

TECHNICAL SUPPORT DOCUMENT FOR  
THE PREVENTION OF SIGNIFICANT DETERIORATION  
(PSD) PERMIT FOR THE RESOURCE RECOVERY  
FACILITY IN SOUTH BROWARD COUNTY, FLORIDA

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## 1.0 INTRODUCTION

This report presents the results of an air quality analysis and study performed by Environmental Science and Engineering, Inc. (ESE) for the proposed South Broward County Resource Recovery (SBCRR) facility. The proposed plant will be located in the south portion of Broward County and, therefore, is referred to as the SBCRR facility. The facility will be owned and operated by Signal Environmental Services and by Broward County. 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 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. Solid waste will fuel steam generation boilers at each facility for the purpose of reducing waste volume and generating electricity.

The SBCRR facility will have initial nameplate operating capacity of charging 2,250 TPD. For modeling purposes, the facility is assumed to operate at 115% of its initial nameplate capacity at an 85% annual availability factor. The air quality modeling analyses were performed to address impacts from a facility that is capable of charging 2,588 TPD for initial conditions on a short-term basis. These modeling assumptions will produce conservative (i.e., higher-than-expected) concentrations because the facility is not likely to operate at 115% of its nameplate capacity.

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 Regulation (DER) and the United States Environmental Protection 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 facility 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 plant. 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 SBCRR facility 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 SBCRR facility 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 facility, 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<sup>2</sup>) 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 1985, Broward County generated approximately 3,650 TPD of solid waste (Broward County Environmental Quality Control Board, 1986). 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 1987. 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. A proposed expansion of the latter site could extend this date for several years at current disposal rates.

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. 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 a long-term, full-service waste disposal system.

Figure 2-1 illustrates the general location of the proposed facility. A resource recovery facility and landfill area will be located at the site.

The location of the proposed facility in Broward County is shown in Figure 2-2. The facility will be located about 1.5 kilometers (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 sulfur dioxide (SO<sub>2</sub>);
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.

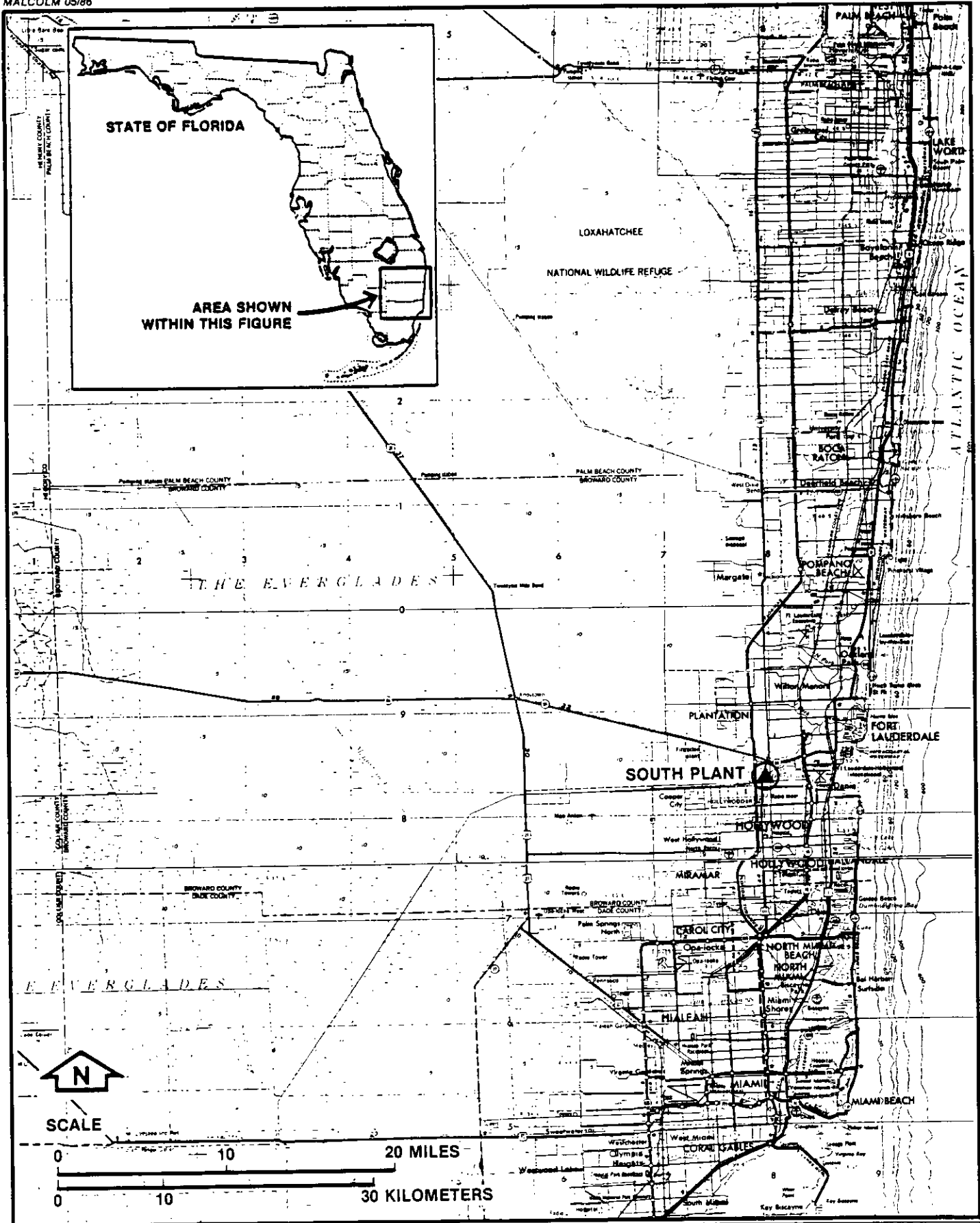


Figure 2-1  
 LOCATION OF THE PROPOSED SOUTH BROWARD  
 COUNTY RESOURCE RECOVERY FACILITY IN  
 FLORIDA

SOURCE: ESE, 1986.

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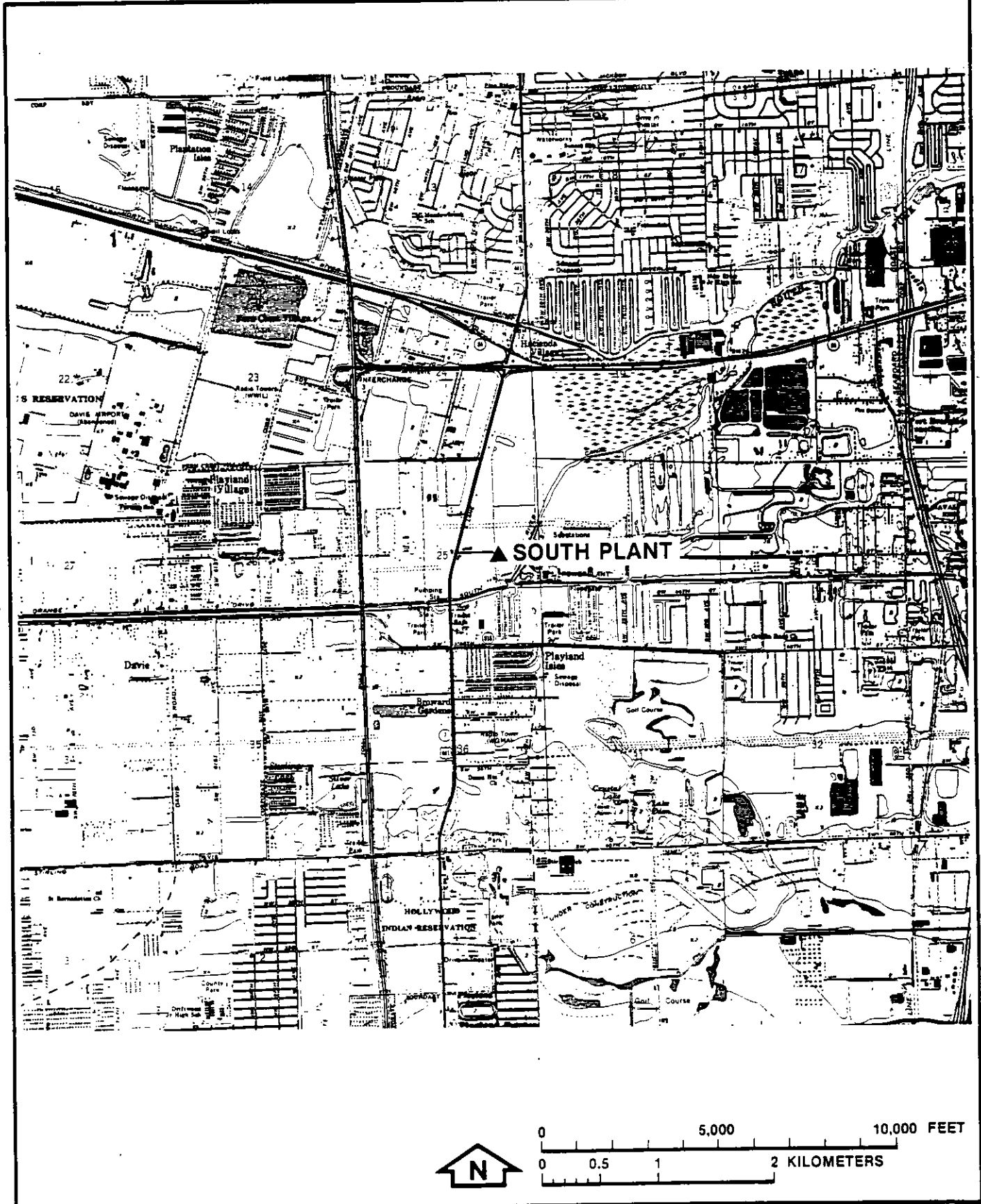


Figure 2-2  
 LOCATION OF PROPOSED SOUTH BROWARD  
 COUNTY RESOURCE RECOVERY FACILITY IN  
 BROWARD COUNTY

SOURCE: ESE, 1986.

MALCOLM PIRNIE, INC.

Table 2-1. National and Florida AAQS

Pollutant	Averaging Time	National AAQS* (ug/m <sup>3</sup> )		PSD Increments (ug/m <sup>3</sup> )	
		Primary	Secondary	Class I	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	NA	2	20
	24-Hour Maximum†	365	NA	5	91
	3-Hour Maximum†	NA	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<sup>3</sup>, annual average, and 260 ug/m<sup>3</sup>, 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<sup>3</sup> = micrograms per cubic meter.  
NA = Not applicable.

Source: 40 CFR, Parts 50 and 52.

05/06/86

Prior to these changes, the State of Florida promulgated the secondary national AAQS for SO<sub>2</sub> 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 retain the secondary AAQS for SO<sub>2</sub> 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 km of the proposed plant site.

## 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 (although DER has been delegated full PSD authority, those sources licensed under Florida's Electrical Power Plant Siting Act must receive final approval by EPA Region IV). 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., 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 SO<sub>2</sub> 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 criteria established in the CAA Amendments. Initially, Congress promulgated areas as Class I [international parks,

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 <sup>3</sup> )
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<sup>3</sup>, 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.

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<sup>3</sup>, calendar quarter; hydrogen sulfide—0.2 ug/m<sup>3</sup>, 1-hour; and beryllium—0.001 ug/m<sup>3</sup>, 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.



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 57 km from the SBCRR facility.

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 date 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 date.

"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-% carbon dioxide (CO<sub>2</sub>).

DER has promulgated pollutant emission limitations to attain and preserve ambient air quality. The only emission regulation that applies to the proposed BCRR facility 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-% excess air. Opacity is limited to 20%.

On June 19, 1984, EPA proposed a revision to NSPS for fossil-fuel-fired steam generators (Subpart D of 40 CFR Part 60) capable of combusting more than  $250 \times 10^6$  Btu/hr heat input. The revision would include PM and NO<sub>x</sub> emission limits for industrial-commercial-institutional steam generating units capable of combusting more than  $100 \times 10^6$  Btu/hr heat input. For units that are capable of burning municipal-type solid waste, the PM emission standard is 0.10 lb/10<sup>6</sup> Btu. No NO<sub>x</sub> emission limits are proposed for this source type at this time.

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 than the 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 excess of the defined PSD SIGNIFICANT EMISSION RATE.

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 than 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 ug/m<sup>3</sup> and 0.2 ug/m<sup>3</sup>, 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, 1978a) and "Regional Workshops on Air Quality Modeling: A Summary Report" (EPA, 1983a). 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 Analysis

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.

Table 2-3. Significant Impact Levels for Criteria Pollutants

Pollutant	Averaging Period	Concentration (ug/m <sup>3</sup> )
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.

#### 2.4 NONATTAINMENT RULES

On August 7, 1980, EPA promulgated rules for review of major new sources and major modifications in areas where air quality does not meet federal standards (i.e., nonattainment areas). Those rules defined source as either an entire plant or an individual piece of process equipment within the plant (i.e., dual definition). On October 14, 1981, EPA deleted the dual definition and defined a source as an entire industrial plant (i.e., plant-wide or bubble definition). In an opinion on Natural Resources Defense Council versus Gorsuch on August 17, 1982, the Washington, D.C. Circuit Court vacated the plant-wide definition and apparently reinstated the dual definition of source. Although no final decision has been reached, EPA's guidance to regional offices concerning the court decision is to reinstate the dual definition of a source. This ruling not only affects the new source review (NSR) permit program as specified in 40 CFR 51.18(j), but also the Emission Offset Interpretative Ruling (40 CFR 51, Appendix S), which applies to new and modified major sources affecting nonattainment areas. Under Section IV.A of the Ruling, such sources are required to: (1) meet an emission limitation which specifies the lowest achievable emission rate for such sources, (2) certify that all existing major sources owned or operated by the applicant in the same state are in compliance with all applicable emission limitations and standards under the Act, (3) obtain emission offsets such that there will be reasonable progress toward attainment of the applicable national AAQS, and (4) demonstrate that the emission offsets would provide a positive net air quality benefit in the affected area [not applicable for VOC or nitrogen oxides (NO<sub>x</sub>)].

Based on these current nonattainment provisions, all major new sources and modifications to existing major sources locating in the nonattainment area must undergo the nonattainment review procedures if the proposed pieces of equipment have the potential to emit 100 TPY or more of the nonattainment pollutant, or the major modification results in a significant net emission increase at the facility of the nonattainment

pollutant. For major sources or major modifications which locate in an attainment or unclassifiable area, the nonattainment review procedures apply if the source or modification exceeds the significant impact levels presented in Table 2-3 at any locality that does not meet AAQS.

## 2.5 SOURCE APPLICABILITY

The estimated emissions of regulated pollutants from the SBCRR facility are presented in Tables 2-4. These emissions are based on 115 percent of initial nameplate capacity. The proposed facility will be located in Broward County, which is designated by EPA and DER as an attainment area for all criteria pollutants except ozone, and a PSD Class II area for SO<sub>2</sub> and TSP. Because VOC emissions from the proposed facility will be less than 100 TPY, nonattainment review is not required. The nearest nonattainment area for any other criteria pollutant is located more than 100 km from the proposed SBCRR facility. 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 SBCRR facility will be located about 57 km, from the PSD Class I area of the Everglades National Park. As a result, potential impacts on the Class I area 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<sub>2</sub>, nitrogen dioxide (NO<sub>2</sub>), carbon monoxide (CO), fluorides, and sulfuric acid mist. As a result, any regulated pollutant emitted from the SBCRR facility 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<sub>2</sub>, NO<sub>2</sub>,



Table 2-4. Maximum Hourly and Annual Average Emission Rates for the SBCRR Facility

Pollutant	Initial Capacity = 2,250 TPD		PSD Significant Emission Rate (TPY)
	lb/hr*	TPY†	
Particulate Matter	71.8	232	25
Sulfur Dioxide	533.8	1,728	40
Nitrogen Dioxide	543.5	1,760	40
Carbon Monoxide	87.4	283	100
Volatile Organic Compounds	12.6	40.8	40
Lead	2.9	9.39	0.6
Fluorides	17.5	56.6	3
Sulfuric Acid Mist	45.6	148	7
Beryllium	0.00090	0.0029	0.0004
Mercury	0.89	2.9	0.1
Arsenic	0.030	0.097	0

\*Based on capacity of 2,588 TPD, which is 115% of nameplate capacity of 2,250 TPD.

†Based on annual availability factor of 85%.

Source: Malcolm Pirnie, Inc., 1985.

CO, lead, fluorides, beryllium, mercury, sulfuric acid mist, 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 used to estimate the emissions of the regulated pollutants are presented in Section 3.0.

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 the proposed SBCRR facility for regulated pollutants subject to PSD review are presented in Table 2-5. The methods used to predict the proposed facility's impacts are described in Section 5.0. Based on these results, the impacts from the proposed facility are expected to be below the de minimis impact levels for all pollutants. Currently, there are no de minimis levels designated for inorganic arsenic and sulfuric acid mist because an appropriate monitoring method has not yet been developed for these pollutants. Therefore, no monitoring is required, and no modeling has been performed for these pollutants in this analysis.

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Table 2-5. Predicted Impacts for the Proposed SBCRR Facility Compared to De Minimis Air Quality Impacts

Pollutant	Averaging Period	Impacts (ug/m <sup>3</sup> )	
		Maximum Predicted Due to Proposal Facility	<u>De Minimis</u> Level*
Particulate Matter	24-hour	0.7	10
Sulfur Dioxide	24-hour	5.3	13
Nitrogen Dioxide	Annual	0.4	14
Carbon Monoxide	8-hour	2.6	575
Lead	24-hour (Quarterly)	0.03 (0.002)†	0.1 (0.1)
Fluorides	24-hour	0.18	0.25
Beryllium	24-hour	0.000009	0.0005 (0.001)
Mercury	24-hour	0.009	0.25

\*Values in parentheses represent results associated with revised de minimis monitoring levels; however, these revisions have not been published in the Federal Register or incorporated into the Code of Federal Regulations.

†Based on annual average concentrations.

Source: ESE, 1985.

### 3.0 FACILITY EMISSIONS AND STACK OPERATING PARAMETERS

The data presented in this report are based on preliminary or conceptual design of the proposed facility. However, the conceptual design is based on conservative or worst-case assumptions from a potential air quality impact viewpoint, particularly in minimizing the exit gas flow rate and maximizing pollutant emissions.

The SBCRR facility is assumed to have an initial nameplate capacity of 2,250 TPD. The MSW charging rate and location of the SBCRR facility are presented in Table 3-1. The stack and operating parameters for the projected initial capacity (i.e., 115% of nameplate) of the facility considered in the air quality modeling are presented in Table 3-2. The proposed stack height for each facility will not exceed Good Engineering Practice (GEP) height (EPA, 1985a).

The emission factors 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 heat content and amount of MSW burned. These emission factors were obtained from Malcom Pirnie, Inc. and the Signal Environmental Services and 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 maximum hourly and annual average emission rates for the facility, which are 115 and 85% of nameplate capacity, respectively, are presented in Table 2-4.

Table 3-1. MSW Charging Rate and Location of the SBCRR Facility

Parameter	Value
<u>MSW Charging Rate</u>	
Nameplate Capacity	2,250 TPD (93.8 tph)
Projected Capacity	2,588 TPD (107.8 tph)
<u>Heat Input Rate*</u>	
Nameplate Capacity	843.8 x 10 <sup>6</sup> Btu/hr
Projected Capacity	970.5 x 10 <sup>6</sup> Btu/hr
<u>Location</u>	
Latitude, Longitude	26.07°, 80.20°
UTM Zone	17
UTM East, North Coordinate	579.6, 2,883.3 km

\*Based on average heating value of MSW of 4,500 Btu/lb.

Source: Malcolm Pirnie, Inc., 1985.

Table 3-2. Stack and Operating Parameters for the Projected Capacity\* of the SBCRR Facility Considered in the Air Quality Modeling

Parameter	Value
<u>MSW Charging Rate</u> Initial	2,588 TPD
<u>Heat Input Rate</u> Initial	970.5 x 10 <sup>6</sup> Btu/hr
Stack Height	195 ft (59.4 m)
Stack Diameter	16.5 ft (5.03 m)
<u>Exit Gas Temperature</u> Initial	450°F (505°K)
<u>Exit Gas Flow Rate</u> Initial	662,000 acfm 340,000 dscfm†
Initial (used in model)	594,767 acfm
<u>Exit Gas Velocity</u> Initial (used in model)	42.6 ft/s (14.1 m/s)

\*Based on 115% of nameplate capacity.

†At 10-percent CO<sub>2</sub>

Note: acfm = actual cubic feet per minute.  
dscfm = dry standard cubic feet per minute.

Source: Malcolm Pirnie, Inc., 1985.

Table 3-3. Pollutant Emission Factors for the Proposed SBCRR Facility

Pollutant	Emission Factor	
	lb/10 <sup>6</sup> Btu	lb/ton*
Particulate Matter	0.074	0.67
Sulfur Dioxide	0.55	4.95
Nitrogen Dioxide	0.56	5.0
Carbon Monoxide	0.089	0.80
Volatile Organic Compounds	0.013	0.12
Lead	0.003	0.027
Fluorides	0.018	0.16
Sulfuric Acid Mist	0.047	0.42
Hydrogen Sulfide	NA	NA
Total Reduced Sulfur	NA	NA
Reduced Sulfur Compounds	NA	NA
Asbestos	NA	NA
Beryllium	9.3 x 10 <sup>-7</sup>	8.4 x 10 <sup>6</sup>
Mercury	0.00092	0.0083
Vinyl Chloride	NA	NA
Benzene	NA	NA
Radionuclides	NA	NA
Inorganic Arsenic	0.000031	0.00028

NA = Not applicable.

\*Based on average heating value of MSW of 4,500 Btu/lb.

Source: Malcolm Pirnie, Inc., 1985.  
Signal Environmental Services, 1985.

#### 4.0 BEST AVAILABLE CONTROL TECHNOLOGY EVALUATION

##### 4.1 REQUIREMENTS AND APPLICABILITY

The control technology review requirements of the federal and state PSD regulations require that all applicable federal and state emission limiting standards be met and that BACT be applied to control emissions from the source. See 40 CFR 52.21 (1985). See Fla. Admin. Code § 17.2.500(5)(b)-(c) (Supp. 1985). The BACT requirements are applicable to all "regulated" pollutants for which the increase in emissions from the source or modification exceeds the significant emission rate (see Table 4-1). Regulated pollutants are those subject to new source review under Rule 17-2.500(2)(f). For the south Broward County Resource Recovery project the following pollutants must undergo BACT review [as set forth in Rule 17-2.500(2)(f)]: PM, SO<sub>2</sub>, NO<sub>x</sub>, CO, Pb, F<sup>-</sup>, Be, Hg, H<sub>2</sub>SO<sub>4</sub> mist, and As.

BACT is defined in Rule 17-2.100(22) of the Fla. Admin. Code as "[an] emission limitation, including a visible emissions standard, based on the maximum degree of reduction of each pollutant emitted which [DER], 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." If the imposition of an emission standard is not feasible, a design, equipment, work practice, operational standard, or combination thereof may be prescribed instead to satisfy the requirement for the application of BACT.

DER has been delegated authority for PSD Review except where sources are licensed under Florida's Electrical Power Plant Siting Act [Fla. Stat. §403.500-403.517 (1985)] and implementing regulations. See Fla. Admin. Code Rule 17-17). For this exception, DER has been delegated administrative and technical review but the final approval rests with EPA Region IV.



Table 4-1. Proposed BACT Emission Rates and Applicability for the SBCRR Facility

Pollutant	Proposed BACT Emission Rate		Maximum Emissions (TPY)**	Significant Rates (TPY)
	(lb/10 <sup>6</sup> Btu)	(lb/ton of MSW)*		
Particulate Matter† (PM)	0.074	0.67	232	25
Sulfur Dioxide (SO <sub>2</sub> )	0.55	4.95	1,728	40
Nitrogen Oxides (NO <sub>x</sub> )	0.56	5.0	1,760	40
Carbon Monoxide (CO)	0.09	0.80	283	100
Lead (Pb)	0.003	0.027	9.4	0.6
Fluorides (F <sup>-</sup> )	0.018	0.16	56.5	3
Sulfuric Acid Mist (H <sub>2</sub> SO <sub>4</sub> )	0.047	0.42	148	7
Mercury (Hg)	0.00092	0.0083	2.9	0.1
Beryllium (Be)	9.3 x 10 <sup>-7</sup>	8.4 x 10 <sup>-6</sup>	0.0029	0.0004
Inorganic Arsenic (As)	3.1 x 10 <sup>-5</sup>	2.8 x 10 <sup>-4</sup>	0.097	0

\*Based on average heating value of MSW of 4,500 Btu/lb.

†0.03 gr/dscf corrected to 12% CO<sub>2</sub>.

\*\*Based on 698,063 TPY (for an equivalent 717.2 x 10<sup>-6</sup> BTU/hr), which assumes 85% availability factor.

Sources: ESE, 1986.

KBN, 1986.

Broward County Resource Recovery Office, 1986.

In making a BACT determination, DER must consider [Rule 17-2.630(a) of the Fla. Admin. Code] the following:

1. Any EPA determination of BACT pursuant to Section 169 and any emission limitation contained in 40 CFR Part 60 (Standards of Performance for New Stationary Sources) or 40 CFR Part 61 (National Emission Standards for Hazardous Air Pollutants). The above references are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., and may be inspected at DER's Tallahassee office. In no event shall application of BACT result in emissions of any pollutant which would exceed the emissions allowed under 40 CFR Parts 60 or 61.
2. All scientific, engineering, and technical material and other information available to DER.
3. The emission-limiting standards or BACT determinations of any other state.
4. The social and economic impact of the application of such technology.

The requirements for BACT were promulgated within the framework of PSD in the 1977 amendments of the CAA ([Public Law 95-95; Part C, Section 165(a)(4)]. The primary purpose of BACT is to optimize consumption of PSD air quality increment thereby enlarging the potential for future economic growth without significantly degrading air quality (EPA, 1978; EPA, 1980b). Guidelines for the evaluation of BACT can be found in EPA's Guidelines for the Evaluation of BACT (EPA, 1978b) and in the PSD Workshop Manual (EPA, 1980b). These guidelines were promulgated by EPA to provide a consistent approach to BACT and to ensure that the impacts of alternative emission control systems are measured by the same set of parameters. In addition, through implementation of these guidelines, BACT in one area may not be identical to another. 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 a source. 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 than NSPS, 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. A decision on BACT is based on sound judgment, balancing environmental benefits with energy, economic and other impacts (EPA, 1978b).

#### 4.2 DESCRIPTION OF PROPOSED CONTROL TECHNOLOGY AND EMISSIONS

The proposed BACT emission rates are presented in Table 4-1. Permitted emissions for other MSW-fired resource recovery facilities are presented in Table 4-2 for comparison.

The only applicable emission-limiting standard for MSW-fired facilities is for PM and is contained in the federal NSPS (40 CFR Part 60 subpart E, Standards of Performance for Incinerators) and in the state emission limiting and performance standards for incinerators [Rule 17-2.600(1) of the Fla. Admin. Code]. Both regulations limit particulate emissions to 0.08 gr/dscf (corrected to 12% CO<sub>2</sub>).

In June 1984, EPA proposed revisions to NSPS for industrial/commercial/institutional steam-generating units that would limit particulate emissions to 0.1 lb/10<sup>6</sup> BTU for MSW-fired boilers capable of combusting more than 100 x 10<sup>6</sup> BTU/hr heat input (49FR25102). This regulation is currently under review with final promulgation set for late 1986.

Proposed New Source Performance Standards (NSPS) limiting SO<sub>2</sub> emissions from industrial-commercial-institutional steam boilers are scheduled for

Table 4-2. BACT Determinations for MSW, Florida Resource Recovery Facilities and Proposed BACT Emission Limit for the South Broward Facility

Pollutant	Emission Limit (in lb/ton of MSW unless otherwise indicated)*						Proposed for South Broward
	Hillsborough	Pinellas Units 1 & 2	Pinellas Unit 3	McKay Bay	Bay County	Dade County	
Particulate Matter (PM)	0.021 gr/dscf	0.08 gr/dscf	0.03 gr/dscf	0.67†	0.56	0.08 gr/dscf	0.03 gr/dscf
Sulfur Dioxide (SO <sub>2</sub> )	3.2	1.9	1.9	4.1	2.8	—	4.95
Nitrogen Oxides (NO <sub>x</sub> )	3.0	—	3.0	7.2	2.2	—	5.0
Carbon Monoxide (CO)	1.8	—	1.5	0.4	11.4	—	0.8
4-5 Volatile Organic Compounds (VOC)	0.2	—	0.3	0.2	0.232	—	—
Lead (Pb)	0.048	—	0.03	0.074	0.0036	—	0.027
Mercury (Hg)	0.0028	—	0.01	0.0996	0.00171	—	0.0083
Beryllium (Be) (x 10 <sup>-6</sup> )	13.1	—	1.3	6.2	48	—	8.4
Fluorides (F <sup>-</sup> )	0.06	—	0.1	0.1	—	—	0.16
Sulfuric Acid Mist (H <sub>2</sub> SO <sub>4</sub> )	0.0768	—	—	—	—	—	0.42
Inorganic Arsenic (As) (x10 <sup>-4</sup> )	—	—	—	—	—	—	2.8

\*Multiply by 0.11 to obtain lb/10<sup>6</sup> Btu based on an average heating value of 4,500 Btu/lb.

†Required LAER due to non-attainment area.

Note: Emissions given in gr/dscf are corrected to 12% CO<sub>2</sub>.

Sources: Hillsborough County, Energy Recovery Facility, Case No. 83-19, Conditions of Certification, Revised 11/6/84  
 Pinellas County, Resource Recovery Facility, Case No. PA 78-11 and PA 83-18, Conditions of Certification.  
 FDER Permit AC 29-47277, McKay Bay  
 FDER Permits AC 03-84703 and AC03-84704, Bay County  
 Metropolitan Dade County Resource Recovery Facility, Case No. 77-607 Conditions of Certification

promulgation in the summer of 1986. Emission-limiting standards for SO<sub>2</sub> from MSW-fired steam generation units will not be included in this proposal since sulfur content of MSW is low relative to other fuels (Burn, 1986).

The sections that follow present the emissions and control technology proposed as BACT for the facility.

#### 4.2.1 Particulate Matter (PM)

The proposed PM emission limit is 0.03 gr/dscf, corrected to 12% CO<sub>2</sub> (or 0.074 lb/10<sup>6</sup> Btu), based upon operation of a well designed electrostatic precipitator (ESP). This level of control is substantially lower than the federal NSPS and Florida emission standards of 0.08 gr/dscf and is consistent with two recent permit approvals in Florida (Pinellas County Unit 3 and Bay County). In addition, this limitation results in emissions below the proposed NSPS for PM of 0.1 lb/10<sup>6</sup> BTU.

PM generated by the combustion of MSW will be minimized through a combination of combustion controls/boiler design and installation of an ESP. PM exiting the boilers in the exhaust gases will be controlled by use of ESPs. The combustion design will be the mass-burn type and capable of firing as-received MSW on a continuous-feed basis without auxiliary fuel firing. The combustion efficiency will yield a residue, or ash, containing not more than 4% combustibles and 2% noncombustibles. This design requirement will serve to minimize the generation of ash.

ESPs are the traditional method of controlling PM emissions from incinerators and steam-generating units. ESPs use the principle of attraction between electrostatically charged objects and an uncharged ground or an oppositely charged object. In 1907, Cottrell developed the first successful application of ESP. The first ESP used for collecting fly ash was installed 1923 and since then thousands have been installed.

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Operation of a modern ESP includes the following sequence:

1. Generation of a high-voltage corona discharge;
2. Bombardment and charging of particles in the gas stream;
3. Migration of charged particles to a collection plate; and
4. Transfer of collected particles from the ESP for disposal.

The generation of a high-voltage corona discharge is accomplished with transformer-rectifiers which energize discharge and grounded electrodes. The flue gas is passed between the electrodes, and the PM in the gas stream becomes charged. The charged particles then migrate to the collecting electrodes, where they are periodically displaced and removed to collecting hoppers, and subsequently removed by the fly ash handling system.

ESP design depends on the electrical properties of the particulate being collected, flue gas volume and properties, and the desired collection efficiency. ESP efficiency is affected by the alignment of ESP electrodes, the specific collection area (SCA), the flow pattern of gas through the ESP, the rapping method, and the electrical characteristics of the corona discharge system.

The ESP for the SBCRR will be designed to achieve at least 98.8% efficiency with typical design features such as:

Fields--4

Effective collector plate area--72,576 ft<sup>2</sup> per ESP

Flow--220,000 acfm

Residence Time--9.9 sec

Total current in electrical section--1,150 milliamps per T/R set

Applied voltage each section--50,000 volts

Max. Gas Temperature--500°F

Electrical length per plate--approximately 12 ft

Wire diameter--Rigid electrode with 10-gage spikes on 6-inch vertical spacing

Wires per section--224-36 Hg (electrodes)  
Wire to Plate Spacing--6"  
Wire to Wire Spacing--18"  
Particle Resistivity-- $10^9$  -  $10^{10}$  ohm-cm

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 500°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).

ESP gas distribution 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 generally is not acceptable. ESP high-voltage systems will have stainless-steel electrodes. Weighted-wire systems generally are not acceptable. ESP discharge electrode rapping will be accomplished by shaft-mounted rotary hammers; solenoid impact or vibrating rapping is not acceptable.

ESP fly ash hopper heaters will be the 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.

#### 4.2.2 Sulfur Dioxide (SO<sub>2</sub>)

SO<sub>2</sub> formation in a MSW-fired furnace is a function of the sulfur content of the fuel and the chemical form in which it occurs. Sulfur in refuse occurs in several organic forms as sulfides, sulfates, and sulfites. Only the sulfate fraction can be converted to SO<sub>2</sub> during combustion. Literature has suggested that a significant fraction of the total sulfur in the fuel is retained in the furnace bottom ash and in the fly ash. The form of the sulfur emitted in the flue gas exiting the ESP is predominantly SO<sub>2</sub>, with a very small percentage as gaseous sulfur trioxide (SO<sub>3</sub>) and H<sub>2</sub>SO<sub>4</sub>.

There are no state emission-limiting standards for SO<sub>2</sub> from MSW-fired boilers. NSPS have not been promulgated or proposed which would regulate SO<sub>2</sub> emissions from the proposed facility.

From Table 4-2, SO<sub>2</sub> emissions for other permitted or proposed MSW-fired facilities in Florida have ranged from 1.9 to 4.1 lb/ton MSW. According to DER, the lower factor of 1.9 lb/ton (Pinellas County Unit 3) has not been achieved based on source testing, and a revised higher emission rate of 4.1 lb/ton MSW has been requested. According to Camp, Dresser & McKee, Inc. (CDM) (1984), stack test results from six mass-burn facilities located throughout the United States showed SO<sub>2</sub> emissions ranging from 1.0 to 4.0 lb/ton. Three other facilities were permitted at rates ranging from 2.0 to 4.0 lb/ton. EPA (1984a) cites an average emission factor of 2.5 lb/ton. Henningson, Durham, and Richardson (HDR) (1985b) surveyed a total of 16 incinerators throughout the world and reported SO<sub>2</sub> emissions ranging from 0.8 to 6.5 lb/ton. An A.D. Little (1981) literature survey found emissions to range from 0.77 to 4.6 lb/ton.

EPA (1982) has reported an average SO<sub>2</sub> emission rate of 0.492 lb/10<sup>6</sup> Btu for overfeed stoker mass-burn facilities. California Air Resources Board (CARB) (1984) reported emission rates from mass-burn and Refuse-Derived



Fuel (RDF) facilities ranging from 0.02 to 1.19 lb/10<sup>6</sup> Btu, with average emissions of about 0.3 lb/10<sup>6</sup> Btu.

These data illustrate that MSW is a non-homogeneous fuel and that sulfur content and SO<sub>2</sub> emissions can vary over a wide range. Nevertheless, SO<sub>2</sub> emissions from MSW firing are lower compared with other solid and liquid fuels.

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<sub>2</sub>/10<sup>6</sup> Btu. No SO<sub>2</sub> emission-limiting standard currently exists or are proposed for incinerators or MSW-fired boilers.

Recent BACT determinations made by the DER for the South Broward County Resource Recovery Facility, Palm Beach County Resource Recovery Project, and the Collier County Resource Recovery Project clearly indicate that flue gas desulfurization systems are not necessary to control SO<sub>2</sub> emissions. In fact, the DER staff analysis for the electric power plant site certification review of the SBCRR project states (DER, 1985):

Burning low sulfur fuel is one acceptable method of controlling SO<sub>2</sub> emissions. The installation of flue gas desulfurization to control SO<sub>2</sub> emissions is not warranted when burning MSW.

The proposed BACT emission limit for the south Broward Resource Recovery project is 0.55 lb/10<sup>6</sup> Btu which is consistent with the upper end of available data and represents a maximum limit. This emission limit is equivalent to about 0.12% sulfur in fuel with no sulfur retained in the ash and is about the same as observed in 23 samples taken from the Central and Davie Landfills in 1983. Depending upon the amount of sulfur retained in the ash, actual SO<sub>2</sub> emissions will vary but would likely be less than the proposed limit.

#### 4.2.3 Nitrogen Oxides (NO<sub>x</sub>)

Factors that influence NO<sub>x</sub> emissions from MSW-fired furnaces include furnace design, excess air, and combustion temperatures. Formation of NO<sub>x</sub> is due to "thermal" NO<sub>x</sub> formation and "fuel" NO<sub>x</sub> formation. Thermal NO<sub>x</sub> is produced by oxidizing the nitrogen contained in the combustion air at high temperatures. Fuel NO<sub>x</sub> is formed when the nitrogen contained in the fuel is oxidized to NO<sub>2</sub>. Fuel NO<sub>x</sub> is most likely the dominant formation mechanism. The level of NO<sub>x</sub> produced, therefore, is a function of temperature and excess air (oxygen availability).

Review of Table 4-2 shows NO<sub>x</sub> emission factors for other MSW-fired facilities in Florida have ranged from 2.2 to 7.2 lb/ton. CDM (1984) reported emission factors for five operating MSW-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. CARB (1984), in its exhaustive study of MSW-fired facilities throughout the United States, found NO<sub>x</sub> emissions ranging from 0.08 to 0.47 lb/10<sup>6</sup> Btu for mass-burn and RDF facilities. EPA (1982) found an average emission rate of 0.308 lb/10<sup>6</sup> Btu for overfeed stoker mass-burn units. HDR (1985b) surveyed 11 MSW incinerators throughout the United States and found NO<sub>x</sub> emissions ranging between 1.1 and 4.7 lb/ton. A.D. Little's (1981) survey showed emissions to range from 0.7 to 4.4 lb/ton.

An emission limit of 0.56 lb/10<sup>6</sup> Btu (approximately 5 lb/ton MSW) is proposed as BACT. Although this emission rate is consistent with the upper end of available data, it provides a reasonable, conservative safety factor for possible variations in fuel composition and furnace operation. In addition, application of NO<sub>x</sub> control technology would tend to create greater emissions of CO and VOC. Also, the desire to achieve combustion conditions (>1,000°C for at least 1 second) that allow complete destruction of chlorinated organics could be inhibited using NO<sub>x</sub> control technology. A proposed limit of 0.56 lb/10<sup>6</sup> Btu is lower than

the NSPS NO<sub>x</sub> limit for solid-fuel-fired, steam-generating facilities [i.e., NSPS for fossil-fuel-fired boilers codified in 40 CFR 60, Subparts D and D(a) limit NO<sub>x</sub> (as NO<sub>2</sub>) emissions to 0.7 and 0.6 lb/10<sup>6</sup> Btu, respectively, for bituminous coal firing].

#### 4.2.4 Carbon Monoxide (CO)

CO emissions from MSW-fired furnaces are a product of incomplete combustion conditions, and solid-waste composition is not an important factor. The quantity of CO produced is dependent upon the design and operation of the furnace. Advancements in combustion technology have resulted in a decreasing trend in CO emissions from MSW furnaces.

High excess air and proper air/fuel mixing are important factors in reducing CO emissions. Even when operated at high excess air levels, CO can be generated from localized areas of the furnace where oxygen deficiencies may exist. Modern MSW-fired furnaces are designed to maximize air and fuel mixing and complete combustion through proper design and refuse feed control.

Table 4-2 shows that CO emission factors approved for other similar facilities in Florida have ranged from 0.4 to 11.4 lb/ton.

CMD (1984) reported CO emission factors ranging from 0.62 to 4.3 lb/ton for over eight operating or permitted MSW-fired facilities located throughout the United States. EPA (1984a) cites a factor of 35 lb/ton, and A.D. Little (1981) reported a range of 0.05 to 34.8 lb/ton based on a literature survey. However, these higher factors are based on an old-design (prior to 1970) furnace. The CARB (1984) study found CO emissions from MSW-fired facilities ranging from 0.18 to 2.0 lb/10<sup>6</sup> Btu for mass-burn and RDF units.

For the south Broward Resource Recovery Project, a CO emission limit of 0.09 lb/10<sup>6</sup> Btu (approximately 0.8 lb/ton) is proposed.

#### 4.2.5 Lead (Pb)

Emissions of Pb from MSW-fired furnaces is primarily a function of the Pb content of the MSW. Pb is a trace metal found in solid waste. Pb is melted and then volatilized in the combustion process but then is deposited onto the fly ash or condensed into the solid phase after leaving the furnace. The Pb is thus susceptible for collection by an ESP or other particulate control device. Pb emission factors for Florida resource recovery facilities, shown in Table 4-2, range from 0.0036 to 0.074 lb/ton. A.D. Little (1981) reports emission rates ranging from 0.04 to 0.34 lb/ton. The CARB (1984) study showed a range of from 5,600 to 16,000 micrograms per megaJoules ( $\mu\text{g}/\text{MJ}$ ) (0.013 to 0.37 lb/ $10^6$  Btu) with an average of 9,531  $\mu\text{g}/\text{MJ}$  (0.022 lb/ $10^6$  Btu).

A BACT emission limit of 0.003 lb/ $10^6$  Btu (approximately 0.03 lb/ton MSW) is proposed for the SBCRR facility. A high efficiency ESP will be installed to meet this limit (see section 4.2.1).

#### 4.2.6 Mercury (Hg)

Hg is present in solid waste in trace quantities. Because of its low boiling point and high vapor pressure, it will exit MSW-fired furnace primarily in the vapor phase. As a result, Hg emissions are not generally capable of control by the PM control device. Florida MSW-fired facilities have accepted Hg emission factors ranging from 0.00171 to 0.0996 lb/ton MSW. The McKay Bay emission factor of 0.0996 lb/ton, which is considerably higher than the other values, is considered unrepresentative of Hg content in Florida MSW. CARB (1984) found rates ranging from 17 to 390  $\mu\text{g}/\text{MJ}$  (0.000039 to 0.000905 lb/ $10^6$  Btu), with an average emission level of 157  $\mu\text{g}/\text{MJ}$  (0.00036 lb/ $10^6$  Btu).

Based on this information, an Hg emission factor of 0.00092 lb/ $10^6$  Btu was considered to represent a reasonable upper limit for the SBCRR facility. The SBCRR facility will not burn any sewage sludge, which may contain Hg in higher concentrations than MSW.

#### 4.2.7 Beryllium (Be)

Be emissions from MSW-fired furnaces, like Pb emissions, are primarily in the solid phase and are dependent upon trace element content of the MSW and PM control device collection efficiency.

Be emission rates for Florida MSW-fired facilities range from  $1.3 \times 10^{-6}$  lb/ton to  $48 \times 10^{-6}$  lb/ton. The CARB (1984) study reported a range of from less than 0.08 to 3.0  $\mu\text{g}/\text{MJ}$  ( $0.19 \times 10^{-6}$  to  $7.0 \times 10^{-6}$  lb/ $10^6$  Btu). Based upon these studies and the application of a high efficiency ESP, a Be factor of  $9.3 \times 10^{-7}$  lb/ $10^6$  Btu (approximately  $8.4 \times 10^{-6}$  lb/ton MSW) is proposed for BACT.

#### 4.2.8 Fluorides (F<sup>-</sup>)

F<sup>-</sup> emissions from MSW-fired furnaces are a function of the F<sup>-</sup> content of the MSW. Little is known about concentrations of F<sup>-</sup> in MSW. F<sup>-</sup> can be emitted as a gaseous product or be bound or absorbed in the fly ash. In the gaseous form, the F<sup>-</sup> will be emitted primarily as hydrogen fluoride (HF).

Few test data are available for F<sup>-</sup> emissions from MSW-fired furnaces. Previously permitted Florida facilities have used emission factors ranging from 0.06 to 0.1 lb/ton. A.D. Little (1981) reported HF emissions from MSW incinerators, based upon a literature survey, to range from 0.1 to 0.12 lb/ton (only two facilities reporting). The CARB (1984) study found limited test data (only one facility) and reported emissions were 0.003 lb/ $10^6$  Btu.

Sufficient data are not available on fluorine content in Broward County MSW to estimate emissions. However, limited data suggest an emission limit of 0.018 lb/ $10^6$  BTU (0.16 lb/ton) is appropriate as BACT.

#### 4.2.9 Sulfuric Acid (H<sub>2</sub>SO<sub>4</sub>) Mist

H<sub>2</sub>SO<sub>4</sub> mist emissions are expected from MSW-fired facilities due to small quantities of sulfur trioxide (SO<sub>3</sub>) associated with the SO<sub>2</sub> emissions.

The  $\text{SO}_3$  reacts with water droplets in the flue gases to form  $\text{H}_2\text{SO}_4$  mist.  $\text{H}_2\text{SO}_4$  formation will depend upon the amount of  $\text{SO}_3$  present and the degree of oxidation to  $\text{H}_2\text{SO}_4$ . Test data for  $\text{H}_2\text{SO}_4$  from MSW-fired furnaces are not available from literature. Test data from coal- and oil-fired industrial boilers found that less than 2% of fuel sulfur content is converted to  $\text{SO}_3$  (EPA, 1981). Similarly, data for coal and oil utility boilers found  $\text{SO}_3$  conversion to be less than 3% of the fuel sulfur (EPA, 1981). In both studies, oil-fired boiler  $\text{SO}_3$  emissions were a factor of 2 or more higher than coal-fired boilers. Data for only  $\text{H}_2\text{SO}_4$  emissions are not available.

Only one Florida facility is currently permitted for this pollutant (Table 4-2). This factor is 0.077 lb/ton MSW and is equivalent to converting about 2% of the fuel sulfur to  $\text{H}_2\text{SO}_4$ . An emission rate of 0.047 lb/ $10^6$  Btu (approximately 0.42 lb/ton MSW) is proposed for the Broward County Resource Recovery project as a conservative upper-level estimate of  $\text{H}_2\text{SO}_4$  emissions. This emission rate is proposed based upon the following considerations:

1. Emission factors for  $\text{H}_2\text{SO}_4$  emissions (as well as  $\text{SO}_3$  emissions) are not available for MSW firing.
2. Available test data suggest that MSW is a non-homogeneous fuel and that sulfur content could potentially vary over a wide range; thus,  $\text{SO}_3$  emissions and potential  $\text{H}_2\text{SO}_4$  emissions could vary as well.
3. An emission factor based on about 6 percent of fuel converted to  $\text{SO}_3$  and potentially  $\text{H}_2\text{SO}_4$  would represent a worst-case emission estimate.

The proposed  $\text{H}_2\text{SO}_4$  emission limit, however, is conservative and may reflect an emission level a factor of 2 or more greater than any  $\text{H}_2\text{SO}_4$  emissions that are likely to be observed from the facility.

#### 4.2.10 Inorganic Arsenic (As)

As is another trace element present in MSW which will be emitted primarily in the solid phase and, therefore, is susceptible to collection by the PM control device. The only information available concerning As emission rates is from the A.D. Little (1981) and CARB (1984) studies. A.D. Little found four MSW facilities in the literature which had reported As emissions, which ranged from 0.0001 to 0.0014 lb/ton. The CARB study reported uncontrolled As emissions ranging from 16 to 1,763  $\mu\text{g}/\text{MJ}$  (0.000037 to 0.0041 lb/10<sup>6</sup> Btu), with an average of 469  $\mu\text{g}/\text{MJ}$  (0.0011 lb/10<sup>6</sup> Btu). Based on using a high efficiency ESP, an emission rate of  $3.1 \times 10^{-5}$  lb/10<sup>6</sup> Btu (approximately  $2.8 \times 10^{-4}$  lb/ton MSW) is proposed for the Broward County project.

#### 4.3 DESCRIPTION AND EVALUATION OF ALTERNATIVE CONTROL TECHNOLOGIES

The following subsections describe and evaluate control technologies that could provide a higher degree of control for the air-regulated pollutants. In some cases, similar control technology can remove a variety of air pollutants. For these common pollutant control applications, a variety of air pollutants will be grouped together.

The economic and energy information presented was developed from:

1. Cost of Sulfur Dioxide, Particulate Matter and Nitrogen Oxide Controls on Fossil Fuel Fired, Industrial Boilers, EPA, August 1982, EPA-450/3-82-021; and
2. Costs of Particulate Matter Controls for Non-Fossil Fuel Fired Boilers, EPA, February 1983, EPA-450/3-83-004.

These references include algorithms for calculating annualized control costs (Table 4-3) and provides the most applicable information for developing economic and energy estimates on MSW-fired steam generators. In addition, the algorithms developed in these documents have been used by EPA to assess economic impacts of various proposed emission-limiting

Table 4-3. Components of Capital, Operating, and Maintenance and Total Annualized Costs

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Capital Costs

Direct Costs--Equipment and Installation

Indirect Costs

Engineering  
Construction and Field Expenses  
Construction Fees  
Start Upcosts  
Performance Costs  
Contingencies  
Working Capital

Operating and Maintenance Costs

Supervision  
Maintenance  
Electricity  
Water  
Solid Waste  
Chemicals  
Indirect (Overhead)  
Lost Revenue

Total Annualized Costs

Operating Costs  
Capital Charges

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Sources: EPA, 1982.  
Malcolm Pirnie, 1986.  
KBN, 1986.



standards. However, the costs developed from these documents are generic and should be considered as a lower level estimate of actual costs.

All costs presented in this section are mid-1985 dollars and were adjusted using the Chemical Engineering Plant Cost Index as necessary.

The alternative technologies considered are presented in Table 4-4. Tables 4-5 and 4-6 present the annualized costs and energy usage, respectively, of the alternative technologies considered in the BACT evaluation.

#### 4.3.1 Particulate Matter (PM)

Application of a higher level of particulate control than that proposed has been permitted as either BACT or lowest achievable emission rate (LAER) in various states (EPA, 1985b). In general, these permits restricted emissions to 0.015 gr/dscf corrected to 12% CO<sub>2</sub>. This level of control will be evaluated in the evaluation of alternative control technologies (see also Table 4-4).

PM control technologies for MSW firing in furnaces and boilers has been extensively examined by EPA (1979) in its review of the NSPS for incinerators, by EPA (1982) in its Background Information Document (BID) for nonfossil-fuel-fired industrial boilers, by CARB (1984), and in the several applications for MSW-fired facilities in Florida as discussed in Section 4.2. The major conclusions of these studies are summarized below:

1. Three types of control devices are potentially applicable to MSW-fueled facilities: electrostatic precipitators (ESP), fabric filters, and venturi scrubbers.
2. ESPs and fabric filters can generally be designed to achieve the same level of control. ESPs provide a much better emission reduction than do venturi scrubbers.

Table 4-4. Alternative Control Technologies Evaluated

Pollutant	Alternative Control		Decrease of Pollutant Emission Over Proposed BACT (TPY)
	Type	Level of Control	
Particulate	ESP/FF	0.015 gr/dscf (corrected to 12% CO <sub>2</sub> )	116
SO <sub>2</sub>	Dry Scrubber	70%	1,210
F-	Dry Scrubber	90%	51
H <sub>2</sub> SO <sub>4</sub> Mist	Dry Scrubber	90%	133
Pb	ESP/FF	See Particulate	4.7
Be	ESP/FF	See Particulate	0.0015
As	ESP/FF	See Particulate	0.049
Hg	Dry Scrubber	50%	1.5

ESP/FF = Electrostatic Precipitator/Fabric Filter

Source: KBN, 1986.

Table 4-5. Annualized Costs of Proposed and Alternative Control Technologies Evaluated

Control	Annualized Cost	Annualized Cost Difference Over Proposed Level of Control
Proposed--ESP @ 0.02 gr/dscf corrected for 12% CO <sub>2</sub>	\$2,485,000	N.A.
ESP/Fabric Filter @ 0.015 gr/dscf corrected for 12% CO <sub>2</sub>	\$2,915,000 - 3,384,000	\$430,000 - 899,000
Dry Scrubber/Fabric Filter	\$5,868,000 - 9,198,000*	\$3,383,000 - 6,713,000*

\*Includes lost revenue; based on 10% downtime due to dry scrubber operation.

NA = Not applicable.

Source: KBN, 1986.

Table 4-6. Energy Usage of Proposed and Alternative Control Technologies Evaluated

Control	Energy Usage (kwh/year)	Energy Usage Increase (kwh/year)
Proposed--ESP @ 0.03 gr/dscf corrected to 12% CO <sub>2</sub>	3,853,000	N.A.
ESP/Fabric Filter @ 0.015 gr/dscf	4,658,000	805,000*
Dry Scrubber/Fabric Filter	6,183,000	2,330,000†

NA = Not applicable.

\*20.9% increase from proposed BACT.

†60.5% increase from proposed BACT.

Source: KBN, 1986.

3. Fabric filters and venturi scrubbers have not been extensively tested and proven on MSW boilers. Those which have been installed on MSW boilers have encountered severe operational and maintenance problems that include: fires and corrosive attack (fabric filters); plugging, severe corrosion, and wastewater treatment (venturi scrubbers).
4. The ESP is by far the most common control technique for control of PM at these facilities and is well proven. Of the 25 PSD permits issued to RDF/MSW fired facilities and listed in the BACT/LAER Clearinghouse--A Compilation of Control Technology Determinations, June 1985, 21 were permitted with ESPs and four with fabric filters.
5. Venturi scrubbers require much more energy in order to provide adequate PM control, operating and maintenance costs are high, and the liquid scrubber waste must be treated and/or disposed of. Improper disposal of liquid wastes may result in significant environmental impacts to surface and ground waters.
6. ESP and fabric filters have low energy requirements, and the waste by-product can be handled in a dry manner.
7. ESP have been proven capable of meeting the proposed BACT emission limit of 0.03 gr/dscf, corrected to 12% CO<sub>2</sub>. A fabric filter would also be capable of meeting the 0.03 gr/dscf limit, but this control technique has not been proven as reliable as the ESP.
8. ESP have been used on MSW-burning facilities, and have been proven reliable.
9. All operating, permitted or proposed MSW-fired facilities in Florida have selected the ESP as the PM control device.

Based on these data, the venturi scrubber was not considered as a PM control alternative. The ESP is considered to be the most proven control device for limiting PM emissions from MSW-fired facilities. A fabric filter is also capable of achieving this level of control, and energy and environmental impacts are similar to the ESP. However, significant

questions arise with the fabric filter regarding its reliability and maintenance when MSW is fired. Applications of fabric filters to MSW-fired facilities generally require flue gas quenching to ensure particles still under combustion do not reach the filters and cause a fire.

Economic Impacts--The costs of the alternative control are shown in Table 4-7 and will range from \$3,710/ton to \$7,750/ton of PM removed. Over the proposed level of control, a 17- to 36% increase in annualized cost is calculated.

Environmental Impacts--The air quality impacts of the proposed facility are presented in detail in Section 6.0. Table 4-8 presents the improvement in air quality from installing a higher level of control (i.e., 0.015 gr/dscf corrected to 12% CO<sub>2</sub>). As shown by Table 4-8, the maximum predicted air quality improvement for PM will be about 1 percent or less of the PSD increments or AAQS.

Energy Impacts--The installation of an ESP to achieve the alternate PM control level will increase annual average energy usage by 805,000 kilowatt hours (kwh) or by about 20.9% (see Table 4-6). For dry scrubber/fabric, the annual average energy usage will increase by 2,330,000 kwh or by about 60.5%.

#### 4.3.2 Sulfur Dioxide (SO<sub>2</sub>), Fluorides (F<sup>-</sup>), and Sulfuric Acid (H<sub>2</sub>SO<sub>4</sub>) Mist

Currently, there are no emission-limiting standards which apply to SO<sub>2</sub>, H<sub>2</sub>SO<sub>4</sub>, F<sup>-</sup>, or HCl emissions from MSW-fired boilers. NSPS have not been proposed or promulgated (nor will they be in the near future) (Burn, 1986), and there are no FDER emission-limiting standards.

Emissions of SO<sub>2</sub>, H<sub>2</sub>SO<sub>4</sub>, and F<sup>-</sup> can all be controlled by the same control technique. H<sub>2</sub>SO<sub>4</sub> emissions are a function of SO<sub>2</sub> emissions; thus, controlling SO<sub>2</sub> also controls H<sub>2</sub>SO<sub>4</sub>.

Table 4-7. Economic Evaluation for Alternative Control Technologies for BACT Pollutants

Pollutant	Annualized Cost Differential (\$)	Cost Per Ton Pollutant Removed (\$/Ton)	Cost Differential Increase from Proposed Control Level (%)
PM	430,000 to 899,000	3,710 to 7,750	17 to 36
SO <sub>2</sub>	3,383,000 to 6,713,000	2,800 to 5,550	136 to 270
F-	3,383,000 to 6,713,000	66,300 to 132,000	136 to 270
H <sub>2</sub> SO <sub>4</sub> Mist	3,383,000 to 6,713,000	25,400 to 50,500	136 to 270
Pb	430,000 to 899,000	91,500 to 191,000	17 to 36
Be	430,000 to 899,000	2.9 x 10 <sup>8</sup> to 6.0 x 10 <sup>8</sup>	17 to 36
As	430,000 to 899,000	8.8 x 10 <sup>6</sup> to 1.8 x 10 <sup>7</sup>	17 to 36
Hg	3,383,000 to 6,713,000	2.3 x 10 <sup>6</sup> to 4.5 x 10 <sup>6</sup>	136 to 270

Source: KBN, 1986.

Table 4-8. Environmental Impacts of Alternative Control Technologies for BACT Pollutants Evaluation

Pollutant	Improvement in Air Quality* ( $\mu\text{g}/\text{m}^3$ )			Maximum Percentage of PSD Increment	Maximum Percentage of AAQS
	3-hour	24-hour	Annual		
PM	1.6	0.4	0.03	1.1	0.3
SO <sub>2</sub>	15.8	3.7	0.28	4.1	1.4
F-	1.0	0.23	0.01	--	--
H <sub>2</sub> SO <sub>4</sub> Mist	1.8	0.4	0.03	--	--
Pb	0.07	0.02	<0.01	--	<0.2
Hg	0.02	<0.01	<0.01	--	--

\*Decrease in maximum predicted ground-level concentrations based on results for the proposed plant.

Sources: ESE, 1986.  
KBN, 1986.



Pre- and post-combustion control technologies for SO<sub>2</sub> have been developed for fossil-fuel-fired boilers, but not for MSW combustion, primarily due to the low sulfur content of the MSW fuel and resultant low SO<sub>2</sub> emissions. Pre-combustion controls include using low sulfur fuel and physical or chemical cleaning. MSW would be classified as a low-sulfur fuel. MSW, at a maximum of 4.9 lb/ton SO<sub>2</sub> emissions, would yield about 0.55 lb/10<sup>6</sup> Btu. By comparison, high sulfur (2.5%) coal and low sulfur (0.5%) coal would yield about 5.0 lb/10<sup>6</sup> Btu and 1.0 lb/10<sup>6</sup> Btu, respectively. Physical/chemical cleaning methods to remove sulfur from MSW fuel are not known to have been developed, primarily because there has not been a need for such methods. Consequently, pre-combustion sulfur and F<sup>-</sup> removal from MSW is considered unnecessary and technologically infeasible at this time.

Post-combustion controls for SO<sub>2</sub> include wet scrubbers and dry scrubbers, the latter requiring a PM collection device to remove the dry waste material from the flue gases. Wet scrubbing systems developed to date include limestone/lime, sodium, and dual alkali scrubbing. Dry scrubbing systems are based upon calcium or sodium scrubbing and evaporation of the scrubbing medium, leaving behind a dry waste material which can be captured in an ESP or fabric filter. Because of the relative low sulfur content of MSW dry scrubbing can be less costly than wet scrubbing.

CARB (1984) presented a comprehensive review of SO<sub>2</sub>, H<sub>2</sub>SO<sub>4</sub> and F<sup>-</sup> control technologies for MSW-fired facilities. This study concluded that both wet and dry scrubbing systems have been satisfactorily proven for application to MSW-fired facilities; however, this conclusion was developed without data from any major installation in the United States. Depending on scrubber technology and scrubbing media, SO<sub>2</sub>, H<sub>2</sub>SO<sub>4</sub>, and F<sup>-</sup> (as HF) removal efficiencies can range from 70 to more than 90% depending upon design.

The major drawbacks of all these systems are:

1. The capital and annual operating costs of a wet or dry scrubbing system are large.
2. These systems are rarely available 100% of the time due to operational problems. Either costly redundancy built into the system is required to ensure 100% availability or loss of plant operation will occur.
3. They produce large amounts of solid and/or liquid wastes which must be treated and/or disposed. Proper disposal to avoid related environmental contamination is required.
4. Energy usage of these systems is high, typically requiring 10 to 15% of the energy output of the facility.
5. Large amounts of water may be required for the scrubber systems.

Applications of scrubbing technology to MSW-fired facilities, for which much of the information in the CARB report was developed, have occurred in Europe and Japan. Most scrubbing applications were of the spray dryer type followed by either an ESP or fabric filter. Combinations of the ESP and spray dryer/scrubber include installations at the Schwandorf Refuse Plant, Germany (Graf, 1984), the Munich North Refuse Plant, Germany (Hahn et al., 1985), the Kommunekemi Nyburg Refuse Plant, Denmark, the Sakab Norrtorp Refuse Plant, Sweden, and the Leverkusen Refuse Plant, Germany (Moller and Christiansen, 1984). Combinations of fabric filter and spray dryer/scrubber include installations at the Ongelmajate Richimaki Refuse Plant, Finland (Moller and Christiansen, 1984), Framingham Refuse Plant, Massachusetts and 10 installations in Japan (Carb, 1984).

Because a number of facilities have been recently permitted (but not yet operated) that use dry scrubbing, this alternative control technology was evaluated (see Table 4-4) for SO<sub>2</sub>, H<sub>2</sub>SO<sub>4</sub> and F<sup>-</sup> removal.

Economic Impacts--The annualized cost differential between the proposed level of control (i.e., ESP) and dry scrubbers is from \$3,383,000 to \$6,713,000 or about 136 to 270% higher than the ESP alone (see Table 4-4). Pollutant removal costs are estimated to be \$2,800/ton to \$5,550/ton for SO<sub>2</sub>, \$66,300/ton to \$132,000/ton for F<sup>-</sup>, and \$25,400/ton to \$50,500/ton for H<sub>2</sub>SO<sub>4</sub>.

Environmental Impacts--The environmental impacts of the proposed level of control are presented in detail in Section 6.0. Improvements in maximum predicted impacts at the alternative control level (i.e., approximately 0.17 lb SO<sub>2</sub>/10<sup>6</sup> Btu) will not exceed 5 percent of the PSD increment and 2 percent of the AAQS (Table 4-8).

Federal or State of Florida AAQS do not exist for F<sup>-</sup> or H<sub>2</sub>SO<sub>4</sub>. Acceptable ambient concentration (AAC) levels for toxic and hazardous pollutants are currently under development by DER (Mora and Gunn, 1985). For pollutants such as HF or H<sub>2</sub>SO<sub>4</sub>, AAC levels of approximately 1/210 of the Threshold Limit Value (TLV), which are typically 8-hour average limits, promulgated by the American Conference of Government and Industrial Hygienist are being considered by DER for new source BACT. A comparison of these developmental AAC levels and predicted concentrations are presented below.

Pollutant	TLV† (µg/m <sup>3</sup> )	AAC (µg/m <sup>3</sup> )	Maximum Predicted Concentration (µg/m <sup>3</sup> )		
			Average 8-hour	Average 24-hour	Annual Average
HF	2,452	11.7	0.5	0.25	0.01
H <sub>2</sub> SO <sub>4</sub>	1,000	4.8	1.4	0.45	0.034

† 8-hour, time-weighted average.

As illustrated above, even at the maximum predicted concentration level the AAC currently under development will not be exceeded.

Energy Impacts--The energy associated with the alternative control is calculated to increase by approximately 2,330,000 kwh/year or approximately 60% higher.

#### 4.3.3. Nitrogen Oxides (NO<sub>x</sub>)

NO<sub>x</sub> emissions from MSW combustion processes result for the oxidation of nitrogen compounds in the combustion air (thermal NO<sub>x</sub>) and in the fuel (fuel NO<sub>x</sub>). Thermal NO<sub>x</sub> formation is highly dependent on temperature and design of the combustion unit (i.e., heat release rates, residence time, and oxygen availability). However, according to CARB (1984), 75 to 80% of the NO<sub>x</sub> generated from refuse burners is a result of fuel NO<sub>x</sub>. Fuel NO<sub>x</sub> is influenced by the fuel nitrogen content, combustion air distribution, and excess air. The amount of NO<sub>x</sub> released from a specific source, both thermal and fuel, is, therefore, a function of the design and operation of the combustion unit.

NO<sub>x</sub> emissions from combustion sources can potentially be reduced by three methods:

1. Reduce fuel nitrogen content,
2. Combustion design, and
3. Flue gas denitrification.

Reducing fuel nitrogen content is not presently feasible. No cost-effective method has been found to separate out materials in MSW which are high in nitrogen content. Flue gas denitrification processes have not been demonstrated on MSW combustion systems on a commercial scale. One process, the selective non-catalytic reduction (SNCR) method, has been applied to four refuse burning facilities in Japan (CARB, 1984). However, operating problems are reported, which reflects the developmental status of this technology. Flue gas denitrification processes were not considered further as BACT for the NBCRR facility due to the lack of reliable, full-scale operating experience and the large costs associated with such a process.

No emission-limiting standards or NSPS exist for NO<sub>x</sub> emissions from MSW-fired facilities. The proposed BACT for NO<sub>x</sub> emissions due to MSW firing, and the only feasible control alternative, is combustion controls.

More extensive NO<sub>x</sub> controls, such as low excess air firing, would tend to create greater emissions of CO and VOC and possibly chlorinated organics due to incomplete combustion; therefore, more extensive NO<sub>x</sub> controls would be counterproductive to the design of the facility. Thus, the combustion design will attempt to limit NO<sub>x</sub>, CO, and VOC emissions to the greatest extent possible within practical limits. As a consequence, a more detailed evaluation of NO<sub>x</sub> control will not be performed.

The air quality impacts of the proposed NO<sub>x</sub> emission levels are discussed in detail in Section 6.0. This analysis demonstrated minimal NO<sub>x</sub> impacts as a result of operation of the proposed facility at the proposed BACT emission rate. This proposed BACT is also consistent with control technologies and BACT determinations for all operating and permitted MSW facilities in Florida.

#### 4.3.4 Carbon Monoxide (CO)

CO emissions from burning are a result of incomplete combustion. High combustion temperatures, good mixing, and proper air/fuel ratios allow optimum control of CO. However, high combustion temperatures and high excess air rates can lead to greater levels of NO<sub>x</sub>; therefore, a tradeoff must exist between NO<sub>x</sub> and CO emissions.

No emission-limiting standards exist for CO emissions from MSW-fired facilities. Specific add-on technologies for control of CO have not been developed or incorporated into operating or permitted MSW-fired facilities designs. As a result, the selected BACT for the proposed facility is good combustion control and furnace design. This BACT is consistent with CO control techniques employed at all operating or permitted MSW-fired facilities in Florida, including four facilities

located in O<sub>3</sub> nonattainment areas (two in Hillsborough County, one in Pinellas County, and one in Dade County). The proposed BACT emission rate for CO is 0.09 lb/Btu of MSW. The air quality impact of the proposed CO BACT emission level is predicted to be insignificant.

#### 4.3.5 Lead (Pb), Beryllium (Be), and Arsenic (As)

As discussed in Section 4.2, small quantities of Pb, Be, and As are present in MSW, and a portion of these metals will be volatilized and then condensed or absorbed upon other particulates contained in the flue gas exhaust stream. Thus, control of PM will also control these trace metals. No emission-limiting standards have been promulgated or proposed to restrict emissions of these trace metals from MSW-fired boilers.

As discussed in Section 4.3.1, the ESP or fabric filter was chosen as an alternative control technology of PM emissions.

Economic Impacts--As shown in Table 4-7, the cost for an alternative level of control for these pollutants exceeds \$90,000/ton for Pb and \$1 million/ton for both Be and As.

Environmental Impacts--The maximum predicted impact of Pb emissions at the BACT emission rate is small and well below the AAQS (see Section 6.0). No Florida AAQS exist for Be or As, although the State of New York has established an AAQS of 0.01 micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ), monthly average, for Be. The maximum predicted 24-hour impact of Be due to the proposed SBCRR is  $0.000001 \mu\text{g}/\text{m}^3$ , which is well below the New York State standard.

Energy Impacts--The energy impacts associated with an alternative control are presented in Table 4-6.

#### 4.3.6 Mercury (Hg)

No emission-limiting standards for Hg emissions from MSW-fired facilities exist. As discussed in Section 4.7, emissions of Hg from MSW combustion

will occur primarily in the gaseous phase and, therefore, will not be controlled by the ESP or fabric filter. Although no known technology currently exists to remove trace quantities of Hg in flue gas streams, some type of scrubbing device may remove a fraction of the Hg emitted. Therefore, for the purpose of this analysis, it was assumed that installation of a dry scrubber system would remove 50% of the emitted Hg.

Economic Impacts--The economic impacts of potentially controlling 50% of the emitted Hg using dry scrubbing is estimated to be more than \$2 million/ton.

Environmental Impacts--An AAQS has not been established for Hg. However, EPA (1984b) developed a guideline of 0.1 ug/m<sup>3</sup>, 30-day average, as part of the development of the National Emission Standards for Hazardous Pollutants (NESHAP) for Hg. (The NESHAP for Hg does not apply to the proposed SBCRR because sewage sludge will not be burned at the facility.) The predicted maximum impact of the proposed facility is 0.09 ug/m<sup>3</sup>, 24-hour average. This short-term maximum is well below the 30-day average guideline.

#### 4.4 RATIONALE FOR PROPOSED BACT

The proposed BACT for NBCRR consists of:

1. A high efficiency ESP to control PM, as well as Pb, Be, and As, to 0.03 gr/dscf corrected to 12% CO<sub>2</sub>;
2. Combustion controls to control NO<sub>x</sub> and CO emissions; and
3. Fuel content to control SO<sub>2</sub> and H<sub>2</sub>SO<sub>4</sub> emissions.

The alternative control technologies evaluated in Section 4.3 provide the basis for comparing economic, environmental, and energy impacts with the proposed BACT. The subsections that follow evaluate the significance of that information.

#### 4.4.1 Economic Impacts

The economic information presented in Section 4.3 was, in part, presented in dollars per ton of pollutant removal. EPA, in evaluating the cost and benefits of various control technologies, uses such economic comparisons. Currently, EPA does not have a standard policy for evaluating pollutants but uses a range of values depending on the pollutant and the governmental organization performing the evaluation (Burn, 1986 and Stevenson, 1986). Recent EPA proposed regulations (EPA, 1984c) and general policy guidance (Burn, 1986 and Stevenson, 1986) indicate that the following ranges are applicable for PM and SO<sub>2</sub>:

PM: \$2,000<sup>1</sup> - \$3,000<sup>2</sup>/ton pollutant removed

SO<sub>2</sub>: \$1,250<sup>3</sup> - \$2,000<sup>2</sup>/ton pollutant removed

1. Proposed NSPS for non-fossil fuel boilers;
2. EPA Office of Air Quality Planning and Standards; and
3. Office of Policy, Planning, and Evaluation.

As discussed in Section 4.3 the costs developed for the alternative control evaluation were based upon information developed by EPA. Sufficient experience has not been developed in the installation of dry scrubbers on MSW-fired facilities to estimate costs with precision. Costs estimated for the scrubber/fabric filter combination were adapted from fossil fuel burning technology. Using the algorithms developed for fossil fuel technology alone would tend to underestimate the costs for MSW applications since the greater variability in MSW fuel characteristics compared with fossil fuel must be considered in design. Consequently, the estimated costs for the dry scrubber/fabric filter are generic and conservative (i.e., underestimating costs). A comparison of the costs and the EPA criteria clearly indicates that the cost of the alternative control technologies evaluated is significant and above the cost which is reasonable.



#### 4.4.2 Environmental Impacts

As discussed in Section 4.2, the improvements in air quality by applying the alternative control technologies are considered insignificant. The maximum improvement by applying alternative controls as a percentage of PSD increment is less than 5% for SO<sub>2</sub> and about 1% for PM. For the proposed control level, the PSD increments for SO<sub>2</sub> and PM consumed at the maximum impact receptor are small compared to the available increment. Clearly, the primary purpose of BACT will be met with the proposed control because sufficient PSD air quality increments are available for potential future economic growth without significantly degrading air quality.

The predicted environmental impacts as a percentage of the AAQS are also minimal with SO<sub>2</sub> and PM concentrations less than 3% of the applicable standard. Improvements in air quality with alternative technology will be less than 2 percent of the applicable AAQS for these pollutants. For Pb, the air quality impacts associated with the proposed BACT will be less than 1% of the AAQS.

The impacts associated with the non-criteria pollutants (i.e., F<sup>-</sup>, H<sub>2</sub>SO<sub>4</sub>, Be, As, and Hg) are well below the currently recognized health or impact levels.

#### 4.4.3 Energy Impacts

The increased energy usage caused by the alternative BACT control technologies is considered significant.

#### 4.4.4 Discussion

Recent permits issued in other states (especially the northeastern United States and western United States) have required control of "acid gases" (including SO<sub>2</sub>, F<sup>-</sup>, and H<sub>2</sub>SO<sub>4</sub>). Dry scrubbing has been the most common control technology selected in these cases. However, a careful review of other state BACT determinations is necessary to eliminate two confounding factors. First, those controls which were generally associated with

Lowest Achievable Emission Rate (LAER) determinations must be distinguished. Second, consideration of the air quality impacts associated with the site-specific meteorology must be made since air quality impacts may have necessitated the need for greater control.

The difference between LAER and BACT determinations is significant. Application of LAER reflects the need to meet non-attainment provisions of a specific State Implementation Plan. These non-attainment provisions, including LAER, generally apply to new or modified sources which are located in, or have a significant impact on, a designated non-attainment area. LAER as defined in EPA's Emission Offset Interpretative Ruling (see 40 CFR, Part 51, Appendix S) is:

"Lowest achievable emission rate" means, for any source, the more stringent rate of emissions based on the following:

- (i) The most stringent emissions limitation which is contained in the implementation plan of any State for such class or category of stationary source, unless the owner or operator of the proposed stationary source demonstrates that such limitations are not achievable; or
- (ii) The most stringent emissions limitation which is achieved in practice by such class or category of stationary source. This limitation, when applied to a modification, means the lowest achievable emissions rate for the new or modified emissions units within the stationary source. In no event shall the application of this term permit a proposed new or modified stationary source to emit any pollutant in excess of the amount allowable under applicable new source standards of performance.

This definition, which is similar to that promulgated by DER (See Rule 17-2.640 Fla. Admin. Code) does not allow consideration of any economic or environmental impacts; rather LAER is technology based. As a result, a clear distinction must be made between LAER and BACT determinations. For the SBCRR facility, the application of LAER is

clearly inappropriate in that economic, environmental, and energy impacts must be taken into account determining BACT.<sup>1</sup>

The differences in meteorology from one area to another can lead to substantial differences in air quality impacts. This effect of meteorological differences is illustrated in Table 4-9, which compares the environmental impacts from the proposed BACT for SBCRR with the similar-sized, MSW/RDF-fired facilities installed with dry-scrubbers and located in Connecticut. As shown in this comparison, the impacts of resource recovery facilities in Connecticut are many times larger than that of the proposed project which is located in south Florida. Furthermore, in many cases the permitted emissions are not significantly lower (with a dry scrubber) than that proposed for SBCRR. This comparison illustrates that the application of more stringent control of MSW-fired facilities for other states is not directly comparable to that proposed for SBCRR and that site-specific conditions must be considered as part of a case-by-case BACT analysis.

#### 4.4.5 Conclusion

Based on an evaluation of the proposed and alternative control technologies, the proposed control technology is considered the appropriate choice for BACT. This conclusion is based on the relative significance of economic and energy impacts associated with the low air quality benefits that would result from applying the alternative technology and on proven reliability of the proposed technology. The conclusion matrix presented as Table 4-10 illustrates the engineering conclusion drawn from the data presented in the BACT section.

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1. Resource recovery facilities locating in non-attainment areas can be exempted under certain circumstances from applying LAER. Clearly, EPA recognized the need to dispose of MSW in urban areas.

05/29/86

Table 4-9. Comparison of Proposed BACT Environmental Impacts with Alternative Control Technology—Dry Scrubbers Permitted in Connecticut

Pollutant	South Broward County				Bridgeport, Connecticut				Mid-Connecticut			
	Proposed Emissions* (TPY)	Air Quality Impact**			Allowable Emissions† (TPY)	Air Quality Impact**			Allowable†† Emissions (TPY)	Air Quality Impact**		
		3-hour	24-hour	Annual		3-hour	24-hour	Annual		3-hour	24-hour	Annual
PM	320	3.1	0.7	0.06	145	23.2	2.65	0.6	165	16	7	0.7
SO <sub>2</sub>	2,340	22.8	5.3	0.4	1,367	219	25	6	1,371	137	59	6
F <sup>-</sup>	110	1.1	0.25	0.01	19.5	3.1	0.4	0.09	NL	—	—	—
H <sub>2</sub> SO <sub>4</sub> Mist	200	2.0	0.45	0.035	132	21.1	2.4	0.6	NL	—	—	—
Pb	13	0.13	0.03	0.002	2.8	0.5	0.05	0.01	14.4	1.4	0.6	0.06
Hg	3.9	0.04	0.09	0.001	3.9	0.6	0.07	0.02	NL	—	—	—

\*Based on maximum of 2,588 tons/day and average of 698,063 TPY of MSW.

†Based on maximum of 2,250 tons/day and average of 821,250 TPY of MSW.

\*\*Predicted highest, second-highest 3- and 24-hour and highest annual concentrations due to proposed emissions only.

††Based on maximum of 2,000 tons/day and average of 730,000 TPY of RDF fuel.

Sources: Connecticut DEP, 1985b.  
ESE, 1986.

Table 4-10. BACT Conclusion Matrix for Alternative Control Technologies Evaluated

Summary of Impacts of Alternative Control Technologies		
Economic	Environmental	Energy
<p>Significant</p> <ul style="list-style-type: none"> <li>o Cost greater than EPA criteria</li> <li>o Dry scrubbing will cost from \$4.85 to \$9.62/ton of MSW or approximately 17 to 34% of tipping fee</li> <li>o Over a 30-year life of the facility the total cost will range from \$101,490,000 to \$201,390,000 (1985 dollars) for a dry scrubber system</li> </ul>	<p>No significant improvement for proposed BACT</p> <ul style="list-style-type: none"> <li>o Small percentage (&lt;5%) of PSD increment consumed</li> <li>o Impacts small (&lt;2%) compared to AAQS</li> <li>o Lower reliability of alternative controls</li> <li>o All predicted maximum concentrations are many times lower than levels where public health or welfare effects may occur</li> </ul>	<p>Significant increase in energy consumption over proposed; from 20.9 to 60.5% energy usage increase calculated for alternative controls</p>

Source: KBN, 1986.

## 5.0 AIR QUALITY MODELING APPROACH

### 5.1 MODEL SELECTION

The ISC dispersion model (Cramer, 1979) was used to evaluate the proposed SBCRR facility's 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, 1984).
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 criterion 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% 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 to 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 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 sites.

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, 3.9, and 4.3 km along each radial.

In the refined modeling analysis, concentrations were predicted using a radial receptor grid centered on the receptor that produced the highest, second-highest concentration for the short-term averaging period. The grid consisted of 49 receptors which were located along seven radials spaced at 2-degree intervals and separated by 100-m intervals along each radial. 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 proposed facility was modeled to predict impacts at 17 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 source. No refined modeling analysis was performed for Class I impacts.

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#### 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. 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 facility are listed in Table 5-2. The maximum concentrations measured during 1984 are also presented in Table 5-2. Based on these measured maximum concentrations in Table 5-2, pollutant concentrations within a 10-km radius from the facility are less than the national and Florida AAQS, except for CO. It should be noted that the SO<sub>2</sub> and NO<sub>2</sub> concentrations are not measured by an acceptable technique for use in PSD applications. However, based on the data presented in Table 5-2, the measured SO<sub>2</sub> and NO<sub>2</sub> concentrations are well below AAQS. Also, based on the modeling results presented in Section 6.0, the maximum predicted concentrations due to SBCRR facility operating at initial capacity are expected to be below the de minimis impact levels for all pollutants; therefore, no monitoring is required for those pollutants under those plant operating conditions. 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.

Table 5-1. Ambient Air Monitoring Sites in Broward County During 1984

SAROAD No.	Broward County No. or Operator	Location		Pollutant Measured	Location with Respect to Proposed South Facility	
		City/Division	UTM, X,Y Coordinates (km)		Direction (°)	Distance (km)
3700003G01	1	Pompano Beach	590.17, 2908.00	TSP, Pb	23	26.8
3700002G01	3	Pompano Beach	587.85, 2902.78	TSP	23	21.1
2270001G01/09	4	Lauderdale Lakes	579.55, 2894.76	TSP, NO <sub>2</sub> , SO <sub>2</sub> , CO	360	11.4
3640002G01	5	Plantation	575.52, 2891.27	TSP	334	9.4
1260003G01	6	Ft. Lauderdale	583.11, 2890.09	TSP, NO <sub>2</sub> , SO <sub>2</sub> , CO, Pb	27	7.6
4350001G01	7	Tamarac	574.44, 2897.87	TSP	340	15.4
0910002G01	8	Davie	576.19, 2884.99	TSP, NO <sub>2</sub> , SO <sub>2</sub>	296	3.81
3530001G01	9	Pembroke Pines	575.26, 2877.44	NO <sub>2</sub> , SO <sub>2</sub>	216	7.3
1840001G01	10	Hollywood	582.21, 2876.98	TSP, Pb	158	6.9
1640001G01	11	Hallandale	584.60, 2874.44	TSP	151	10.2
1260004G01/09	12	Ft. Lauderdale	585.20, 2887.20	TSP, NO <sub>2</sub> , SO <sub>2</sub>	55	6.8
0420002G01	13	Hacienda Village	579.70, 2885.34	CO	3	2.0
0420003G03	14	Coral Springs	571.60, 2906.88	O <sub>3</sub>	341	24.9
3530002G01/09	15	Pembroke Pines	570.00, 2878.40	TSP	297	10.8

Table 5-1. Ambient Air Monitoring Sites in Broward County During 1984 (Continued, Page 2 of 2)

SAROAD No.	Broward County No. or Operator	Location		Pollutant Measured	Location with Respect to Proposed South Facility	
		City/Division	UTM, X,Y Coordinates (km)		Direction (°)	Distance (km)
0420004G01	16	N. Lauderdale	577.73, 2900.11	O <sub>3</sub>	354	16.9
3700004G01	17	Pompano Beach	585.34, 2900.13	CO	19	17.8
1840002G01	18	Hollywood	584.00, 2875.87	CO	150	8.6
2560002G01	19	Margate	578.86, 2903.51	TSP, Pb	358	20.2

Source: ESE, 1985.

Table 5-2. 1984 Ambient Air Quality Data for Monitoring Stations Within 10 km of the SBCRR Facility

Broward County No. or Operator	SAROAD No.	Concentration ( $\mu\text{g}/\text{m}^3$ )*							
		TSP		SO <sub>2</sub>		NO <sub>2</sub>	CO†		Pb
		24-hr	Annual	24-hr	Annual	Annual	1-hr	8-hr	Quarter
5	3640002G01	59	31	—	—	—	—	—	—
6	1260003G01	93	59	4	3	42	11	7	0.9
8	0910002G01	64**	33**	4**	3**	28**	—	—	—
9	3530001G01	—	—	6	3	30	—	—	—
10	1840001G01	70	39	—	—	—	—	—	0.2**
12	1260004G01	72	41	28	4	31	—	—	—
13	0420002G01	—	—	—	—	—	17**	10**	—
18	1840002G01	—	—	—	—	—	9	7	—
Florida AAQS		150	60	260	60	100	40	10	1.5

\*For short-term averages, second-highest concentration is shown.  
†CO concentrations in  $\text{mg}/\text{m}^3$ .  
\*\*Closest monitoring station for specified pollutant.

Source: ESE, 1985.

The only measured pollutant that approached AAQS in 1983 was CO. Within a 10-km radius of the proposed south facility, the highest and second-highest 8-hour average CO concentrations equalled the 8-hour AAQS at one monitor location (i.e., Broward County Site No. 13). Based on the model results presented in Section 6.0, the maximum predicted 8-hour average concentration due to the proposed facility is well below the PSD significant impact level. Therefore, the proposed facility will not have a significant impact in the vicinity of the monitor.

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## 6.0 AIR QUALITY MODELING RESULTS

Predicted maximum impact concentrations for the proposed SBCRR facility at initial projected operation, using screening and refined modeling receptor grids, are presented in Tables 6-1 and 6-2, respectively. These results are based on the plant charging 2,588 TPD or 107.8 tons per hour of MSW at initial projected operation. The maximum hourly emission rates are presented in Table 2-4 (see Section 2.5).

In general, maximum pollutant concentrations increased slightly for the refined receptor grid compared to the screening grid. For most of the pollutants, the predicted maximum concentrations are below the PSD significant impact levels and de minimis monitoring levels. As a result, the proposed plant's emissions do not produce a significant impact for PM, NO<sub>2</sub>, or CO concentrations, and, therefore, do not require additional modeling analyses. For SO<sub>2</sub>, the maximum 24-hour concentration is greater than the significant impact level. However, the maximum concentration is predicted to be only 6 percent above the 24-hour significant impact level. 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. Based on these results and the existing low measured pollutant concentrations in Broward County (see Section 5.4), the proposed emissions from the SBCRR facility is expected to comply with the national and Florida AAQS and PSD Class II increments.

The proposed emissions for the SBCRR facility 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 Everglades National Park (Table 6-3). These results are consistent with the predicted maximum concentrations within the near vicinity of the proposed facility. Thus, the emissions for the proposed SBCRR facility are expected to comply with national and Florida AAQS and PSD Class I increments in the Everglades National Park.

Table 6-1. Predicted Maximum Concentrations for the Proposed SBCRR Facility at Initial Projected Operation (115% of Nameplate Capacity) Using Screening Modeling Methods

Pollutant	Averaging Time	Maximum Concentration* (ug/m <sup>3</sup> )	Receptor Location†		Period		
			Direction (°)	Distance (km)	Year	Julian Day	Hour Ending
SO <sub>2</sub>	3-hour	22.8	300	2.7	1971	126	12
	24-hour	5.2	310	2.3	1972	112	24
	Annual	0.4	280	4.3	1970	—	—
			300	3.1	1972,1974	—	—
TSP	24-hour	0.70	310	2.3	1972	112	24
	Annual	0.06	280	4.3	1970	—	—
			300	3.1	1972,1974	—	—
NO <sub>2</sub>	Annual	0.4	280	4.3	1970	—	—
			300	3.1	1972,1974	—	—
CO	1-hour	9.3	10	1.1	1970	187	11
	8-hour	2.3	310	2.3	1972	111	16
Pb	24-hour (Quarterly)	0.03 (0.002)**	310	2.3	1972	112	24
			(300)	(3.5)	(1972)	(—)	(—)
			(300)	(3.9)	(1974)	(—)	(—)
F <sup>-</sup>	24-hour	0.17	310	2.3	1972	112	24
Be	24-hour	0.000009	310	2.3	1972	112	24
Hg	24-hour	0.009	310	2.3	1972	112	24

\*Highest, second-highest concentrations 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, 1985.

Table 6-2. Predicted Maximum Concentrations for the Proposed SBCRR Facility at Initial Projected Operation (115% of Nameplate Capacity) Using Refined Modeling Methods

Pollutant	Averaging Time	Maximum* Concentration (ug/m <sup>3</sup> )	Receptor Location†		Period			Significant Impact Level (ug/m <sup>3</sup> )	De Minimis Monitoring Level (ug/m <sup>3</sup> )
			Direction (°)	Distance (km)	Year	Julian Day	Hour Ending		
SO <sub>2</sub>	3-hour	22.8	300	2.7	1971	126	12	25	NA
	24-hour	5.3	312	2.4	1973	112	24	5	13
	Annual	0.4	280	4.3	1970	--	--	1	NA
			300	3.1	1972, 74	--	--		
TSP	24-hour	0.71	312	2.4	1972	112	24	5	10
	Annual	0.06	280	4.3	1970	--	--	1	NA
			300	3.1	1972, 74	--	--		
NO <sub>2</sub>	Annual	0.4	280	4.3	1970	--	--	1	14
			300	3.1	1972, 74	--	--		
CO	1-hour	10.0	8	1.0	1970	187	11	2,000	NA
	8-hour	2.6	312	2.3	1972	111	16	500	575
Pb	24-hour (Quarterly)	0.03 (0.002)**	312	2.4	1972	112	24	NA	0.1
			(280)	(4.3)	(1970)	--	--	(NA)	(0.1)
			(300)	(3.1)	(1972, 74)	--	--		
F <sup>-</sup>	24-hour	0.18	312	2.4	1972	112	24	NA	0.25
Be	24-hour	0.000009	312	2.4	1972	112	24	NA	0.0005 (0.001)
Hg	24-hour	0.009	312	2.4	1972	112	24	NA	0.25

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, 1985.

6-3



Table 6-3. Predicted Maximum Concentrations at the PSD Class I Area Due to the Proposed SBCRR Facility at Initial Projected Load (115% of Nameplate Capacity)

Pollutant	Averaging Time	Maximum Concentration* (ug/m <sup>3</sup> )	Receptor Location		Period			Significant Impact Level (ug/m <sup>3</sup> )	Monitoring Level (ug/m <sup>3</sup> )
			UIM Coordinates (km)		Year	Julian Day	Hour Ending		
			x	y					
SO <sub>2</sub>	3-hour	3.9	520.75	2849.4	1973	18	3	25	NA
	24-hour	0.74	522.75	2849.4	1973	17	24	5	13
	Annual	0.1	—	—	1971-74	—	—	1	NA
TSP	24-hour	0.10	522.75	2849.4	1973	17	24	5	10
	Annual	0.01	—	—	1971-74	—	—	1	NA
NO <sub>2</sub>	Annual	0.1	—	—	1971-74	—	—	1	14
CO	1-hour	1.3	532.75	2847.4	1971	216	20	2,000	NA
	8-hour	0.21	522.75	2849.4	1971	204	24	500	575
Pb	24-hour (Quarterly)	0.004 (0.0)†	522.75	2849.4	1973	17	24	NA	0.1 (0.1)
F <sup>-</sup>	24-hour	0.02	522.75	2849.4	1973	17	24	NA	0.25
Be	24-hour	0.000001	522.75	2849.4	1973	17	24	NA	0.0005 (0.001)
Hg	24-hour	0.001	522.75	2849.4	1973	17	24	NA	0.25

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.  
†Annual average.

Source: ESE, 1985.

## 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 SBCRR 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 (Myrica cerifera), and various upland grasses. In mixed wetlands and upland areas to the north, typical species include 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 eastern border of the Everglades National Park, a PSD Class I area, is approximately 57 km southwest of the south plant site. 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 doses (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 the 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 the 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 monitoring station nearest the proposed plant location (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 facility 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 facility, no impact on the vegetation of the Class I area due to operation of the facilities is expected.

Table 7-1. Maximum Predicted Concentrations Due to the Proposed SBCRR Facility Compared to Concentrations Known to Adversely Impact Vegetation

Pollutant	Average Period	Concentration (ug/m <sup>3</sup> )			Lowest Concentration Known to Impact Vegetation (ug/m <sup>3</sup> )	Reference
		Maximum Predicted Due to Facility	Background*	Total (Facility Plus Background)		
SO <sub>2</sub>	3-hour	22.8	4†	26.8	260	Tingey, 1973.
TSP	24-hour	0.7	93	93.7	1,000 g/m <sup>2</sup>	Williams, 1971.
NO <sub>2</sub>	Annual	0.4	42	42.4	120	Thompson, 1970.
	3-hour	23.2	**	23.2	188	Tingey, 1971.
CO	1-hour	9.3	17,000	17,009	Vegetation not impacted by CO	--
Pb	3-month	0.002	0.9	0.902	Not known to be available to plants	Zimdahl, 1973.
F <sup>-</sup>	24-hour	0.18	**	0.18	1 to 3	McCune, 1969. Adams, 1956.
Be	24-hour	0.000009	**	0.000009	Not known to be available to plants	Gough, 1979.
Hg	24-hour	0.009	**	0.009	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, 1985.

Soils in the region of south Florida, where the proposed site is 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 SBCRR facility is so low that, in any event, effects on soils will be negligible.

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## 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 km from the facility. 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 plant 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 south facility. The results of this analysis indicated that the absolute values of the contrast 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 the proposed facility 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 facility would be attributable to the increased automotive traffic generated by employee travel and solid waste delivery. It is anticipated that about 570 solid waste transport vehicles per day would deliver municipal refuse to the facility when operating at initial projected capacity (i.e., 2,588 TPD, which is 115% above nameplate capacity). The impact of the exhaust emissions from the solid waste transport vehicles is expected to be minimal. The vehicles associated with the facility would represent an increase of less than 1 percent of the traffic that travels on existing roadways (Malcolm Pirnie, 1985). 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 facility will require only about 40 fulltime employees, the impacts associated with employee traffic also will be negligible.

## 8.0 SUMMARY AND CONCLUSIONS

The following discussions present a summary and conclusions drawn from the results of this study.

1. The proposed SBCRR facility will be a major source of emissions for PM, SO<sub>2</sub>, NO<sub>2</sub>, CO, sulfuric acid, and Fl. The facility will also be ~~in excess of the PSD SIGNIFICANT EMISSION RATES for 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. Since VOC emissions are expected to be less than 100 TPY, nonattainment review for O<sub>3</sub> is not required.
2. Emission control equipment to be used at the proposed facility will be designed to remove approximately 99% of PM. This will result in the emission of 0.03 gr/dscf of PM, which is about 60% 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<sub>2</sub>, NO<sub>2</sub>, 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 facility.
4. The air quality dispersion modeling results show that the proposed emissions from the facility operating at initial capacity will comply with the national and Florida AAQS and PSD Class I and II increments. The model results are conservative (i.e., higher than expected) because the plant was assumed to operate at 115% of nameplate capacity for initial conditions. The proposed emissions from the facility produce maximum ground-level concentrations that

are below the de minimis air quality impact monitoring levels for all pollutants near the vicinity of 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 the 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 the proposed facility are highly unlikely to cause adverse visibility impairment in the Everglades National Park.



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