRR facilities are presented in Table 2-4. The proposed facilities will be located in Broward County, which is designated by EPA and DER as an attainment area for all criteria

TABLE 2-3

Significant Impact Levels for Criteria Pollutants

Pollutant	Averaging Period	Concentration (ug/m^3)
Sulfur Dioxide	3-Hour	25
	24-Hour	5
	Annual	1
Particulate Matter	24-Hour	5
	Annual	1
Nitrogen Dioxide	Annual	1
Carbon Monoxide	1-Hour	2,000
	8-Hour	500

Source: 40 CFR 52.

TABLE 2-4

Potential Emissions for Each Proposed BCRR Facility Compared to PSD Significant Emission Rates

Pollutant	Emission* Factor (lb/ton)	Estimated Emissions† (TPY)	PSD Significant Emission Rate (TPY)
Particulate Matter	1.14**	312	25
Sulfur Dioxide	3.0	821	40
Nitrogen Dioxide	3.0	821	40
Carbon Monoxide	0.6	164	100
Volatile Organic Compounds	0.14	38	40
Lead	0.15	41	0.6
Fluorides	0.1	27	3
Sulfuric Acid Mist	0.025	6.8	7
Hydrogen Sulfide	NA	NA	10
Total Reduced Sulfur	NA	NA	10
Reduced Sulfur Compounds	NA	NA	10
Asbestos	NA	NA	0.007
Beryllium	0.000011	0.003	0.0004
Mercury	0.0023	0.63	0.1
Vinyl Chloride	NA	NA	1
Benzene	NA	NA	0
Radionuclides	NA	NA	0
Inorganic Arsenic	0.00028	0.077	0

NA = Not applicable.

* See Table 3-3 for references for emission factors.
† Based on burning 1,500 TPD of MSW and 100-percent annual availability factor, for a total of 547,500 TPY.
** Assumes emission rate of 0.03 gr/dscf.

Source: ESE, 1983.

pollutants except ozone, and a PSD Class II area for SO_2 and TSP. Because volatile organic compound (VOC) emissions from the proposed facilities will be less than the significant impact levels, no additional analyses are required to address VOC impacts. The nearest nonattainment area for any other criteria pollutant is located more than 100 km from either of the proposed BCRR facilities. Because impacts from the proposed plant's emissions are not expected to be significant at such distances, potential impacts on the nearest nonattainment areas were not addressed in the analysis.

The proposed north and south BCRR facilities will be located about 57 and 75 km, respectively, from the PSD Class I area of the Everglades National Park. As a result, potential impacts on the Class I were addressed in the analysis.

Under PSD regulations, the proposed project will be a major source because it is one of the 28 named "major stationary sources" (i.e., municipal incinerator capable of charging more than 250 tons of refuse per day) which has the potential to emit more than 100 TPY of PM, SO_2, nitrogen dioxide (NO_2), and carbon monoxide (CO). As a result, any regulated pollutant emitted from the BCRR facilities above the significant emission rates presented in Table 2-4 is subject to PSD review.

Emissions of the following pollutants from the proposed sources will be in excess of the appropriate significant emission levels: PM, SO_2, NO_2, CO, lead, fluorides, beryllium, mercury, and arsenic. It should be noted that no significant emission rate has been established for arsenic, and, therefore, any emissions are considered significant. The methods and references used to estimate the emissions of the regulated pollutants are presented in Section 3.3.

As discussed in Section 2.3.4, a new major source may be exempt from preconstruction air quality monitoring requirements of the PSD regulations for those pollutants which have air quality impacts less than the de minimis levels presented in Table 2-2. The maximum predicted impacts due to emissions from each of the proposed BCRR facilities, for regulated pollutants subject to PSD review are presented in Table 2-5. The methods used to predict the proposed facilities impacts are described in Section 5.0. Based on these results, the impacts from the proposed facilities are expected to be below the de minimis impact levels for all pollutants except lead. Currently, there is no de minimis level designated for inorganic arsenic because an appropriate monitoring method has not yet been developed for this pollutant. Therefore, no monitoring is required, and no modeling has been performed for this pollutant in this analysis.

For lead, the impacts from the proposed facilities are expected to be slightly above the de minimis impact level promulgated by the State of Florida. Based on a review of existing monitoring data in the county (see Section 5.4), there is at least one lead monitor within 8 km of each of the proposed facilities' locations. These monitoring sites, which are expected to measure general population-created pollution in the county, have measured maximum concentrations that are less than 55 percent of AAQS. Because the maximum lead impacts from the proposed facilities are expected to be low and existing ambient lead concentrations are well below AAQS, existing monitoring data should be suitable for determining preconstruction monitoring lead levels and acceptable as part of the PSD permit application. Therefore, preconstruction monitoring for lead is not considered necessary for the BCRR facilities. It should be noted that EPA has revised the de minimis level for lead from a 24-hour to calendar-quarter averaging time. Based on this revision, the maximum predicted lead construction is well below the calendar-quarter averaging time. Based on this revision, the maximum predicted lead

TABLE 2-5

Predicted Impacts for Each Proposed BCRR Facility Compared to De Minimis Air Quality Impacts

Pollutant	Averaging Period	Impacts (ug/m^3) Maximum Predicted Due to Each Facility	De Minimis Level
Particulate Matter	24-hour	0.9	10
Sulfur Dioxide	24-hour	2.4	13
Nitrogen Dioxide	Annual	0.3	14
Carbon Monoxide	8-hour	1.4	575
Lead	24-hour (Quarterly)*	0.12 (0.02)	0.1 (0.1)
Fluorides	24-hour	0.08	0.25
Beryllium	24-hour	0.000009	0.0005 (0.001)
Mercury	24-hour	0.0018	0.25

* Values in parentheses represent results associated with revised de minimis monitoring levels.

Source: ESE, 1983.

concentration is well below the calendar-quarter average *de minimis* level and, therefore, monitoring would not be required as part of the PSD permit application.

3.0 FACILITY DESIGN

3.1 Process Description

The BCRR facilities will be designed such that MSW will be delivered to each facility by collection trucks that are either municipally or privately operated. MSW will be dumped from these vehicles into a totally enclosed tipping area which will be kept under negative pressure. The drawn air will be used as combustion air in the boilers. MSW will be moved from the storage pit and fed or charged into the furnaces by means of an overhead crane-and-grapple system. The cranes and grapples will also be used to mix processable waste in the pit to produce a homogeneous mass. This system will also be capable of removing large, bulky, combustible trash items from the storage pit and feeding them to the crusher and shears process. The crusher and shears, located at one end of the storage pit, will be used for size reduction of the oversized, processable trash prior to charging them into the furnaces. Provisions will also be made for removal of salvageable, oversized, noncombustible trash from the storage pit, using the overhead crane-and-grapple system.

The furnace design will be of the mass-burn stoker-fired or stoker/rotary kiln tandem type, capable of firing as-received processable waste, without auxiliary fuel burning, on a continuous-feed basis. Each combustion system will be equipped with an individual multiple-pass, waterwall-type boiler. This system will convert feed water to steam by the heat released during combustion of the solid waste. The steam will be used to drive a steam turbine which, in turn, drives an electric generator for the production of electricity.

The combustion air systems for the furnace will be designed to control automatically the furnace temperature within ±50° Fahrenheit of the set-point temperature selected by the vendor while firing processable waste with higher heating values (HHV) varying from 3,500 to 6,000 British thermal units per pound (Btu/lb). Sampling conducted on Broward County's processable waste (Malcolm Pirnie, Inc., 1983a) indicates that the minimum and maximum extremes of the range may be realized on a sustained seasonal basis (e.g., November through April at the upper range) as a result of significant variation in moisture content associated with extremes in rainfall.

The combustion air will be vented from the refuse storage area, tipping area, and/or the outside atmosphere. This procedure will maintain negative pressure in the refuse storage and tipping areas and thereby provide odor and dust control.

Gases exiting the furnaces and boilers will enter an electrostatic precipitator for removal of particulates matter prior to release of the gases to the atmosphere.

The proposed facilities will also have a residue handling system to collected the postincineration bottom ash and fly ash while separating any recyclable materials in a dust-free manner. The systems will have ash conveyors to transport the ash to the handling areas at each facility. Provisions for an enclosed tractor-trailer loading area with ventilation and dust control will be incorporated into the design. A clam-shell-type bucket for loading ash onto trucks from an ash storage pit may be provided. The residue ash will contain less than 4.0 percent combustibles and less than 0.2 percent putrescibles.

The bottom ash or residue will be water-cooled by spray or quenched in tanks or sumps before it is handled by the conveyors. The cooled bottom ash handling system will consist of drag or vibrating conveyors designed to handle the total plant load. The fly ash may be combined with the quenched bottom ash or collected separately by the vendor to market the fly ash for reuse. The fly ash handling system will include, but not be limited to, screw conveyors inside the precipitator hoppers, rotary or double-flap airlock valves, and dry drag-type transfer conveyors.

3.2 Solid Waste Composition

The proposed resource recovery facilities have been designed to process residential, commercial, institutional, and nonhazardous industrial waste. Field experience (Malcolm Pirnie, Inc., 1983a, 1983b) in Broward County has shown that the gross or HHV of municipal wastes averages 5,000 Btu/lb and ranges from 3,500 to 6,500 Btu/lb. General characteristics of the composition of the municipal waste determined from field analyses are presented in Table 3-1.

3.3 Emission and Stack Operating Parameters

The proposed project consists of two resource recovery facilities to be located in Broward County. The data presented in this report are based on preliminary or conceptual design of the proposed facilities. The design will be subject to certain refinements following selection of a full-service vendor scheduled for March 1984. However, the conceptual design is based on conservative or worst-case assumptions from a potential air quality impact viewpoint.

Each BCRR facility is assumed to be capable of burning 1,500 TPD of MSW. One of the facilities is to be located in north Broward County, approximately 22 km north-northeast of the other facility, located in south Broward County. Because the two facilities are assumed to be identical in stack and operating design, the data presented in Table 3-2 are applicable for each facility. The proposed stack heights for each facility will be at a Good Engineering Practice (GEP) height; therefore, building downwash conditions are not considered in this analysis.

TABLE 3-1

Proximate and Ultimate Analyses of MSW for BCRR Project

Component	Percent by Weight of MSW
<u>Proximate Analysis</u>	
Moisture	51.1
Combustibles	35.8
Ash Inert	13.1
HHV (Btu/lb)	5,000
<u>Ultimate Analysis</u>	
Carbon	53.4
Hydrogen	7.4
Nitrogen	0.0061
Oxygen	38.7
HHV (Btu/lb)	9,781

Source: Malcolm Pirnie, Inc., 1983b.

TABLE 3-2

Stack and Operating Parameters for North and South BCRR Facilities*

Parameter	Value
MSW charging rate (maximum)	1,500 TPD (62.5 ton/hr)
MSW heat input rate†	625 x 10^6 Btu/hr
Stack height	195 ft (59.5 m)
Stack diameter	13.8 ft (4.2 m)
Exit gas temperature	450°F (505 K)
Exit gas flow rate†	438,770 acfm (207.2 m^3/s)
	276,585 dscfm (130.6 m^3/s)
Exit gas velocity	48.9 ft/s (14.9 m/s)
Location	
North Facility	
Latitude, longitude	26.26°, 80.16°
UTM zone	17
UTM x, y coordinates	584.0 km, 2904.7 km
South Facility	
Latitude, longitude	26.07°, 80.20°
UTM zone	17
UTM x, y coordinates	579.6 km, 2883.3 km

* Stack and operation parameters are assumed to be the same for both facilities.

† Based on average heating value of MSW of 5,000 Btu/lb for wet season.

Notes: acfm = actual cubic feet per minute
dscfm = dry standard cubic feet per minute

Sources: Malcolm Pirnie, Inc., 1983b.
ESE, 1983.

It should be noted that the exit gas flow rate presented in Table 3-2 is based on wet-season conditions when moisture content in MSW is relatively high. This results in the boiler exhaust gas flow rate also being the lowest during the wet season. For air dispersion modeling purposes, the flow rate presented in Table 3-2 was used to estimate ground-level concentrations because the lower flow rate will result in a lower plume rise compared to that produced with a higher flow rate. As a result, higher ground-level concentrations are predicted with the lower exit gas flow conditions.

The emission factors and literature references for the regulated pollutants that will be emitted from the proposed BCRR facilities are presented in Table 3-3. For most of the regulated pollutants, the emission factors are based on estimates derived for resource recovery facilities similar in size to the proposed facilities. The emission factors are given as a function of the amount of MSW buried. These emission factors are based on a review of the literature, such as EPA AP-42 emission factors and A.D. Little reports, or manufacturer's design specification.

The emission factor for particulate matter is based on an emission level of 0.03 gr/dscf. This emission limit will be obtained with an electrostatic precipitator that is greater than 98-percent efficient. Based on the researched emission factors, the estimated emissions for each facility are presented in Table 3-4. The maximum hourly emission rates were used in the air dispersion modeling analysis.

TABLE 3-3

Emission Factors of Regulated Pollutants

Pollutant	Emission Factor (lb/ton)	Reference
Particulate Matter	1.14	1
Sulfur Dioxide	3.0	2
Nitrogen Dioxide	3.0	4
Carbon Monoxide	0.6	5
Volatile Organic Compounds	0.14	3
Lead	0.15	2
Fluorides	0.1	2
Sulfuric Acid Mist	0.025	6
Beryllium	0.000011	2
Mercury	0.0023	2
Arsenic	0.00028	2
Other regulated pollutants	*	*

* There is no evidence in the literature that total reduced sulfur, reduced sulfur compounds, hydrogen sulfides, asbestos, vinyl chloride, benzene, or radionuclides are emitted in measurable quantities.

References

1. PM emissions based on emission limit of 0.03 gr/dscf.
2. Little, A.D. 1981. Municipal Incinerator Emission Estimates. Report to O'Brien and Gese Engineers.
3. United States Environmental Protection Agency. 1980. Environmental Assessment of a Waste-to-Energy Process--Braintree Municipal Incinerator, Publication EPA-600/PS7-80-149.
4. United States Environmental Protection Agency. 1983. Compilation of Air Pollutant Emission Factors, Third Edition, Supplements 1-14.
5. CO emissions based on stack test results from Saugus (Mass.) municipal incinerator (Malcolm Pirnie, 1983b).
6. Battelle. 1973. Final Report on Harrisburg Municipal Incinerator, Evaluation to the Harrisburg Incinerator Authority.

TABLE 3-4

Maximum Hourly and Annual Average Emission Rates for Both North and South BCRR Facilities

Pollutant	Emission Rate* Annual (TPY)	Maximum Hourly (lb/hr)
Particulate Matter	312	71
Sulfur Dioxide	821	188
Nitrogen Dioxide	821	188
Carbon Monoxide	164	38
Volatile Organic Compounds	38	8.8
Lead	41	9.4
Fluorides	27	6.3
Sulfuric Acid Mist	6.8	1.6
Beryllium	0.003	0.0007
Mercury	0.63	0.14
Arsenic	0.077	0.02

* Hourly emission rate based on burning 62.5 ton/hr of MSW. Annual emission rate based on burning 1,500 TPD and a 100-percent annual availability factor, for a total of 547,500 TPY.

Source: Malcolm Pirnie, Inc., 1983b.

4.0 BEST AVAILABLE CONTROL TECHNOLOGY EVALUATION

4.1 Description of Proposed Control Technology

The source applicability analysis for the proposed BCRR facilities, presented in Section 2.0, identified the following emitted air pollutants as requiring a BACT review under federal and state PSD regulations:

Particulate Matter (PM)
Sulfur Dioxide (SO_2)
Nitrogen Oxides (NO_X)
Carbon Monoxide (CO)
Lead (Pb)
Fluorides (F^-)
Beryllium (Be)
Mercury (Hg)
Arsenic (As)

The State of Florida has received administrative and technical review authority for the federal PSD program. In addition, Florida has passed PSD regulations and BACT requirements similar to EPA. DER defines BACT as follows (Ch 17-2.100(22), FAC):

> An emission limitation, including a visible emissions standard, based on the maximum degree of reduction of each pollutant emitted which the Department, on a case by case basis, taking into account energy, environmental and economic impacts, and other costs, determines is achievable through application of production processes and available methods, systems, and techniques (including fuel cleaning or treatment or innovative fuel combustion techniques) for control of each such pollutant... Each BACT determination shall include applicable test methods or shall provide for determining compliance with the standard(s) by means which achieve equivalent results.

The remainder of this section describes the proposed BACT, emission limit, visible emission (opacity) standard, and compliance test methods for each pollutant subject to BACT. An analysis of alternative control technologies, including economic, energy, and environmental considerations, is presented in Section 4.2.

4.1.1 Particulate Matter

PM generated by the combustion of MSW will be minimized through combustion controls and boiler design. PM exiting the boilers in the exhaust gases will be controlled by use of electrostatic precipitators (ESPs). The combustion boiler design will be of the mass-burn stoker-fired, or stoker/rotary kiln tandem, type and capable of firing as-received MSW on a continuous-feed basis without auxiliary fuel firing. The combustion efficiency of the stokers will yield a residue, or ash, containing not more than 4-percent combustibles or 0.2-percent noncombustibles. This boiler design requirement will serve to minimize the generation of ash and, therefore, PM in the furnace.

The number of boilers to be located at the north and south facilities has not been determined to date, but each facility will be capable of charging 1,500 TPD of MSW, based on a 100-percent annual availability factor. The exhaust gases of each boiler will pass through an ESP prior to discharge to the atmosphere through a common stack. Design details for the ESP are not known at this time. Design details will be supplied to DER as they become available for regulatory review. However, the following minimum criteria will have to be met by the selected manufacturer: Each ESP will be capable of reducing the exhaust gas PM concentration to 0.03 gr/dscf, corrected to 12-percent CO_2, over the range of boiler operating conditions. Opacity of the emissions will not exceed 20 percent.

The ESP will be complete with all appurtenances, structural supports, foundations, external and internal walkways, platforms, access stairways, fly ash hoppers with discharge air lock valves, power and control wiring, induced-draft fan, and other accessories for a complete operation system. Each ESP will be a multi-field type with the output of each ESP flowing into a single flue. The fields will be sized adequately considering both the volume of gases and amount of excess air. The temperature of flue gases entering the ESP will be below 600°F and at least 40°F above the dew point temperature. The maximum ESP inlet temperature is based on operating experience from ESPs at incinerator installations (EPA, 1979). The ESP design will have been successfully operated in a facility firing MSW for a minimum of 3 years.

ESP gas distributions will be accomplished via a low-velocity, multiple-vane system or a perforated-plate system. ESP collecting surface rapping will be by shaft-driven rotary hammers. Solenoid impact or vibration rapping is not acceptable. ESP high-voltage systems will have star-shaped, spiked, stainless-steel electrodes, with rigid mast mounting and high-alumina refractory-type insulators. Weighted wire systems are not acceptable. ESP discharge electrode raping will be accomplished by shaft-mounted rotary hammers; solenoid impact or vibrating raping is not acceptable.

ESP fly ash hopper heaters will be resistance type, extending two thirds of the ash hopper height from the bottom of the hopper (to prevent blockage). The fly ash handling systems include, but are not limited to, screw conveyors inside precipitator hoppers, rotary or double-flap air lock valves, and dry-drag type transfer conveyors.

Each furnace-boiler will be equipped with an induced-draft fan, an induced-draft fan drive, an induced-fan inlet damper, and appropriate breechings. Induced-draft fans will be centrifugal, backward-curved, inclined blade, treated radial-tip-type, designed for continuous operation at 600°F in a dusty environment.

An ESP with an outlet grain loading of 0.03 gr/dscf is considered to represent BACT for the proposed BCRR facilities, based on economic, energy, environmental, and plant operating considerations. NSPS for new incinerators charging more than 50 TPD of solid waste are applicable to this proposed project (40 CFR 601, Subpart E). The NSPS emission standard limits PM emissions to 0.08 gr/dscf, corrected to 12-percent CO_2. The proposed ESP emission rate is well below this allowable level.

The MSW boilers will be used to generate steam which will drive turbine electrical generators. The boilers will not be subject to the provisions of Subpart D or D(a) of 40 CFR 60, which are the NSPS for fossil-fuel-fired steam generators and electric utility steam generating units, respectively, because MSW is not a fossil fuel.

State of Florida PM emission-limiting standards require new incinerators with a charging rate of greater than 50 TPD to meet 0.08 gr/dscf, corrected to 50-percent excess air. This standard is similar to the federal NSPS, and the proposed facilities will emit PM at a significantly lower rate. State of Florida emission regulations also require an opacity limit of 20 percent, which the proposed facilities will not exceed.

The proposed ESP maximum PM emission rate of 0.03 gr/dscf and estimated maximum exhaust gas flow rate of 276,585 dscfm (see Table 3-2) will result in a maximum PM emission rate of 71 lb/hr. Based on EPA emission factors for municipal incinerators (EPA, 1983), uncontrolled PM emissions are estimated at 30 lb/ton of solid waste fired. EPA's review of NSPS for incinerators (EPA, 1979) cites uncontrolled PM emissions in the range of 10 to 70 lb/ton. However, it is noted that these values are for municipal incinerators and may not be applicable to resource recovery units. Nevertheless, if an average value of 30 lb/ton is assumed, the proposed facilities would generate 1,875 lb/hr of PM. The ESP would then have a PM removal efficiency of at least 98 percent. Assuming an average MSW heating value of 5,000 Btu/lb, the facilities would emit 0.11 lb/10^6 Btu of PM.

4.1.2 Sulfur Dioxide

The control technology of firing low-sulfur fuel in the mass-burn resource recovery facility is proposed as BACT. The BACT emission limit of 3.0 lb SO_2/ton of MSW fired is equivalent to 188 lb/hr or 0.30 lb/10^6 Btu heat input. By comparison, NSPS for fossil-fuel-fired boilers and electric utility steam generators firing solid fuel (40 CFR 60, Subparts D and D(a)] would allow up to 1.2 lb SO_2/10^6 Btu. No SO_2 emission-limiting standard currently exists for incinerators or MSW-fired boilers.

4.1.3 Nitrogen Oxides and Carbon Monoxide

The proposed BACT for NO_x and CO emissions is boiler design and good combustion practices. The proposed BACT emission limits are 3.0 lb/ton of MSW fired for NO_x (as NO_2), and 0.6 lb/ton for CO. These emission factors are equivalent to 188 lb/hr or 0.30 lb/10^6 Btu for NO_x (as NO_2) and 38 lb/hr or 0.061 lb/10^6 Btu for CO.

By comparison, NSPS for fossil-fuel-fired boilers [40 CFR 60, Subparts D and D(a)] limit NO_x (as NO_2) emissions to between 0.5 and 0.7 lb/10^6 Btu for solid fuel. No NO_x or CO emission-limiting standard currently exist for incinerators or MSW-fired boilers.

Factors that influence NO_x emissions from MSW boilers consist of boiler design, excess air, and peak combustion temperatures. NO_x emissions are derived from either the fuel-bound nitrogen being reduced and subsequently oxidized, or thermal oxidation of nitrogen in the combustion air. The latter source of NO_x is much greater than the former source. The primary factors affecting combustion air NO_x is the amount of oxygen in the combustion zone (i.e., related to excess air) and the peak combustion temperature. MSW boilers are typically designed for low-temperature operation, about 1,800°F (EPA, 1979).

For the proposed facilities, the combustion temperature will be maintained between 1,500°F and 1,800°F. The combustion air system will be designed to automatically control the boiler temperature within 50°F of the set-point temperature selected by the operator, while firing MSW over varying moisture compositions and heating values. Consequently, NO_x formation will be suppressed, with expected emissions of 3.0 lb/ton or 0.30 lb/10^6 Btu.

CO is produced when carbon-containing fuel is burned in an oxygen-deficient atmosphere, resulting in the carbon atoms being oxidized partially to CO instead of totally to CO_2. An oxygen-deficient atmosphere may result from deficient amounts of combustion air or incomplete air/fuel mixing. High excess air, proper primary and secondary air distribution, and proper air/fuel mixing all tend to minimize unburned carbon and CO emissions.

4.1.4 Other Pollutants

Other pollutants emitted from the proposed source requiring BACT review are lead, fluorides, beryllium, mercury, and inorganic arsenic. These are all trace elements contained in MSW in very minor quantifies. The proposed BACT for lead, beryllium, and inorganic arsenic is the ESP selected in Section 4.1.1 for the control of PM emissions. These pollutants are emitted in the solid phase; therefore, control of PM emissions will also control these pollutants. The BACT emission limits are the emission rates presented in Table 3-4 for each pollutant.

Fluorides and mercury are emitted primarily in the gaseous phase and are not susceptible to collection by ESP. No additional control technology is proposed for these pollutants since such controls would be costly and would not provide significant environmental benefits.

4.1.5 Test Methods to Demonstrate Compliance

Compliance with NSPS for PM will be demonstrated by source emission tests conducted in accordance with the Federal Reference Methods specified in 40 CFR 60, Appendix A. Reference Method 5 will be used in determination of PM emissions, grain loading, and moisture content.

4.2 Comparison of Alternative Control Technologies

Federal and state PSD/BACT regulations and guidelines require that an analysis of alternative control technologies be conducted (EPA, 1980; EPA, 1978). The only alternatives that need be addressed are those "which have greater control capabilities than the system proposed as BACT and which have been used or proposed for the same or similar operations" (EPA, 1978). If no better control technology than the proposed technology exists, no further analysis is necessary. Other equipment with similar control potential need not be evaluated.

The BACT analysis must support that the identified alternative control techniques would cause unreasonably adverse energy, environmental, or economic impacts. The following sections present the alternative analysis required under BACT review and justify selection of the proposed control equipment described in Section 4.1.

4.2.1 Particulate Matter

In March 1979, EPA conducted a survey of all existing and proposed incinerators in the United States (EPA, 1979). The study identified three types of control devices as potentially applicable to incinerators: ESPs, fabric filters, and venturi scrubbers. Test results for PM were compiled for 14 municipal incinerators where the federal reference method (Method 5) was known to be used for testing. MSW charging rates varied from 30 to 600 TPD. Of these installations, only one used a fabric filter for PM control, while nine used ESPs and four utilized venturi scrubbers. Test results were as follows (corrected to 12-percent CO_2):

Fabric filter:	0.024 gr/dscf
ESP:	0.018 to 0.060 gr/dscf, average of 0.041 gr/dscf
Venturi scrubber:	0.046 to 0.416 gr/dscf, average of 0.14 gr/dscf

These data indicate that fabric filter technology for incinerators is not well proven. Operational problems with filter gas were noted with the test results. However, the 0.024 gr/dscf emission rate was the second lowest of all test results; one ESP test was lower, with an emission rate of 0.018 gr/dscf.

ESPs are by far the most prevalent type of control and provide much better emission reduction than do venturi scrubbers. The venturi scrubber test results not only indicate much higher average emissions than the ESP, but scrubber deterioriation due to wearing of scrubber parts has been noted on several installations. In addition, high scrubber pressure drops are required to meet the 0.08 gr/dscf NSPS, resulting in a significant energy penalty. Those venturi scrubbers meeting NSPS operated with pressure drops of 15 inches of water (in. H_2O) or greater, whereas an ESP typically operates at 1 to 2 in. H_2O.

Test data from eight additional municipal incinerator installations where the test method was not specified were also presented. MSW charging rates varied from 120 to 360 TPD, and ESPs were used at all of these installations. The PM emissions ranged from 0.013 to 0.108 gr/dscf and averaged 0.059 gr/dscf (excluding two facilities where test results were reported in gr/acf).

In March 1982, EPA issued a background information document for nonfossil-fuel-fired industrial boilers (EPA, 1982b). The study included a survey of MSW boilers as well as refuse-derived fuel (RDF). This study stated:

> No successful scrubber applications to MSW or RDF boilers exist: the fine particulate in these boiler exhausts can be removed only by every high-energy scrubbers which must be constructed of expensive corrosion resistant materials. The only MSW boiler that used a wet scrubber replaced the scrubber with an electrostatic precipitator.
>
> Few full-scale baghouses have been applied to nonfossil fuel fired boilers...no baghouse installations exist on bagasse, MSW or RDF boilers. However, one baghouse operates successfully on an MSW incinerator. The principal drawback to fabric filtration, as perceived by potential users, is a fire danger arising from the collection of a combustible carbonaceous fly ash.
>
> Electrostatic precipitators are currently used on boilers fired with wood, MSW or RDF.

The data from the EPA study show that ESP is highly proven for municipal incinerator applications and is capable of achieving PM emission levels well below NSPS and State of Florida emission standards. In addition, this technology has low energy requirements (i.e., pressure drop of 1 to 2 in. H_2O) and no liquid waste disposal problem. On the other hand, a high pressure drop is required across a venturi scrubber to achieve levels as low as the proposed emission rate of 0.03 gr/dscf. This requirement would increase maintenance costs because of the severe wear on the venturi and increase energy costs significantly. The fabric filter is relatively unproven on municipal incinerators; although fabric filters potentially could achieve PM levels below 0.03 gr/dscf, they have experienced maintenance and operational problems which must be overcome before they are deemed reliable. For these reasons, venturi scrubbers and fabric filters were not considered further as viable control technologies.

Test data presented in the EPA non-fossil-fuel boiler study consisted of ESP data only for MSW-fired boilers. PM emissions ranged from 0.2 to 0.05 $lb/10^6$ Btu at average specific collection areas (SCA) of 140 to 570 ft^2/1,000 acfm, respectively. Data for the most efficient control device for PM emissions from MSW boilers were also presented (obviously for an ESP; since no other test data were available). These data were for ESPs with SCAs of 240 ft^2/1,000 acfm or more, and emissions averaged less than 0.1 lb/10^6 Btu in each of the four cases presented. Emissions in lb/10^6 Btu were shown to decrease as the SCA increased, the lowest test case yielding about 0.05 lb/10^6 Btu with an SCA of 573 ft^2/1,000 acfm. The proposed BCRR facilities will achieve a PM emission level of approximately 0.11 lb/10^6 Btu.

A resource recovery facility similar to the BCRR facilities is now operating in Dade County, Florida. The facility fires a maximum of 3,456 YTP of refuse-derived fuel (RDF). The PM emission rate determined as BACT for this facility was 0.037 gr/dscf and 94.05 lb/hr, or 0.65 lb/ton of RDF fired in the boilers. By comparison, the proposed BCRR facilities emission limit is 0.03 gr/dscf, which is equivalent to 71 lb/hr and 1.14 lb/ton.

The environmental impact of the selected control technology is considered to be minimal. The predicted maximum 24-hour average PM impact due solely to the proposed facilities will be less than 10 percent of the <u>de minimis</u> air quality impact level (i.e., for monitoring exemption), less than 20 percent of the significant impact level (i.e., for modeling exemption), less than 3 percent of the PSD Class II increment, and less than 1 percent of Florida AAQS. Predicted annual average PM impacts due to the facilities are 10 percent of the significant impact level (for modeling exemption), less than 1 percent of the PSD Class II increment, and less than 1 percent of Florida AAQS. These minimal environmental impacts do not justify a lower BACT emission level.

4.2.2 Sulfur Dioxide

Sulfur is contained in MSW in very small quantities, typically about 0.12 percent on an as-fired basis. For the proposed facilities, the resulting SO_2 emissions are 3.0 lb/ton or 0.30 lb/10^6 Btu heat input. Precombustion and postcombustion SO_2 control technologies have been developed for boilers firing fossil fuels. However, SO_2 control technologies have not been applied to boilers burning non-fossil fuels, such as MSW, due to the low SO_2 emissions.

Precombustion control technologies consist of: (1) using naturally occurring low-sulfur fuels, and (2) physically or chemically cleaning the fuel. The MSW fired in the proposed facility falls into this first category, with a sulfur content of 0.12 percent (i.e., 0.30 lb/10^6 Btu). By comparison, low-sulfur coal typically contains 0.5-percent sulfur (i.e., about 0.8 lb/10^6 Btu). and No. 2 distillate oil typically is a as low as 0.35-percent sulfur by weight (i.e., about 0.4 lb/10^6 Btu).

No method of physically or chemically cleaning MSW to lower its sulfur content is known to have been developed. The naturally low sulfur content of MSW has not required such a process to be developed. Therefore, precombustion sulfur removal from MSW is deemed technologically unfeasible.

Postcombustion SO_2 removal techniques for boilers consist of the implementation of flue gas desulfurization (FGD) technology. Several different FGD systems have been developed, primarily for use on high-sulfur-fuel-fired boilers. These consist of sodium scrubbing, dual-alkali scrubbing, lime and limestone scrubbing, and dry scrubbing. These systems use calcium- or sodium-based scrubbing solutions which react with SO_2 to form sulfite and sulfate salts.

The major drawbacks to all of these systems are:

1. They produce large amounts of solid and/or liquid wastes, which must be disposed of properly.

Disposal may cause other environmental effects (i.e., ground water contamination).

2. Energy requirements to operate the FGD system are high. Typical FGD installations on electric utility boilers use 10 percent or more of the energy output of the boiler.

3. FGD systems have not been applied to incinerators where SO_2 concentrations are low and highly variable due to the variable nature of MSW.

4. FGD systems are costly to install and operate and require considerable maintenance; due to operational problems they are rarely available 100 percent of the time, unless costly redundancy is built into the plant.

5. FGD systems typically use large amounts of water for the scrubbing solution.

Costs of applying an FGD system to a resource recovery/incinerator facility were estimated by Environmental Research and Technology, Inc. (1981) as part of the PSD permit application for Westchester County (New York) Resource Recovery Facility. This facility is capable of firing 1,890 TPD of MSW, which is approximately the size of the proposed Broward County facilities (1,650 TPD each). Five different FGD system types were evaluated.

SO_2 removal efficiency of each system was assumed to be 70 percent. Capital costs of an FGD system were found to range from $7 to $9 million (1983 dollars). Annual costs, including fixed capital charges and operating and maintenance costs, ranged from $0.94 to $1.34 per 10^6 Btu for the first year of operation. These annual costs equate to $4.6 to $6.5 million, based on a 90-percent availability factor.

There are no energy penalties associated with the proposed control technology. The associated environmental impacts are minimal. The predicted maximum 24-hour SO_2 impacts due to the proposed facility are 18 percent of the _de minimis_ impact level (i.e., for monitoring exemption) and less than 48 percent of the significant impact levels (i.e., for modeling exemption). Predicted impacts for all averaging times are less than 4 percent of all PSD Class II increments and Florida AAQS. The minimal SO_2 emissions and environmental impacts do not justify a lower BACT emission limit.

Considering the low SO_2 emissions from the proposed facility and the severe economic penalties, potential additional environmental impacts due to solid/liquid waste disposal, additional water and energy requirements, and unproven ability on MSW-fired boilers, implementation of an FGD system on the proposed BCRR facilities is considered economically and environmentally unacceptable. None of the SO_2 removal alternatives is considered superior to that of firing low-sulfur MSW fuel in the boiler.

4.2.3 Nitrogen Oxides and Carbon Monoxide

The proposed BACT control techniques for NO_x and CO emissions from the proposed BCRR facilities are: (1) limit peak combustion temperature to 1,800°F, (2) proper MSW firing in the boiler, and (3) high excess air operation. These control techniques are considered the only currently available methods of control for these pollutants.

The proposed BACT emission limits for NO_x result in maximum annual average predicted impacts of less than 3 percent of the de minimis impact level (i.e., for monitoring exemption), 30 percent of the significant impact level (i.e., for modeling exemption), and less than 0.5 percent of Florida AAQS. The proposed CO emission limit results in maximum predicted impacts of less than 1 percent of any de minimis impact level, significant impact level, or Florida AAQS.

Further reduction in emissions could be achieved through add-on flue gas cleaning equipment, but such equipment or processes have not been demonstrated in practice on incinerators (EPA, 1979). Flue gas cleaning methods for application to industrial/utility boilers with higher NO_x emissions are currently in the developmental stage only. Therefore, add-on NO_x/CO controls are not considered technically feasible for this application. In addition, the very small air quality impacts due to NO_x and CO emissions from the proposed BCRR facilities do not justify further reduction in emissions.

4.2.4 Other Pollutants

As discussed in Section 4.1.4, ESP used to control PM emissions will also control emissions of lead, beryllium, and inorganic arsenic. Alternative PM control technology is discussed in Section 4.2.1. For the reasons stated therein, ESP is considered to be the best choice of PM control technology for the proposed source and, therefore, BACT for control of lead, beryllium, and arsenic. The maximum predicted air quality impacts for these pollutants are well below all applicable air quality standards and de minimis impact levels (see Table 6-2). The minimal environmental impacts of these pollutants do not justify addition controls or reduced emission levels.

Additional control technology (i.e., add-on equipment) could be used to further reduce emissions of fluorides and mercury, which are emitted primarily in the gaseous phase. For example, a wet scrubber could be used, which has been demonstrated to remove more than 99 percent of the fluorides at phosphate rock plants. However, due to the low emission rates for these pollutants and the economic and energy penalties associated with add-on control equipment, additional add-on equipment is not justified. The maximum predicted air quality impacts for these pollutants are well below all applicable air quality standards and de minimis impact levels.

5.0 AIR QUALITY MODELING APPROACH

5.1 Model Selection

The ISC dispersion model (Cramer, 1979) was used to evaluate the proposed BCRR facilities' emissions. This model is contained in EPA's User's Network for Applied Modeling of Air Pollution (UNAMAP), Version 5 (EPA, 1983). The ISC model was selected primarily for the following reasons:

1. EPA and Florida DER have approved the general use of the model for air quality dispersion analyses because the model assumptions and methods are consistent with those in the Guideline on Air Quality Models (EPA, April 1978).

2. The ISC model is capable of predicting the impacts from stack, area, and volume sources that are spatially distributed over large areas and located in flat or gently rolling terrain.

3. The results from the ISC model are appropriate for addressing compliance with AAQS and PSD Class I and Class II increments.

The ISC model has rural and urban options which affect the plume rise formulas, wind speed profile exponent law, dispersion curves, and mixing height formulations used in calculating ground-level concentrations. One of the criteria used to determine when the rural or urban mode is appropriate is based on land use near the proposed plant (Auer, 1978). If the land use is classified as heavy industrial, light-moderate industrial, commercial, or compact residential for more than 50 percent of the area within a 3-km radius circle centered on the proposed source, the urban mode should be selected. Otherwise, the rural option is more appropriate. Based on a review of the land use around both facilities, the rural mode was selected because of the general lack of or minimal industrial and commercial development.

The ISC model consists of two model codes. The first model code, the ISC short-term (ISCST) model, is an extended version of the single-source (CRSTER) model (EPA, 1977). The ISCST model is designed to calculate hourly concentrations based on hourly meteorological parameters (i.e., wind direction, wind speed, atmospheric stability, ambient temperature, and mixing heights). The hourly concentrations are processed into non-overlapping, short-term averaging periods. For example, a 24-hour average concentration is based on twenty-four 1-hour averages calculated from midnight of each day. For each short-term averaging period selected, the highest and second-highest average concentrations are calculated for each receptor. As an option, a table of the 50 highest concentrations over the entire field of receptors can be produced. For the annual averaging period, the 1-hour concentrations are summed for all hours in the year for each receptor.

The second model code is the ISC long-term (ISCLT) model, which is an extension of the Air Quality Display Model (AQDM) and the Climatological Dispersion Model (CDM). The ISCLT model uses joint frequencies of wind direction, wind speed, and atmospheric stability to calculate seasonal and/or annual average ground-level concentrations. This model code was not used because the annual average concentrations were obtained from the ISCST model.

5.2 Meteorological Data

Meteorological data used in the ISCST model to determine air quality impacts consisted of a 5-year period (1970 to 1974) of hourly surface weather observations and twice-daily concurrent radiosonde soundings from the NWS station in Miami, Florida.

The NWS station in Miami, located approximately 55 km south-southwest of the proposed north plant site and 35 km south-southwest of the proposed south plant site, was selected for use in the study because it is the closest primary weather station to the study area with similar surrounding topographical features and land-water boundaries. This station also has the most readily available and complete data base which is representative of the proposed plant site. The surface observations included wind direction, wind speed, temperature, cloud cover, and cloud ceiling. The wind speed, cloud cover, and cloud ceiling values are used in the ISCST meteorological preprocessor program to determine atmospheric stability using the Turner stability scheme. Based on the temperature measurements at Miami, Florida, morning and afternoon mixing heights were calculated with the radiosonde data at Miami using the Holzworth approach (1972). Hourly mixing heights were derived from the morning and afternoon mixing heights using the interpolation method developed by EPA (Holzworth, 1972). The hourly surface data and mixing heights were used to develop a sequential series of hourly meteorological data (i.e., wind direction, wind speed, temperature, stability, and mixing heights). Because the observed hourly wind directions are classified into one of thirty-six 10-degree sectors, the wind directions are randomized within each sector using an EPA preprocessing program to account for the expected variability in air flow.

5.3 Receptor Grid

In the screening modeling analysis, concentrations were predicted for 360 receptor locations in a radial grid around each facility. The radial grid consisted of 36 radials located 10 degrees apart with 10 receptors located along each radial. The downwind distances of the receptors from the proposed source were 0.3, 0.7, 1.1, 1.5., 1.9, 2.3, 2.7, 3.1, 3.5, and 3.9 km along each radial. For addressing compliance with PSD Class II increments, model results were calculated for only one facility because the proposed facilities are identical in stack and operating design; results for one facility will apply to the other.

In the refined modeling analysis, concentrations were predicted using a 700-m by 700-m receptor grid centered on the receptor that produced the highest, second-highest concentration for the short-term averaging period. Receptors were separated by 100-m intervals. Refined modeling analysis was not performed for the annual average concentration because their spatial distribution is not expected to vary significantly for the radial receptor grid.

For addressing compliance with PSD Class I impacts, the two proposed facilities were modeled in the same model run to predict maximum impacts at 30 receptor locations, spaced 2 km apart, along the northeast boundary of the Everglades National Park. These receptor locations were selected along this boundary because it is the closest portion of the Class I area to the proposed sources. No refined modeling analysis was performed for Class I impacts.

5.4 Review of Existing Ambient Monitoring Data

A listing of all the ambient monitoring locations in Broward County is presented in Table 5-1. There are currently 18 sites operated by Broward County and 3 sites operated by Florida Power & Light Company (FP&L). Based on the PSD monitoring guidelines (EPA, 1981), for a proposed source located in an area of multisource emissions and flat terrain, existing ambient monitoring data may be acceptable if the existing monitor is within 10 km of the proposed source or 1 km of predicted maximum impacts.

The existing monitoring sites located within 10 km of the north and south facilities are listed in Tables 5-2 and 5-3, respectively. The maximum concentrations measured during 1982 are also presented in Tables 5-2 and 5-3. Based on these

Table 5-1. Ambient Air Monitoring Sites in Broward County

SAROAD No.	Broward County No. or Operator	Location		Pollutant Measured	Location with Respect to			
					North Facility		South Facility	
		City/Division	UTM X,Y Coordinates (km)		Direction (°)	Distance (km)	Direction (°)	Distance (km)
3700003G01	1	Pompano Beach	590.17, 2908.00	TSP	62	7.0	23	26.8
3700002G01	3	Pompano Beach	587.85, 2902.78	TSP	117	4.3	23	21.1
2270001G01/09	4	Lauderdale Lakes	579.55, 2894.76	TSP, NO_2, SO_2, CO	204	10.9	360	11.4
3640002G01	5	Plantation	575.52, 2891.27	TSP	212	15.9	334	9.4
1260003G01	6	Ft. Lauderdale	583.11, 2890.09	TSP, NO_2, SO_2, CO, Pb	183	14.7	27	7.6
4350001G01	7	Tamarac	574.44, 2897.87	TSP	234	11.8	340	15.4
0910002G01	8	Davie	576.19, 2884.99	TSP, NO_2, SO_2	202	21.2	296	3.81
3530001G01	9	Pembroke Pines	575.26, 2877.44	NO_2, SO_2	198	28.7	216	7.3
1840001G01	10	Hollywood	582.21, 2876.98	TSP, Pb	184	27.8	158	6.9
1640001G01	11	Hallandale	584.60, 2874.44	TSP	179	30.3	151	10.2
1260004G01/09	12	Ft. Lauderdale	585.20, 2887.20	TSP, NO_2, SO_2	176	17.6	55	6.8
0420002G01	13	Hacienda Village	579.70, 2885.34	CO	192	19.9	3	2.0
0420003G03	14	Coral Springs	571.60, 2906.88	O_3	280	12.6	341	24.9
3530002G01/09	15	Pembroke Pines	570.00, 2878.40	TSP	208	29.8	297	10.8
0420004G01	16	N. Lauderdale	577.73, 2900.11	O_3	234	7.8	354	16.9
3700004G01	17	Pompano Beach	585.34, 2900.13	CO	164	4.8	19	17.8
1840002G01	18	Hollywood	584.00, 2875.87	CO	180	28.9	150	8.6
2560002G01	19	Margate	578.86, 2903.51	TSP, Pb	257	5.3	358	20.2
1260005J02	FP&L	Ft. Lauderdale	579.28, 2882.35	TSP, NO_2, SO_2	192	22.9	199	1.0
1260006J02	FP&L	Ft. Lauderdale	583.05, 2883.85	TSP, NO_2, SO_2	183	20.9	81	3.5
1260007J02	FP&L	Ft. Lauderdale	589.10, 2886.85	TSP, NO_2, SO_2	164	18.6	70	10.1

Source: ESE, 1983.

Table 5-2. 1982 Ambient Air Quality Data for Monitoring Stations Within 10 km of the North BCRR Facility

Broward County No. or Operator	SAROAD No.	Concentration (ug/m^3)*							
		TSP		SO_2		NO_2	CO†		Pb
		24-hr	Annual	24-Hr	Annual	Annual	1-hr	8-hr	Quarter
1	3700003G01	60	35	—	—	—	—	—	—
3	3700002G01	72**	31**	—	—	—	—	—	—
4	2270001G01	73	39	3**	3**	33**	13	6	—
4C††	2270001G09	66	39	3	3	34	—	—	—
17	3700004G01	—	—	—	—	—	11**	6**	—
19	2560002G01	56	28	—	—	—	—	—	0.1**
Florida AAQS		150	60	260	60	100	40	10	1.5

* For short-term averages, second-highest concentration is shown.
† CO concentrations in mg/m^3.
** Closest monitoring station for specified pollutant.
†† Colocated with Site No. 4.

Source: ESE, 1983.

Table 5-3. 1982 Ambient Air Quality Data for Monitoring Stations Within 10 km of the South BCRR Facility

Broward County No. or Operator	SAROAD No.	Concentration (ug/m³)* TSP 24-hr	TSP Annual	SO_2 24-Hr	SO_2 Annual	NO_2 Annual	CO† 1-hr	CO† 8-hr	Pb Quarter
5	3640002G01	59	29	—	—	—	—	—	—
6	1260003G01	90	56	16	5	38	15	9	0.8
8	0910002G01	73	33	10	3	27	—	—	—
9	3530001G01	—	—	5	3	28	—	—	—
10	1840001G01	92	43	—	—	—	—	—	0.3**
12	1260004G01	72	36	16	4	30	—	—	—
12C††	1260004G09	—	—	16	4	30	—	—	—
13	0420002G01	—	—	—	—	—	25**	10**	—
18	1840002G01	—	—	—	—	—	12	7	—
FP&L	1260005J02	95**	38**	17**	3**	36**	—	—	—
FP&L	1260006J02	93	39	8	3	47	—	—	—
FP&L	1260007J02	78	32	5	3	21	—	—	—
Florida AAQS		150	60	260	60	100	40	10	1.5

* For short-term averages, second-highest concentration is shown.
† CO concentrations in mg/m³.
** Closest monitoring site for specified pollutant.
†† Colocated with Site No. 12.

Source: ESE, 1983.

measured maximum concentrations, pollutant concentrations within a 10-km radius from each facility are generally less than 65 percent of the national and Florida AAQS, except for CO. It should be noted that the SO_2 and NO_2 concentrations are not measured by an acceptable technique for use in PSD applications. However, based on the data presented in Tables 5-2 and 5-3, the measured SO_2 and NO_2 concentrations are well below AAQS. Also, based on the modeling results presented in Section 6.0, the maximum predicted concentrations due to each resource recovery facility are expected to be below the de minimis impact levels for all pollutants except lead; therefore, no monitoring is required for those pollutants. Currently, a de minimis impact level has not been designated for inorganic arsenic because an appropriate monitoring method has not yet been developed. As a result, no monitoring is required for that pollutant. For lead, ambient concentrations are measured at 1 monitor within 6 km from the north facility and 2 monitors within 8 km from the south facility. These monitoring sites, which are expected to measure general population-created pollution, have measured maximum concentrations that are less than 55 percent of AAQS. Because the maximum impacts from the proposed facilities are expected to be low and existing ambient lead concentrations are well below AAQS, preconstruction monitoring for lead is not considered necessary for the BCRR facilities.

The only measured pollutant that approached AAQS in 1982 was CO. Within a 10-km radius of the proposed south facility, the highest and second-highest 8-hour average CO concentrations for 1982 equalled the 8-hour AAQS at one monitor location (i.e., Broward County Site No. 13). Based on data received through August 1983 from DER and Broward County Environmental Quality Control Board (EQCB), the highest and second-highest 8-hour average concentrations measured at Broward County Site No. 13 in 1983 were 10 and 9.5 mg/m^3, respectively. Thus, the second-highest concentration at this site is slightly less than the AAQS of 10 ug/m^3. Based on the model results presented in Section 6.0, the maximum predicted 8-hour average concentration due to the proposed facilities is well below the PSD significant impact level. Therefore, the proposed facilities will not have a significant impact in the vicinity of the monitor.

6.0 AIR QUALITY MODELING RESULTS

Predicted maximum impact concentrations for each of the proposed BCRR facilities, using screening and refined modeling receptor grids, are presented in Tables 6-1 and 6-2, respectively. These results are based on each plant charging 1,500 TPD, or 62.5 tons per hour, of MSW and using the maximum hourly emission rates presented in Table 3-4 (see Section 3.3.3).

In general, maximum pollutant concentrations increased slightly for the refined receptor grid as compared to the screening grid. For all the pollutants, the predicted maximum concentrations are below the PSD significant impact levels and de minimis monitoring levels, as a result, the proposed plants' emissions do not produce a significant impact for SO_2, PM, NO_2, and CO concentrations, and, therefore, do not require additional modeling analyses. For the other regulated pollutants, for which significant impact levels have not been established, the predicted maximum concentrations are well below the de minimis monitoring levels established for these pollutants. It should be noted that even if the two plants were colocated (i.e., double the concentrations presented in Tables 6-1 and 6-2), the predicted maximum concentrations are below the PSD significant impact levels and de minimis monitoring levels (i.e., combined impact would slightly exceed significant impact level). Based on these results and the existing low measured pollutant concentrations in Broward County (see Section 5.4), the proposed emissions from each of the resource recovery facilities are expected to comply with the national and Florida AAQS and PSD Class II increments.

The proposed emissions from both of the BCRR facilities, modeled together, also produce predicted maximum concentrations that are less than the PSD significant impact levels and de minimis monitoring levels in the PSD Class I area in the

TABLE 6-1

Predicted Maximum Concentrations for Each Proposed Resource Recovery Facility Using Screening Modeling Methods

Pollutant	Averaging Time	Maximum Concentration* (ug/m^3)	Receptor Location† Direction (°)	Receptor Location† Distance (km)	Period Year	Period Julian Day	Period Hour Ending
SO_2	3-hour	10.3	300	2.3	1971	126	12
	24-hour	2.4	270	3.1	1970	165	24
			260	2.7	1973	107	24
	Annual	0.3	280	3.1-3.9	1970	—	—
			300	2.3-3.9	1972,1974	—	—
TSP	24-hour	0.9	270	3.1	1970	165	24
			260	2.7	1973	107	24
	Annual	0.1	280	3.1-3.9	1970	—	—
			300	2.3-3.9	1972,1974	—	—
NO_2	Annual	0.3	280	3.1-3.9	1970	—	—
			300	2.3-3.9	1972,1974	—	—
CO	1-hour	4.5	90	1.5	1973	191	11
	8-hour	1.3	310	1.9	1972	111	16
Pb	24-hour	0.12	270	3.1	1970	165	24
			260	2.7	1973	107	24
	(Quarterly)	(0.02)**	(280)	(3.1-3.9)	(1970)	(—)	(—)
			(300)	(2.3-3.9)	(1972,1974)	(—)	(—)
F^-	24-hour	0.08	270	3.1	1970	165	24
			260	2.7	1973	107	24
Be	24-hour	0.000009	270	3.1	1970	165	24
			260	2.7	1973	107	24
Hg	24-hour	0.0018	270	3.1	1970	165	24
			260	2.7	1973	107	24

* Highest, second-highest concentration for short-term period; highest concentration for annual period. Values in parentheses represent results associated with revised de minimis monitoring levels. See Section 2.2 for details.

† With respect to proposed facility.

** Annual average.

Source: ESE, 1983.

TABLE 6-2

PREDICTED MAXIMUM CONCENTRATIONS FOR THE PROPOSED RESOURCE RECOVERY FACILITY USING REFINED MODELING METHODS

Pollutant	Averaging Time	Maximum* Concentration (ug/m^3)	Receptor Location† Direction (°)	Receptor Location† Distance (km)	Period Year	Period Julian Day	Period Hour Ending	Significant Impact Levels (ug/m^3)	*De Minimis* Monitoring Levels (ug/m^3)
SO_2	3-hour	10.3	301	2.44	1971	167	15	25	NA
			300	2.3	1971	126	12		
	24-hour	2.4	260,	2.6-3.1	1970	165	24	5	13
			270		1973	107	24		
	Annual	0.3	280	3.1-3.9	1970	-	-	1	NA
			300	2.3-3.9	1972,74	-	-		
TSP	24-hour	0.9	260,	2.6-3.1	1970	165	24	5	10
			270		1973	107	24		
	Annual	0.1	280	3.1-3.9	1970	-	-		
			300	2.3-3.9	1972,74	-	-	1	NA
NO_2	Annual	0.3	280	3.1-3.9	1970	-	-	1	14
			300	2.3-3.9	1972,74	-	-		
CO	1-hour	5.0	94	1.4	1973	189	12	2,000	NA
	8-hour	1.4	312	2.0	1972	112	16	500	575
Pb	24-hour	0.12	260,	2.6-3.1	1970	165	24	NA	0.1
			270		1973	107	24		
	(Quarterly)	(0.02)**	(280)	(3.1-3.9)	(1970)	-	-	(NA)	(0.1)
			(300)	(2.3-3.9)	(1972,74)	-	-		
F^-	24-hour	0.08	260,	2.6-3.1	1970	165	24	NA	0.25
			270		1973	107	24		
Be	24-hour	0.000009	260,	2.6-3.1	1970	165	24	NA	0.0005
			270		1973	107	24		(0.001)
Hg	24-hour	0.0018	260,	2.6-3.1	1970	165	24	NA	0.25
			270		1973	107	24		

NA - Not applicable.

* Highest, second-highest concentration for short-term period; highest concentration for annual period. Values in parentheses represent results associated with revised *de minimis* monitoring levels. See Section 2.2 for details.

† With respect to proposed facility.

** Annual average.

Source: ESE, 1983.

Everglades National Park (Table 6-3). These results are consistent with the predicted maximum concentrations within the near vicinity of the proposed facilities. Thus, the emissions for the two proposed BCRR facilities are expected to comply with national and Florida AAQS and PSD Class I increments in the Everglades National Park.

TABLE 6-3

PREDICTED MAXIMUM CONCENTRATIONS AT THE PSD CLASS I AREA DUE TO BOTH PROPOSED RESOURCE RECOVERY FACILITIES

Pollutant	Averaging Time	Maximum Concentration*	Receptor Location† UIM Coord. (km) x	y	Period Year	Julian Day	Hour Ending	Significant Impact Levels (ug/m^3)	De Minimis Monitoring Levels (ug/m^3)
SO_2	3-hour	1.5	522.75	2849.4	1971	261	24	25	N/A
	24-hour	0.4	520.75	2849.4	1973	311	24	5	13
	Annual	0.0	-	-	-	-	-	1	N/A
TSP	24-hour	0.2	520.75	2849.4	1973	311	24	5	10
	Annual	0.0	-	-	-	-	-	1	N/A
NO_2	Annual	0.0	-	-	-	-	-	1	14
CO	1-hour	0.6	532.75	2847.4	1971	216	20	2,000	N/A
	8-hour	0.2	532.75	2847.4	1972	346	8	500	575
Pb	24-hour (Quarterly)	0.02 (0.0)**	520.75	2849.4	1973	311	24	N/A	0.1 (0.1)
F	24-hour	0.01	520.75	2849.4	1973	311	24	N/A	0.25
Be	24-hour	0.000002	520.75	2849.4	1973	311	24	N/A	0.001 (0.0005)
Hg	24-hour	0.0003	520.75	2849.4	1973	411	24	N/A	0.25

* Highest, second-highest concentration for short-term period; highest concentration for annual period. Values in parentheses represent results associated with revised de minimis monitoring levels. See Section 2.2 for details.

† North and south facilities UIM x,y coordinates are 583.96, 2904.7 and 579.62, 2883.45 km, respectively.

** Annual average.

Source: ESE, 1983.

7.0 IMPACTS ON VEGETATION, SOILS, AND VISIBILITY

7.1 Impacts on Vegetation and Soils

The vegetation in the Broward County portion of southeastern Florida consists primarily of garden and landscape plants and weeds which occupy disturbed and undeveloped sites. Common plants for landscaping include tropical broadleaf evergreens such as Ficus species (spp.), palms, and Araucaria spp. Common species on disturbed sites include Brazilian pepper tree (Schinus terebinthefolius), Melaleuca quinquenervia, castor bean (Ricinis communis), and other quick-growing woody shrubs.

The site location for the proposed south resource recovery facility contains a combination of upland and wetland vegetation. The southern portion of the site is upland in character and contains species such as Brazilian pepper, wax myrtle, water pennywort (Hydrocatyle sp.), pickerel weed (Pontederia lanceolata), water plantain (Sagittaria sp.), water hyssop (Bacopa sp.), and spike rush (Eleocharis sp.), as well as exotic species such as Melaleuca, Brazilian pepper, and Australian pine (Casuarina equisetifolia). Deposition of dredge material from previous dredging operations along the South Fork of the New River, which flows along the southern and eastern border of the site, has created a narrow berm on which exotic and upland species grow. Much of the existing wetland area on the site has been degraded by previous site disturbances and is in a state of transition to weedy plant species.

The site location for the proposed north resource recovery facility also contains a combination of upland and wetland vegetation. Most of the site is characterized as upland, with the predominant vegetation being dense stands of Brazilian pepper. There are three identifiable stands of cypress (Taxodium distichum) on the site which probably represent the remnants of an earlier, more extensive system. Other cypress trees and cabbage palms (Sabal palmetto) are scattered throughout the Brazilian pepper but are gradually being replaced by the Brazilian pepper.

The eastern border of the Everglades National Park, a PSD Class I area, is approximately 75 and 57 km southwest of the north and south plant sites, respectively. Important plant species in the park include sawgrass (Cladium jamaicense), Dade County slash pine (Pinus elliotti var. densa), and epiphytic vascular plants.

Plant response to atmospheric pollutants is influenced by the concentration, duration of each exposure, and the frequency of exposures. The usual pattern of pollutant exposure is that of a few episodes of relatively high concentrations for a short duration, interspersed with long periods of extremely low concentrations. Effects on most plants will be from the short-term higher doeses (i.e., product of the pollutant concentration and the duration of exposure). Very little information is available on the effects of airborne pollutants on species in south Florida. Therefore, the pollutant concentrations expected as a result of each facility operation are compared with the lowest concentrations known to affect the most sensitive plants that have been tested for response to each pollutant. It should be noted that these concentration levels that adversely affect plants are based on a literature review for plants that may not grow in this part of the state. Thus, these concentration levels represent a conservative threshold for comparison with the maximum predicted concentrations.

The maximum predicted total concentration for each pollutant due to each facility is presented in Table 7-1. The total predicted concentration consists of the maximum predicted facility concentration added to a background concentration developed from the maximum concentration measured at the

Table 7-1. Maximum Predicted Concentrations Due to Proposed Resource Recovery Facilities Compared to Concentrations Known to Adversely Impact Vegetation

		Concentration (ug/m^3)				
Pollutant	Average Period	Maximum Predicted Due to Facility	Background*	Total (Facility Plus Background)	Lowest Concentration Known to Impact Vegetation (ug/m^3)	Reference
SO_2	3-hour	10.3	17†	27.3	260	Tingey, 1973.
TSP	24-hour	0.9	95	95.9	1,000 g/m^2	Williams, 1971.
NO_2	Annual	0.3	47	47.3	120	Thompson, 1970.
	3-hour	10.3	89†	99.3	188	Tingey, 1971.
CO	1-hour	5.0	25,000	25,006	Vegetation not impacted by CO	—
Pb	3-month	0.02	0.8	0.82	Not known to be available to plants	Zimdahl, 1973.
F^-	24-hour	0.01	**	0.01	0.10	NAS, 1971.
Be	24-hour	0.000011	**	0.000011	Not known to be available to plants	Gough, 1979.
Hg	24-hour	0.0024	**	0.0024	10 (Duration unknown)	Stahl, 1979.

* Second highest 3- or 24-hour or highest annual average concentration measured within 10 km of either the north or south facility (see Section 5.4).

† 24-hour average concentration; shorter averaging period not available with monitoring technique.

** Ambient monitoring data not available in Broward County.

Source: ESE, 1983.

monitoring station nearest either of the two proposed plant locations (See Section 5.4). The lowest concentrations known to adversely impact the most sensitive plants tested for effects of pollutants are also presented in Table 7-1.

As indicated in Table 7-1, the maximum concentrations of pollutants expected to result from operation of the proposed facilities are either orders of magnitude below concentrations known to adversely impact sensitive plants or are not known to impact vegetation at all. Since the maximum concentrations of the same pollutants that are expected in the Everglades National Park are even lower than those expected near the facilities, no impact on the vegetation of the Class I area due to operation of the facilities is expected.

Soils in the region of south Florida where the proposed sites are located and the Everglades National Park are highly calcareous sands or organic soils with high cation exchange capacity. Thus, the soils have the capability of neutralizing or adsorbing any acidic pollutants attributable to the proposed facilities. Again, the concentration of pollutants expected to result from operation of the BCRR facilities is so low that, in any event, effects on soils will be negligible.

7.2 Visibility Impacts

CAA Amendments of 1977 provide for implementation of guidelines to prevent visibility impairment in mandatory Class I areas. The guidelines are intended to protect the aesthetic quality of these pristine areas from reduction in visual range and atmospheric discoloration due to various pollutants. The nearest Class I area to the proposed plant site is the Everglades National Park, located about 57 and 75 km from south and north resource recovery facilities, respectively. Because the maximum predicted impacts are below the PSD significant and *de minimis* impact levels for all regulated pollutants, the impact on visibility in Class I areas due to the proposed plants will be insignificant. To demonstrate this conclusion, a Level-1 visibility screening analysis to determine potential adverse visibility effects was performed using the procedures suggested in the Workbook for Estimating Visibility Impairment (EPA, 1980). Based on this analysis using worst-case meteorological conditions and assumptions, the three contrast parameters (i.e., plume contrast against sky plume contrast against terrain, and change in sky/terrain contrast caused by primary and secondary aerosols) were estimated for the total emissions from the proposed north and south facilities. The results of this analysis indicated that the absolute values of the contract parameters were lower than the criteria used to determine if potential adverse visibility impairment could occur in Class I areas. Based on these results, the emissions from both proposed facilities are highly unlikely to cause adverse visibility impairment in the Everglades National Park.

7.3 Indirect Air Quality Impacts

The indirect air quality impacts associated with the proposed facilities would be attributable to the increased automotive traffic generated by employee travel and solid waste delivery. It is anticipated that about 330 solid waste transport vehicles per day would deliver municipal refuse to each facility. The impact of the exhaust emissions from the solid waste transport vehicles is expected to be minimal. The vehicles associated with each facility would represent an increase of less than 1 percent of the traffic that travels on existing roadways (Malcolm Pirnie, 1983b). In addition, the solid waste transport vehicles would largely replace the vehicles used for the existing solid waste transport pattern. Since the operation of the proposed facilities will require only about 40 fulltime employees, the impacts associated with employee traffic also will be neglible.

8.0 SUMMARY AND CONCLUSIONS

The following discussions present a summary and conclusions drawn from the results of this study.

1. Each of the proposed BCRR facilities will be a major source of emissions for PM, SO_2, NO_2, and CO. Each facility will also have significant emissions for Pb, F, Be, Hg, and As. Therefore, these pollutants must undergo review under the new source review requirements of the PSD regulations. The other regulated pollutants are not emitted above the PSD significant emission rates and, therefore, do not require PSD review.

2. Emission control equipment to be used at each of the proposed facilities will be designed to remove more than 98 percent of PM. This will result in the emission of 0.03 gr/dscf of PM, which is about 60 percent better than existing EPA NSPS requirements for solid waste incinerators.

3. The proposed control systems included in the design and operational procedures for PM, SO_2, NO_2, CO and trace pollutant emissions are considered BACT. No alternative particulate and trace pollutant control device, which would be capable of a higher degree of emission reduction, is currently considered for the proposed facilities.

4. The air quality dispersion modeling results show that the proposed emissions from both facilities will comply with the national and Florida AAQS and PSD Class I and II increments. The proposed emissions from each facility produce maximum ground-level concentration that are below the established significant impact and <u>de minimis</u> air quality impact levels for all pollutants, except lead near the vicinity of each facility. For lead, the maximum predicted impact due to each facility slightly exceeds the <u>de minimis</u> air quality level (no significant impact level has been established). However, PSD monitoring is not considered necessary for any pollutants, including lead, because of the existing monitoring stations in Broward County which measure criteria pollutant concentrations and the predicted low concentrations due to each facility.

   Because the maximum predicted concentrations for pollutants emitted above the PSD significant emissions rates are below the AAQS and threshold limits that cause injury to vegetation and soils, the impacts due to each facility are not expected to have a significant impact on vegetation and soils in the PSD Class I and II areas. Also, the emissions from both proposed facilities are highly unlikely to cause adverse visibility impairment in the Everglades National Park.

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APPENDIX D

TYPICAL AIR POLLUTION CONTROL
SYSTEM DESIGN DETAILS - FOR WASTE
MANAGEMENT, INC. - BECHTEL
CIVIL & MINERALS, INC. VENDOR

POLLUTION CONTROL SYSTEM

9.0 **Description**

Attached hereto:

Exploded view "Electrostatic Precipitator, type F300/WS/CCP"

Pages 0A-D
01A
02A
06A
09A
010A-B
011A-B
012A
013A
016A
017A
019A

F.L. SMIDTH "Electrostatic Precipitator"

FLS Newsfront "FLS Electrostatic Precipitators ..... for incinerator plants"

9.0.1 General Design

FLS electrostatic precipitator type F is designed for horizontal flow of flue gases. The precipitator casing is an all-welded steel construction made of prefabricated plate sections (1) welded to a rigid frame (2). (The numbers in brackets refer to sketches 9.1 and 9.2).

Depending on the tasks concerned, the precipitator is designed to withstand high temperatures, under-pressure or over-pressure, as well as wind, snow, and earthquake forces.

The precipitator is provided with longitudinal or transverse bottom hoppers (3) or, if desired, with pyramidal hoppers (4). The hoppers may be provided with heating elements (5).

One or more electrically independent fields is arranged in the precipitator casing.

In special cases each field may also be electrically divided into more electrically independent so-called bus sections.

Each precipitator field can be inspected through inspection doors fitted before and after the field (6).

Because of the high working temperatures, the precipitator is mounted in a way to ensure minimum stresses on the precipitator casing and support during repeated thermal expansions and contractions.

If a rigid support of concrete or steel is used, the precipitator is placed on roller bearings (7).

An alternative to the use of roller bearings is a pendular support, in which heat expansion is absorbed as angular movement of the individual supporting columns (8).

The precipitator casing is provided with inlet and outlet transition pieces, the design of which varies according to applications (9).

In the inlet and outlet transition pieces gas distribution devices are installed to ensure equal and uniform gas distribution over the cross-section of the precipitator (10).

The precipitator casing inclusive of bottom hoppers and inlet and outlet transition pieces are insulated with mineral wool to avoid harmful condensation which causes corrosion and reduces lifetime. The insulation also prevents uncontrollable heat expansion (11), which may cause dangerous tension in the structure.

Each field consists of an earthed collecting system and a high-voltage discharge system. Both systems are provided with independent rapping devices.

The collecting system consists of long, specially designed plate lamellae, "collecting plates" (12), which are suspended from the roof of the precipitator thus forming a number of ducts, each consisting of 5-10 plates, depending on the length of the field. The collecting plates of each row are connected at the lower end by means of rapping bars (13). The distance between the individual rows of plates is called the duct spacing which may vary according to the task.

The discharge system is a framework consisting of two transverse gables (14). Between the gables are arranged frame tubes (15) at several levels through the ducts formed by the collecting plates.

Between the frame tubes discharge electrodes (16) are suspended, the design of which may vary. The discharge system is electrically isolated from the remaining parts of the precipitator being sus-pended in four insulators (17) placed on top of the precipitator roof. These insulators are placed in insulator boxes (18) to which the high voltage supply for the precipitator is connected.

The dust accumulated on the collecting plates is dislodged by means of tumbling hammers (19) mounted on a slowly rotating hori-zontal shaft. The tumbling hammers, the weight and consequently the rapping energy of which vary according to the type of tasks, hit the rap-ping bars of the collecting plates.

The dust accumulated on the discharge system is also dislodged by means of tumbling hammers (20) hitting an impact beam fixed to the frame-work of the discharge system.

The rapping gears of the collecting plates and the discharge systems, have drive units (21) which are mounted at the outside of the precipitator casing and consist of geared motors and sealing devices. Between the drive units for the discharge rapping gear and the high voltage rapping gear is mounted a flex-ible insulator shaft. On the rapping gear shaft for the collecting plates extra tumb-ling hammers are mounted for rapping the air distribution screens fitted in the inlet and outlet transition pieces of the precipitator. In some cases the air distribution screens may have separate rapping gears or vibrators.

The precipitated dust is removed from the bottom hoppers of the precipitator by means of a drag chain (22), screw conveyor, sluice, etc. according to the type of hopper or appli-cation.

The electrostatic precipitator is provided with platforms, staircases, and ladders for inspection and maintenance purposes (23).

9.0.2 Precipitator Casing

The primary supporting structure of the precipitator casing consists of a number of portals, so-called frames, two for each field. Each portal consists of roof beam, two columns and a bottom beam, all made of heavy I-iron. The portals and their corner joints are designed to withstand all forces due to the dead load of the precipitator, wind and snow loads, dust in bottom hoppers, under- and overpressure, etc. See sketch 02A.

With this design it is not necessary to use any sort of internal stiffenings as for instance girders, diagonal stays etc. which may give rise to uncontrolled forces during heating and cooling and which may result in deformation and fracture. Finally, internal stiffenings can cause dust build-ups.

Further, the design has the advantage that any corrosion of the thin plates of the precipitator will not influence the safety and stability of the structure.

The supporting portal structure is covered with prefabricated plate sections provided with secondary reinforcing ribs and welded gastight to the portals.

For extraordinarily wide precipitators the portals will be provided with a centre column made of a thick-walled hollow section steel.

Inspections doors are fitted before and after each field.

9.0.3 Bottom Hopper, Longitudinal

The precipitator has one or more longitudinal bottom hoppers, de-pending on the width of the precipitator. The hoppers are designed to withstand normal operational and wind loads as well as total filling with dust. See sketch 02A.

Under each field are arranged two partition plates preventing the gases from passing underneath the electrode systems.

The end walls of the bottom hoppers are provided with inspection doors, and there are also doors in the dividing plates allowing passage inside the hoppers.

The lower part of the hoppers are trough-shaped for drag chains or screw conveyor, respectively. In the bottom of the trough it is possible to empty the dust through a special safety door. The hoppers can be supplied with varying angles of inclination.

Depending on the process concerned, the lowest approx. 2 m of the hopper may be provided with thermostatically-controlled heating elements, heating an air gap between the walls of the hopper and the insulation and thus maintaining a temperature of the walls above the desired lower limit.

9.0.4 <u>Inlet and Outlet Transition Piece, Type C</u>

This type of inlet and outlet transition piece is used especially for moderate inlet dust concentrations. The inlet transition piece is normally provided with three subsequent vertical air distribut-ion screens. See sketches 06A and 06B.

The two first screens consist of vertical U-shaped lamellae, be-tween which adjustable horizontal guide and distribution plates are arranged. The design makes it possible, if necessary, to close total areas of the screen entirely and to change the angles of the guide plates. The last screen consists of perforated plates di-vided into modules and suspended in vertical suspension irons. The arrangement with the three screens makes it possible to obtain an efficient and even distribution of the air stream over the cross-section of the precipitator, which is of vital importance for the efficiency of the precipitator.

The outlet transition piece is provided with one screen of the same adjustable design as the first two inlet transition pieces.

The vertical screens are normally rapped by means of extra tumbling hammers mounted on the rapping gear shafts for the collecting plates for the first and last field. In special cases with very sticky dust, separate rapping gears are installed for the inlet screens in the form of tumbling hammers or vibrators.

9.0.5 Collecting System

The collecting electrode system consists of long, specially designed plate lamellae, called collecting plates. See sketch 09A.

The plates form a number of rows, each consisting of 5-10 plates, depending on the length of the field.

Each plate is eccentrically suspended from supporting irons welded on to the roof beams of the precipitator casing.

At the bottom each plate passes through the rapping bar and rests against traverses welded on to the rapping bar.

Because of the eccentric suspension and as each plate hangs vertically, there is good contact between rapping bar and collecting plate, which ensures an efficient transmission of the rapping effect from the collecting plate rapping gear to each individual collecting plate.

If the collecting plates exceed a certain length the plates forming a row are flexibly interconnected, which prevents the plates from oscillating or twisting.

The collecting plate profile is designed with a view to obtaining maximum stiffness simultaneously with a minimum risk of flash-over and with a view to obtaining maximum level of acceleration.

Between the walls of the precipitator casing and the outermost rows of plates before and after each field, flexible, efficient guard plates are fitted to prevent the gases from passing outside the field without being cleaned.

To prevent passage of gases over and under the fields, partition plates are installed.

9.0.6 Collecting System, Rapping Gear

The rapping bars for the collecting plates are made of heavy flat bars. Between the flat bars specially shaped cross members are inserted, one for each collecting plate. At the impact end of the rapping bars a specially shaped hardened impact anvil is fixed. See sketch 010A.

The rapping bars are supported by a bearing bridge and a rapping bar guide, respectively, and there are no fixed connections be-tween the collecting plates and the rapping bars. The level of the rapping bars can be adjusted in the supports.

The collecting plates are inserted in the rapping bars, and be-cause of the eccentric suspension of the collecting plates, each plate will press against the specially shaped cross members of the rapping bars, thus resulting in efficient contact for transmission of impact energy. Individual heat expansion of the collecting plates is allowed by the clearance between rapping bars and col-lecting plates, without vertical movement of the rapping bars. As the rapping bars do not move vertically, irrespective of the vary-ing temperatures in the precipitator, the tumbling hammers accu-rately hit a precalculated point on the bars, thus obtaining uniform transmission of maximum impact energy.

L1B12

The tumbling hammers, the weights of which depend on the height of the collecting plates, are made of drop-forged hardened steel to prevent forging at the impact point.

Because of the "fixed" position of the rapping bars, and as the tumbling hammers hit a precalculated point, it is ensured that no reactions occur in the centre of rotation of the hammers, this reducing wear to a minimum.

The total patented rapping mechanism ensures maximum rapping ef-ficiency of the collecting plates as well as ensuring long life of the various components.

The tumbling hammers are mounted on a shaft, so that each hammer is turned approx. 30° in relation to the preceding hammer, so that only a few hammers hit at the same time.

The turning interval of the hammer shafts are controlled by a timer unit which may be set from 5 to 24 r/h, depending on the field in question.

The shafts, which are equipped with necessary expansion couplings, rotate in heavy cast iron bearings. Shaft with bearings are mounted in the "bearing bridge", which also serves as a gangway.

The bearing bridge which is made of heavy L-sectional iron, form a very rigid unit, which through laminated springs are suspended in the side walls of the precipitator. This design prevents damage to the rapping mechanism in case of deformations of the precipitator casings as for instance buckling due to heat or explosions.

9.0.7 <u>Discharge System, Incl. of Insulator Chambers</u>

Each discharge electrode system consists of transverse upper and lower supporting beams as well as - depending on the height of the precipitator - of one or more intermediate beams, all connected with vertical stay beams forming a gable for the discharge electrode system. Between two gables the discharge electrode system framework tubes are bolted on in one or more layers, depending on the height of the precipitator. See sketch 011A.

The framework tubes are placed in the ducts formed by the collecting plates and discharge electrodes are suspended between the individual tubes. The total height of the discharge electrode system is less than the height of the collecting plates, which means that no discharge electrode passes the upper or lower edge of a collecting plate with the consequent great risk of frequent high voltage flashovers and spark erosion of the electrode.

The helical discharge electrodes are made of an absolutely smooth cold-drawn stainless steel wire, dia. 2.7 mm, and are supplied as coils. During the erection these coils are stretched and erected by means of special tools to ensure uniform, mechanical tension of each single electrode.

At the ends of the electrode there is a thick-walled reinforced hook, which together with the special clamps welded on to the framework form a flexible link to prevent electrode fractures due to fatigue.

The helical discharge electrode has further the following advantages:

1) Because of the helical shape, the discharge electrodes are self-tightening, which means that they can withstand the elec-tric field strengths and remain in the centres of the flue gas ducts, thus securing the highest possible operating voltage.

2) The helical shape of the discharge electrodes results in a large number of evenly distributed points, from which the corona discharges take place.

3) The tensile force of the discharge electrodes obviates the necessity to use any sort of weights to keep the electrodes taut.

L1B15

4) The tensile force of the discharge electrodes re-sults in good transmission of the rapping effect from the discharge electrode rapping gear which again results in cleaner electrodes.

Each discharge electrode system is suspended from the roof of the casing through four cylindrical supporting insulators. The supporting insulators are mounted on special flanges and with specials gaskets compensating for different coefficients of expansions of steel and the insulating material, which might otherwise cause breakage of the insulators. See sketch 011B.

The supporting insulators are provided with a top cover making it possible to clean the insulators without having to enter the precipitator. The connection between supporting insulators and discharge electrodes system is flexible so that no lateral forces are exerted on the insulators.

To facilitate replacement of the supporting insulators, a set of lifting tools is supplied, whereby it is possible to carry out replacement work without having to enter the precipitator.

All the supporting insulators are placed in the insulator chambers, which are heatinsulated and provided with a heat-ing element for each insulator, as well as a thermostat to control the temperature in order to avoid condensation on and inside the insulators.

9.0.8 Discharge System, Rapping Gear

Depending on the height of the precipitator the discharge system is rapped at several levels.

The discharge framework tubes at the level in question is fixed to a transverse sectional iron impact beam, which distributes the impact energy of the tumbling hammers evenly over the width of the precipitator. See sketch 011A.

The tumbling hammers are made of drop-forged hardened steel and the impact point of the hammer is curved, which together with the position of the curvature ensures that no reactions occur in the centre of rotation of the hammers, thereby reducing the wear to a minimum.

The shaft on which the tumbling hammers are mounted is equipped with the necessary expansion couplings and rotates in heavy cast iron bearings.

The rapping gear shaft is driven by a driving mechanism placed outside on the precipitator casing. Between the driving mechanism and the rapping gear shaft an insulator shaft is inser-ted, de-signed in such a way no axial forces occur, which might cause misalignment of the discharge system. The special couplings of the insulator shaft are made with a view to obtaining maximum flex-ibility in both radial and axial directions. See sketch 012A.

9.0.9 Drive Unit for Rapping Gears

The rapping gear shafts for collecting plates and discharge systems are powered by drive units fitted on the outside of the precipita-tor casing. Where the shafts pass through the precipit-ator wall, special maintenance-free slide ring seals are fitted to prevent entrance of false air into the precipitator under all conditions. The seal consists of an adjustable cast iron bearing against which a slide ring is pressed by stainless steel bellows, which means that the whole sealing arrangement is self-adjusting. See sketch 013A.

The drive unit is mounted in an heat-insulated box which is provided with inspection doors.

The drive unit, which is weather-protected, has a geared motor to drive the rapping gear shaft through a chain drive with take-up device. The chain drive has the effect that the impact from the hammer shaft is not transmitted to the gear with the consequent risk of damaging same.

9.0.10 Pendular Support

In certain situations it may be advantageous to use a pendular support. This support is a combination of vertical columns and cross diagonals, both made of square tube profiles to be welded together during erection. The heat expansion of the precipitator is absorbed in the individual columns by their angular movement in relation to the points of support on the foundations. One of the columns is fixed with cross diagonals in several directions, and the other columns move radially from this column, some of them being, however, provided with cross diagonals in one direction be-cause of wind and possible earthquake forces. At the top and bottom each column has a semispherical journal which partly centralizes the loads from the precipitator and partly prevents the occurrence of undesired bending moments in the columns. See sketch 016A.

L1B19

Unlike the precipitator itself, the support is considered as a building, and if nothing else is agreed upon, the calculations is made according to DIN standards.

9.0.11 Insulation

An important factor for the function and life of the precipitator is efficient heat-insulation. To avoid condensation with conse-quent corrosion and reduced lifetime as well as to avoid uncon-trolled heat expansion and deformation, the total surface of the precipitator is to be insulated carefully with mineral wool from 100 to 200 mm thick. The insulation is to be covered, taking into account the heat expansion of the precipitator, with corrugated aluminium plates, if this is considered suitable. The columns of the precipitator are to be equipped with "therm al jackets" to ensure uniform temperatures at the inside and outside flanges of the columns. See sketch 017A.

The roof of the precipitator is to be insulated with tread-resistant stiff batts, to be built up with a slope of approx. 2o or in certain cases with plane normal insulation where the chequer plate covering is then supported by a sectional steel. The covering of the roof insulation is to be made with 3 mm thick steel chequer plates resting direct on the tread-resistant insulation.

L1B20

Because of the thermal expansion of the precipitator, the plate covering is to be fastened flexibly to the roof of the precipitator. The tread-resistant and water-tight roof covering is normally to be equipped with gutters and chutes.

9.0.12 Stair Tower and Gangways

The precipitator is to be provided with the necessary access facilities for inspection and maintenance purposes.

From the level of the foundation a stair tower is to reach up to the roof of the precipitator. The stair tower should give access to gangways placed at the inspection doors and driving mechanisms for the rapping gears of the collecting system as well as to possible gangways at the rapping gears of the discharge systems. The gangways are to be mounted all the way along the precipitator. From the top of the stair tower there should be access to the tread-resistant insulation covering of the precipitator roof. Gangways and platforms are to be made of sectional steel and grating, and like the precipitator roof they are to be equipped with railing made of tubes.

If stair tower and gangways are included in the supply from FLS, they may be made according to any standard, but if no standard is specified, they will be made according to DIN or FLS standards.

9.1 Scope of Supply

7 F.L. Smidth electrostatic precipitator, type F300/H3S/3x30-72100/C/C/L1SA, with fans and ducts, each with the following elements:

	Quantity
External support frames	6
Casing with secondary stiffeners	1
Roofs	1
Pendular supporting structure, leaving 2.5 m below bottom hoppers, assuming top level of concrete is 0.5 m above ground level	1 set
Inlets with flange, central	1
Distribution screens in each inlet, fixed	1
Distribution screens in each inlet, adjustable	2
Outlets with flange, central	1
Distribution screens in each outlet, fixed	1

L1B22

Description	Quantity
Longitudinal hoppers with heating elements and flange	1
Screw conveyor, Ø 315 mm, with air sluice and common geared motor, for installation in bottom hopper	1
Collecting systems	3
Rapping systems for collecting systems, incl. geared motors	3
Discharge systems, rigid frame with spiral shaped electrodes	3
Rapping systems for discharge systems, with geared motors	3
Alumina supporting insulators for discharge systems	12
Insulator boxes for support insulators, with heating elements	8
T/R sets, silicon oil-immersed self-cooled type with automatic control system, with oil pan	3
Inspection doors, casing	4
Inspection doors, bottom hopper	1

Description	Quantity
Staircase from 2.5 m below bottom hoppers	4 for 7 chambers
Gangway at inspection door level	4 for 7 chambers
Railing for roof	1 set
Platform with ladder for bottom hopper outlet inspection door	1
Key interlocking system.	
Grounding cables	1 set
Switchboards for T/R sets. The boards contain thyristor controllers for T/R sets with instruments and signal lamps, fuses and start-stop switches. The boards are foreseen for remote control and separate power supply	3
Switchboard for heating elements and rapper drives. The board contains programmer for intermittent function of rapper drives, contactors with motor control centers, signal lamps, fuses, and start-stop switches. The board is foreseen for remote control and separate power supply	1

Only parts not to be insulated are primed at delivery.

9.2 Specifications of Areas to be Insulated (by others)

For each line:

Inlet duct:	Approx. 110 sq.m
Esp casing excl. roof:	Approx. 750 sq.m
Inlet:	Approx. 100 sq.m
Outlet:	Approx. 90 sq.m
Bottom hopper:	Approx. 400 sq.m
Outlet duct (ESP - ID fan):	Approx. 180 sq.m
Outlet duct (ID fan - stack):	Approx. 200 sq.m
ID fan:	Approx. 60 sq.m
Esp roof:	Approx. 160 sq.m

Esp roof to be insulated with min. 2 x 50 mm stiff mineral wool blocks, covered with min. 3 mm steel plate, inclining 2 degr. from the middle of each casing towards the sides.

Esp frames to be insulated with 2 x 100 mm mineral wool, covered with min. 0.7 mm aluminum or galvanized steel plate.

L1B26

Ducts, casing, hoppers to be insulated with 2 x 50 mm mineral wool, covered with min. 0.7 mm aluminum or galvanized steel plate.

Bottom hopper area is also to be covered with 1 mm steel plate for the lowest 2 m, forming the heating zone, by the insulating company, before normal insulation.

Gutters and downsprouts for water and T/R sets drainage pans to be supplied by the insulating company.

9.3 **Erection (by others) and Commissioning**

It is an assumption for our performance guarantee that the precip-itators are erected and commissioned under supervision by one of our trained precipitator specialists. The services of these are offered under conditions as attached hereto.

9.4 **Precipitator Data**

Each precipitator,
type F300/H3S/3x30-72100/C/C/L1SA,
is dimensioned for the following data:

Gas temperature	200 degr.C
Amount of gas	120,015 Ncu.m/h
Casing design temperature	288 degr.C
Gas pressure	-150 mm WG
Casing design pressure	-305 mm WG
Plate in casing, hoppers, inlet and outlet	5 mm
Wind load	296 kp/sq.m

L1B28

Live load on roof, platforms, etc.	200 kp/sq.m
Snow load	125 kp/sq.m

Other data:

Number of chambers	1
Number of bus sections in each field	1
Number of fields	3
Total number of sections	3
Effective height of each section	10.0 m
Effective length of each section	3.0 m
Effective width of each section	7.2 m
Total gas flow at 100% MCR	57.8 cu.m/s
Gas velocity	0.80 m/s
Retention time in electrical field	11.2 s

<u>Collecting system</u>

Collecting plate, FLS type H, rolled steel.

Height	10.0 m
Length	0.5 m
Plate thickness	1.5 mm
Channel width	300 mm
Number of collecting plates per section	150
Total projected collecting area	4320 sq.m
Total collecting area	5616 sq.m
Number of collecting rapping systems per field	1
Type	Tumbling hammer
Acceleration level	200 G

<u>Discharge system</u>

Type of discharge system	Rigid frame

L1B30

Type of discharge electrode	FLS spiral shaped
Material of construction	SIS 2343
Material thickness	2.7 mm dia.
Electrode length:	3.3 m
Number of electrode layers	3
Number of discharge electrodes per section	864
Distance between discharge and collecting electrodes	150 mm
Distance between discharge electrodes (lengthwise)	180/320 mm
Number of discharge rapper layers per section	2 (common drive motor)
Type	Tumbling hammer
Supporting insulators per section	4
Material for construction	Alumina
Effect of heating element	1 kW

L1B31

Temperature in insulator chambers	90 degr.C

<u>Bottom hoppers</u>

Total number	1
Type	Longitudinal
Heating effect, each hopper	15 x 2 kW
Volume in each hopper	384 cu.m

<u>T/R sets</u>

Number	3
Type	80/600
Nominal voltage (peak)	80 kV
Nominal current (average)	600 mA
Projected collecting area per T/R set	1440 sq.m
Specific collecting area current	0.42 mA/sq.m
Installed effect, each T/R set	48 kVA

L1B32

Installed effect

Heating of insulator boxes (intermittent)	12 kW
Bottom hopper heating (intermittent)	30 kW
Geared motors for rapper drives (intermittent)	1 kW
T/R sets	144 kVA
Power requirements under normal and stable running conditions, at max. de-dusting efficiency	53 kW (T/R sets) + 22 kW (heating)

For your information, filled-in data sheets from your inquiry are enclosed.

9.5 Scope of Supply

7 Electrostatic precipitators

7 Support steel

7 Electrical controls

7 Flyash hoppers and outlet rotary valve.

Interface Equipment Termination Points:

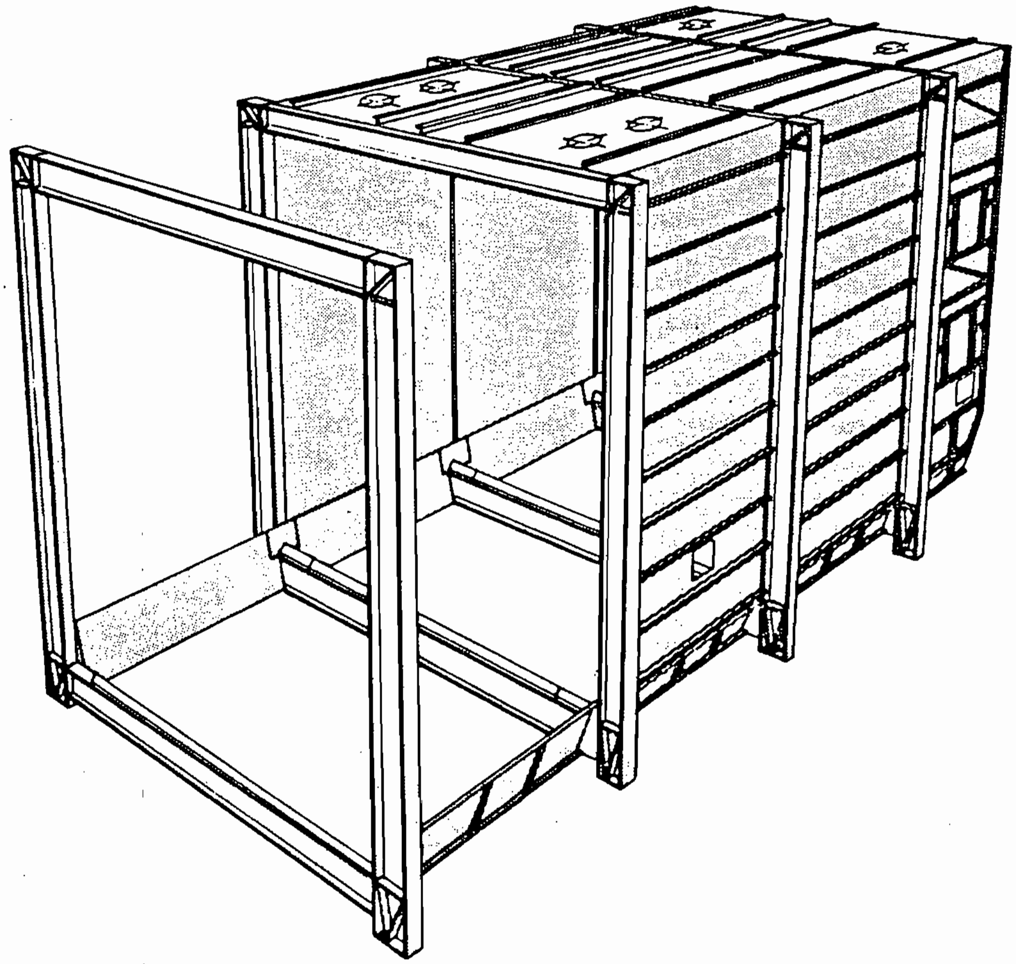
- Foundation bolts (concrete foundation by others to be 0.5 m above ground)
- In- and outlet fluegas hoppers including flexible connections
- Outlet flyash rotary feeder
- Power connection for control boards and remote control connections.

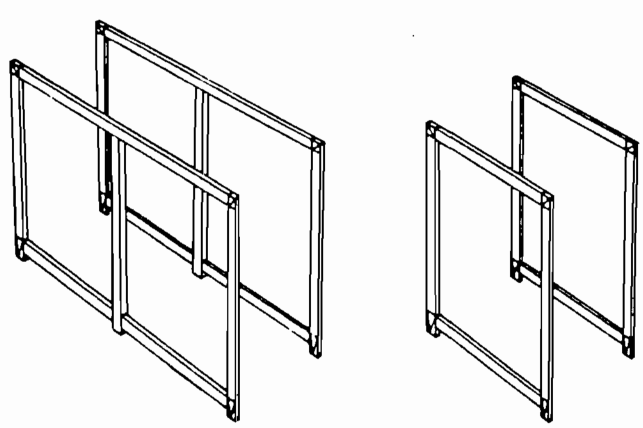
ELECTROSTATIC PRECIPITATOR TYPE F
PRECIPITATOR CASING

F. L. SMIDTH & CO.

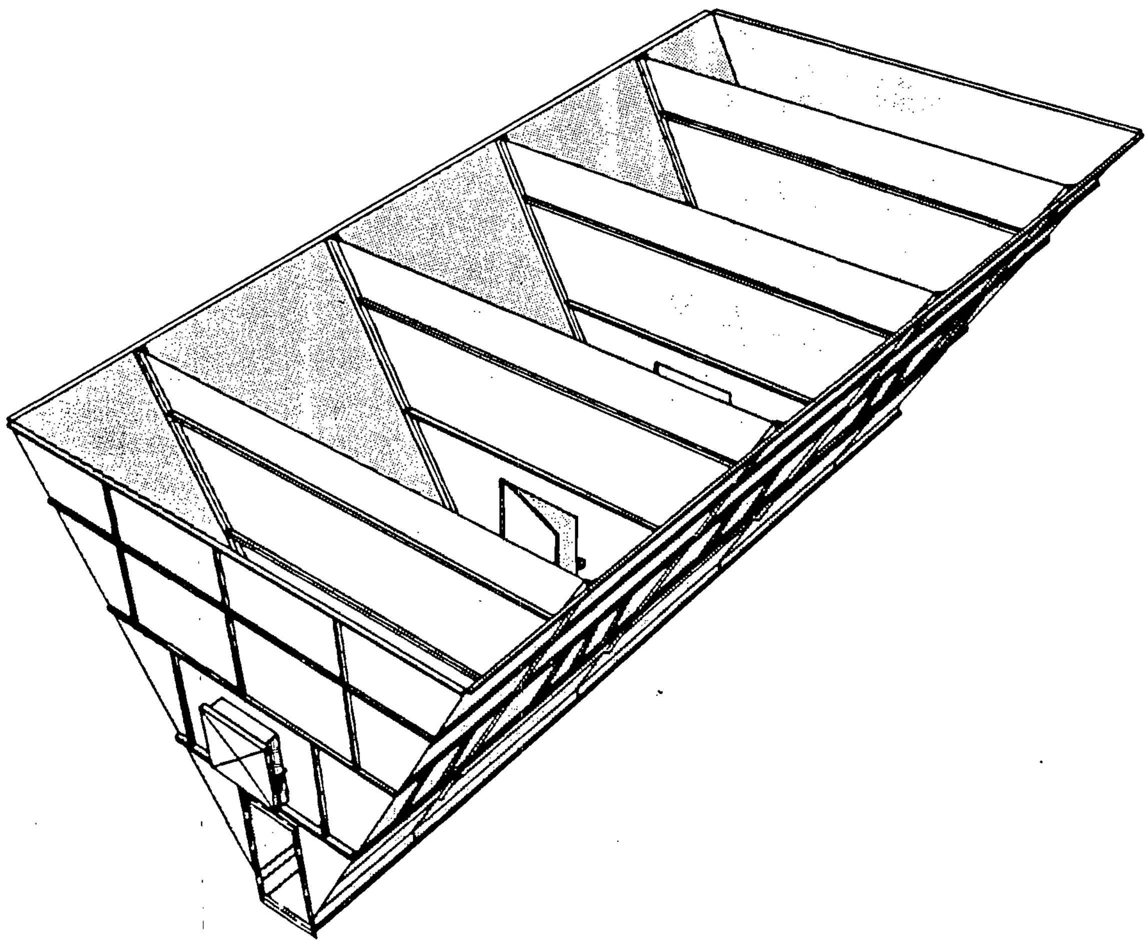
SKETCH 01A

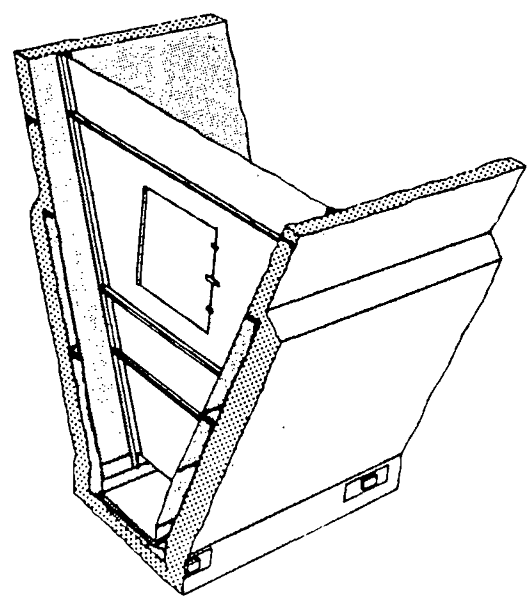
F-8670-1





ELECTROSTATIC PRECIPITATOR TYPE F BOTTOM HOPPER, LONGITUDINAL	F. L. SMIDTH & Co.	
	SKETCH	02A





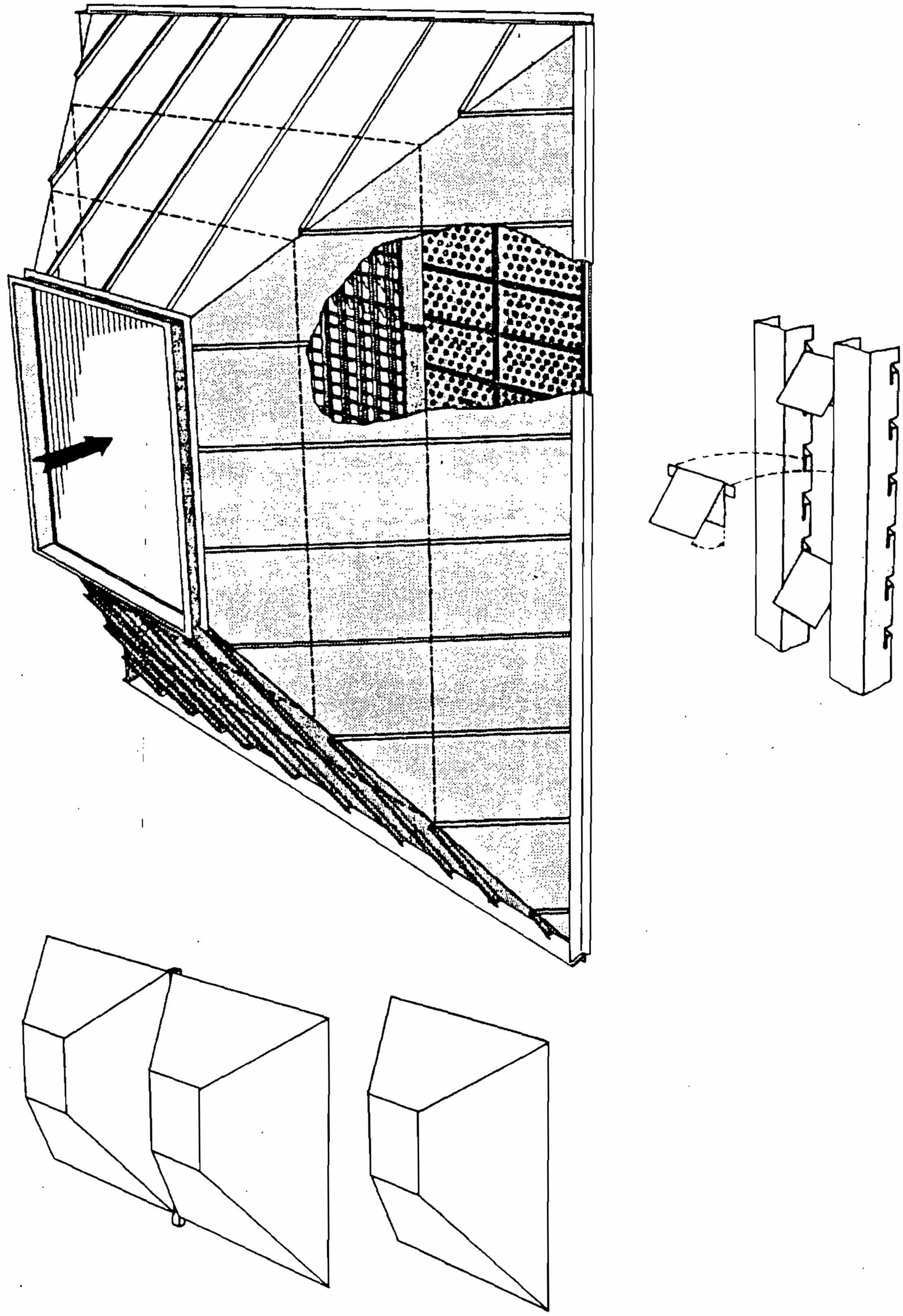
F-6670-1

ELECTROSTATIC PRECIPITATOR TYPE F
INLET TRANSITION PIECE, TYPE C, INCLUSIVE
OF GAS DISTRIBUTION SCREEN

F. L. SMIDTH & Co.

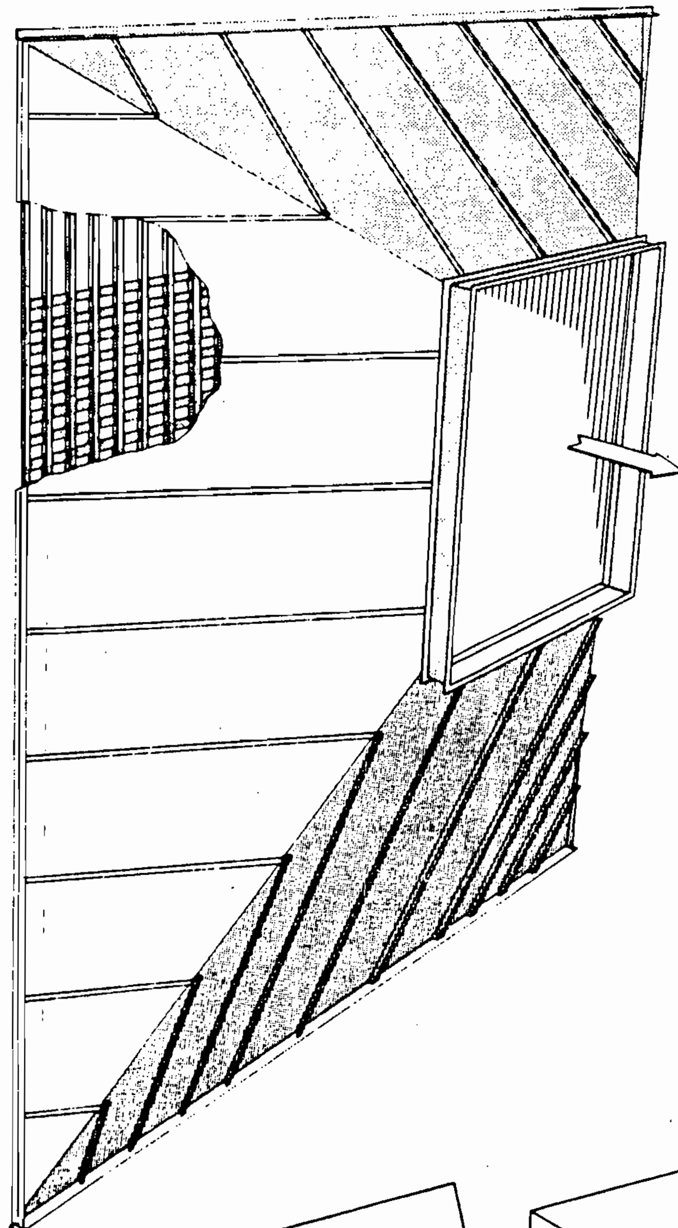
SKETCH 06A

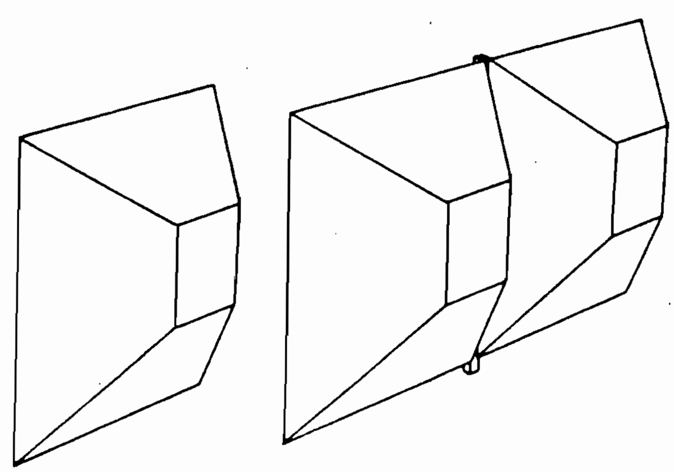
F-6670-1



ELECTROSTATIC PRECIPITATOR TYPE F OUTLET TRANSITION PIECE, TYPE C, INCLUSIVE OF GAS DISTRIBUTION SCREEN	F. L. SMIDTH & CO.	
	SKETCH	06B

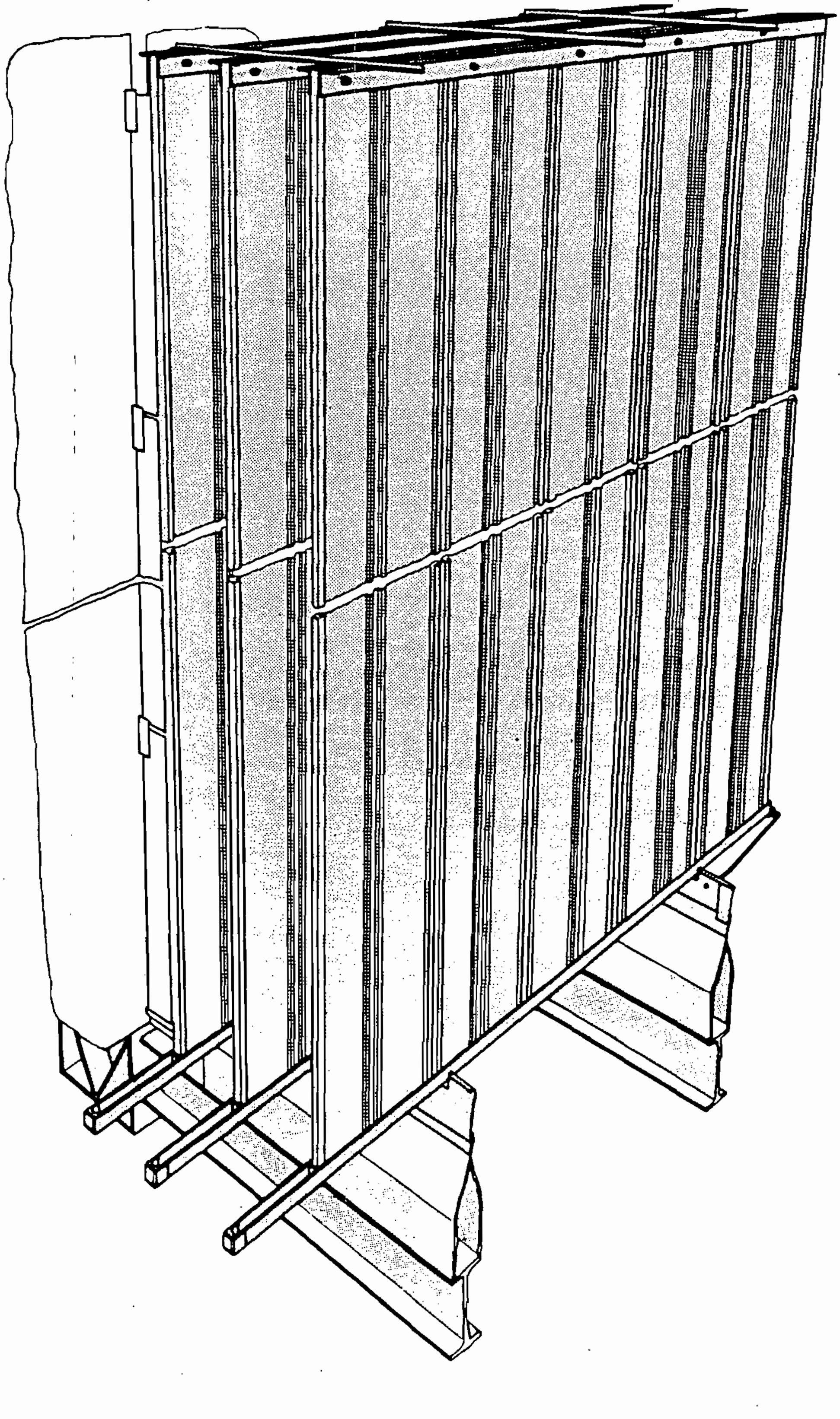
F-8870-1



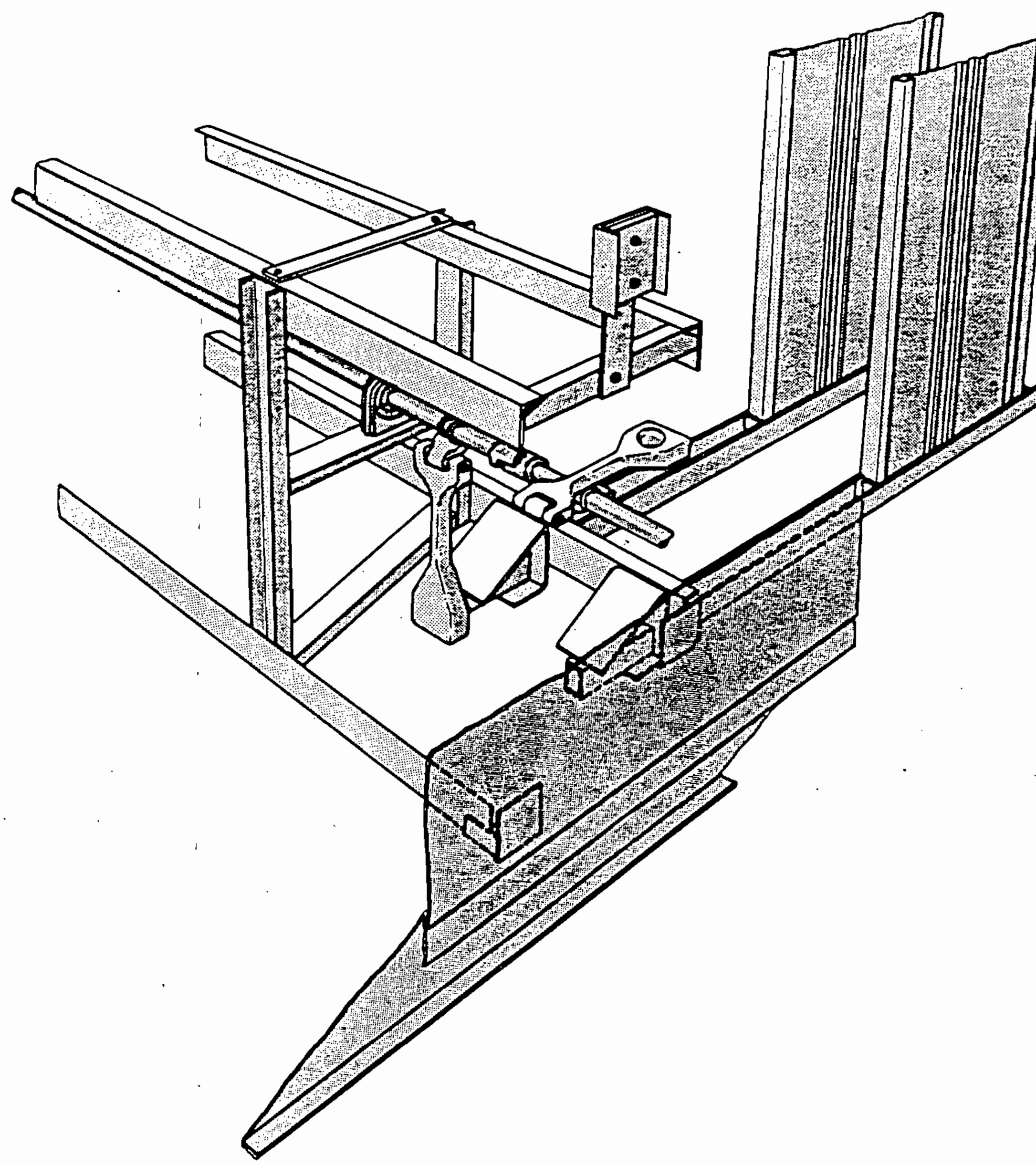


ELECTROSTATIC PRECIPITATOR TYPE F COLLECTING SYSTEM	F. L. SMIDTH & CO.	
	SKETCH	09A

F-6870-1

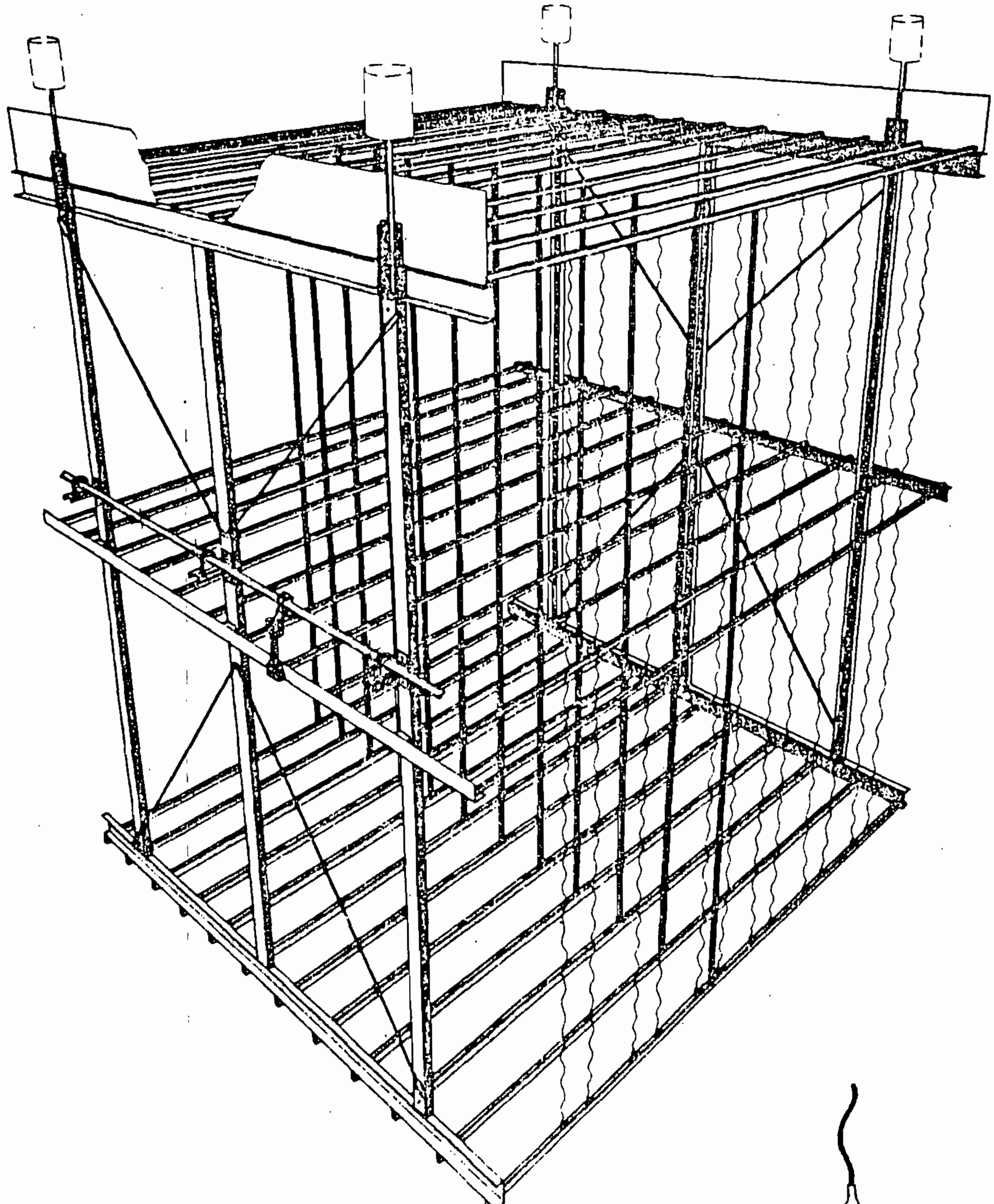


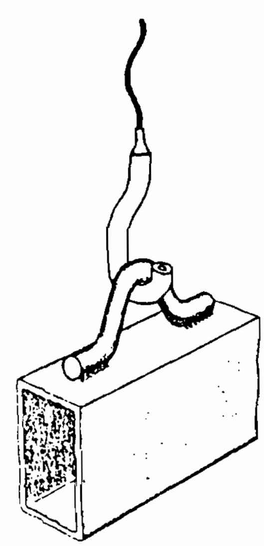
ELECTROSTATIC PRECIPITATOR TYPE F COLLECTING SYSTEM, RAPPING GEAR	F. L. SMIDTH & Co.	
	SKETCH	010A



F-6870-1

ELECTROSTATIC PRECIPITATOR TYPE F DISCHARGE SYSTEM, INCL. OF INSULATOR CHAMBERS	F. L. SMIDTH & CO.	
	SKETCH	011A





F-8670-1

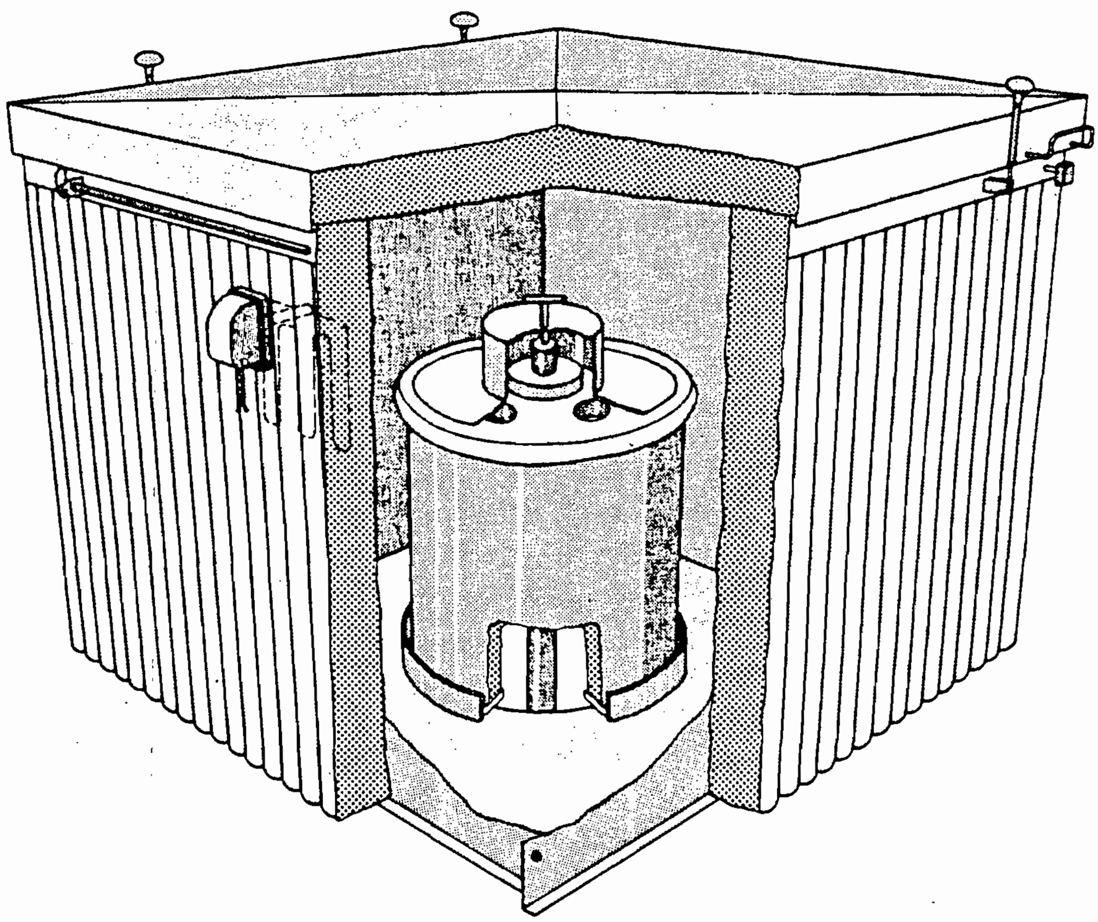
EMB 307

ELECTROSTATIC PRECIPITATOR TYPE F
DISCHARGE SYSTEM, INCL. OF INSULATOR CHAMBERS

F. L. SMIDTH & CO.

SKETCH 011B

F-6670-1

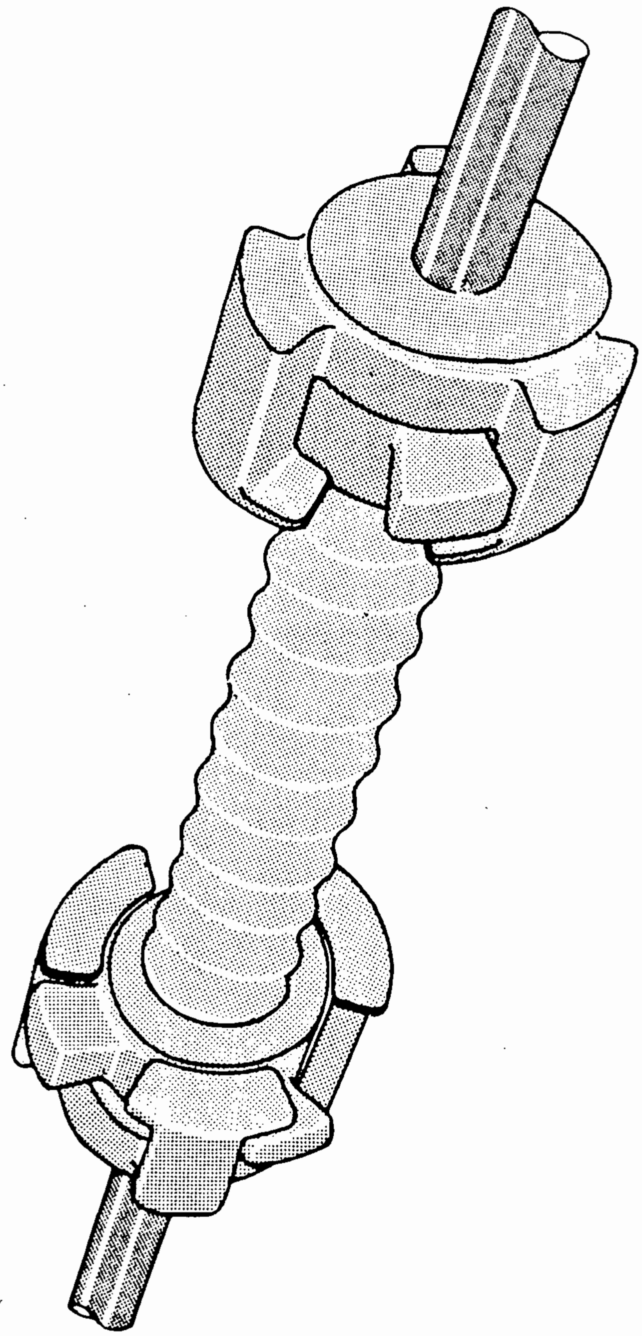


ELECTROSTATIC PRECIPITATOR TYPE F
DISCHARGE SYSTEM, RAPPING GEAR

F. L. SMIDTH & CO.

SKETCH 012A

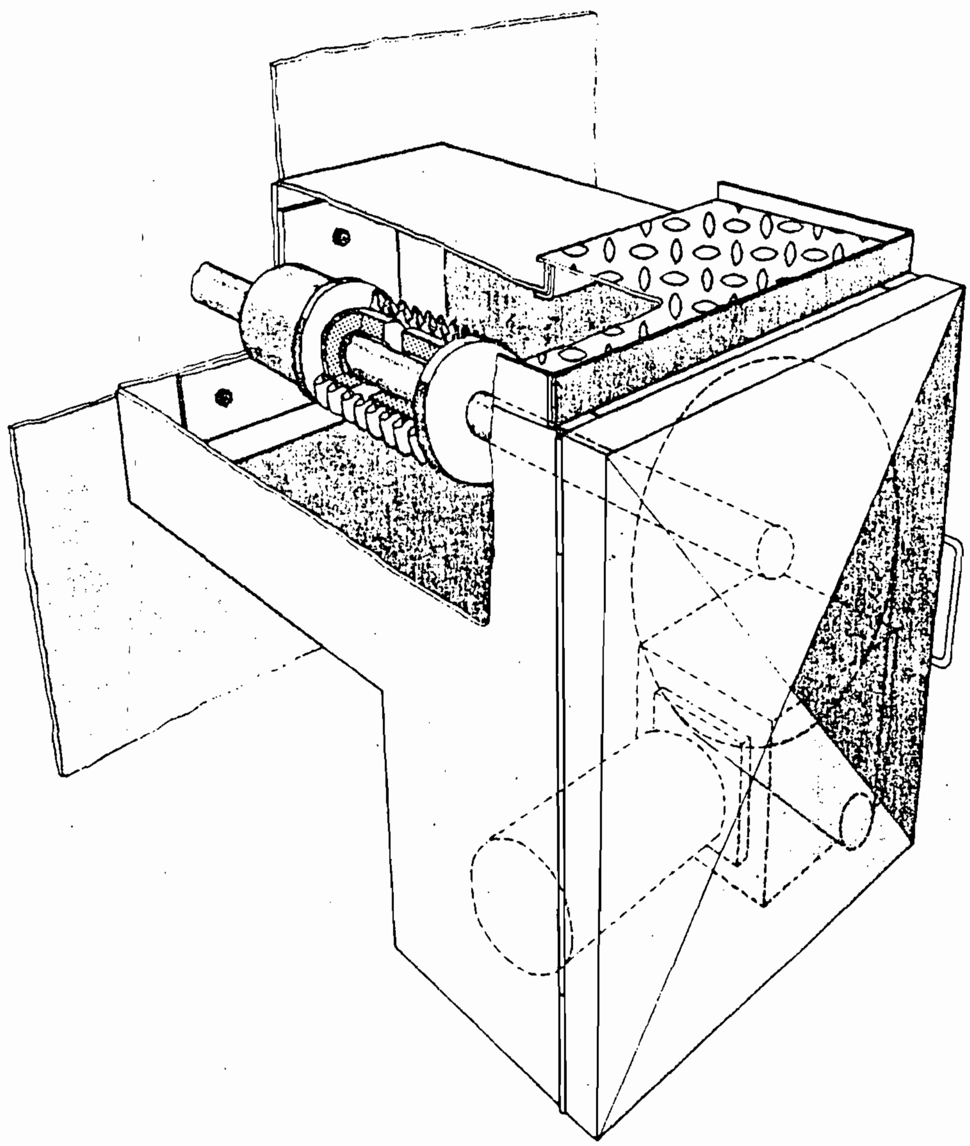
F-8670-1



ELECTROSTATIC PRECIPITATOR TYPE F
DRIVING MECHANISM FOR RAPPING GEARS

F. L. SMIDTH & Co.

SKETCH 013A



F-8870-1

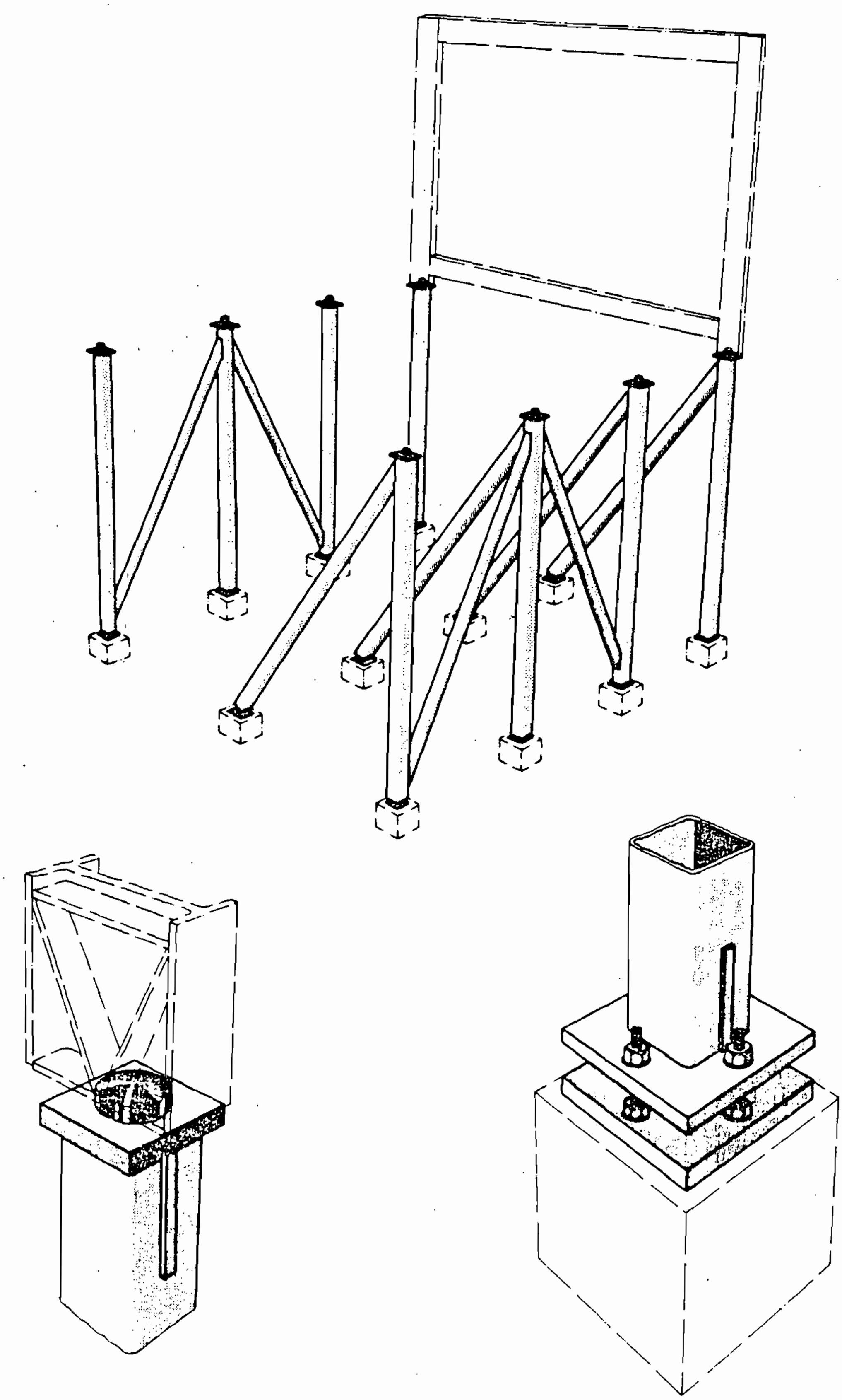
EHB 307

ELECTROSTATIC PRECIPITATOR TYPE F
PENDULAR SUPPORT

F. L. SMIDTH & CO.

SKETCH 016A

F-8670-1

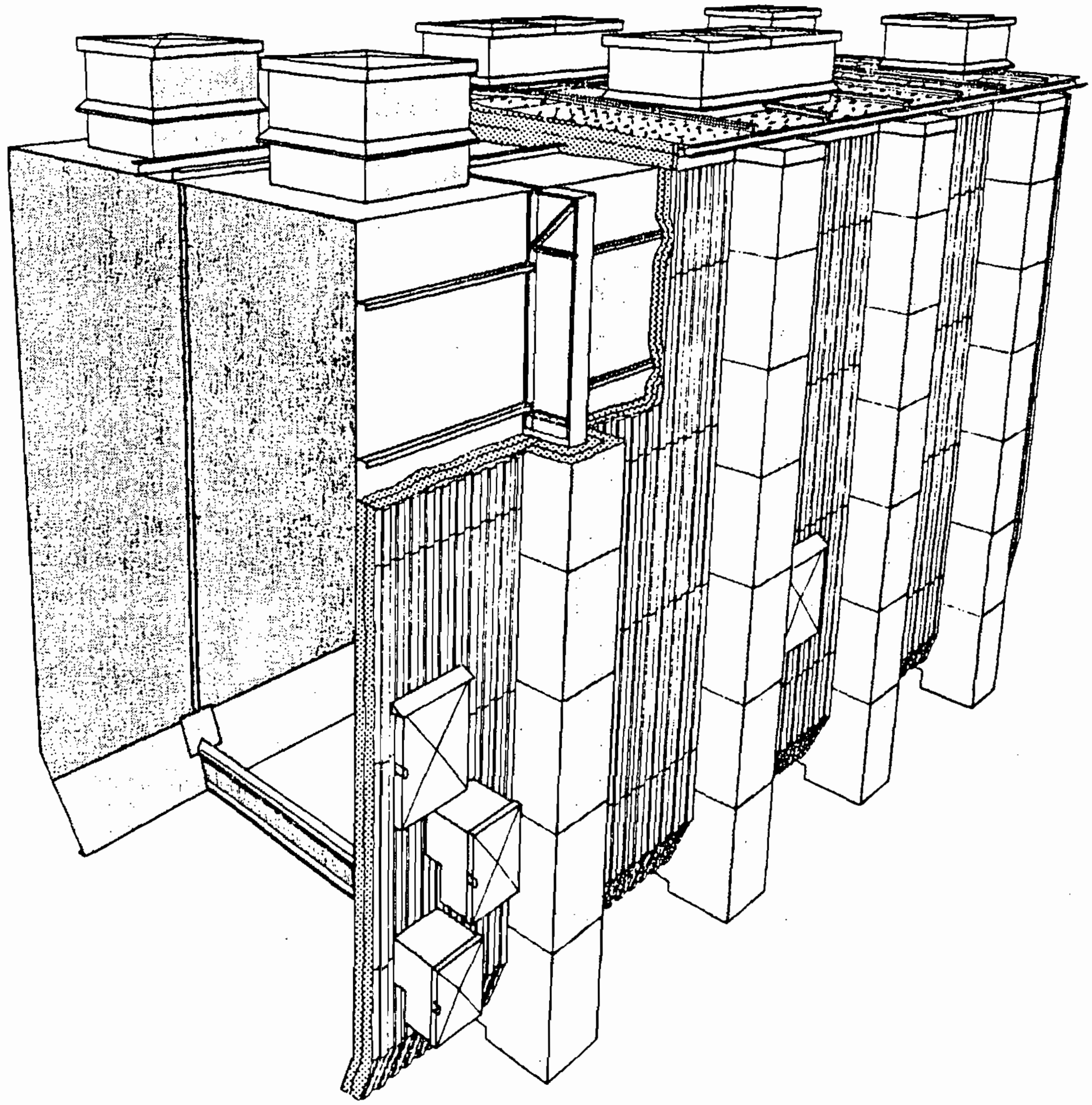


EMB 307

ELECTROSTATIC PRECIPITATOR TYPE F
INSULATION

F. L. SMIDTH & Co.

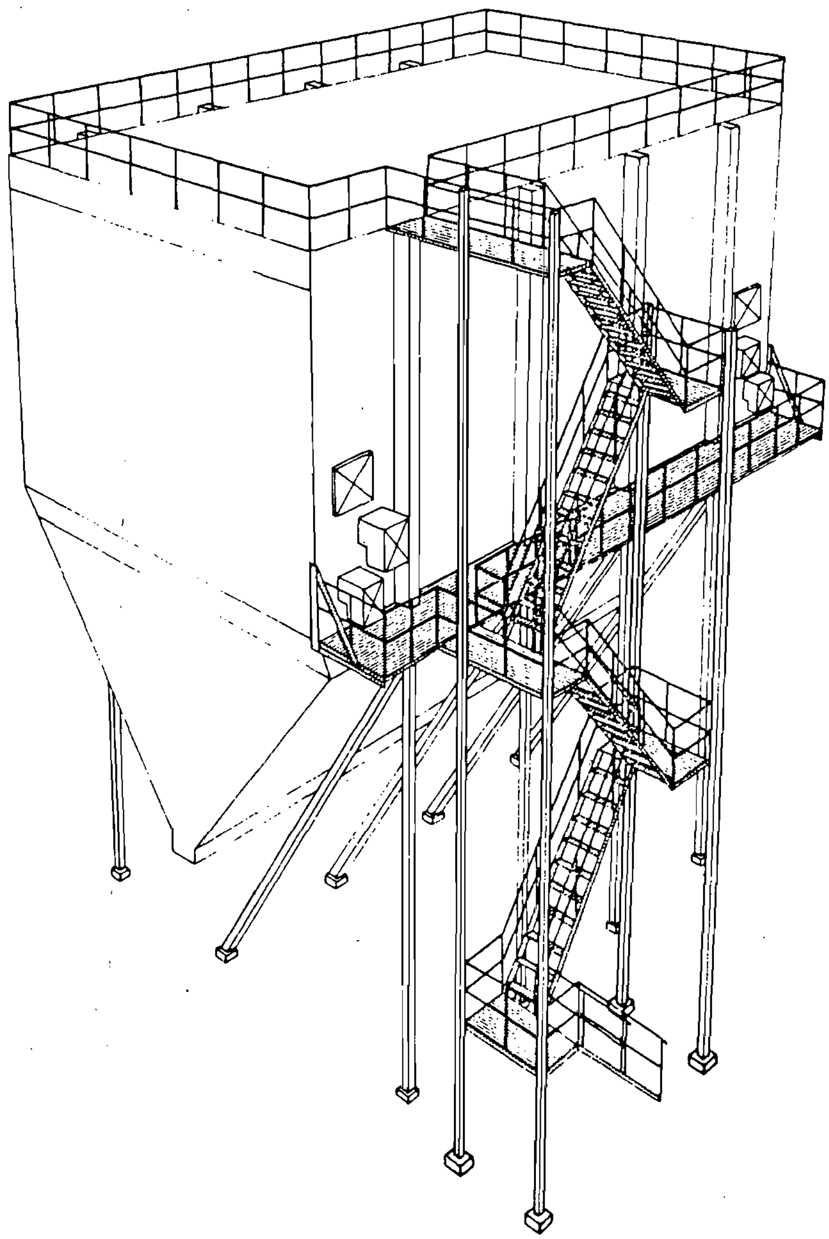
SKETCH 017A

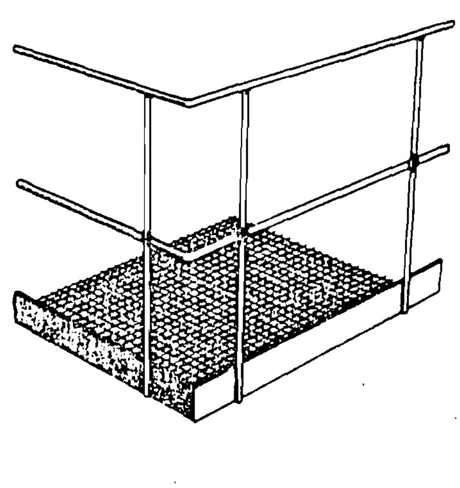


ELECTROSTATIC PRECIPITATOR TYPE F
STAIR TOWER AND GANGWAYS

F. L. SMIDTH & Co.

SKETCH 019A





F-6670-1

APPENDIX E

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION

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

BOB GRAHAM
GOVERNOR

VICTORIA J. TSCHINKEL
SECRETARY

November 9, 1983

Mr. Ronald J. Mills
Malcolm Pirnie, Inc.
2 Corporate Park Dr.
Box 751
White Plains, New York 10602

Re: Broward County, Florida, Resource Recovery Project

Dear Mr. Mills:

We have reviewed the draft Air Quality Analysis report prepared by Environmental Science and Engineering, Inc., your subconsultant on the subject project. The atmospheric dispersion modeling completed for this report shows that for all air pollutants subject to PSD review the predicted maximum ground-level ambient concentrations are less than the deminimus levels that trigger the requirement of preconstruction monitoring. Based on the information contained in this draft report and subject to a more thorough review of the final application package, including the actual modeling output, we can conclude that preconstruction ambient air quality monitoring will not be necessary for any of the air pollutants emitted from this project.

In reviewing your draft report we have compared the emission factors you have used with those of similiar operations and with some of the literature on the subject. We believe that the emission factors you have used for VOC's and CO may be low. Since the area in which the sources will be built is a nonattainment area for ozone, an increase in the emission factor for VOC's may trigger nonattainment review. A change in the CO emission factor will not affect the review of this pollutant. If you do change your emission factor for VOC's, check it against the applicability for nonattainment review and submit any additional required information if necessary.

In general, the modeling methodology used in the report is appropriate for PSD review. In the final report, however, be sure to include all parts of the complete PSD review including a BACT analysis, an air quality analysis, an additional impacts analysis, and a GEP stack height determination.

If you have any questions about either the PSD or nonattainment review process please call Tom Rogers on modeling issues or Willard Hanks on the emission factor issues at (904)488-1344.

Sincerely

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

CHF/TR/s
cc: Tom Tittle
Bill Stone, Broward County
Phyllis A. Korab, Broward County

APPENDIX F

DESCRIPTION OF WASTE

Processable Waste is that portion of the County's waste stream which is processable in a mass burn resource recovery system. Processable Waste shall include but not be limited to all forms of garbage, commercial waste, rubbish, leaves and brush, paper and cardboard, plastics, wood and lumber, rags, carpeting, a limited amount of tires, wood furniture, mattresses, stumps, wood pallets, timber, tree limbs, ties, and logs, and minor amounts of pathological and biological wastes stream), but excluding hazardous wastes, liquid wastes, pathological and biological wastes, sludges, sewage, bulk shipments of majure, explosives, chemicals, radioactive materials, and Unprocessable Wastes.

WASTE COMPOSITION AND TYPE

Based on a weighing and sampling program conducted at the County Landfill in Davie, during April 1983, the following data was compiled on garbage and trash:

PHYSICAL COMPOSITION - GARBAGE AND PROCESSABLE TRASH FRACTIONS
(As Received Basis)

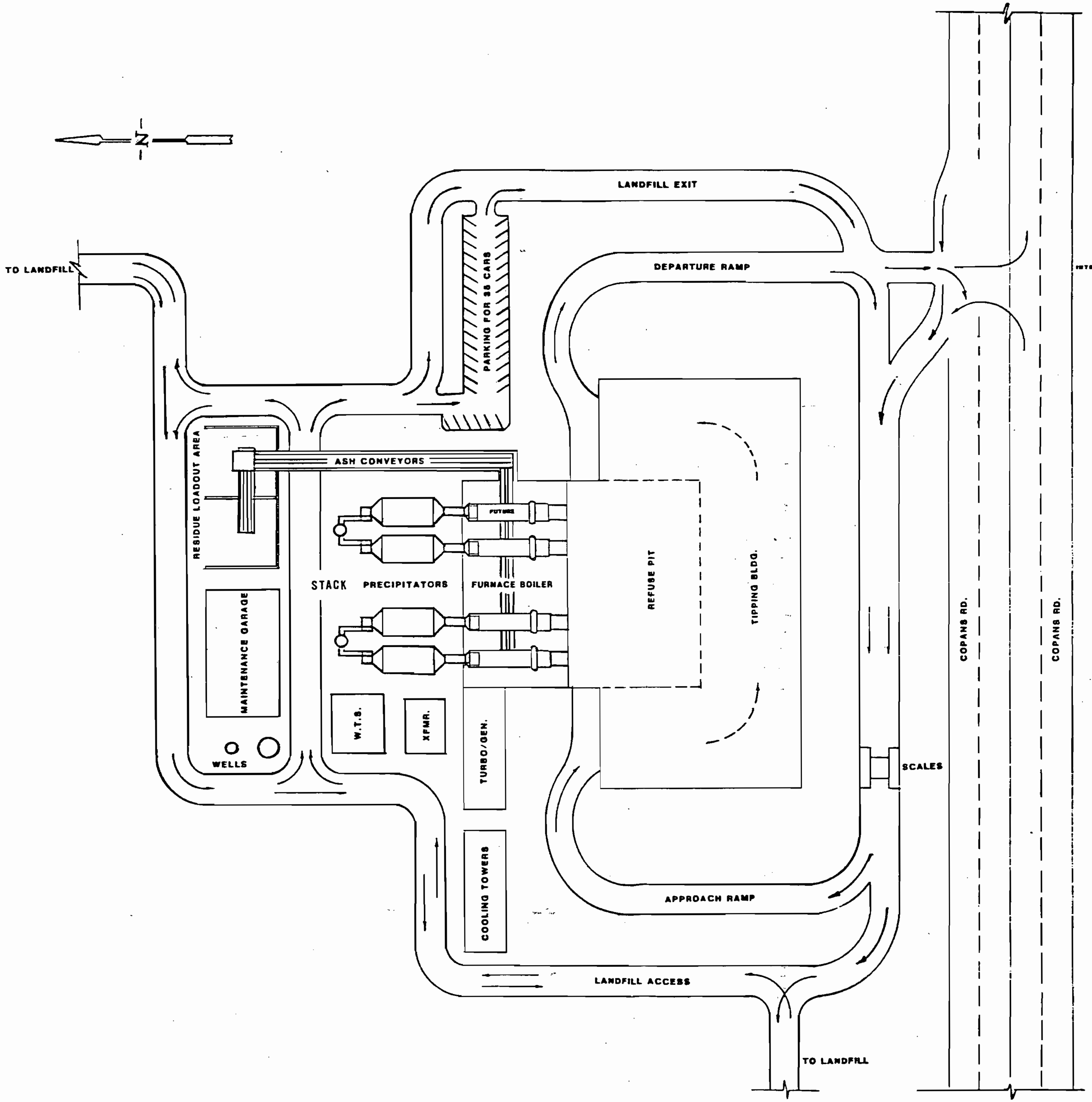
Component	Percent by Weight		
	Garbage	Trash	Combined
Paper, Cardboard	47	11	36
Plastics	9	3	7
Rubber, Tires	-	9	3
Textiles, Rags, Carpeting and Mattresses	2	1	2
Food Wastes	9	-	6
Garden Wastes, Stumps, Leaves and Brush	17	36	22
Wood	3	35	13
Glass	7	-	5
Metals	6	-	4
Rock, Brick	-	-	-
Other	-	5	8
	100	100	106.77

PROXIMATE ANALYSIS (PERCENT BY WEIGHT)

	As Received Basis		Dry Basis	
	Min.	Max.	Min.	Max.
Moisture	19.27	52.21	0.00	0.00
Volatile	NDP	NDP	48.20	82.39
Ash	NDP	NDP	9.75	36.00
Fixed Carbon	NDP	NDP	1.06	20.40
Higher Heating Value (btu/lb)	3,645	6,504	6,454	8,875

NDP - No Data Provided

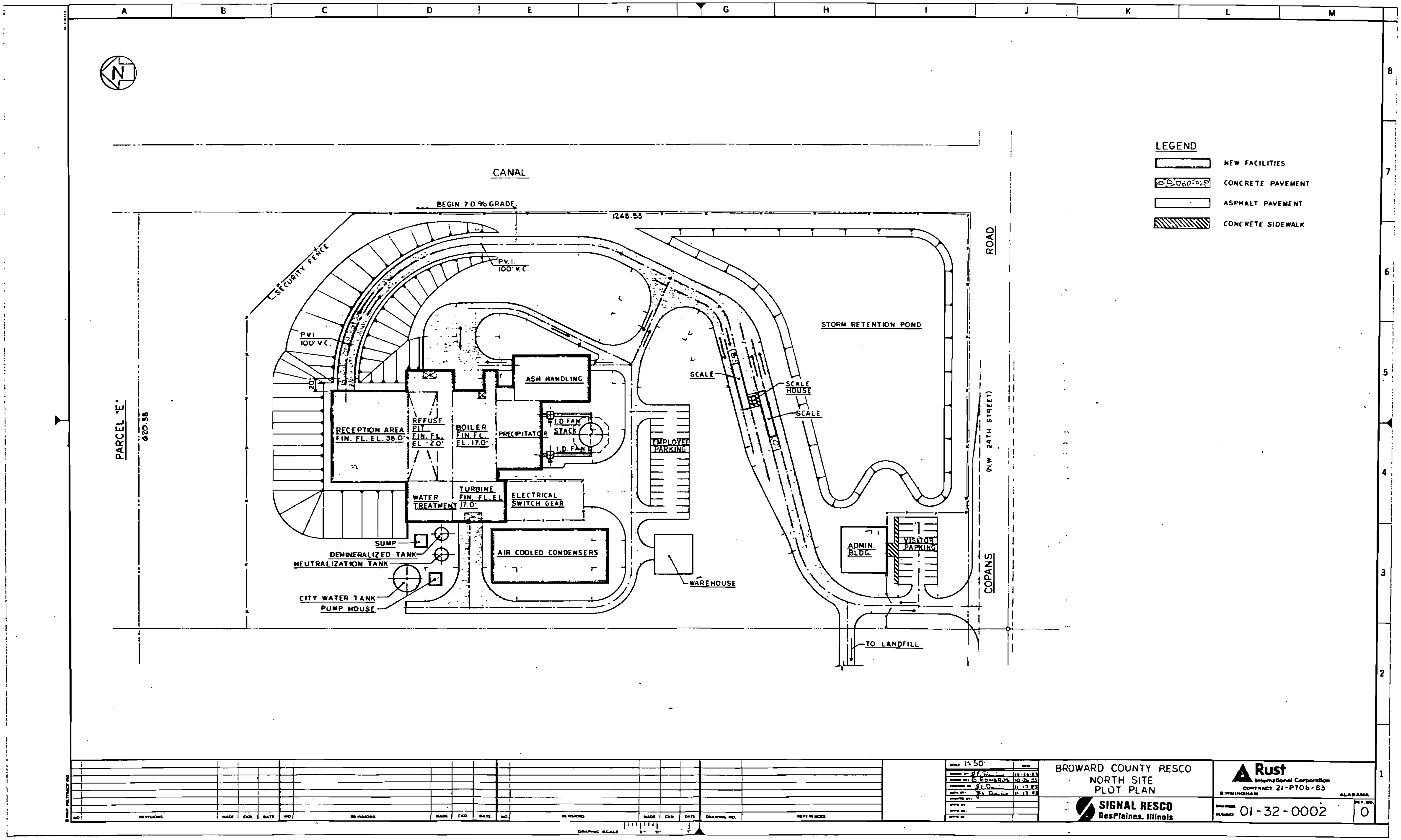
FIGURE 3



BROWARD COUNTY, FLORIDA
WASTE TO ENERGY PROJECT
PLOT PLAN - NORTH SITE

WASTE MANAGEMENT INC. -
BECHTEL CIVIL & MINERALS, INC.

FIGURE 4



CANAL
BEGIN 7.0 % GRADE
1248.53
SECURITY FENCE
P.V.I
100' V.C.
P.V.I
100' V.C.
PARCEL "E"
620.38
RECEPTION AREA
FIN. FL. EL. 38.0'
REFUSE PIT
FIN. FL.
EL. -2.0'
BOILER
FIN. FL.
EL. 17.0'
PRECIPITATOR
ASH HANDLING
I.D. FAN
STACK
I.D. FAN
WATER TREATMENT
TURBINE
FIN. FL. EL.
17.0'
ELECTRICAL SWITCH GEAR
AIR COOLED CONDENSERS
SUMP
DEMINERALIZED TANK
NEUTRALIZATION TANK
CITY WATER TANK
PUMP HOUSE
EMPLOYEE PARKING
WAREHOUSE
SCALE
SCALE HOUSE
SCALE
STORM RETENTION POND
ADMIN. BLDG.
VISITOR PARKING
TO LANDFILL
ROAD
(N.W. 24TH STREET)
COPANS
LEGEND
NEW FACILITIES
CONCRETE PAVEMENT
ASPHALT PAVEMENT
CONCRETE SIDEWALK
BROWARD COUNTY RESCO
NORTH SITE
PLOT PLAN
Rust
International Corporation
CONTRACT 21-P706-83
BIRMINGHAM ALABAMA
SIGNAL RESCO
DesPlaines, Illinois
01-32-0002
0
1"=50'
GRAPHIC SCALE
REVISIONS
REFERENCES

Florida Department of Environmental Regulation
Twin Towers Office Bldg. • 2600 Blair Stone Road • Tallahassee, Florida 32399-2400
Lawton Chiles, Governor
Carol M. Browner, Secretary

July 7, 1992

Honorable Earl Morrall
Mayor Town of Davie
6591 S.W. 45th Street
Davie, Florida 33314

Dear Mayor Morrall:

This is in response to your June 3 resolution concerning the disposal of waste tires at the North and South Broward County Resource Recovery Facilities.

We recognize that waste tires frequently are disposed of at resource recovery facilities in Florida, and do not object to the combustion of waste tires in resource recovery facilities at a maximum 3% level, by weight. We recently issued a memorandum to district staff dated April 16, 1992, regarding this issue. It is attached for your reference.

The Department has determined that if this 3% level is not exceeded, disposing of waste tires at the North and South Broward County facilities is acceptable, and the County's permits do not expressly prohibit such a practice. Given these facts, the County may lawfully dispose of waste tires at the facilities, subject to the terms of the County's permits, so long as the quantity of waste tires does not exceed 3% of the total weight of waste material handled at each facility.

Sincerely,

Carol M. Browner
Secretary

CHF/rbm
Enclosures

cc: I. Goldman, SED
J. Hart, BCBCC
P. Comer, Esq., DER
G. Smallridge, Esq., DER

3% by weight tire burning

For Routing To Other Than The Addressee

To: ______ Location: ______
To: ______ Location: ______
To: ______ Location: ______
From: ______ Date: ______

DEPARTMENT OF ENVIRONMENTAL REGULATION STATE OF FLORIDA

State of Florida
DEPARTMENT OF ENVIRONMENTAL REGULATION

Interoffice Memorandum

TO: District Waste Program Administrators
District Air Program Administrators
County Air Program Administrators

Commissioner John Hart, Chairman
Broward County Board of County Commission
Governmental Center
115 So Andrews Ave., Suite 421
Fort Lauderdale, FL 33301

FROM: Steve Smallwood, Director
Division of Air Resources Management

John Ruddell, Director
Division of Waste Management

SUBJ: Tire Burning at Municipal Waste Combustors and Resource Recovery Facilities

DATE: April 16, 1992

This joint memorandum is to clarify the Division of Air Resources Management's and the Division of Waste Management's guidance on the use of municipal waste combustors and resource recovery facilities to dispose of tires through incineration.

Tires (shredded and whole) may be processed/fed to these units up to 3%, by weight, of the permitted capacity without any change in the existing permits.

However, any desire to process/feed tires above the 3% level will be considered a modification and the owner/operator of the source(s) will be required to obtain the necessary document(s) (i.e., construction permit modification) prior to increasing the processing/feed rate of the tires. This type of activity will require a Florida P.E. sealed application for a modification, processing fee, public notice, and additional air emission testing to determine the suitability of the unit for the processing of tires. The Air Construction Permit Modification will be processed by the Bureau of Air Regulation's Permitting and Standards Section. However, waste-to-energy facilities certified under the Power Plant Siting Act would require a modification of the certification. Submission of the same information by a Florida P.E. using the same forms you listed would be required. The $10,000 modification fee would apply in those cases.

If you have any questions on the above, please contact Barry Andrews at (904)488-1344 or SunCom 278-1344.

SS/BM/rbm

DARM
draft hep CB

RESOLUTION NO. R-92-118

A RESOLUTION OF THE TOWN OF DAVIE, FLORIDA, OBJECTING TO THE BURNING OF WASTE TIRES IN BROWARD COUNTY'S RESOURCE RECOVERY INCINERATORS; URGING THE BROWARD COUNTY COMMISSION TO PROHIBIT SUCH BURNING; DIRECTING THE TOWN CLERK TO FORWARD A COPY OF THIS RESOLUTION TO THE BROWARD COUNTY COMMISSION, TO THE STATE OF FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION AND TO THE FLORIDA LEAGUE OF CITIES; AND PROVIDING AN EFFECTIVE DATE.

WHEREAS, the Board of Directors of the Broward County League of Cities has learned that the Broward County Resource Recovery incinerators have begun to burn waste tires; and

WHEREAS, such a practice is harmful to the air quality of the surrounding communities in that waste tires were not originally planned to be burned and the emission control systems for the incinerator smoke stacks were not designed to eliminate the noxious fumes from the burning of waste tires; and

WHEREAS, recycling of waste tires is a preferred method of disposal that does not create air pollution; and

WHEREAS, burning waste tires violated the approved "Plan of Operation" which ensures that environmentally dangerous material is not incinerated; and

WHEREAS, Broward County's Resource Recovery Board was never notified of the decision to burn waste tires, and such failure to notify the Board is in violation of the Inter-local agreement between the Cities and Broward County.

NOW, THEREFORE, BE IT RESOLVED BY THE TOWN COUNCIL OF THE TOWN OF DAVIE, FLORIDA.

<u>SECTION 1.</u> That the burning of waste tires in the Broward County Resource Recovery incinerators is objectionable in that it is harmful to air quality and is injurious to the environment.

RECEIVED

JUN 15 1992

Division of Air
Resources Management

SECTION 2. That the Broward County Commission is hereby urged to immediately prohibit the burning of waste tires at the County's Resource Recovery incinerators and directs that such tires be recycled.

SECTION 3. That the Town Clerk is hereby instructed to provide copies of this resolution to the Broward County Commission, the State of Florida Department of Environmental Regulations and the Florida League of Cities.

SECTION 4. This resolution shall take effect immediately upon its passage and adoption.

PASSED AND ADOPTED THIS 3rd DAY OF June, 1992

MAYOR/COUNCILMEMBER

ATTEST:

TOWN CLERK

APPROVED THIS 3rd DAY OF June, 1992

BEST AVAILABLE COPY

RECEIVED

JUN 15 1992

Division of Air Resources Management

Department of Environmental Regulation

Mail Response — Action Slip

Date out: 6.15 Action Item No. 6.029 DATE DUE: 6.29.92

TO:

Mark Latch ☐ Richard Harvey ☐ Dan Thompson ☐ Mike Peyton ☐
Steve Smallwood ☑ John Ruddell ☐ Mimi Drew ☐ Gil Bergquist ☐
Dana Minerva ☐ Other

[illegible]

ACTION:

Handle ☐ Draft Resp. CMB ☑ Draft for Gov. ☐ Respond, Your Signature ☐
Other

(ITEMS for Secretary's Signature **MUST** be reviewed by Division and Secretary's Staff)

Draft Reviewed by (Div.) ______ Date ______ Reviewed by (O.Sec.) [illegible] Date 6/26

Return to Doris Hayes **NO LATER THAN**: 6.29.92

Department of Environmental Regulation

Routing and Transmittal Slip

To: (Name, Office, Location)

1. [illegible] A.I.: 6-029
2. DUE: 6-24-92
3. 6/16
4. Preston

Remarks:

Draft needed for CMB's sig. to Howard's review by 6/24. Final is due to Carol by 6/29

Have Bruce draft brief response, our the policy memo answers most of these questions,

[illegible]

From: Judy

Date

Phone