

LEE COUNTY, FLORIDA
SOLID WASTE ENERGY RECOVERY FACILITY
APPLICATION FOR
POWER PLANT CERTIFICATION

VOLUME I - APPLICATION



SUBMITTED BY
THE LEE COUNTY
BOARD OF COUNTY COMMISSIONERS

JUNE 1980
JUNE 1991 (REVISED)

PREPARED BY
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THIS DOCUMENT IS PRINTED ON RECYCLED PAPER.

environmental engineers, scientists,
planners, & management consultants

CDM

PREFACE

On May 1, 1991, the Board of County Commissioners of Lee County formally adopted a resolution to build an energy recovery facility with an initial capacity of 1,200 tons per day (tpd), and a future maximum capacity of 1,800 tpd. This facility will be smaller than that previously considered by the County (1,800 tpd initially, with a future maximum of 2,400 tpd). An Application for Power Plant Site Certification was submitted to the Florida Department of Environmental Regulation for the previously considered larger facility in June, 1990. This current permit application contains revisions to the one submitted in June, 1990, to reflect the reduced predicted air quality impacts for the current smaller Facility size. Other changes have been made to incorporate the recently promulgated New Source Performance Standards for Municipal Waste Combustors, and the passage of the Clean Air Act Amendments of 1990.

Most of the changes, updates and revisions are found in Volume III; however, changes are also found in Volume I. The changes in air quality impacts for Volume I are provided in a revised copy of Sections 3.0 and 5.0. Other changes in Volume I have been provided in the June 9, 1991 Errata Sheet. Revised Sections 3.0 and 5.0 (June 28, 1991) include the revisions provided in the June 5, 1991 Errata Sheet.

SECTION 3.0
THE FACILITY
AND
DIRECTLY ASSOCIATED FACILITIES

3.0 THE FACILITY AND DIRECTLY ASSOCIATED FACILITIES

3.1 BACKGROUND

Commercial-scale energy recovery began in the United States in the late 1960s, but European countries have been recovering energy from solid waste for more than 30 years. Denmark converts 70 percent of its solid waste to energy, Switzerland converts 40 percent, and Sweden converts 30 percent. Currently, the United States converts less than 2 percent of its solid waste to energy, but this quantity is expected to increase to 10 percent during the early 1990s. More and more communities in the United States are building energy recovery facilities as the technology is tested and proven effective.

Lee County wishes to construct its own energy recovery facility to serve its solid waste processing and disposal needs for the waste which remains after recycling. Interest in the concept of energy recovery has been stimulated by an increased awareness of the environmental and siting problems associated with landfill disposal methods.

A Solid Waste Master Plan completed for Lee County by Camp Dresser & McKee Inc. (CDM) in August 1989 recommended the development of a mass-burn energy recovery facility. On November 29, 1989, the Lee County Board of County Commissioners executed an agreement with CDM for implementing an energy recovery-based solid waste management system. Shortly after the contract was approved, a management team was organized to guide this project to completion. The management team includes the consultant team (engineers, legal and financial advisors) and Lee County staff and decision-makers.

On October 17, 1989, Hendry County entered into an agreement with Lee County which states that:

Lee County shall acquire, own, permit, develop, operate, and maintain land within Hendry County as the combined solid waste disposal site for both Lee and Hendry counties.

Lee County shall obtain all necessary permits for, construct and operate the following solid waste facilities to serve the needs of both Counties:

1. A Class I solid waste disposal facility;
2. An ash landfill for bottom ash, fly ash and siftings from the energy recovery facility;
3. A Class III solid waste disposal facility for waste generated in both Counties;
4. An energy recovery facility;
5. Materials recycling facilities;
6. Sludge disposal and composting facilities;
7. Used'tire and white goods disposal facilities;
8. Not more than two transfer stations within Hendry County for the transfer of waste; and
9. Ancillary property and facilities necessary for the efficient and proper operation of a complete solid waste disposal system for both counties.

The ash landfill and Class I and Class III solid waste disposal facilities shall be located at a common disposal site in Hendry County. The energy recovery facility shall be located in Lee County. Transfer stations shall be located at sites designated by Hendry County. Other facilities may be located at the Hendry County common disposal site or at sites designated by agreement of both counties.

A copy of the interlocal agreement between Lee County and Hendry County is provided in Appendix 5.1. It should be noted that the volume of solid waste currently generated in Hendry County is less than one-tenth that generated in Lee County.

3.1.1 SOLID WASTE COLLECTION

Lee County has strong control over collection and disposal activities within the County through its Mandatory Garbage and Solid Waste Collection Ordinance No. 86-38 (effective April 1987). The incorporated cities of Fort Myers, Cape Coral, and Sanibel Island are not regulated under the County's ordinance, but they each have or are formulating their own ordinances. The City of Fort Myers provides its own collection services and the remaining areas are under private contract for waste collection.

In general, the private contract franchises of Lee County operate under similar terms with respect to the various aspects of collection. For example, a weight limitation for typical residential pick-up is 40 pounds per container. All non-containerized or unbagged garbage or waste must be bundled, with a maximum length not to exceed four feet. Other collection rules and regulations, together with well-defined franchise boundaries, are clearly delineated in formal agreements with the County; therefore, the flow of waste within Lee County is tightly controlled through legislation. All franchise and the City of Fort Myers collection operations are closely monitored by the County's solid waste department. User fees are paid directly to the County, by franchise and non-franchise haulers (hauling more than one ton), for disposing of collected wastes at the existing privately-owned landfill. Lee County, in turn, pays the landfill owner/contract operator.

Hendry County has two franchise haulers servicing the county. The southern end of the county is exclusively serviced by Immokalee Disposal. The northern unincorporated area of the county is exclusively serviced by Holland Disposal, which also serves the incorporated areas of LaBelle and Clewiston. All solid waste is currently being hauled to the Hendry County landfill.

Hendry County has a mandatory collection ordinance in place. Residences are billed by the county quarterly through the tax collector. There is a flat rate which is set through an annual rate resolution process every year. The county pays the hauler, less the tipping fee. Commercial collection and disposal is handled separately.

Collection strategies will not require a great amount of modification in Lee County to accommodate the energy recovery facility. Agreements will have to be amended to reflect delivery to the energy recovery facility site, and the disposal cost will change. Collection and hauling of refuse from Hendry County will be significantly altered in that transfer stations may be constructed for the cities of Clewiston and LaBelle and the waste thence hauled to the energy recovery facility in Lee County. Ash will be transported from the energy recovery facility in Lee County to the ash landfill in the western portion of Hendry County in covered water-tight transfer trucks. The location of the energy recovery facility in Lee County minimizes overall haul costs because most of the solid wastes are generated in Lee County.

3.1.2 FACILITY SITING

The site selection process for the energy recovery facility began with a detailed study prepared by the County's consulting engineers (CDM, August 1989). A specific siting methodology was used to evaluate the suitability of all potential sites. The initial steps of this methodology eliminated areas that were either unacceptable or marginal by applying negative siting criteria such as flood potential, well field impacts, airport proximity, urban development, and the presence of water bodies. Environmentally-sensitive areas such as cypress forests, wildlife management areas, and high water table areas were avoided. Remaining sites were then characterized by comparing land availability and ownership, and a shortlist of sites was developed.

Subsequent to the August 1989 study, six candidate sites meeting positive siting criteria were identified and shortlisted in a workshop with Lee County staff.

A site analysis completed by CDM in February 1990 provided a more detailed comparison of these six candidate sites. This analysis compared the sites in terms of availability of water and wastewater services, proximity to electrical interconnection with Florida Power and Light (FP&L) or the Lee County Electrical Co-op, transportation impacts and access, zoning and land use, haul cost, air quality, flood plains, wetlands, wildlife, soils and geology with respect to earthwork and foundation requirements, hydrologic conditions, and relative cost. The preferred energy recovery facility site was selected based on these criteria and additional information received at a public hearing before the Board of Lee County Commissioners. A copy of the February 1990 siting report is included in Appendix 4.0.

The ash landfill site had previously been selected and is located in the western portion of Hendry County. It is not intended that this document serve as the application for a permit for the landfill/ashfill. Discussions about the landfill/ashfill contained herein are for reference only as needed to permit the energy recovery facility. The landfill/ashfill will be the subject of separate permit applications.

3.1.3 PROPOSED FACILITIES

After evaluating several technologies, the County has found that its current and foreseeable needs would be best served by a facility which uses the mass-burn technology for combustion of solid waste. This process recovers heat energy in the form of steam, and converts that steam energy into electricity which can be sold. The primary facility proposed for the Lee County site is a mass-burn energy recovery facility (the Facility). Ancillary facilities will include truck scales and a scale house for weighing refuse, an ash handling building, cooling tower, and switch yard.

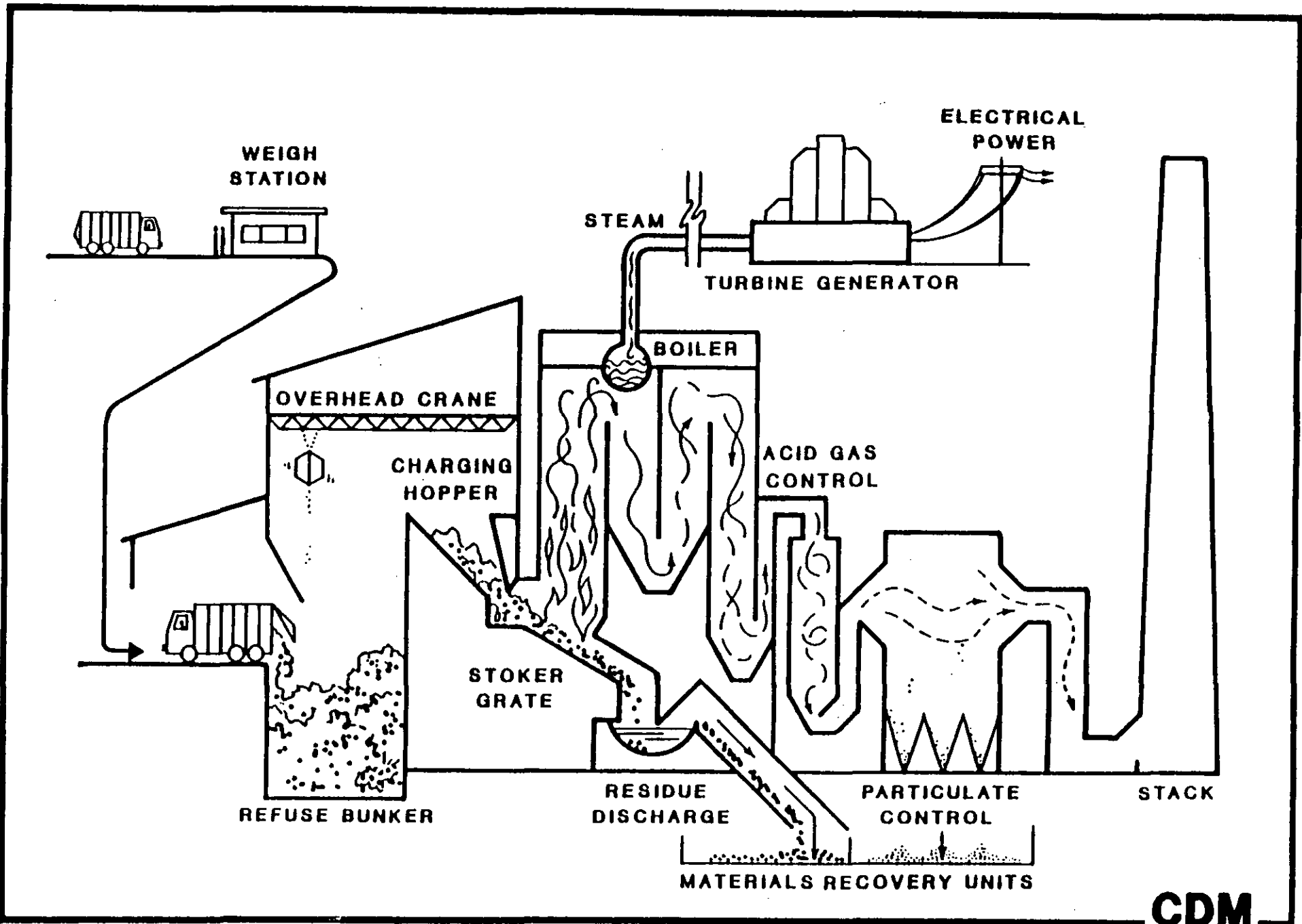
The Facility will be owned by Lee County, and operated by a full-service vendor/contractor under contract to the County. This full-service vendor/contractor will provide design, construction, start-up, and acceptance testing services, and 20 years of continuous operation and maintenance. Lee County will select an appropriate vendor/contractor through the Request for Qualifications/Request for Proposals (simultaneous negotiation competitive) procurement process.

Energy Recovery Facility

The proposed energy recovery facility will have an ultimate design-rated capacity of 1,800 tons per day (tpd). However, its initial continuous design-rated capacity will be 1,200 tpd, using three stoker waterwall combustion/steam generation units with a continuous design-rated capacity of 600 tpd each. Each boiler unit will operate independently; therefore, it will be possible to shut down one unit at a time for maintenance and inspection. An additional boiler unit of the selected technology type will be added to expand the Facility to its ultimate capacity as needed.

Initial project construction will include a tipping area and refuse storage pit sized to handle 1,800 tpd (continuous design-rated capacity). The emissions stack will be equipped with four or five flues, depending on the type of combustion/steam generation unit employed. The project will have one steam turbine generator which will generate approximately 60 megawatts at 1,800 tpd. Power lines from the project's electrical switch yard will connect with the FP&L Buckingham substation near the Facility. Revenues from energy sales will be shared (90/10) by the County and vendor/contractor during the life of the operating contract.

Since the proposed Facility will use mass-burn technology, there will be no significant pre-processing of wastes at the Facility prior to combustion; however, separation of recyclables will occur at the waste generation sites. A schematic diagram of a typical stoker mass-burn facility is presented in Figure 3-1. Municipal solid waste will be truck-delivered to the Facility, and ash residue will be removed by the same mode of transport. The solid waste will be placed in the refuse bunker directly from transfer trailers and packer trucks inside the bunker housing. All waste will be stored inside the bunker housing so that no waste is visible from the outside. Two overhead cranes will mix the waste in the bunker and load the charging hoppers.



Energy Recovery Schematic - Lee County Energy Recovery Facility

Municipal solid wastes will be reduced to 10 percent of their original volume and about 30 percent of their original weight by the combustion process. The resulting ash will be quenched to approximately 30 percent moisture. Bottom ash from the furnace and fly ash from the emission control system will be mixed before removal from the Facility.

The Facility will be equipped with fabric filters (baghouses) for particulate removal. Acid gas dry scrubbers will also be used. A dry scrubber and baghouse will be furnished for each combustion train.

3.2 SITE LAYOUT

The general site development plan (Figure 2-6) shows the conceptual building layout on the site. The Facility structures will be set back about 200 feet from the eastern property boundary and about 1,500 feet from Buckingham Road, which will meet the requirements of local set-back ordinances. An access road will loop around the Facility; roads and scale houses are arranged to separate most of the truck traffic from employee and visitor parking and administration areas. The energy recovery facility will include landscaping as necessary to comply with local development standards.

Roadway grades on Facility access roads will not exceed three to five percent for inbound traffic, and five percent on egress to minimize gear shifting by trucks and the associated noise. All roads shall be concrete all-weather construction for heavy traffic and shall comply with FDOT design standards and requirements. Traffic patterns will be regulated by signs and control lights as needed to allow efficient and safe traffic flow.

Parking spaces have been provided to accommodate the work force, potential visitors, and shift overlaps. Automobile parking will be separated from truck circulation to minimize potential conflicts.

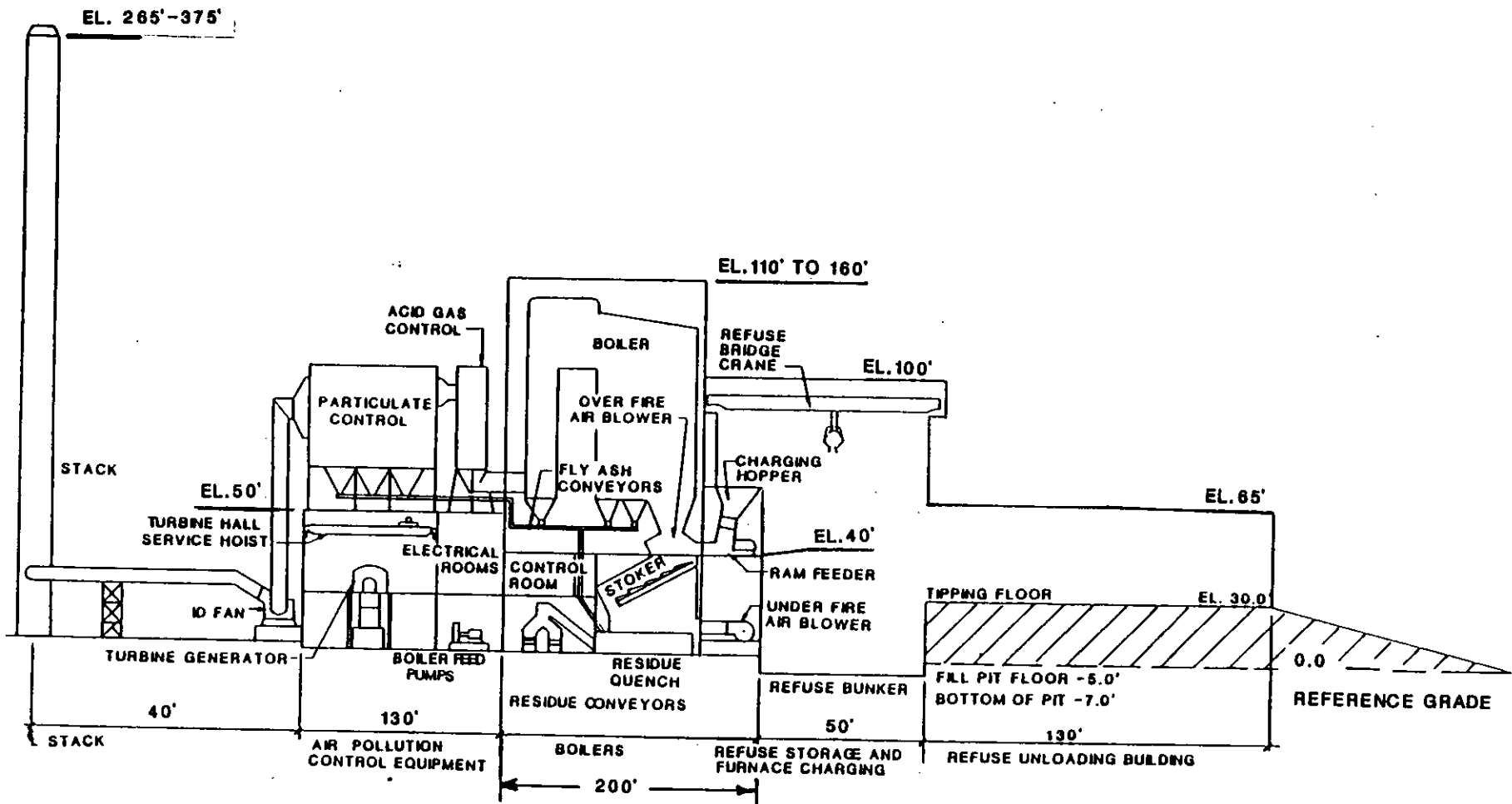
3.2.1 BUILDING DIMENSIONS

The proposed Facility will consist of several contiguous buildings as shown in Figure 2-6. A profile with approximate dimensions is given in Figures 3-2a and 3-2b. The exact Facility dimensions will be determined by the vendor/contractor selected to design, construct, and operate the Facility.

The administration building will be approximately 40 feet high, 250 feet long, and 90 feet wide. It will be bordered on three sides by the centrally-located processing facilities, with the fourth side facing the parking area. Offices will be located along the inner side of the administration building.

The processing facility will vary in height and area depending on the processing function housed in that portion of the building. On the tipping floor side, the building will be about 65 feet high, and 130 feet by 350 feet in surface area to accommodate refuse unloading activities. The maximum height of fill at the tipping floor will be about 30 feet above existing grade. This portion of the Facility must be elevated to allow waste collection trucks to drop refuse into the storage pit. The pit itself will be 70 feet by 235 feet in surface area with its bottom about 20 feet below existing grade.

The three stoker waterwall or four rotary waterwall combustion/steam generation units, with appurtenances, will occupy a surface area of about 200 feet by 260 feet at the Facility's ultimate capacity. Appurtenances include charging hoppers and chutes, feeders, stokers or combustors, siftings hoppers and conveyors, waterwall furnace and non-radiant superheater and convection sections, steam drums, soot cleaning system, boiler support steel, water quenching residue discharge/conveyor, combustion air blowers, auxiliary fuel burners, controls, and economizer. The height of the building over the boiler units will be about 110 to 160 feet. The turbine building, about 130 feet long by 90 feet wide, will adjoin the air pollution equipment area and the administration building.



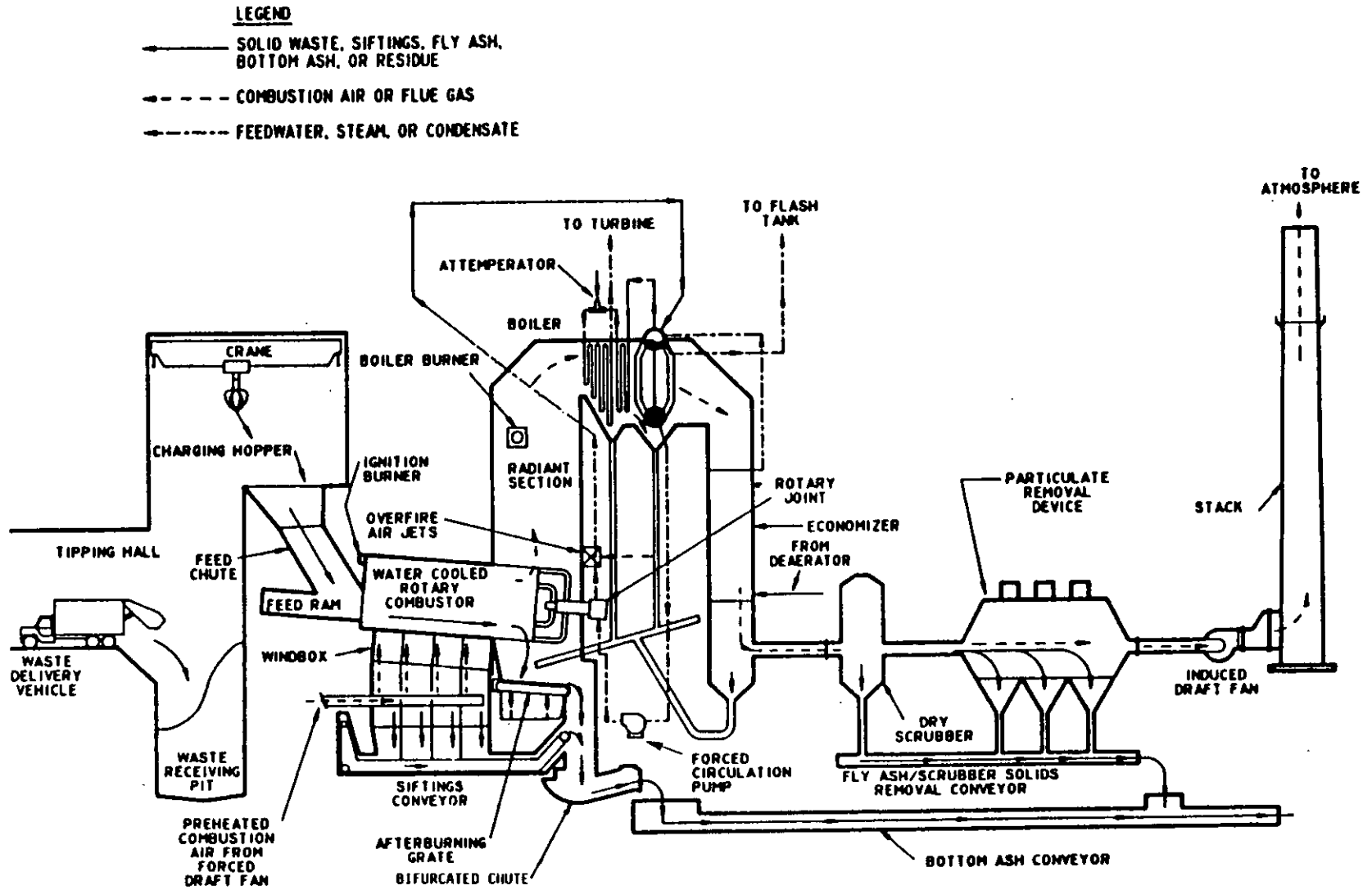
NOTE

O.O REFERENCE GRADE IS 20 TO 25 FEET ABOVE MSL. ALL DIMENSIONS ARE APPROXIMATE.
 NOT TO SCALE.

FIGURE 3-2A

CDM

Typical Facility Cross-Section (Stoker Water Wall Design) - Lee County Energy Recovery Facility



LEE COUNTY
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FIGURE 3-2b
 TYPICAL FACILITY CROSS-SECTION
 (Rotary Waterwall Design)

The air pollution control equipment housing will have an approximate 130-foot by 260-foot surface area at the expanded capacity of 2,400 tpd. The Facility stack, located about 40 feet west of the air pollution equipment, will have a maximum height of about 375 feet above existing grade or about 400 feet above mean sea level. A Federal Aviation Administration (FAA) stack height application has been submitted to FAA, and is included in Appendix 6.4. The FAA permit will be forwarded to DER upon receipt by the County. Direct communication with the FAA staff in reviewing of the proposed maximum height indicates that the stack will not pose a hazard to air navigation but must be obstruction marked and lighted. Note that the height of the stack may only be about 265 feet, depending on the vendor/contractor selected. In any case, the stack height will be established in accordance with good engineering practice (GEP).

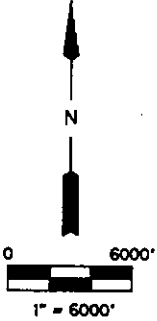
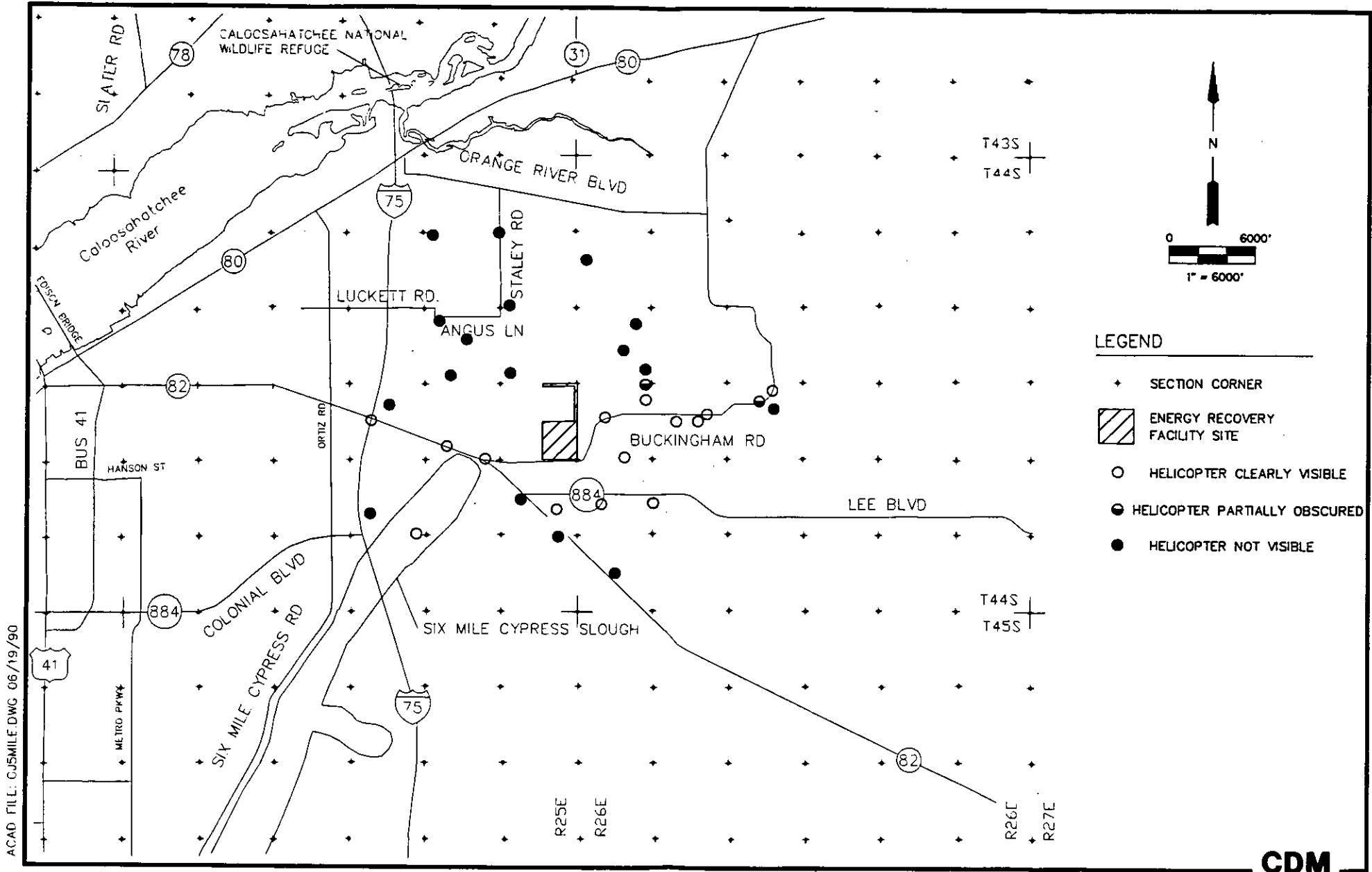
The cooling tower and electrical switch yard will be located west of the Facility proper. The ash building, to the north, will be about 100 feet wide by 100 feet long.

3.2.2 VISUAL IMPACT


A preliminary study was performed to determine the visual impact of the Facility on residences in the area. Since the emissions stack is the tallest structure of the Facility, its maximum height of 400 feet above MSL was chosen for study purposes.

To simulate the emissions stack, a helicopter was flown over the site at a height of about 400 feet MSL. The helicopter was unable to hover over the exact stack location; instead, it circled the location in as narrow a radius as possible. Observations were made from four different directions from the Facility site. Visibility of the helicopter was dependent upon distance from the site, and the proximity of obstructions which consisted primarily of trees.

The results of the visual impact study are shown in Figure 3-3. At each observation point, the figure indicates whether the helicopter was clearly visible, visible only part of the time (it was circling the site and came



LEGEND

- + SECTION CORNER
-  ENERGY RECOVERY FACILITY SITE
- HELICOPTER CLEARLY VISIBLE
- ◐ HELICOPTER PARTIALLY OBSCURED
- HELICOPTER NOT VISIBLE

into and out of view at some locations), or not visible. Because the location of the helicopter was not constant, the results of this study err on the conservative side. Where the helicopter was visible only part of the time, it is assumed that the stack will be partially or fully obscured and will not cause a major impact to area aesthetics.

Based on the results of the study, the visibility of the proposed stack is as follows.

- o To the northwest, a residential/rural area, the helicopter was not visible, even as close as one-half mile from the site.
- o To the northeast, the helicopter was not visible from most locations. The furthest visibility point was about one and one-half miles.
- o To the southwest, the helicopter was visible up to about two miles from the site.
- o To the southeast, the visibility extended to about one mile from the site.

Again, it must be emphasized that the methodology employed here represents a worse-case scenario and may tend to over-exaggerate the visual impact of the emissions stack. Its full height may be less than 400 feet MSL.

Visual impacts cannot be completely avoided given the stack height needed to meet GEP requirements. The stack may be visible up to about two miles away from the site, depending on the direction, and vegetation and other obstructions. However, it is felt that the Facility will not produce major aesthetic impacts in the area. Furthermore, buffers will be provided to minimize the Facility's visibility. Existing on-site vegetation will be left intact as much as possible. Removal of trees in excess of ten feet in height or with diameters of three inches or greater at breast height shall be minimized to the greatest extent possible, except in areas where structures are to be placed or landscape plantings are to be provided.

The Facility landscaping plan is intended to provide a natural appearance and limit the visibility of the Facility buildings. In addition to the buffer requirements of local zoning and development ordinances, the plan shall incorporate primary, secondary, and minor trees and shrubbery. Primary trees shall be at least 10 to 12 feet in height, secondary trees at least 6 to 10 feet, and minor shrubs less than 6 feet. Landscaping shall be provided along the entrance road and adjacent to the administration building and parking area. Plants species shall be native wherever possible.

3.3 FUEL

3.3.1 FUEL SUPPLY

The energy recovery facility will obtain its fuel supply from municipal solid waste collected in Lee and Hendry counties. The term "municipal solid waste" applies to all of the non-recycled solid waste generated within the two counties, excluding hazardous and pathogenic wastes and sewage sludges. Since this waste is heterogeneous, characteristics such as heating value, moisture content, and ash content of the waste will vary. However, the solid waste may be classified according to the following general characteristics and sources of generation.

- o Residential Wastes - Mixed domestic household wastes (including non-composted yard wastes) generated by individuals or families in single-family or multiple-family dwellings (comprises approximately 46 percent of the waste stream).

- o Commercial/Institutional Wastes - Wastes generated by the commercial and retail sector of the counties, including wastes from hospitals, schools, and churches. The physical characteristics of these wastes are similar to residential wastes, consisting primarily of combustible materials in the form of paper and food wastes from offices, restaurants, and retail establishments (comprises approximately 40 percent of the waste stream).

- o Special Wastes - Wastes generated by the construction industry, including construction and demolition debris and white goods. Any wastes classified as infectious by federal and state regulations will be excluded (comprises approximately 11 percent of the waste stream).
- o Industrial Wastes - Wastes generated by industrial process and manufacturing operations, excluding any wastes classified as hazardous or infectious by federal and state regulations. These wastes also include general housekeeping and support activity wastes associated with industry (comprises approximately 3 percent of the waste stream).

All calculations, analyses, and performance data for the energy recovery facility have been based on the as-fired solid waste higher heat value of 5,000 Btu per pound, with a 21 percent moisture content by weight. Table 3-1 presents the as-received reference solid waste composition, and Table 3-2 lists the reference waste ultimate analysis.

3.3.2 FUEL STORAGE

The energy recovery facility will be equipped with an automatic weighing station to weigh and record the quantity of solid waste delivered. The waste will be delivered in standard municipal-type packer vehicles, open-bodied dump trucks, and transfer trailers with capacities up to 110 cubic yards. The Facility will receive solid waste deliveries 6 days per week, 52 weeks per year. The fuel storage design capacity is based on the ultimate expanded Facility capacity of 1,800 tpd.

The energy recovery facility will include a totally enclosed tipping floor with 13 tipping bays, each 15 feet wide and 1 bay, 24 feet wide (inside dimension). Back-up barriers will be provided at each tipping bay to prevent vehicles from backing into the solid waste storage pit. Solid waste will be stored in a completely enclosed pit with a floor elevation below that of the tipping floor. The pit will be sized for a minimum storage capacity of 5,400 tons of solid waste at a density of 550 pounds per cubic yard, which will provide at least three days storage at the Facility's ultimate capacity of 1,800 tpd.

TABLE 3-1
REFERENCE SOLID WASTE COMPOSITION

Waste Category	Nominal Percentage By Weight
Combustibles	58.4
Moisture	20.7
Non-Combustibles	<u>20.9</u>
TOTAL	100.0

TABLE 3-2

REFERENCE SOLID WASTE ULTIMATE ANALYSIS

Component	Nominal Percentage By Weight
Moisture	20.7
Total Inert	20.9
Carbon	28.5
Hydrogen	3.8
Oxygen	25.1
Nitrogen	0.5
Chlorine	0.4
Sulfur	<u>0.1</u>
TOTAL	100.0
Higher Heat Value (HHV)	5,000 Btu/lb

The primary purpose of three-day pit capacity is to ensure adequate on-site storage for refuse over a three-day weekend. However, the pit capacity could also be used to store incoming refuse when the Facility is down for scheduled or unscheduled maintenance. In this manner, the need to bypass waste directly to the landfill is minimized.

Three examples have been prepared to illustrate the waste processing capabilities of the Facility with one or more units out of operation. The examples are based on the following assumptions, with the Facility operating at its ultimate capacity.

- o The Facility combusts wastes continuously: 24 hours per day, seven days per week.
- o The Facility receives an average of 1,800 tpd or 12,600 tons per week. However, the Facility will actually be open to receive wastes only six days a week (Monday through Saturday). Based on current trends within the County, approximately half as much waste is received on Saturday as during the week. Therefore, under this example the Facility will receive 2,291 tpd on Monday through Friday and 1,145 tpd on Saturday.
- o The Facility will have three processing trains, each with a design capacity of 600 tpd.
- o The refuse pit will have a storage capacity of approximately 19,600 cubic yards to the elevation of the tipping floor. An additional 9,800 cubic yards of storage above the tipping floor elevation is available when waste is stored against the pit sidewalls. The ultimate capacity of the pit is 29,400 cubic yards. (Based on a density of 550 pounds per cubic yard, the pit will store 5,390 tons (if filled to the elevation of the tipping floor) to 8,085 tons (if waste is stored against the pit sidewalls) of waste.)

Example One - Three Unit Operation

One unit shuts down due to mechanical failure at 6:00 a.m. on Monday. The remaining two units are capable of operating at 100 percent of their total combined capacity of 1,200 tpd. At the time of breakdown, the pit contains 900 tons (normal minimum half-day storage reserve).

<u>Time/Day</u>	<u>Received (tons)</u>	<u>Processed (tons)</u>	<u>Waste in Pit (tons)</u>
6:00 a.m., Mon. (Week 1)	2,291	1,200	900
			<u>+1,091</u>
6:00 a.m., Tues.	2,291	1,200	1,991
			<u>+1,091</u>
6:00 a.m., Wed.	2,291	1,200	3,082
			<u>+1,091</u>
6:00 a.m., Thurs.	2,291	1,200	4,173
			<u>+1,091</u>
6:00 a.m., Fri.	2,291	1,200	5,264
			<u>+1,091</u>
6:00 a.m., Sat.	1,145	1,200	6,355
			<u>- 55</u>
6:00 a.m., Sun.	0	1,200	6,300
			<u>-1,200</u>
6:00 a.m., Mon. (Week 2)	2,291	1,200	5,100
			<u>+1,091</u>
6:00 a.m., Tues.	2,291	1,200	6,191
			<u>+1,091</u>
6:00 a.m., Wed.	2,291	1,200	7,282
			<u>+1,091</u>
6:00 a.m., Thurs.	2,291	1,200	8,373
			<u>+1,091</u>
6:00 a.m., Fri.	2,291	1,200	9,464

The pit will be filled to capacity in the late evening of the second Wednesday. The total reserve time for this situation is 10 days.

Example Two - Two Unit Operation

At 6:00 a.m. on Monday, two units shut down due to mechanical failure. The remaining unit continues to process waste at 100 percent of its capacity, for a total capacity of 600 tpd.

<u>Time/Day</u>	<u>Received (tons)</u>	<u>Processed (tons)</u>	<u>Waste in Pit (tons)</u>
6:00 a.m., Mon.	2,291	600	900
			<u>+1,691</u>
6:00 a.m., Tues.	2,291	600	2,591
			<u>+1,691</u>
6:00 a.m., Wed.	2,291	600	4,282
			<u>+1,691</u>
6:00 a.m., Thurs.	2,291	600	5,973
			<u>+1,691</u>
6:00 a.m., Fri.	2,291	600	7,664
			<u>+1,691</u>
6:00 a.m., Sat.	1,145	600	9,355

The pit will be filled to capacity at some time during the early afternoon on Friday. The total reserve time in this example is 4.5 days.

Example Three - Alternative to Example One

At 6:00 a.m. on Saturday of week 1 in example one, a second unit shuts down due to mechanical failure. The remaining unit continues to process waste at 100 percent of its nameplate capacity.

<u>Time/Day</u>	<u>Received (tons)</u>	<u>Processed (tons)</u>	<u>Waste in Pit (tons)</u>
6:00 a.m., Sat. (Week 1)	1,145	600	6,355
			<u>+ 545</u>
6:00 a.m., Sun.	0	600	6,900
			<u>- 600</u>
6:00 a.m., Mon. (Week 2)	2,291	600	6,300
			<u>+1,691</u>
6:00 a.m., Tues.	2,291	600	7,991
			<u>+1,691</u>
6:00 a.m., Wed.	2,291	600	9,682

The pit will be filled to capacity early Tuesday morning of week 2. The total reserve time in this situation is 8 days.

These three scenarios show that the Facility will continue to receive the entire waste stream without any bypass to the landfill or another Facility for 10 days in Example One; for 4.5 days when two units fail simultaneously (Example Two); or for 8 days when two units fail in a staggered manner (Example Three). Incoming refuse need not be diverted to the landfill/ashfill during these periods.

3.4 AIR EMISSIONS AND CONTROLS

3.4.1 AIR EMISSION TYPES AND SOURCES

The proposed energy recovery facility is a new facility that will be located in Lee County. At ultimate size, the Facility will contain: three mass-burn stoker waterwall combustor boilers each with a rated capacity of 600 tpd of municipal solid waste, for a total of 1,800 tpd. The flues from all of the combustor trains will be encased in a single stack shell.

The refuse bunker will be enclosed and under negative pressure, which is achieved by drawing combustion air during normal operations from this area. There will be no on-site storage of either refuse or residue except within controlled, enclosed areas. Loading and unloading of trucks will take place inside the residue storage building and enclosed tipping floor building, respectively. Provisions for loading containers or trucks outside using a redundant conveyor during main ash conveyor outages will be designed featuring impervious surface areas and controlled stormwater runoff. Trucks entering and leaving the site will be covered and will travel on paved roads.

The ash handling area may be a minor source of particulate emissions, but a fabric filter device will be used to ensure that virtually no emissions will be released from this area. Thus, the common boiler stack will be the only major source of emissions from the Facility.

A complete description of stack emissions is contained in Section 3.0 of the Prevention of Significant Deterioration (PSD) permit application (see Volume III - Air Quality). Maximum expected emission rates for the proposed Facility are contained in Table 3-2, Section 3.0 of the PSD permit application in Volume III (see Section 7.6 in Volume III). A complete FDER Form 17-1.202 (1), "Application to Operate/Construct Air Pollution Sources," may also be found in the front of Volume III.

3.4.2 AIR EMISSION CONTROLS

A number of air pollution control technologies are available to control different classes of pollutants which include particulate matter, trace metals and organic compound emissions, SO₂ and acid gases, NO_x and products of incomplete combustion such as CO and VOCs. Commercially available pollution control systems and their operating characteristics are fully described in the Best Available Control Technology (BACT) analysis in Section 4.0 of the PSD permit application (see Volume III - Air Quality).

3.4.3 BEST AVAILABLE CONTROL TECHNOLOGY (BACT)

The BACT analysis is presented in Section 4.0 of the Prevention of Significant Deterioration permit application (Volume III - Air Quality). The analysis evaluates the environmental, economic, and energy aspects of alternative control techniques and methods. For all of the criteria pollutants, Lee County is designated as being in attainment of the National Ambient Air Quality Standards (or unclassified), and hence subject to BACT. Based on a review of various air pollution control alternatives, a dry scrubber and baghouse are proposed as BACT for the Lee County energy recovery facility for all pollutants subject to PSD review. The dry scrubber will be designed to achieve an emission limit of 30 parts per million on a dry volume basis (ppmdv) at 7 percent O₂, or 80 percent reduction, 24-hour block geometric average for SO₂; and 25 ppmdv at 7 percent O₂, or 95 percent reduction, for HCl. The baghouse will be designed to achieve an outlet grain loading of 0.010 grains per dry standard cubic foot corrected to 7 percent O₂ (gr/dscf @ 7% O₂). Combustion control techniques will be employed to minimize emissions of VOC and CO. Selective non-catalytic reduction (SNCR) will be used to control NO_x emissions.

3.4.4 DESIGN DATA FOR CONTROL EQUIPMENT

Design data for control equipment are not available because a furnace/boiler supplier has not been selected yet. Design parameters for the mass-burn energy recovery facilities under consideration, used in the BACT analysis, are presented in Section 4.0 of Volume III - Air Quality.

3.4.5 DESIGN PHILOSOPHY

The proposed control technologies, including dry scrubber and baghouse, are designed to neutralize acid gas emissions and capture particulate matter entrained in the flue gas from the furnace/boiler. The particulate matter is collected in a dry form to avoid wastewater disposal, corrosion, and stack gas reheat problems.

3.5 PLANT WATER USE

During normal operation of the energy recovery facility, all process cooling water will be treated wastewater effluent (reclaimed water) drawn from the City of Fort Myers Central Advanced Wastewater Treatment Plant (Central WWTP). The Central WWTP is located approximately four miles west of the site. The cooling tower blowdown water will be internally used in the Facility, to the greatest practicable extent, for ash quenching, lime slaking, and the like. Potable water provided by the Lee County Utilities will be used for process and potable purposes. An on-site well will be used for back-up cooling water needs. No process or sanitary wastewater will be discharged to surface water or groundwater bodies. Alternative sources of water are discussed in Section 8.0. A quantitative water use diagram is provided in Figure 3-4. The quantities of water presented in this figure are approximate and will be more accurately determined when a vendor/contractor is selected to design and build the Facility.

3.5.1 HEAT DISSIPATION SYSTEM

System Design

Cooling water will be used in a closed-loop system which employs water-cooled condensers to condense the low pressure steam discharged from the turbine. Cooling water will circulate through the condensers, and waste heat will be dissipated from the condenser cooling water by passage through a wet mechanical draft cooling tower.

The cooling tower system has adequate capacity to dissipate the heat from steam generated by firing 1,200 tpd of solid waste. If the steam turbine generator is out of service at any time when the boilers are producing high pressure steam, a separate bypass condenser will be used to accept the full rated design capacity of high pressure steam from the plant boilers. Through the use of the bypass condenser system, Facility processing capacity will not be diminished during periods of full or partial turbine generator outage.

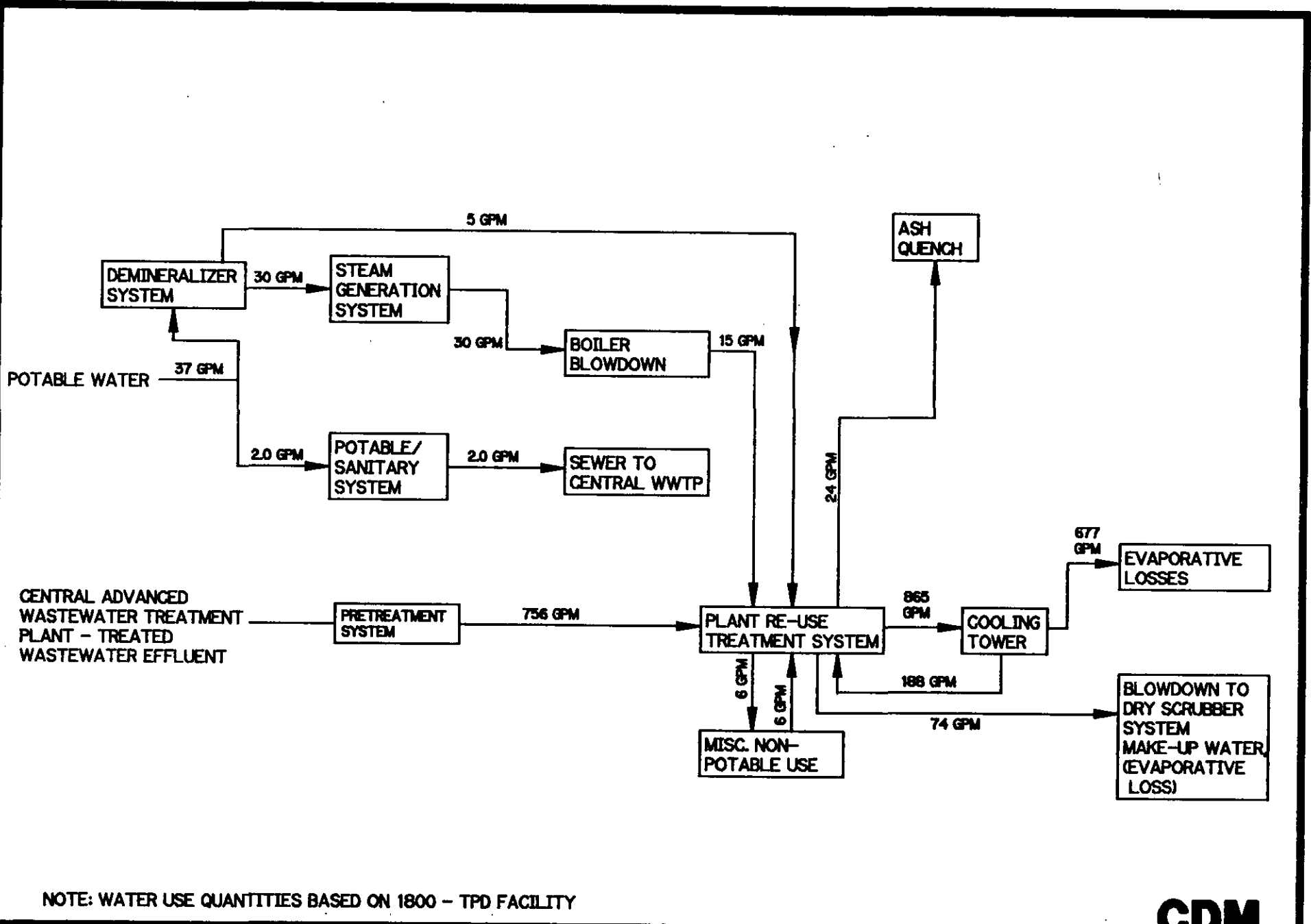
Consumptive (non-potable) water use will primarily be losses from the cooling tower system in the form of evaporation and drift. The average water loss due to evaporation will be 0.70 mgd at 1,200 tpd. Other water uses (losses) include water consumed in ash quenching operations and the operation of the dry scrubber system.

No conventional water intake structure will be needed in the energy recovery facility system, since all cooling water will be taken by pipeline from the Central WWTP. Similarly, no water will be discharged from the energy recovery facility system, except for approximately 0.15 mgd of combined sanitary and process wastewater which will be routed to the Central WWTP for treatment and reuse. Cooling ponds will not be used in the system.

Source of Cooling Water

All cooling tower makeup water will be obtained through a direct pipeline link with the Central WWTP. Approximately 0.80 mgd of reclaimed water will be needed for cooling tower makeup when the Facility is operating at 1,200 tpd. This will increase to 1.1 mgd at the Facility's ultimate capacity of 1,800 tpd. The WWTP has a capacity of 11 mgd, which is ample to supply the reclaimed water needed by the energy recovery facility even during low wastewater flow periods. Table 3-3 lists the current effluent permit limits for the Central WWTP. Table 3-4 contains the results of a recent comprehensive analysis of the reclaimed water. A letter of commitment from the City to furnish the reclaimed water can be found in Appendix 5.2.

The back-up cooling water supply for the Facility will be an on-site well. Information on the proposed well can be found in the water use permit application in Appendix 7.2.



NOTE: WATER USE QUANTITIES BASED ON 1800 - TPD FACILITY

CDM

Lee County Energy Recovery Facility - Quantitative Water Use Diagram

FIGURE 3-4

TABLE 3-3

CURRENT EFFLUENT LIMITS FOR THE
FORT MYERS CENTRAL ADVANCED WASTEWATER TREATMENT PLANT

Parameter	Concentration (mg/L)*
Annual Average BOD & TSS	20
Monthly Average BOD & TSS	30
Daily Sample BOD & TSS	60
Total Nitrogen	3.0 at 11 mgd (300 lb/day)
Total Phosphorus	0.5 at 11 mgd (50 lb/day)
Residual Chlorine	0.01 Daily Maximum
pH	Between 6.0 & 8.5 pH units
Annual Fecal Coliforms	200 per 100 ml
Individual Sample Fecal Coliforms	800 per 100 ml

*Unless Otherwise Noted.

TABLE 3-4

APRIL 19, 1990 EFFLUENT SAMPLE ANALYSIS RESULTS
FOR THE
FORT MYERS CENTRAL ADVANCED WASTEWATER TREATMENT PLANT

Parameter	Concentration, mg/L (unless otherwise noted)
Calcium	53
Magnesium	20
Manganese	0.010
Sodium	200
Potassium	14
Iron	0.11
Iron, dissolved	0.11
Silica	10
Hydroxide	<0.50
Carbonate Alkalinity (as CaCO ₃)	<1.0
Bicarbonate Alkalinity (as CaCO ₃)	98
Sulfate (as SO ₄)	120
Sulfite	<0.10
Chloride	250
Fluoride	0.85
Nitrite-N	<0.050
Nitrate-N	<0.050
Ortho-Phosphate-P	0.12
Total Kjeldahl Nitrogen-N	1.4
Ammonia-N	0.041
Carbon Dioxide	100
Total Organic Carbon	22
Chemical Oxygen Demand	17
Biochemical Oxygen Demand (5 day)	1.2
Suspended Solids	8.0
Total Dissolved Solids	850
Alkalinity (to pH 8.3)	<1.0
Hydroxide Alkalinity (as CaCO ₃)	<1.0
Specific Conductance, umhos/cm	1100
pH, units	7.2
Turbidity, NTU	1.7
Color, PCU	20
Sulfide, EPA 600-376.1	<0.10
Arsenic	<0.0010
Aluminum	0.32
Barium	<0.010
Cadmium	<0.0050
Chromium	<0.010

TABLE 3-4
(continued)

Parameter	Concentration, mg/L (unless otherwise noted)
Copper	<0.010
Lead	<0.0050
Mercury	<0.00020
Selenium	<0.0020
Silver	<0.010
Zinc	0.022
Endrin ketone, ug/L	<0.10
Gamma-BHC, ug/L	0.027
Methoxychlor, ug/L	<0.50
Toxaphene, ug/L	<1.0
2,4-D, ug/L	<0.10
2,4,5-TP Silvex, ug/L	<0.010
Surfactants (MBAS-EPA 425.1)	<0.10
Total Coliform MF, colonies/100 ml	130
Gross Alpha, pCi/L	6.6+/-4.2
Gross Beta, pCi/L	56.8+/-6.7
Benzene, ug/L	<1.0
Carbon Tetrachloride, ug/L	<1.0
1,2-Dichloroethane, ug/L	<1.0
1,1-Dichloroethylene, ug/L	<1.0
Trichloroethylene	6.4
1,1,1-Trichloroethane, ug/L	<1.0
Vinyl Chloride, ug/L	<1.0
1,2-Dichlorobenzene, ug/L	<1.0
Tetrachloroethylene, ug/L	<1.0

Dilution System

Process water will be treated and reused internally within the Facility to the greatest extent practical. A maximum wastewater discharge of 150,000 gpd will consist of a combination of sanitary wastewater and process water. No Facility outfall will be required.

Blowdown

Liquid flows from blowdown systems will come from the boiler drums, the cooling towers, and the boiler feedwater demineralizers (BFDS). Blowdown flows from BFDS and boilers will be collected in the blowdown tank and either discharged to the residue quench tank or treated and reused in for the Facility. Cooling tower blowdown will be used in the lime slaking dry scrubber system and other Facility uses to the extent necessary and will achieve a maximum sewer discharge of 0.15 mgd. Since no intake structures are required, no intake structure trash disposal will be required.

Injection Wells

No injection wells will be used at this Facility.

3.5.2 DOMESTIC/SANITARY WASTEWATER

Sanitary wastewater flows will be generated within the Facility only in the personnel service areas (e.g., showers and washrooms). The Facility will employ approximately 50 people for normal operation, with fluctuating staff increases from time to time as contractors and other specialty staff are retained for task-specific work. Provisions will be made to accommodate up to 30 visitors at the Facility at any one time.

Wastewater discharged from the Facility will be limited to 0.15 mgd and will consist of sanitary sewage, and other waste process water. Wastewater discharges will be treated as necessary to comply with the City of Fort Myers pretreatment requirements, detailed in Section 2.2.7, prior to discharge. Wastewater will be discharged via sewer to the Central WWTP for treatment.

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3.5.3 POTABLE WATER SYSTEMS

Potable water requirements (up to 0.075 mgd) will be supplied by tapping into the Lee County Corkscrew Water Treatment Plant's distribution system. The proposed potable water transmission route is described in Section 6.2.

3.5.4 PROCESS WATER SYSTEMS

To meet its process water needs at the initial design capacity of 1,200 tpd, the Facility will use approximately 0.80 mgd of advanced-treated effluent from the Fort Myers Central WWTP. The energy recovery facility will use this reclaimed water for cooling purposes, and will treat and reuse the spent process water to achieve a limited discharge from the process train. All residue liquid wastes will become part of the returned sanitary and process flows for treatment at the Fort Myers wastewater treatment plant.

3.6 CHEMICAL AND BIOCIDES WASTE

Both anti-corrosion and anti-fouling agents will be used at the Facility in the boilers and cooling tower. Blowdown will be treated and reused at the Facility. The exact flow diagram of the chemical waste system will be developed by the selected contractor. There will be no discharges from chemical processing, spent process water treatment, or waste piles as a result of plant operation that may enter the local environment.

3.7 SOLID AND HAZARDOUS WASTES

3.7.1 SOLID WASTES (INCLUDING ASH)

The residues of combustion will consist of noncombustible by-products, fly ash, spent lime, and bottom ash siftings. The residue handling system will be designed to remove these materials from the combustion system for disposal. The bottom ash siftings from the combustion units will be

quenched and subsequently dewatered. Conveyers will also be supplied to transport fly ash and spent lime from the boilers, dry scrubbers, and bag house to the residue system.

The residue handling system will consist of totally enclosed conveyors and an enclosed building with a truck loading area and residue storage bunkers. Residue will be hauled from the Facility in covered trucks to the landfill/ashfill in Hendry County. The residue to be disposed of at the landfill/ashfill will meet all local, state, and federal regulations which govern such disposal. The residue will contain no more than four percent noncombustible material by dry weight content. Ferrous materials will be recovered from the residue prior to final disposal.

The only other solid wastes to be produced under normal operating conditions will be minute amounts of solid waste, primarily office and lunchroom trash. Since the Facility is specifically designed for the processing of solid waste, the Facility will dispose of its own trash.

Ash Management Plan

The residue of combustion will consist of non-combustible by-products fly ash, bottom ash, and siftings. The residue removal systems will be designed to remove these materials from the combustion and air pollution control systems for disposal. Ash will fall from the bottom of each combustion unit directly into a water-filled quench tank. The quench tank will be fully enclosed to prevent ash siftings from becoming airborne. The quenched ash will then be allowed to drain free water, and will then be mechanically loaded into an enclosed conveyor system which will transport the ash and residue to the enclosed ash storage building. A back-up system for ash transport to the ash storage building will be provided.

Fly ash will be handled in the same manner. Ash removal conveyors (fully enclosed) to transport fly ash from the boilers, dry scrubbers, and bag house to the residue water system will be used for the bottom ash. The

combined ash is quenched and taken to the ash storage building. The floor of the ash building will be watertight. It will have a sealed concrete floor. Any free liquid which is generated by the storage piles will be collected and treated as required. The ash storage building will be covered to keep out precipitation and enclosed to prevent wind blown emissions. The ash will be stored in piles inside the building.

The transfer of the ash from the storage piles to the covered watertight vehicles for transport to the landfill will be accomplished by using rubber tire front-end loaders. All loading and preparation for ash transport will occur within the fully enclosed ash storage building. The ash residue will be transported from the energy recovery facility in covered watertight trucks, to the proposed landfill/ashfill located approximately 15 miles from the Facility.

Because of the moist nature of the ash materials, dust will not be generated by the ash handling, conveying, and transport activities. The consistency and appearance of the wetted ash material will be that of wet aggregate. This condition will continue to be maintained during transport to the landfill, unloading via hydraulic lift truck beds and spreading in relatively thin layers (lifts) of approximately 12- to 24-inch thickness.

Depending on the amount of waste recycled and the amount of processable waste, the facility may begin operating at or near its 1200 tpd capacity. Ash quantities are expected to be approximately 306 tons per day or 112,000 tons per year for the 1200 tpd facility. In the future when the Facility is expanded to 1,800 tons per day, the maximum annual quantity of residue requiring disposal will reach approximately 168,000 tons per year or 459 tons per day. It is not possible to accurately estimate the quantities of fly ash separate from total ash to be produced. Most facilities currently in operation in the United States combine fly and bottom ash in the total ash quench system. Thus, there is little information for calculating the precise amounts of fly vs. bottom ash.

TABLE 3-5

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As part of the ash handling system, a ferrous metal removal system will be installed to recover ferrous material. Experience at other energy recovery facilities has indicated that from six to eight percent of the total ash residue (wet condition) is comprised of recoverable ferrous metal. For the Lee County energy recovery facility, it can be estimated that between 6,500 and 8,500 tons of ferrous materials can be recovered during the first full year of Facility operation. It is not clear whether these quantities will decrease during the life of the Facility because the County's aggressive recycling program will become fully implemented. The development and implementation of the comprehensive recycling program will benefit the operations of the Facility by reducing the noncombustible recyclable materials entering the Facility for processing. A complete description of the Lee County recycling program, including a general implementation plan, can be found in Section 5.4.1.

The ash materials will be managed in compliance with Chapter 17-702, FAC, and in a manner (i.e., wet) such that an extremely low potential for inhalation ingestion or direct dermal contact will exist. The selected vendor will be required to develop a detailed and specific employee safety training program. This program will provide effective personal respiratory protection equipment if necessary to promote a high degree of protection to all persons who may have contact with the ash material, including landfill personnel. This program will be continuously updated as new information and equipment is developed to assure compliance with all OSHA standards and FDER requirements. After quenching and draining of free water from the residual materials, the ash will still contain about 30 percent moisture which will remain through the period of short-term storage and disposal. The mechanical nature of the ash handling and disposal operations, in enclosed combined systems when possible with the employee safety program will minimize the potential for inhalation, ingestion or body contact with the material.

Ash disposal will be at the regional Lee/Hendry County landfill located in Hendry County. The design of the landfill conforms with the design and performance standards set forth in Chapter 17-701, FAC. As currently proposed, the liner system includes (from bottom to top) a 12-inch low

permeability base layer (1×10^{-5} cm/sec) overlain by a 60-mil high density polyethylene (HDPE) liner, a composite polynet geotextile drainage material, overlain by a primary 60-mil HDPE liner and a 24-inch drainage layer. Both a primary and secondary leachate collection system are included. This double synthetic liner system will provide assurance of total containment of ash and solid waste materials, while reducing the potential for contamination of soils, and ground and surface waters. Separate disposal cells (monofills) will be used for the disposal of ash and municipal solid waste. At this time, Lee County plans to employ monofill disposal areas for ash and municipal solid waste. However, Chapter 17-702, FAC, allows codisposal and the use of ash as cover material. Lee County may utilize these disposal options in the future if they are deemed appropriate. The method of disposal at the landfill will not change the County's operations at the energy recovery facility.

It is anticipated that leachate generated by the landfill will be sampled quarterly, at a minimum, to establish baseline leachate quality characteristics. In addition, the ash will be analyzed quarterly for the following parameters using "Test Methods for Evaluation; Solid Waste Physical/Chemical Methods" EPA Publication SW-846 (3rd Edition as amended, Update #1, December 1987) or other test methods as appropriate.

Parameters for Ash Testing

pH	TDS	Dc	Pb	Ag
BOC	TSS	Cr	Hg	N
COD	As	Cu	N	Se

In addition, quarterly testing will be performed using EPA Method 3050, "Acid Digestion of Sediments; Sludges and Soils For All Priority Pollutants."

As part of the total ash management program, the County will be alert to potential uses of ash. Currently, various pilot projects are underway in Florida and other states to study the possibility of reusing the ash. For example, several communities are studying the effects of incorporating ash

materials into asphalt and concrete aggregate materials used in roadway pavements. This work is still in the development and research stages however, and will require additional study regarding mixing ratios, leachability, and encapsulation techniques for the material. If these programs are successful, Lee County may pursue ash reuse programs of its own. At this time, however, Lee County has no plans to use ash in any other process or product.

3.7.2 HAZARDOUS WASTES

No hazardous wastes will be generated on-site, nor will any be accepted for processing with the solid waste; therefore, there will be no hazardous waste disposal. Section 5.4.2 describes the procedures that will be followed if any apparently hazardous materials are identified by the crane operators or scale house personnel.

3.8 ONSITE DRAINAGE SYSTEM

The stormwater management system for the energy recovery facility is designed to use as much of the natural drainage pattern as possible while protecting the existing wetlands on-site. The natural drainage basins have been delineated on Figure 3-5.

The north basin includes approximately 21 acres within the site that contribute runoff to wetlands located north of the site. The central basin consists of 93 acres of uplands and wetlands. The southeast basin includes 34 acres. Runoff from the southeast basin is stored in isolated wetlands which make up approximately 9 acres of the basin.

During large rain events, stormwater runoff from each of the existing basins discharges to the southwest (through a series of wetlands) and west (along Buckingham Road) where it eventually flows under Buckingham Road (two 10' x 2.2' box culverts) and SR 82 (two 10' x 4' box culverts) into the Six Mile Cypress Slough (see Figure 2-25).

A five-acre wet retention pond is proposed to provide treatment and storage

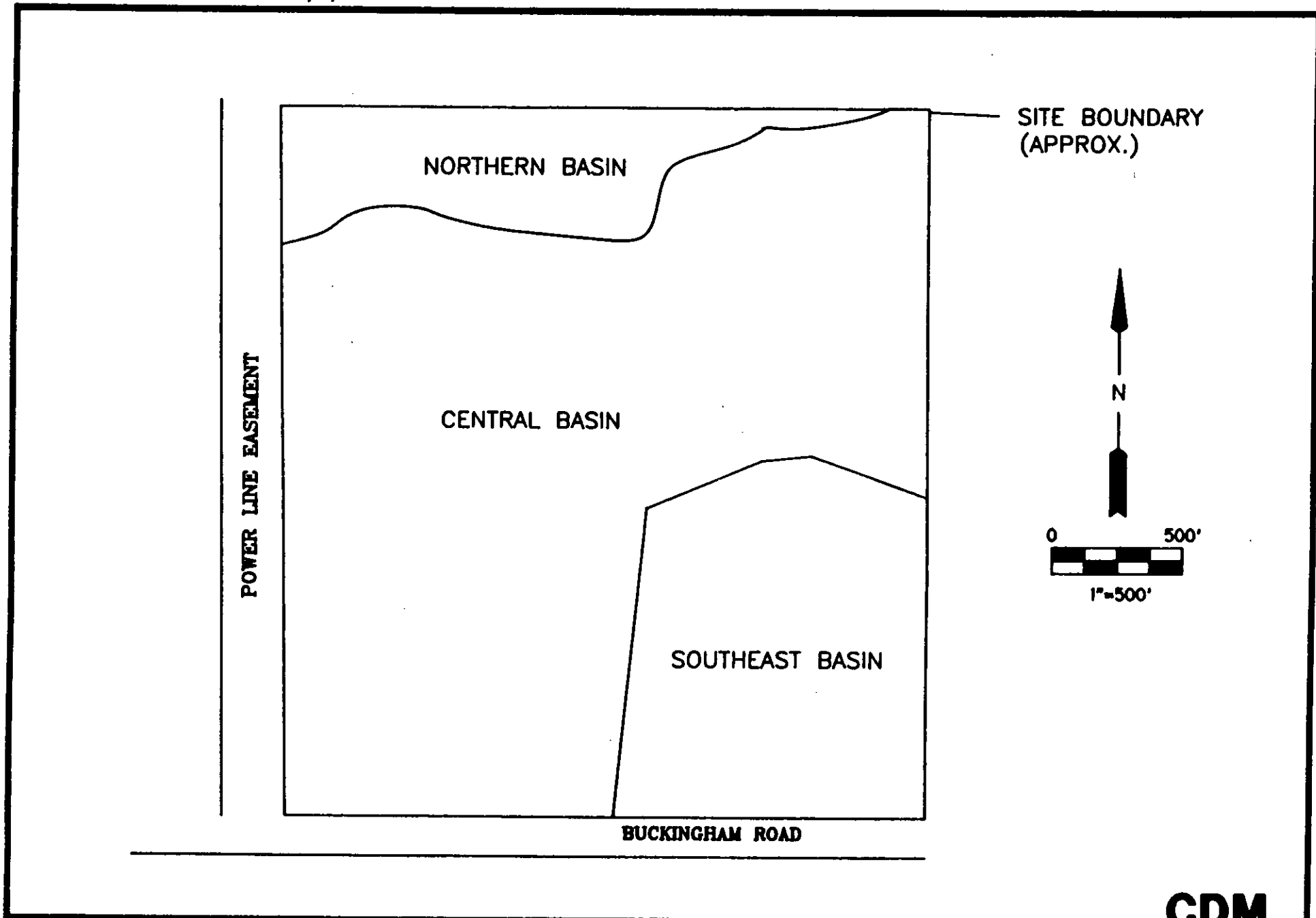


Figure 3-5

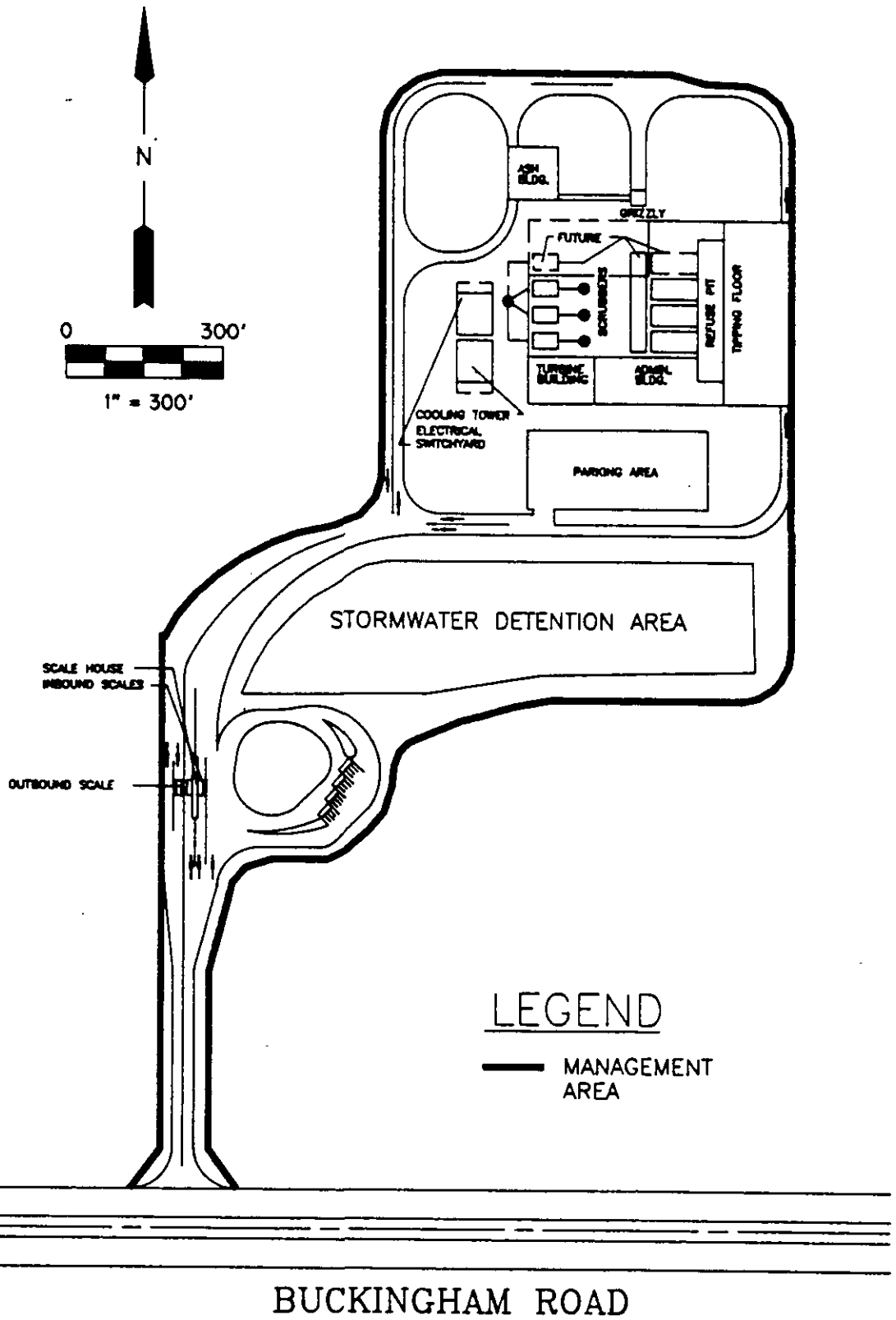
of runoff from the developed portion of the site. In accordance with SFWMD criteria, peak discharge from the developed site will be limited to 37 cubic feet per second per square mile for a 25-year, 72-hour, storm event (10.33 inches of rainfall). The 37-csm criteria imposed by SFWMD is based on the Six Mile Cypress Watershed allowable discharge limit and equates to 1.7 cfs for the developed site. Discharge will be directed south to Buckingham Road after passing through isolated wetlands which will provide additional treatment. It is proposed that the wet retention pond be included in the early stages of construction to ensure storage and treatment of runoff and dewatering from the construction site.

The on-site drainage (Figure 3-6) system is designed to meet both surface water runoff quality (Chapter 17-25, Florida Administrative Code), and quantity Chapter 40E-4 (SFWMD) criteria. Water quality criteria require that wet retention systems provide storage for the first inch of runoff from the developed project, or the total runoff of 2.5 inches times the percentage of imperviousness, whichever is greater. Commercial or industrial projects are also required to provide at least one-half inch of dry retention pretreatment. There are also water quantity regulations regarding peak flow from the site. Generally, SFWMD criteria are based upon: (1) historic discharges (post development peak discharge rates from the 25-year, 72-hour storm event must not exceed the predevelopment runoff rate from the same storm); (2) amounts determined in previous District permit actions; or (3) amounts specified in District criteria (basin-specific limits). As stated above, the energy recovery facility site is restricted to 37 csm based on basin specific limits (see Appendix 7.3).

3.9 MATERIALS HANDLING

The energy recovery facility will have two or three independent process trains. Common elements, such as the waste feed crane, ash conveyers, and boiler feedwater systems, will have redundant capabilities. Initially, two 600-tpd stoker waterwall combustion/steam generation units will be constructed.

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Surface Water Management Area
Lee County Energy Recovery Facility

A third stoker waterwall train, rated at 600 tpd, will later be added to reach the ultimate capacity of 1,800 tpd as the demand on the Facility increases. The facility may begin operating at capacity, or will reach capacity within 18 to 24 months of opening. The independent processing trains will provide flexibility during operation of the Facility, allowing solid waste processing and energy production to continue if one train breaks down or needs to be shut down for scheduled maintenance. Lee County will defer some capital expenditure by not constructing the final 600-tpd train until it is needed.

The refuse bunker and tipping floor area will be under slight negative air pressure to prevent the escape of odors and dust. The underfire and overfire fans which supply the combustion system with air will draw all the necessary air from the refuse bunker and tipping floor area. Vents installed on the walls opposite the air intakes will induce a cross-flow ventilation. The dust particles and odors generated in the area will be directed into the combustion zone, thereby minimizing odors outside the refuse bunker and tipping floor area. The combustion process destroys odorous compounds.

Two overhead solid waste handling cranes will be installed to charge the combustion units and maintain the solid waste storage area. The cranes will be of the traveling bridge type, employing a polyp-type grapple. Each crane will be capable of meeting the solid waste handling requirements of the entire Facility.

No heavy equipment such as large cranes, or plant components such as boilers, will be transported to the site, unloaded, stored, or moved around the site during normal operation or maintenance of the Facility. The room in which the steam turbine generator is housed will have an overhead crane for maintenance of the generator. The Facility's dump condenser will be capable of condensing all steam if the generator is inoperable or being serviced.

Lime for the acid gas dry scrubber will be delivered weekly and will be pneumatically transferred to an on-site storage silo. The lime will be

slaked and pumped in a slurry form to the scrubber unit; approximately 24 tons will be used each day. Ash residue (which includes the spent lime) will be hauled on a six-day per week basis to the landfill/ashfill in Hendry County, except for holidays.

3.10 ASSOCIATED FACILITIES

In conjunction with the energy recovery facility, a landfill/ashfill will be constructed in Hendry County. The location of the proposed landfill/ashfill is shown in Figure 2-16. A separate permit is under preparation for this proposed facility; excerpts from the draft permit, including the transmittal letter, table of contents, and FDER form 17-7.130(1), are presented in Appendix 7.1.

The proposed landfill/ashfill will serve the disposal needs of both Lee and Hendry counties. The landfill site consists of approximately 1,720 acres, of which 400 acres will be used for waste disposal. Approximately 260 acres have been designated for a Class I bypass and ash landfill. Approximately 40 acres will be used for the disposal of construction and demolition wastes. About 60 acres have been designated as a sludge composting/dry trash area. The sludge composting facility will be permitted separately at a later date. No hazardous wastes will be accepted at the facility. The anticipated life of the landfill is 40 years.

The proposed liner system for the Class I and ash fill areas is a double flexible membrane liner with primary and secondary leachate collection systems. A single synthetic liner with a leachate collection system is proposed for the Class III disposal area for construction and demolition debris. A minimum of 14 groundwater monitoring wells, 18 piezometric wells, and two surface water monitoring stations will be installed to assess any potential environmental impacts.

SECTION 5.0

EFFECTS OF FACILITY OPERATION

5.0 EFFECTS OF PLANT OPERATION

This section describes (1) the interaction of the energy recovery Facility with the environment, and (2) Lee County's plans for monitoring the environmental impacts during operation of the Facility. In the discussion which follows, irreversible or unavoidable environmental effects are distinguished from those which are unavoidable, but temporary, or suitable for later amelioration. Mitigation actions are described when applicable. The impacts of Facility operations are quantified whenever possible, and the source of each impact is identified. The relationship between short- and long-term effects is also discussed.

5.1 EFFECTS OF THE OPERATION OF THE HEAT DISSIPATION SYSTEM

As described in Section 3.0, cooling towers will be used on-site. There will be no thermal discharges to surface water bodies; therefore, Section 316 demonstrations for thermal discharges are not applicable.

5.1.1 TEMPERATURE EFFECT ON RECEIVING WATER BODY

This section is not applicable to the Facility since there will be no discharge to surface waters from the Facility. Cooling water will be treated and reused as much as possible. A limited volume of spent cooling process and sanitary wastewater (maximum 150,000 gpd) will be discharged to a sewer. Prior to discharge, all applicable pretreatment requirements will be met.

5.1.2 EFFECTS ON AQUATIC LIFE

This section does not apply to this Facility. There will be no discharge to surface water or groundwater, and no impacts on aquatic life in the area will occur as a result of Facility operations.

5.1.3 BIOLOGICAL EFFECTS OF MODIFIED CIRCULATION

This section is not applicable. The energy recovery facility will use reclaimed water supplied by pipeline from the Fort Myers Central WWTP. No surface water intake structure will be required.

5.1.4 EFFECTS OF OFFSTREAM COOLING

The cooling towers of the proposed Facility will use about 1,500,000 gallons per day (gpd) of reclaimed water from the Central WWTP to "make up" for water lost to evaporation at its ultimate capacity of 2,400 tpd. Chlorine or other equivalent compounds will be used for disinfection of the reclaimed water in conformance with Chapter 17-6 of the Florida Administrative Code. High-level disinfection (HLDI) will provide 1.0 mg/L total chlorine residual after 15 minutes contact time at maximum daily flow or after 30 minutes contact time at average daily flow, whichever provides a higher level of public health protection for the proposed Facility in accordance with Chapter 17-610.460, FAC. The reclaimed water received from the Central WWTP will be pretreated as required to a maximum of 5.0 milligrams per liter of suspended solids prior to high-level disinfection. Filtration will be provided for control of total suspended solids (TSS). Chemical feed facilities for TSS removal will be provided as required. All process water will be treated in compliance with the City of Fort Myers Sewer Use Ordinance.

During the cooling process, approximately 0.015 percent of the makeup water is lost as droplets in the cooling tower exhaust (cooling water "drift"). The drift will be of approximately the same quality as the reclaimed water used as makeup water. When the droplets of water composing the drift are vented from the tower, they are carried away from the Facility. The distance traveled is dependent on the size of the droplets formed. Aerosol particles or droplets larger than 600 microns in diameter (approximately 70 percent of the drift mass) would settle within 400 feet of the tower. Smaller particles would be carried farther (Furlong, 1974). At the

proposed energy recovery facility, the nearest residential area will be about one mile away from the tower, with trees in between as buffer. Thus, all particles or droplets should settle out, or dissipate, before reaching a residential area.

To determine if viruses and bacteria could be emitted from the cooling tower, a computerized literature search was conducted to identify all data available on this topic. Two data bases were searched and a combined total of more than 7,500 journals, books, reports, conference proceedings and research papers were accessed—a total of approximately 100,000 records. Only a small number of articles and reports were found that specifically address the use of treated wastewater as cooling tower makeup water, and these studies were conducted at large power plants rather than energy recovery facilities. The results of these studies are discussed below.

Levels of total bacteria have been measured directly at the exit vent from a cooling tower which uses secondary effluent by Adams, et al. (1980). These results are not representative of the proposed Facility because a lower level of wastewater treatment was provided, and effluent was held in a basin prior to use which can allow the regrowth of organisms. Both of these factors could result in higher counts of bacteria than would be expected at the proposed Lee County Facility. As measured by Adams, et al. (1980), total bacteria counts exiting the vent of a cooling tower on four occasions ranged from 299 to 1,220 particles/m³.

Rogozen, et al. (1981) sampled emissions from two cooling towers ("Olive 1" and "Magnolia 4") which used municipal effluent from the Burbank Water Reclamation Plant as makeup water. This plant treats wastewater to a level of treatment similar to that of the Fort Myers Central WWTP. Rogozen attempted to sample stack emissions isokinetically (air enters the sampler at the same velocity as it leaves the stack). At the Olive 1 tower, the exit velocity was 10.4 meters per second and the total volume of air sampled was 770 cubic meters. No fecal coliform or fecal streptococci bacteria were detected. Total coliform bacteria were greater than or equal to 1.6 most probable number (MPN) of organisms/m³. E. coliphage were enumerated at 0.07 plaque forming units (PFU)/m³. At the Magnolia 4 tower, no bacteria or viruses were detected during isokinetic sampling.

In addition to literature on the use of effluent as cooling tower makeup, the results of virological studies at treatment plants similar to the Fort Myers Central WWTP were examined. Findings are summarized below.

Studies of virus inactivation using chlorine have shown almost complete inactivation of viruses in advanced wastewater treatment (AWT) effluents. Dryden et al. (1979) found that suitable combinations of AWT processes could achieve overall reductions of up to 99.6 percent of viruses. Dryden also studied the use of chlorine for inactivation of AWT effluents seeded with poliovirus type 1. After two hours of contact with a final combined chlorine residual of 4.9 to 5.4 mg/L, an inactivation rate of 99.90 to 99.99 percent was achieved. Many field tests and pilot plant studies substantiate these results.

Virus testing was conducted during a three-day period at the Sand Lake Road pilot wastewater treatment Facility located in Orange County, Florida (Wellings, 1983a). The pilot plant employed a shallow bed dual media filter with pre- and post-chlorination, alum, and alum plus polymer. While the influent wastewater contained from 262 to 397 PFU/l, chlorinated effluent (free chlorine residuals from trace to 1.7 parts per million) contained no detectable virus.

At the McCleod Road wastewater treatment plant in Sarasota County, Florida, sampling was conducted from June 21 to June 27, 1983 (Wellings, 1983b). Influent densities of viruses ranged from greater than 383 PFU/liter to greater than 593 PFU/liter. Again, no viruses were detected in the chlorinated effluent.

The City of St. Petersburg, Florida provides sand media filtration and disinfection prior to urban reuse of its reclaimed water. Virological testing was conducted at the three plants currently employing urban reuse in 1985 and 1986. As shown in Table 5-1, resulting virus levels ranged from non-detectable to 0.0070 PFU/liter.

TABLE 5-1

RESULTS OF VIROLOGICAL TESTING
 CITY OF ST. PETERSBURG
 (PLAQUE FORMING UNITS PER LITER)

	Wastewater Treatment Plants		
	Northeast	Northwest	Southwest
<u>1985</u>			
August	0	0	0.0027
September	0	0	0
October	0	0	0
November	0	0	0.0027
December	0	0	0.0070
<u>1986</u>			
January	0	0	0
February	0	0	0
March	0	0	0
April	0	0	0
May	0	0	0
June	0	0	0
July	0	0	0

SOURCE: Department of Public Utilities, City of St. Petersburg, June 2, 1987.

The City of Fort Myers uses the Bardenpho process to provide AWT. This process provides an excellent source of reuse water for the Facility cooling water processes in that it produces a high quality effluent low in suspended solids, nitrogen, and phosphorus. Based on the results from similar facilities, the drift emanating from the proposed Lee County Facility will not present a virological health hazard to residents of nearby areas if reclaimed water from the Central WWTP is used as cooling tower makeup. The Pinellas and Hillsborough energy recovery facilities are using a similar cooling system, and there have been no reported problems. As discussed previously in this section, high-level disinfection of the Facility's cooling water will be implemented in accordance with Chapter 17-610.460, FAC. To assure the absence of viruses in the makeup water of the proposed Facility, a monitoring program will be instituted as described in the following section.

5.1.5 MEASUREMENT PROGRAM

Samples of influent and chlorinated effluent will be collected daily at the Central WWTP for one week during compliance testing. Sufficient sample volumes will be collected to allow accurate analysis and identification of microorganisms. Samples will be analyzed for total bacteria, total and fecal coliform bacteria, fecal streptococci, and total virus particles (as plaque forming units). Analysis techniques specified in Standard Methods for the Examination of Water and Wastewater, and required by the U.S. Environmental Protection Agency, will be followed.

The discharge system will include continuous on-line monitoring for turbidity prior to disinfection and total chlorine residual (or other disinfectants) at the compliance monitoring point. Prior to Facility start-up, an operating protocol, designed to ensure that the high-level disinfection criteria will be met, will be submitted to DER for review and approval in compliance with 17-610.463, FAC.

5.2 EFFECTS OF CHEMICAL AND BIOCIDAL DISCHARGES

5.2.1 INDUSTRIAL WASTEWATER DISCHARGES

There will be no industrial discharges to surface waters from operation of the energy recovery Facility. Cooling water will be treated and reused; a maximum of 150,000 gpd of sanitary wastewater and spent process water will be routed to the Central WWTP following pretreatment as required to meet Fort Myers sewer use requirements. All applicable local, state and federal discharge regulations and water quality standards for domestic wastewater and industrial wastewater, including chemical and biocidal wastes and oil and grease, will be satisfied.

Water quality data for the reclaimed water is provided in Table 3-4. This data has been provided to the various vendors who are currently negotiating for the energy recovery facility contract. The vendor/contractor selected to build and operate the Facility will design facilities to treat the reclaimed water prior to use in the cooling tower, as needed to meet a maximum wastewater discharge limitation of 0.15 mgd. At a minimum, dual media filtration will be provided.

5.2.2 COOLING TOWER BLOWDOWN

Reclaimed water from the Central WWTP will be used as cooling water for the Facility. The capacity of the Central WWTP is currently 11 mgd and is much greater than the total water demand of the energy recovery facility (1.1 mgd at build-out). Consequently, there is ample wastewater effluent available for cooling water usage at the energy recovery facility. When a pipeline is constructed to supply the reclaimed water, other potential reuse projects in the area will be analyzed, and the pipe will be sized to serve these needs as well as those of the proposed Facility. Cooling tower blowdown will be treated and reused at the energy recovery facility to the greatest extent possible. Cooling tower blowdown not reused at the Facility will be blended with sanitary wastewater and discharged to the Central WWTP via sewer.

5.2.3 MEASUREMENT PROGRAMS

There will be periodic monitoring of the energy recovery facility treatment operations and wastewater discharge to the sewer. The frequency of monitoring of wastewater discharge will be in accordance with the City of Fort Myers Sewer Use Ordinance.

5.3 IMPACTS ON WATER SUPPLIES

5.3.1 SURFACE WATER

There are no long-term impacts to surface water associated with the operation of the proposed energy recovery Facility. A stormwater pond designed to contain the Facility's runoff during a 25-year storm event will be constructed between the Facility and a cypress dome located on the property's southern boundary. An overflow conveyance will be constructed to direct excess stormwater through the isolated cypress dome to maintain its historical flooding cycle.

The proposed Facility will use reclaimed water for cooling tower makeup. Spent process water will be recycled for other uses such that the minimum possible discharge occurs from the Facility. Sanitary wastewater and a small amount of spent process water will be transmitted to the Central WWTP following pretreatment.

5.3.2 GROUNDWATER

The primary source of cooling water and potable water will be the City of Fort Myers and Lee County, respectively. The proposed principal source to meet the estimated 1.1 mgd demand for cooling water is treated reclaimed water from the Central WWTP in Fort Myers. The site's administrative building and other on-site facilities requiring potable water will be tied into the County's potable water distribution network. It is necessary to establish a back-up supply of cooling water. It is proposed that groundwater wells in the sandstone aquifer be installed to provide a back-up supply of water for cooling.

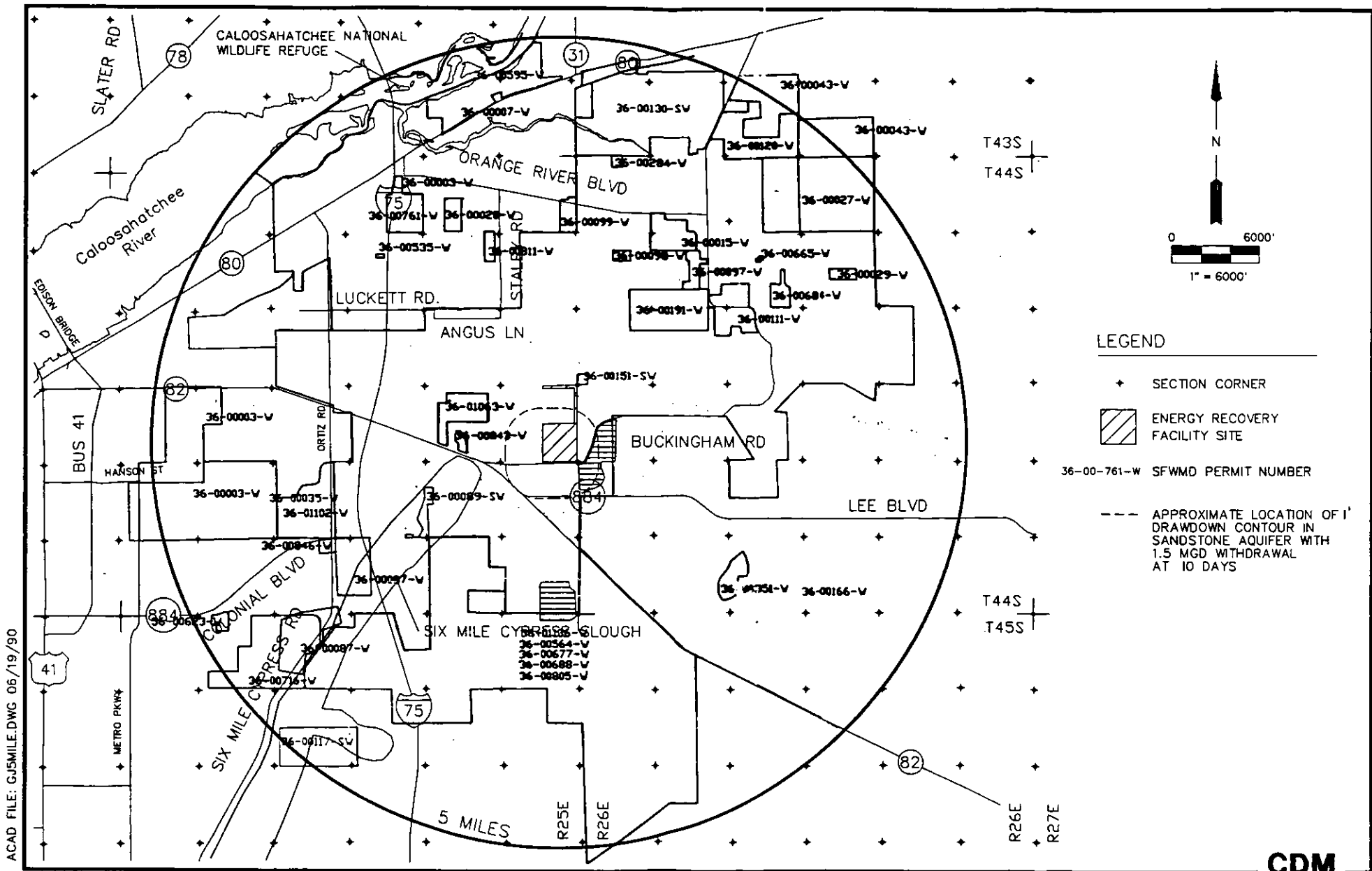
These proposed wells would only be used as an emergency supply for back-up cooling water. The wells would not be used during normal operation or normal conditions. The anticipated annual withdrawal from the wells is expected to be very small because the primary source of cooling water, treated reclaimed water from the Central WWTP, is rated at Class I Reliability—the highest reliability rating.

No impact of the emergency back-up wells on other legal users is anticipated because of the infrequent use of the wells. Figure 5-1 illustrates locations of permitted withdrawals within a five-mile radius of the site. The potential off-site drawdown for a hypothetical pumping scheme is shown on Figure 5-1. The drawdown contour within the sandstone aquifer after 10 days of pumping is shown for illustration only. It is unlikely that the emergency wells will be used at all, and the period of time for their use would be short. No impact on surface waters or wetlands are anticipated due to pumping from the sandstone aquifer because of the low leakance rate through the upper Hawthorn confining unit. In any case, impacts would be negligible because they would be of very short duration on an emergency basis.

There is one existing groundwater well at the project site. It has been used in small quantity applications to support previous agricultural practices. The on-site well is a two-inch diameter well that flows at ground surface. It has an existing shut-off valve. This well will not be used for on-site operations, and will be abandoned and grouted in accordance with SFWMD requirements.

No sources of groundwater contamination from the Facility structures or site operations are anticipated. All solid waste and ash will be stored in enclosed buildings to prevent contact with stormwater runoff. The storage structures for the solid waste and ash will be constructed of concrete and constructed watertight to eliminate the potential for any releases to groundwater or surface waters.

The bottom of the concrete refuse storage bunker (which will be four to five feet and hydrostatically stable) will be completely sealed to prevent groundwater from seeping into the bunker. Any moisture or liquids inherent



Drawdown Effects On Neighboring Wells - Lee County Energy Recovery Facility

to the municipal solid waste will be bound to the waste materials and incorporated into the main storage mass and combusted with the solid wastes. Thus, there will not be any free leachate in the refuse bunker.

There are some potential sources of off-site upgradient contamination including the current site of the County landfill located three miles south of the ERF site, and the former Buckingham Road landfill(s) located one-half mile east and southeast of the ERF site. There are active groundwater quality monitoring programs at these locations.

The surficial groundwater system and the confining unit that underlies the site have a high clay content. Clays have a large adsorptive capacity for organic and inorganic (including metal) contaminants in groundwater. The subsurface clayey materials will tend to bind up or adsorb a high proportion of contaminants and thus retard their migration within the groundwater matrix.

5.3.3 DRINKING WATER

Drinking water and potable water supply needs on-site will be met by distribution from the Lee County system. All municipal water supply systems in the area are approximately 2.5 miles away. The closest supply well fields that produce more than 1 mgd are located upgradient and withdraw primarily from the sandstone aquifer. No impacts on drinking water sources are anticipated.

5.3.4 LEACHATE AND RUNOFF

Runoff collected in the stormwater retention/detention basins following start-up of the Facility operations will be collected from vegetated areas, paved surfaces, and roof tops. All refuse or residue storage areas will be enclosed so that no runoff will occur from these surfaces. Groundwater and surface water quality is thereby protected from unprocessed waste and residue.

The proposed landfill to be located in Hendry County will be used to dispose of the noncombustible material from the energy recovery facility. The ashfill/landfill has been designed in accordance with applicable DER regulations using state-of-the-art construction methods which include double synthetic liners, leachate collection and treatment, and groundwater monitoring. Ash and Class I wastes will be disposed in separate areas (monofilling).

5.3.5 GROUNDWATER MODELING AND MONITORING

A groundwater monitoring program will be established. Some groundwater monitoring wells should be installed before Facility construction and operation to establish site-specific background water quality data.

5.4 SOLID/HAZARDOUS WASTE DISPOSAL IMPACTS

5.4.1 SOLID WASTE

This section discusses impacts not yet discussed in Section 5.2 or 5.3 which are imposed by the processing of solid wastes on the site. This section also describes the potential benefits to be gained from the combustion of solid wastes.

Section 2.2.7 described the existing Lee County solid waste management system. Existing and future quantities of solid waste generated in the County were also presented.

The proposed energy recovery facility will have a net beneficial impact on solid waste disposal in Lee and Hendry counties. The estimated processible solid waste quantities expected to be delivered annually to the energy recovery facility through the year 2010 are shown in Table 5-2. If these quantities of solid waste were to be landfilled rather than combusted, they would require about 888,000 cubic yards of landfill space (including cover) in 1993, increasing annually to about 1,850,000 cubic yards of landfill space in 2016. Instead, by achieving a 90 percent volume reduction through combustion, the ash residue to be landfilled would require only about

89,000 cubic yards of landfill space in 1993, ultimately increasing to about 185,000 cubic yards of landfill space in 2016. Therefore, the potential savings in landfill capacity is considerable. The prolonged life of the landfill will decelerate the need for future landfill sites in Lee and Hendry counties (landfill volume calculations based on 1,000 lb/cy³).

A ferrous materials recovery system will be incorporated in the Facility. A magnetic belt for ferrous removal, associated conveying systems, enclosed ferrous storage area, and enclosed loading area will be provided. However, landfill disposal capacity has been calculated assuming no ferrous material recovery.

In addition to ferrous metal recovery at the proposed Facility, Lee County is incorporating an aggressive recycling program as an integral component of its total solid waste management system. This program is expected to include the curbside collection of recyclables from county residences; a materials recovery facility (MRF) for the initial processing of materials required by end-use markets (e.g., sorting, crushing, baling, shredding, etc.); drop-off/buy-back centers for the collection of recyclables from condominium developments, apartment complexes, and mobile home parks; a commercial recycling program for the recovery of cardboard, glass, aluminum, and high-grade paper from shopping centers, restaurants, and office complexes; and an institutional waste recovery program for the collection of newspaper and aluminum from county schools and hospitals. Additionally, separate areas will be designated at the landfill for the separation, processing, or disposal of special wastes (e.g., batteries, used oil, construction/demolition debris, and used tires) and yard wastes. These activities are currently being phased in over a five-year planning period; the entire recycling/materials recovery program will be fully implemented by 1994 to meet the state's 30 percent reduction goal set in the 1988 Solid Waste Management Act.

TABLE 5-2
 PROJECTED SOLID WASTE QUANTITIES
 LEE & HENDRY COUNTIES 1995-2030

TARGET YEAR	TONS PER YEAR	TONS PER DAY
<u>LEE COUNTY</u>		
1995	591,492	1,620
2000	759,238	2,080
2005	913,346	2,502
2010	1,010,924	2,770
2015	1,106,402	3,031
2020	1,211,059	3,318
2025	1,322,686	3,624
2030	1,445,861	3,961
<u>HENDRY COUNTY</u>		
1995	31,226	86
2000	33,554	92
2005	35,883	98
2010	38,212	105
2015	40,541	111
2020	42,869	117
2025	46,922	124
2030	51,357	130

5.4.2 HAZARDOUS WASTE

This section is not applicable to the proposed Facility, since there will be no handling or disposal of hazardous wastes at this Facility. The Facility will accept only municipal solid waste which includes residential, commercial, and non-hazardous industrial wastes (e.g., office and packing wastes). Public and private users of the Facility will be informed of these limitations. Signs will be posted at the weigh station to indicate what wastes are accepted at the Facility. Routine visual inspections by weigh station personnel will monitor the types of wastes received upon arrival at the Facility gates. The crane operator will be trained to visually inspect waste in the bunker. Additionally, spotters will be stationed on the tipping floor to ensure that loads are inspected prior to unloading into the refuse storage bunker. Finally, contractual agreements between Lee County and the selected vendor will stipulate shared responsibilities in the prevention of hazardous materials entering the Facility. If hazardous materials are discovered to have entered the Facility, the materials will be isolated or temporarily stored. A licensed hazardous materials contractor will be notified to collect and transport these materials to a proper treatment or disposal Facility.

A chemical and toxicity analysis of the combined ash residue (including both combustion residue and air pollution control device residues) will be conducted during acceptance testing and quarterly thereafter, to verify that the ash is not toxic or hazardous. Test methods will be in conformance with Rule 17-702, FAC, Solid Waste Combustor Ash Management.

It is expected, based upon tests at similar facilities, that the ash residue will be non-hazardous according to the regulations of the U.S. Environmental Protection Agency (EPA) and the Florida Department of Environmental Regulation (FDER). This waste material will be suitable for disposal in a Class I permitted sanitary landfill.

5.5 SANITARY AND OTHER WASTE DISCHARGES

Solid waste generated by Facility operations (employee refuse, packing material, etc.) will be collected from receptacles located throughout the Facility and deposited into the main solid waste refuse storage pit. Materials not suitable for placement into the solid waste pit will be separated for off-site disposal at the Hendry County landfill/ashfill or other appropriate Facility. All sanitary wastewater and spent cooling water up to a maximum of 150,000 gpd wastewater will be collected and discharged to the Central WWTP. Therefore, no impacts associated with waste discharges are anticipated during the operations of the Facility.

5.6 AIR QUALITY IMPACTS

5.6.1 IMPACT ASSESSMENT

The air quality modeling analysis was conducted in three phases:

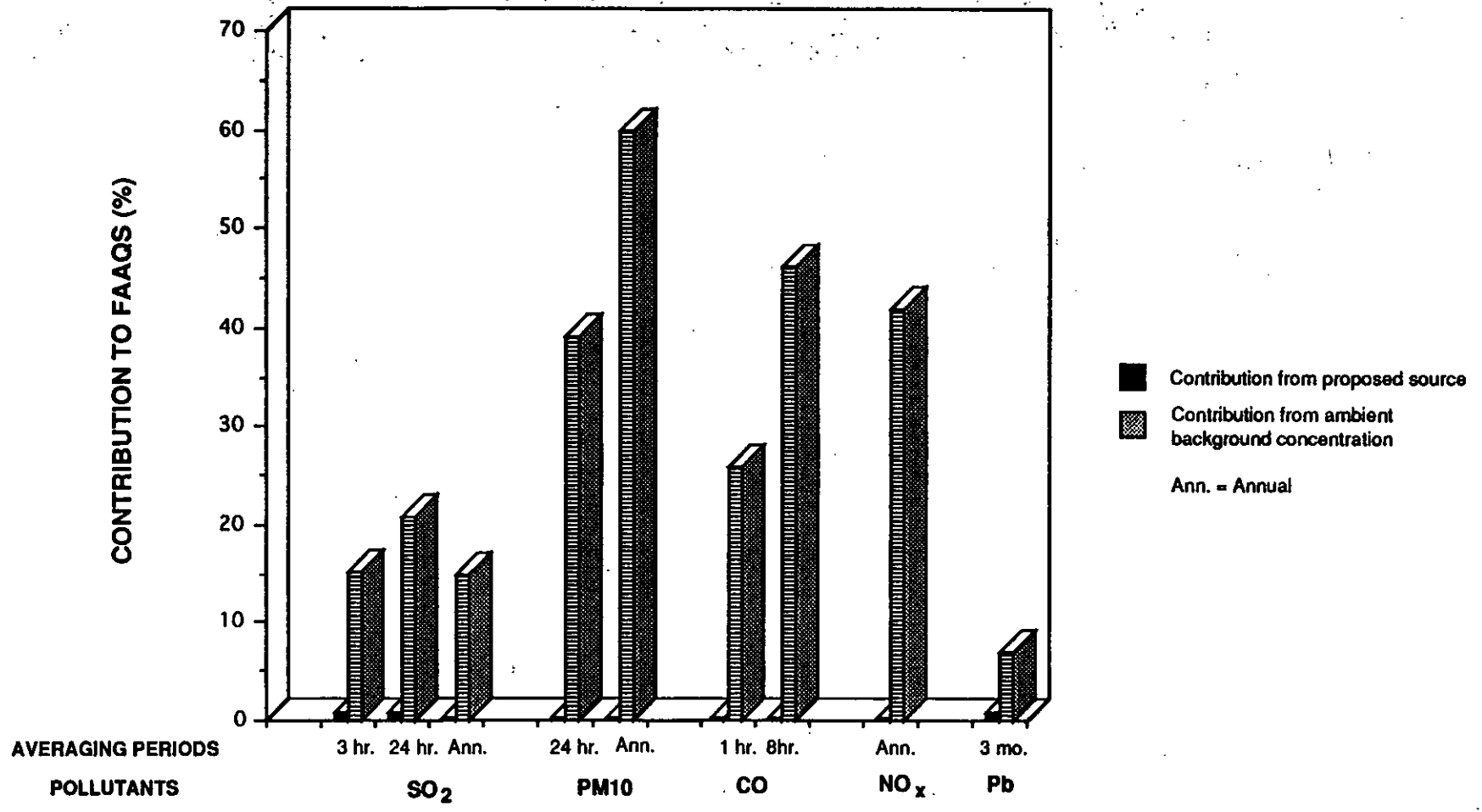
1. Screening analysis - This analysis identified the combustor type and operating condition (based on waste throughput and heat content) which would have the greatest calculated air quality impact. The screening model runs were made using the Industrial Source Complex-Short Term (ISCST) dispersion model and 48 worst case meteorological conditions.
2. Refined Modeling Analysis - The refined modeling analysis was conducted using two postulated worst-case combustor operating conditions for a stoker waterwall design, and a receptor grid, was selected on the basis of the outcome of the screening analysis. The refined modeling analysis identified the maximum ground-level impacts for pollutants emitted from the Facility. The refined modeling was completed using the ISCST model, and five years (1982 to 1986) of surface meteorological data from Page Field Airport in Fort Myers and upper air data from Tampa International Airport.

3. Additional Class I Area Impact Analysis - This analysis modeled concentrations of regulated pollutants with Prevention of Significant Deterioration (PSD) increments, and modeled the affects of the Facility's plume on visibility at Class I and air-quality-sensitive areas. A detailed discussion of the air impacts is contained in Section 6.8, Comparison with PSD Increments and in Section 7.2, Visibility (Volume III - Air Quality).

Under the applicable regulations, a short-term average air quality standard (24 hours or less) is not violated until a receptor exceeds the standard twice in any given year. The highest value of the second highest concentrations (HSH) is chosen from the potential impacts, and the ambient background monitoring data to allow for a single short-term violation. Since a single annual average is calculated for each receptor, the highest annual concentrations were used for comparison.

SO₂, NO₂, CO, PM₁₀, lead, and ozone are regulated federally through the National Ambient Air Quality Standards (NAAQS), and by the State of Florida through the Florida Ambient Air Quality Standards (FAAQS). The predicted Facility impacts for all these pollutants, except ozone, are compared in Table 5-5 and Figure 5-2 to the more stringent of the NAAQS or FAAQS. Ozone is not directly emitted from the Facility, but is formed in the atmosphere as a secondary pollutant. Non-methane hydrocarbons, considered a precursor to ozone formation, are regulated under PSD, and will be minimized by employment of combustion control techniques which represent BACT (see Section 4.0 of Volume III - Air Quality).

As Figure 5-2 shows, the modeled impacts of the proposed Facility are very small in comparison with the existing background concentrations. As shown in Table 5-3 and Figure 5-2, the greatest ground-level pollutant concentration due to the Facility is estimated to be no less than one percent of the applicable NAAQS/FAAQS standards. The 24-hour SO₂ concentration would be 0.97 percent of the standard. The three-hour SO₂ predicted concentration would be 0.96 percent of the FAAQS. The 24-hour average concentration for lead was used as a conservative estimate of the



LEE COUNTY, FLORIDA
Energy Recovery Project
 Application for Power Plant Certification
 Camp Dresser & McKee Inc.

FIGURE 5-2
AIR QUALITY IMPACT COMPARED TO FAAQS

TABLE 5-3

COMPARISON OF PREDICTED IMPACTS FROM THE LEE COUNTY ENERGY RECOVERY FACILITY
 AND AMBIENT BACKGROUND CONCENTRATIONS TO THE NAAQS/FAAQS
 (concentration in $\mu\text{g}/\text{m}^3$)

Pollutant	Averaging Time	Rank ^a	NAAQS/ FAAQS ^b	Facility Impact	Facility Impact as Percent of Standard	Ambient Background Concentration	Total Impact	Total Impact as Percent of Standard
Sulfur Dioxide	3-Hour	HSH	1,300 (1,300)	12.5	0.96	199	211.5	16.3
	24-Hour	HSH	260	2.52	0.97	54	56.52	21.7
	Annual	H	60	0.19	0.3	9	8.2	15.3
Nitrogen Dioxide	Annual	H	100 (100)	0.36	0.4	42	42.4	42.4
Particulate Matter (as PM_{10})	24-Hour	HSH	150 (150)	0.33	0.2	58	58.3	38.9
	Annual	H	50 (50)	0.024	0.05	30	30.0	60.0
Carbon Monoxide	1-Hour	HSH	40,000	47.0	0.12	9200	9247	23.1
	8-Hour	HSH	10,000	4.0	0.04	4600	4604	46.0
Lead	3-Month	H	1.5 (1.5)	0.012 ^c	0.8	0.1	0.11	7

SOURCE: Camp Dresser & McKee Inc., 1991

^aAbbreviations: H = Highest
 HSH = Highest, Second-Highest

^bThe more stringent of federal or state standard is given. Secondary standards are shown in parentheses.

^cHighest 24-Hour average concentration used to conservatively estimate 30-day or 3-month average concentration.

three-month average lead concentration. The lead concentration would be 0.8 percent of the quarterly standard. All other pollutants contribute much less than one percent of the applicable NAAQS/FAAQs.

Since the proposed Lee County Facility is considered a major source of SO_2 , TSP, PM_{10} , and NO_2 , the impacts of these pollutants are compared to the applicable Class II PSD increment for each specified averaging period. As shown in Table 5-4, the Facility is expected to consume less than three percent of any allowable increment. Cumulative modeling of any other PSD-consuming background source was not required because the pollutant impacts did not exceed any of the Significant Impact Levels (see Section 6.5 in Volume III).

The impact of the proposed Facility was also evaluated for visibility, soils, and vegetation. Visibility modeling of the plume was performed for the Everglades National Park, a PSD Class I Area, and for the Big Cypress National Preserve, an air-quality-sensitive area, to determine whether the Facility would have an effect on the clarity of the air in these pristine areas. Discrete receptors for both areas were placed along the boundaries closest to the Facility. Using a worst-case screening analysis (the EPA-approved VISCREEN model), no visibility degradation is predicted. The predicted maximum annual concentrations are well below the thresholds which are considered harmful to soils and plants. Detailed analyses of these air quality issues are presented in Section 7.0, Additional Impact Analyses (Volume III - Air Quality).

5.6.2 MONITORING PROGRAM

No post-construction ambient air monitoring plan is proposed for the Lee County energy recovery Facility. The monitoring network operated by DER is sufficient to monitor ambient air quality levels in the vicinity of the site. However, a continuous in-stack monitoring program will be operated for opacity, and oxygen or carbon dioxide concentrations. The equipment will be installed, calibrated and maintained in accordance with Chapter 17-2.710, FAC and 40 CFR 51, Appendix P. Compliance testing will also be conducted for pollutants with emission limiting standards in accordance with Chapter 17-2.700, FAC and 40 CFR 60 as applicable. This testing will include, but will not be limited to, testing for particulate emissions, SO_2 , NO_x , CO, Pb, and non-methane VOC.

TABLE 5-4

COMPARISON OF IMPACTS FROM THE LEE COUNTY ENERGY RECOVERY Facility
TO PSD CLASS II INCREMENTS

Pollutant	Averaging Period	Rank ^a	Maximum Impacts from Facility (ug/m ³)	PSD Class II Increment	Total Impact as a Percent of Increment
Sulfur Dioxide (SO ₂)	Annual	H	0.19	20	1.0
	24-hour	HSH	2.52	91	2.8
	3-hour	HSH	12.5	512	2.4
Total Suspended Particulate Matter (TSP)	Annual	H	0.024	19	0.13
	24-hour	HSH	0.33	37	0.9
Particulate ^b Matter (PM ₁₀)	Annual	H	0.024	17 ^c	0.14
	24-hour	HSH	0.33	30 ^c	1.1
Nitrogen Dioxide (NO ₂)	Annual	H	0.36	25	1.4

SOURCE: Camp Dresser & McKee Inc., 1991.

^aAbbreviations: H = Highest
HSH = Highest, Second-Highest

^bConservative estimate assuming all TSP is in the form of PM₁₀.

^cProposed EPA standard (54 FR 41218, October 5, 1989).

Dispersion modeling of maximum Facility pollutant emissions has demonstrated that the estimated highest ground-level concentrations are below the PSD de minimis monitoring levels shown in Table 2-24. Therefore, in accordance with 40 CFR 52.21(i)(8), the Facility should be exempted from pre-construction monitoring requirements. In light of the modeling results presented in Table 2-24 and in Section 6.5 of Volume III, the Applicant requests the Florida DER to concur in this determination that pre-construction monitoring is not required.

5.7 NOISE

A technical noise analysis was performed for the proposed Facility. This noise study is contained in Appendix 11 of Volume II. The study explains the methodologies used in estimating the operational impacts of the Facility and the results of the analysis. Ambient noise levels were measured at three locations in the site vicinity to establish baseline conditions during day and night periods. Impacts were modeled at seven locations at the property boundary and in the vicinity.

Equipment noise levels were attenuated and combined with the ambient noise levels at each monitoring site. The results show that Facility noise levels will not cause a discernible impact (an increase of more than three dBA) at any sensitive receptor (see Table 5-5).

Table 5-5 compares the expected Facility noise level at each monitoring station to the County standards. The Facility noise levels are predicted to be lower than both the day-time standard and the night-time standard at all property boundary locations during Facility operations.

Traffic noise was determined using the noise prediction model, STAMINA 2.0 (FHWA, 1982). Using this model, traffic noise levels were compared with and without Facility traffic. Modeling showed that Facility truck traffic would not be audible at any of the nearest residences.

TABLE 5-5

LEE COUNTY ENERGY RECOVERY FACILITY
FACILITY NOISE LEVELS (DBA)

Receptor Location	Distance (FEET)	Period	Background Noise Level (L_{EQ})	Projected Noise Level (L_{EQ})	County Standard	Increase in Noise Level (L_{EQ})
Boundary B1	850	Day	48.0	50.4	66	2.4
		Night	35.0	42.2	55	9.2
Boundary B2	2,200	Day	52.0	52.5	66	0.5
		Night	50.0	50.2	55	0.2
Boundary B3	200	Day	48.0	57.1	66	9.1
		Night	42.0	50.1	55	8.1
Boundary B4	1,500	Day	52.0	53.0	66	1.0
		Night	50.0	50.4	55	0.4
Residence R1	2,400	Day	55.0	55.1	66	0.1
		Night	42.0	42.9	55	0.9
Residence R2	2,850	Day	55.0	55.1	66	0.1
		Night	42.0	42.7	55	0.7
Residence R3	3,000	Day	55.0	55.1	66	0.1
		Night	42.0	42.6	55	0.6

SOURCE: Camp Dresser & McKee Inc., 1990.

5.8 CHANGES IN NON-AQUATIC SPECIES POPULATIONS

5.8.1 IMPACT

Minimal impacts on species populations and long-term species diversity are expected. Limited wetland areas will be impacted by construction, as described in Appendix 6.5 (Dredge and Fill Permit) and Section 4.4.1 (Ecological Impact Assessment). Given the disturbed nature of the present site, development of the Facility site may actually cause a net positive effect on species diversity, abundance, and composition.

No adverse impacts to wetlands are anticipated from the long-term operation of the proposed energy recovery Facility. The stormwater management pond will be designed for a 25-year, 72-hour stormwater event. During design rainfall events, the stormwater pond design will provide a maximum discharge of 1.7 cubic feet per second (cfs) and an average discharge of ≤ 0.5 cfs (see Volume II, Section 7.3). This discharge will flow to the wetlands in the southeast quarter of the property site which should enhance these wetlands and not adversely impact them. Groundwater seepage from the stormwater pond should also be toward these same wetlands. Therefore, these wetlands should have enhanced hydroperiods and thus greater wildlife utilization during the operational phase of the proposed project.

5.8.2 MONITORING

Minimal impacts on species populations are anticipated; therefore, no long-term wildlife monitoring is necessary. Post-construction wetland monitoring of wetlands will be conducted until the agencies' success criteria for the wetlands have been satisfied.

5.9 OTHER FACILITY OPERATION EFFECTS

Florida Transportation Engineering (FTE) was contracted to perform an analysis of the traffic impacts of the proposed Facility. FTE has performed many similar studies in Lee County, and is familiar with the project area. Based on the results of their study, the energy recovery

facility will have no adverse impact on the surrounding roadway network. Existing Level of Service (LOS) for those roadway sections to be affected by the project are currently established at LOS A. 1992 peak season traffic with development of the project remain at LOS A. However, the study does recommend that a left-turn lane for eastbound traffic be constructed to service vehicles accessing the site due to the fact that Buckingham Road is currently posted at 50 miles per hour. The complete FTE report can be found in Appendix 11.2 (Volume II).

5.10 ARCHAEOLOGICAL SITES

An archaeological and historic survey was conducted by Piper Archaeological Research, Inc. for the Facility site (see Appendix 10.2). Two archaeological/historic sites were found:

1. A prehistoric campsite, marked by a single chert waste flake; and
2. An early 20th-century structure of board-and-batten construction, highly modified and in poor condition.

These sites were located within the study area for the archaeological/historic survey, but are not located on the Facility site. Neither of these sites has significance for inclusion in the National Register of Historic Places. Therefore, no significant prehistoric or historic archaeological resources will be impacted by the proposed energy recovery facility.

5.11 RESOURCES COMMITTED

Numerous natural and human resources will be consumed, converted or made unavailable for future use if the proposed Facility is implemented.

The resources used in the construction of the Facility will be committed to this project. Some building materials will be irretrievably used in construction of the energy recovery facility or irreversibly committed to the Facility. Certain lumber products and concrete structures will be committed, as well as glass, ceramics, paint, insulation, and paving materials. In addition to the materials consumed during construction, the

energy and human labor expended could not be retrieved. However, this type of commitment of resources is typical for major capital intensive projects. Financial commitments include dedication of bond issue funds or other sources of construction funds. As with the commitment of labor and materials, the financial requirements for a major capital project are very typical.

The combustion process chemically alters many of the compounds within the waste stream. Many of the heat releasing reactions, practically speaking, are irreversible. Therefore the materials consumed in the combustion process are permanently lost. This, however, is considered a positive reuse of a material for the generation of energy which otherwise would have been buried in a landfill. The Facility will generate over 4.28 billion kilowatt hours of electricity during a 20-year life (assuming no expansion takes place). In addition to the revenue earned on the electricity sold to the power company, the energy production translates into a \$5.58 million reduction on oil expenditures over 20 years and the reduction in consumption of over 7 million barrels of oil. The alternative processing of 1,200 tons per day of municipal solid waste by the Facility will conserve approximately 162,000 tons per year of coal which would otherwise be consumed for power production. It also offers the potential for recovery of reusable materials (ferrous metals).

Thus, the resources committed to this project will benefit the community by providing an environmentally preferred alternative to conventional landfilling, reducing the amount of solid waste to be landfilled and the associated environmental risks, supplying an alternative source of energy, conserving natural resources, and stimulating the economy (by providing new jobs, consuming goods and services from local businesses, etc.).

5.12 VARIANCES

It is not anticipated that variances from applicable standards will be sought as part of the site certification process.

LEE COUNTY, FLORIDA
SOLID WASTE ENERGY RECOVERY FACILITY
APPLICATION FOR
POWER PLANT CERTIFICATION

VOLUME III - AIR QUALITY



SUBMITTED BY
THE LEE COUNTY
BOARD OF COUNTY COMMISSIONERS

JUNE 1990
JUNE 1991 (REVISED)

PREPARED BY
CAMP DRESSER & MCKEE, INC.

THIS DOCUMENT IS PRINTED ON RECYCLED PAPER

environmental engineers, scientists,
planners, & management consultants

CDM



BOARD OF COUNTY COMMISSIONERS

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County Attorney

Robert F. Split
County Hearing
Examiner

June 26, 1991

Mr. Hamilton Oven
Department of Environmental Regulation
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399

Re: Lee County Resource Recovery Facility
DOAH Case No.: 90-3942EPP
DER Case No.: PA90-30

Dear Mr. Oven:

On May 1, 1991, the Board of County Commissioners of Lee County formally adopted a resolution which expresses the Board's desire to build a resource recovery facility with an initial capacity of 1200 tons per day (tpd) and a future maximum capacity of 1800 tpd. Mr. David Dee notified you of this Board action in a May 2, 1991, letter and indicated that the County's PPSA application will be reviewed to determine if any formal modifications are necessary.

The reduction in facility size from a future maximum capacity of 2400 tpd to 1800 tpd has reduced the facility's overall predicted air quality impacts. The attached Volume I and Volume III sections are intended to replace those submitted in June, 1990. All changes are highlighted with underlining to simplify your review of the new material.

We look forward to continuing to work closely with you on this important project.

Sincerely,

George E. Reilly, P.E.
Department of Lee County Utilities
Director

GER:lap
LCL11/8

cc: L. S. Casey, DLCU
D. E. Strobridge, CDM
M. J. Ihnat, CDM
D. Dee, Env. Counsel
All Parties (see attached)

RCVD
July 1, 91

P.O. Box 398
Fort Myers, Florida 33902-0398
(813) 334-2166

335-2276

Writer's Direct Dial Number

L-127-91

PREFACE

On May 1, 1991, the Board of County Commissioners of Lee County formally adopted a resolution to build an energy recovery facility with an initial capacity of 1,200 tons per day (tpd), and a future maximum capacity of 1,800 tpd. This Facility will be smaller than that previously considered by the County (1,800 tpd initially, with a future maximum of 2,400 tpd). An Application for Power Plant Site Certification was submitted to the Florida Department of Environmental Regulation for the previously considered larger Facility in June, 1990. This current permit application contains revisions to the one submitted in June, 1990, to reflect the reduced predicted air quality impacts for the current smaller Facility size. Other changes have been made to incorporate the recently promulgated New Source Performance Standards for Municipal Waste Combustors, and the passage of the Clean Air Act Amendments of 1990.

All changes, updates, and revisions are underlined throughout this Volume III. All other material has remained unchanged from Volume III of the permit application submitted in June, 1990. This highlighting of the new material is intended to simplify the review of this revised permit application.



NOTICE OF CERTIFICATION HEARING ON LEE COUNTY'S APPLICATION TO CONSTRUCT AND OPERATE AN ELECTRICAL POWER PLANT (RESOURCE RECOVERY FACILITY) ON A SITE TO BE LOCATED NEAR FORT MYERS, FLORIDA

1. On June 29, 1990, Lee County filed an application (DER File No. PA-90-30) for authorization to construct and operate an electrical power plant (resource recovery facility) near Fort Myers, in Lee County, Florida. Lee County's application now is pending before the Division of Administrative Hearings, the Florida Department of Environmental Regulation and other agencies, pursuant to the Florida Electrical Power Plant Siting Act, Chapter 403, Part II, Florida Statutes.

2. Lee County's proposed facility will be located on a site east of Fort Myers in central Lee County, Florida. The site is located on Buckingham Road and is approximately 2.5 miles east of the intersection of Interstate 75 and State Road 82. The facility will include a mass burn (resource recovery (waste-to-energy) facility that will burn municipal solid waste to produce electrical energy. The facility also will include a steam generator, electrical generator, waste unloading facilities, and cooling tower. The facility will burn municipal solid waste at an initial rate of 1,200 tons per day and will produce approximately 40 megawatts (MW) of electricity. The facility is designed so that it can be expanded in the future, if necessary, to combust 1,800 tons per day and generate an ultimate site capacity of 60 MW of electricity. The project's associated linear facilities will include one 138 kV transmission line which will connect the resource recovery facility with the Florida Power and Light Company's existing Buckingham substation.

3. The application is available for public inspection and copying at the following addresses:

State of Florida, Department of Environmental Regulation
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400
State of Florida Department of Environmental Regulation

12. Lee County's application for the proposed electrical power plant also is subject to U.S. Environmental Protection Agency (EPA) regulations for the Prevention of Significant Deterioration (PSD) of air quality, which are codified at 40 CFR 52.21 and Florida Administrative Code Chapter 17.27. In general, these regulations provide that a permit must be obtained from DER before construction may begin on a source of air pollution that is subject to PSD review. The permit can be issued only if the new construction has been determined by DER to comply with the requirements of the PSD regulations. These PSD regulations include a restriction on incremental increases in air quality due to the new source. The PSD regulations also require the application of Best Available Control Technology (BACT).

13. The DER has been granted a delegation of authority from EPA for the purposes of conducting the PSD review of this and other sources. Acting pursuant to the delegation of authority, the DER will prepare a draft permit which will be included in the DER staff analysis and report. DER cannot issue the permit unless DER makes a preliminary determination that the proposed construction will comply with all applicable PSD regulations.

14. The County's application indicates that the proposed power plant will consume less than 3% of any applicable Class II PSD increment, as shown in the following table.

Pollutant	Averaging Period	Total Impact As a Percent of Class II Increment
Sulfur Dioxide (SO ₂)	Annual 24 hour	1.0 2.8

electrical power plant (resource recovery facility) near Fort Myers, in Lee County, Florida. Lee County's application now is pending before the Division of Administrative Hearings, the Florida Department of Environmental Regulation and other agencies, pursuant to the Florida Electrical Power Plant Siting Act, Chapter 403, Part II, Florida Statutes.

2. Lee County's proposed facility will be located on a site east of Fort Myers in central Lee County, Florida. The site is located on Buckingham Road and is approximately 2.5 miles east of the intersection of Interstate 75 and State Road 82. The facility will include a main burn (resource recovery waste-to-energy) facility that will burn municipal solid waste to produce electrical energy. The facility also will include a steam generator, electrical generator, waste unloading facilities, and cooling tower. The facility will burn municipal solid waste at an initial rate of 1,200 tons per day and will produce approximately 40 megawatts (MW) of electricity. The facility is designed so that it can be expanded in the future. It is necessary to construct 1800 tons per day and generate an ultimate site capacity of 60 MW of electricity. The project's associated line facilities will include an 118 kV transmission line which will connect the resource recovery facility with the Florida Power and Light Company's existing Buckingham substation.

3. The application is available for public inspection and copying at the following addresses:

State of Florida, Department of Environmental Regulation
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

State of Florida, Department of Environmental Regulation
South Florida District Office
2269 Bay Street
Fort Myers, Florida 33901-2896

Lee County/Fort Myers Public Library
2050 Lee Street
Fort Myers, Florida 33901

Lee County Utilities Department
1178 McGregor Boulevard
Fort Myers, Florida 33901

4. The Department of Environmental Regulation (DER) and other agencies are evaluating the application for the proposed power plant. The report and recommendations of the Florida Department of Environmental Regulation concerning this project will be available for inspection at the locations identified in paragraph no. 3, above, on or about August 1, 1991.

5. Certification of this power plant would allow construction and operation of a new source of air pollution which would consume an increment of air quality resources. The Department's review will result in an assessment of the prevention of significant deterioration (PSD) impacts and a determination of the best available control technology (BACT) necessary to control the emission of air pollutant from this source. The County has proposed to use good combustion practices, a dry scrubber, a filter fabric baghouse, and a selective noncatalytic reduction system as BACT. The County also will use a mercury control device to further reduce facility emissions.

6. Pursuant to Section 403.508, Florida Statutes, a certification hearing will be conducted by the Division of Administrative Hearings at the Sheraton Harbor Place, 2500 Edwards Drive, Fort Myers, Florida beginning on September 9, 1991, at 10 AM. The hearing will continue from day-to-day until completed. The Hearing Officer will receive comments and testimony from the parties, the public, and affected agencies of the certification hearing. The Hearing Officer will take written or oral testimony on the effects of the proposed electrical power plant or any other matter appropriate to the consideration of the site. Need for the facility has been predetermined by the Florida Public Service Commission in a separate hearing.

7. The Hearing Officer will accept comments from the public beginning at 6:30 PM in the evening or Tuesday, September 10, 1991. This portion of this certification hearing also will be conducted at the Sheraton Harbor Place, 2500 Edwards Drive, Fort Myers.

8. Sections 403.508(4) and (5), Florida Statutes, provide as follows:

(4) (a) Parties to the proceeding shall include:

1. The applicant.
2. The Public Service Commission.
3. The Department of Community Affairs.
4. The Department of Natural Resources.
5. The Game and Fresh Water Fish Commission.
6. The water management district.
7. The department.
8. The regional planning council.
9. The local government.

(b) Any party listed in paragraph (a) other than the department or the applicant may waive its right to participate in these proceedings. If such listed party fails to file a notice of its intent to be a party on or before the 90th day prior to the certification hearing, such party shall be deemed to have waived its right to be a party.

(c) Upon the filing with the hearing officer of a notice of intent to be a party at least 15 days prior to the date of the land use hearing, the following shall also be parties to the proceeding:

1. Any agency not listed in paragraph (a) as to matters within its jurisdiction.
2. Any domestic nonprofit corporation or association formed, in whole or in part, to promote conservation or natural beauty, to protect the environment, personal health, or other biological values; to preserve historical sites; to plan or orderly development of the area in which the proposed electrical power plant is to be located.
- (d) Notwithstanding paragraph (a), failure of an agency described in subparagraph (c), to file a notice of intent to be a party within the time provided herein shall constitute a waiver of the right of that agency to participate as a party in the proceeding.
- (e) Other parties may include any person, including those persons enumerated in paragraph (c) who have failed to timely file a notice of intent to be a party, whose substantial interests are affected and being determined by the proceeding and who timely file a motion to intervene pursuant to chapter 120 and applicable rules. Intervention conditions as he may prescribe any time prior to 30 days before the commencement of the certification hearing.
- (f) Any agency, including those whose properties or works are being affected pursuant to s. 403.509(4), shall be made a party upon the request of the department or the applicant.

9. Those wishing to intervene in these proceedings should be represented by an attorney or other person who can be determined to be qualified to appear in administrative proceedings pursuant to Chapter 120, Florida Statutes, or Chapter 17-103.020, Florida Administrative Code.

10. If any party intends to use written direct testimony at the certification hearing, the written testimony must be made available for public inspection at the locations identified in paragraph no. 3, above, at least five days before the hearing.

11. Written comments, notices or petitions filed prior to the hearing may be sent to the Hearing Officer, Ms. Diana Kiesling, at the Division of Administrative Hearings, 230 Apalachee Parkway, Desoto Building, Tallahassee, Florida 32399. All submittals should refer to DOAH Case No. 90-342EPP. Copies of such submittals should be forwarded by U.S. Mail to all the other parties to this proceeding, including the Department of Environmental Regulation and Lee County. For a list of parties and further information concerning the power plant siting process, contact Mr. Hamilton S. Owen, Jr., of the Florida Department of Environmental Regulation, 2600 Blair Stone Road, Twin Towers Office Building, Tallahassee, Florida 32399-2400 or call 904/488-1344.

P.O. #122879

12. Lee County's application for the proposed electrical power plant also is subject to U.S. Environmental Protection Agency (EPA) regulations for the Prevention of Significant Deterioration (PSD) of air quality, which are codified at 40 CFR 52.21, and construction may begin on a source of air pollution that is subject to PSD review. The permit can be issued only if the new construction has been determined by DER to comply with the requirements of the PSD regulations. These PSD regulations include a restriction on incremental increases in air quality due to the new source. The PSD regulations also require the application of Best Available Control Technology (BACT).

13. The DER has been granted a delegation of authority from EPA for the purposes of conducting the PSD review of this and other sources. Acting pursuant to the delegation of authority, the DER will prepare a draft permit which will be included in the DER staff analysis and report. DER cannot issue the permit unless DER makes a preliminary determination that the proposed construction will comply with all applicable PSD regulations.

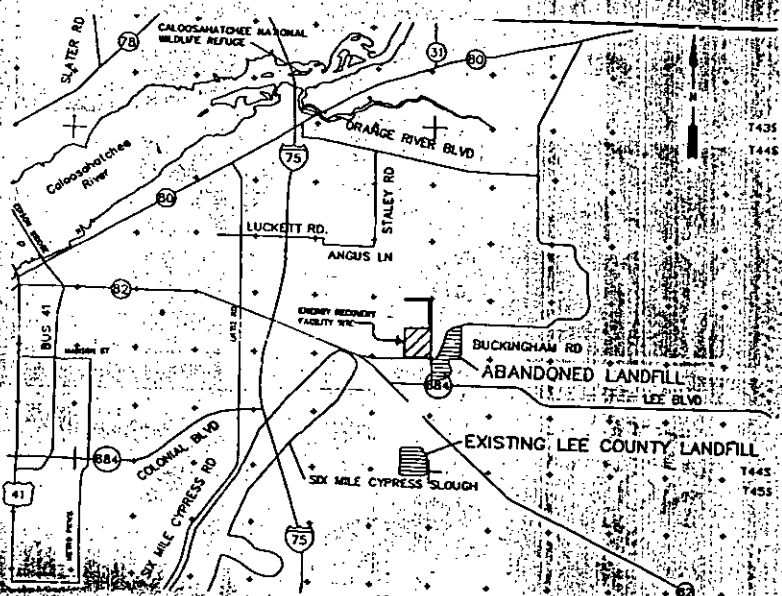
14. The County's application indicates that the proposed power plant will consume less than 3% of any applicable Class II PSD increment, as shown in the following table.

Pollutant	Averaging Period	Total Impact As a Percent of Class II Increment
Sulfur Dioxide (SO ₂)	Annual	1.0
	24-hour	2.8
Total Suspended Particulate Matter (TSP)	Annual	0.13
	24-hour	0.9
Particulate Matter (PM ₁₀)	Annual	0.14
	24-hour	0.7
Nitrogen Dioxide (NO ₂)	Annual	1.4

15. The proposed facility will be located approximately 88 kilometers from the nearest Class I area (the Everglades National Park). The application indicates that the proposed facility's maximum impact or the nearest Class I area will be less than 4% of the applicable Class I increments, as shown on the following table.

Pollutant	Averaging Time	Impact as % of PSD Class I Increment
SO ₂	Annual	0.3
	24-hour	2.4
TSP	Annual	0.02
	24-hour	0.2
PM ₁₀	Annual	0.02
	24-hour	0.2
NO ₂	Annual	0.5

16. Lee County's application states that the construction and operation of the proposed facility will not cause a violation of any ambient air quality standard nor will it cause an exceedance of any PSD increment and, therefore, the DER should recommend approval of this project. Persons wishing to comment on this issue may do so at the certification hearing or by submitting written comments to the Hearing Officer and DER within 30 days after DER's report is received in the DER office in Fort Myers, Florida. As previously noted, the DER report and recommendations should be available for inspection at the DER office in Fort Myers and at the other locations identified in paragraph number 3, above, on or about August 1, 1991.



FDER FORM 17-1.202(1)

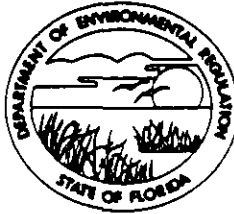
APPLICATION TO OPERATE/CONSTRUCT

AIR POLLUTION SOURCES

STOKER WATERWALL DESIGN

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION

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



BOB MARTINEZ
GOVERNOR
DALE TWACHTMANN
SECRETARY

APPLICATION TO OPERATE/CONSTRUCT AIR POLLUTION SOURCES

SOURCE TYPE: Energy Recovery Facility (ERF) New¹ Existing¹

APPLICATION TYPE: Construction Operation Modification

COMPANY NAME: Lee County COUNTY: Lee

Identify the specific emission point source(s) addressed in this application (i.e. Line
Kiln No. 4 with Venturi Scrubber; Peaking Unit No. 2, Gas Fired) See footnote below**

SOURCE LOCATION: Street Buckingham Road & State Route 82 City Lee County

UTM: East 424 Km North 2946 Km

Latitude 26 ° 37 ' 54 "N Longitude 81 ° 45 ' 41 "W

APPLICANT NAME AND TITLE: Lee County

APPLICANT ADDRESS: 2178 McGregor Blvd., Ft. Myers, FL 33902

SECTION I: STATEMENTS BY APPLICANT AND ENGINEER

A. APPLICANT

I am the undersigned owner or authorized representative* of Lee County

I certify that the statements made in this application for an operate/construct permit are true, correct and complete to the best of my knowledge and belief. Further, I agree to maintain and operate the pollution control source and pollution control facilities in such a manner as to comply with the provision of Chapter 403, Florida Statutes, and all the rules and regulations of the department and revisions thereof. I also understand that a permit, if granted by the department, will be non-transferable and I will promptly notify the department upon sale or legal transfer of the permitted establishment.

*Attach letter of authorization

Signed: George E. Reilly
George E. Reilly, P.E., Director
Dept. of Lee County Utilities

Name and Title (Please Type)

Date: 6/27/91 Telephone No. (813) 335-2276

B. PROFESSIONAL ENGINEER REGISTERED IN FLORIDA (where required by Chapter 471, F.S.)

This is to certify that the engineering features of this pollution control project have been designed/examined by me and found to be in conformity with modern engineering principles applicable to the treatment and disposal of pollutants characterized in the permit application. There is reasonable assurance, in my professional judgment, that

¹ See Florida Administrative Code Rule 17-2.100(57) and (104)

** Mass-burn stoker waterwall combustor with SNCR, reagent injection, dry scrubber and fabric filter.

the pollution control facilities, when properly maintained and operated, will discharge an effluent that complies with all applicable statutes of the State of Florida and the rules and regulations of the department. It is also agreed that the undersigned will furnish, if authorized by the owner, the applicant a set of instructions for the proper maintenance and operation of the pollution control facilities and, if applicable, pollution sources.

Signed Michael J. Ihnat
Michael J. Ihnat, P.E. 6/28/91
Name (Please Type)
Camp Dresser & McKee Inc.
Company Name (Please Type)
8191 College Parkway, Suite 206
Fort Myers, Florida
Mailing Address (Please Type)

Florida Registration No. 39126 Date: 6/28/91 Telephone No. (813) 433-0046

SECTION II: GENERAL PROJECT INFORMATION

A. Describe the nature and extent of the project. Refer to pollution control equipment, and expected improvements in source performance as a result of installation. State whether the project will result in full compliance. Attach additional sheet if necessary.

See Attachment I

B. Schedule of project covered in this application (Construction Permit Application Only)
Start of Construction March 1992 Completion of Construction June 1994

C. Costs of pollution control system(s): (Note: Show breakdown of estimated costs only for individual components/units of the project serving pollution control purposes. Information on actual costs shall be furnished with the application for operation permit.)

See PSD Permit Application Section 4.0

D. Indicate any previous DER permits, orders and notices associated with the emission point, including permit issuance and expiration dates.

Not Applicable

ATTACHMENT I

The Lee County RRF will combust 1,800 tons per day of municipal solid waste in three (3) mass-burn stoker waterwall combustors and generate steam for electrical production. Each of the Facility's combustors will use a SNCR system to reduce nitrogen oxides, innovative reagent injection which may further reduce mercury emissions, a dry scrubber to remove acid gases and a baghouse to remove particulate matter. The proposed emission limits will meet existing state and federal standards and satisfy BACT requirements for all applicable pollutants.

E. Requested permitted equipment operating time: hrs/day 24 ; days/wk 7 ; wks/yr 52 ;
if power plant, hrs/yr 8760 ; if seasonal, describe: _____

F. If this is a new source or major modification, answer the following questions.
(Yes or No)

- 1. Is this source in a non-attainment area for a particular pollutant? No
 - a. If yes, has "offset" been applied? _____
 - b. If yes, has "Lowest Achievable Emission Rate" been applied? _____
 - c. If yes, list non-attainment pollutants. _____
- 2. Does best available control technology (BACT) apply to this source?
If yes, see Section VI. Yes
- 3. Does the State "Prevention of Significant Deterioration" (PSD)
requirement apply to this source? If yes, see Sections VI and VII. Yes
- 4. Do "Standards of Performance for New Stationary Sources" (NSPS)
apply to this source? Yes
- 5. Do "National Emission Standards for Hazardous Air Pollutants"
(NESHAP) apply to this source? No

- H. Do "Reasonably Available Control Technology" (RACT) requirements apply
to this source? No
 - a. If yes, for what pollutants? _____
 - b. If yes, in addition to the information required in this form,
any information requested in Rule 17-2.650 must be submitted.

Attach all supportive information related to any answer of "Yes". Attach any justifi-
cation for any answer of "No" that might be considered questionable.

SECTION III: AIR POLLUTION SOURCES & CONTROL DEVICES (Other than Incinerators)

A. Raw Materials and Chemicals Used in your Process, if applicable:

Description	Contaminants		Approximate Utilization Rate - lbs/hr	Relate to Flow Diagram
	Type	% Wt		
Lime Silo	Pebble Lime		2,300	See Section 4.0 of the PSD Permit Application
Ash Handling Bldg.	Ash Residue		41,600	

B. Process Rate, if applicable: (See Section V, Item 1)

1. Total Process Input Rate (lbs/hr): _____

2. Product Weight (lbs/hr): _____

C. Airborne Contaminants Emitted: (Information in this table must be submitted for each emission point, use additional sheets as necessary)

Name of Contaminant	Emission ¹		Allowed Emission ² Rate per Rule 17-2	Allowable ³ Emission lbs/hr	Potential ⁴ Emission		Relate to Flow Diagram
	Maximum lbs/hr	Actual T/yr			lbs/yr	T/yr	
Pebble Lime	0.006	0.027					See Section 4.0 of PSD Permit Application
Ash Residue*	1.2	5.23					
	* Ash residue wetted to 30 percent moisture to suppress dust formation						

¹See Section V, Item 2.

²Reference applicable emission standards and units (e.g. Rule 17-2.600(5)(b)2. Table II, E. (1) - 0.1 pounds per million BTU heat input)

³Calculated from operating rate and applicable standard.

⁴Emission, if source operated without control (See Section V, Item 3).

D. Control Devices: (See Section V, Item 4)

Name and Type (Model & Serial No.)	Contaminant	Efficiency	Range of Particles Size Collected (in microns) (If applicable)	Basis for Efficiency (Section V Item 5)
Baghouse*	Pebble Lime			Manufacturer
Baghouse*	Ash Residue			Specification
	*Additional information to be provided by vendor			

E. Fuels

Type (Be Specific)	Consumption*		Maximum Heat Input (MMBTU/hr)
	avg/hr	max./hr	
Refuse*	150,000 lb/hr	165,000 lb/hr	825 MMBtu/hr
Propane Gas**	0.0045 MMcf/hr	0.139 MMcf/hr	360 MMBtu/hr
	* Facility Processing Totals		
	** Facility Totals - Used for Auxiliary Purposes		

*Units: Natural Gas--MMCF/hr; Fuel Oils--gallons/hr; Coal, wood, refuse, other--lbs/hr.

Fuel Analysis: (Refuse)

Percent Sulfur: 0.10 (wet basis) Percent Ash: 20.9 (wet basis)
 Density: N/A lbs/gal Typical Percent Nitrogen: 0.50 (wet basis)
 Heat Capacity: 5,000 BTU/lb N/A BTU/gal
 Other Fuel Contaminants (which may cause air pollution): _____
Chlorine 0.40 (wet basis) (See Ultimate Analysis in Section 3.0, attached)

F. If applicable, indicate the percent of fuel used for space heating.

Annual Average _____ Maximum _____

G. Indicate liquid or solid wastes generated and method of disposal.

Spent/Reacted lime and combustion ash which will be landfilled.

H. Emission Stack Geometry and Flow Characteristics (Provide data for each stack):

Stack Height: _____ ft. Stack Diameter: _____ ft.

Gas Flow Rate: _____ ACFM _____ DSCFM Gas Exit Temperature: _____ °F.

Water Vapor Content: _____ % Velocity: _____ FPS

SECTION IV: INCINERATOR INFORMATION

Type of Waste	Type 0 (Plastics)	Type I (Rubbish)	Type II (Refuse)	Type III (Garbage)	Type IV (Pathological)	Type V (Liq. & Gas By-prod.)	Type VI (Solid By-prod.)
Actual lb/hr Incinerated			150,000				
Uncontrolled (lbs/hr)			150,000				

Description of Waste Municipal Solid Waste

Total Weight Incinerated (lbs/hr) 150,000 Design Capacity (lbs/hr) 165,000 (110%)

Approximate Number of Hours of Operation per day 24 day/wk 7 wks/yr. 52

Manufacturer Vendor not yet selected

Date Constructed _____ Model No. _____

	Volume (ft) ³	Heat Release (BTU/hr)	Fuel		Temperature (°F)
			Type	BTU/hr	
Primary Chamber	Vendor Specific Information				
Secondary Chamber					

Stack Height: 275 ft. Stack Diameter: 74 in per flue⁽³⁾ Stack Temp. 239.9°F

Gas Flow Rate: 116943 per flue⁽³⁾ ACFM 72039 DSCFM* Velocity: 65 FPS

*If 50 or more tons per day design capacity, submit the emissions rate in grains per standard cubic foot dry gas corrected to 50% excess air.

Type of pollution control device: Cyclone Wet Scrubber Afterburner
 Other (specify) Selective Non-catalytic Reduction
 Dry Scrubber and Baghouse
 Carbon Injection

Brief description of operating characteristics of control devices: _____

See Attachment II

Ultimate disposal of any effluent other than that emitted from the stack (scrubber water, ash, etc.):

Ash residue will be sent to Lee/Hendry Counties' landfill

Wastewater effluent will be treated at the Facility to meet the City of Fort Myers industrial pretreatment standards.

NOTE: Items 2, 3, 4, 6, 7, 8, and 10 in Section V must be included where applicable.

SECTION V: SUPPLEMENTAL REQUIREMENTS

Please provide the following supplements where required for this application.

1. Total process input rate and product weight -- show derivation [Rule 17-2.100(127)]
2. To a construction application, attach basis of emission estimate (e.g., design calculations, design drawings, pertinent manufacturer's test data, etc.) and attach proposed methods (e.g., FR Part 60 Methods 1, 2, 3, 4, 5) to show proof of compliance with applicable standards. To an operation application, attach test results or methods used to show proof of compliance. Information provided when applying for an operation permit from a construction permit shall be indicative of the time at which the test was made.
3. Attach basis of potential discharge (e.g., emission factor, that is, AP42 test).
4. With construction permit application, include design details for all air pollution control systems (e.g., for baghouse include cloth to air ratio; for scrubber include cross-section sketch, design pressure drop, etc.)
5. With construction permit application, attach derivation of control device(s) efficiency. Include test or design data. Items 2, 3 and 5 should be consistent: actual emissions = potential (1-efficiency).
6. An 8 1/2" x 11" flow diagram which will, without revealing trade secrets, identify the individual operations and/or processes. Indicate where raw materials enter, where solid and liquid waste exit, where gaseous emissions and/or airborne particles are evolved and where finished products are obtained.
7. An 8 1/2" x 11" plot plan showing the location of the establishment, and points of airborne emissions, in relation to the surrounding area, residences and other permanent structures and roadways (Example: Copy of relevant portion of USGS topographic map).
8. An 8 1/2" x 11" plot plan of facility showing the location of manufacturing processes and outlets for airborne emissions. Relate all flows to the flow diagram.

9. The appropriate application fee in accordance with Rule 17-4.05. The check should be made payable to the Department of Environmental Regulation.
10. With an application for operation permit, attach a Certificate of Completion of Construction indicating that the source was constructed as shown in the construction permit.

SECTION VI: BEST AVAILABLE CONTROL TECHNOLOGY

- A. Are standards of performance for new stationary sources pursuant to 40 C.F.R. Part 60 applicable to the source?

Yes No

Contaminant	Rate or Concentration
Particulate Matter	0.010 gr/dscf
Nitrogen Oxides	180 ppmv at 7% O ₂ , 24-hr
Dioxins/Furans (Total tetra-octa PCDD & PCDF)	30 ng/dscm at 7% O ₂
Hydrogen Chloride	95% removal or 25 ppmv at 7% O ₂ , 8-hr avg.
Sulfur Dioxide	80% removal or 30 ppmv at 7% O ₂ , 24-hr avg.

- B. Has EPA declared the best available control technology for this class of sources (if yes, attach copy)

Yes No

Contaminant	Rate or Concentration
See Section 4.0 of PSD Application	

- C. What emission levels do you propose as best available control technology?

Contaminant	Rate or Concentration
Carbon Monoxide, Nitrogen Oxides	See PSD Permit Application
Sulfur Dioxide, Volatile Organic Substances, Particulate, Matter, Lead Beryllium, Mercury, Fluorides and Sulfuric Acid Mist	Section 4.0 & Attachment A

- D. Describe the existing control and treatment technology (if any):

- | | |
|---------------------------|--------------------------|
| 1. Control Device/System: | 2. Operating Principles: |
| 3. Efficiency:* | 4. Capital Costs: |

*Explain method of determining

ATTACHMENT II

Each of the Facility's mass-burn stoker waterwall combustors shall have a dedicated selective non-catalytic reduction (SNCR) system, a dry scrubber, innovative reagent injection (which may further reduce mercury emissions), and a baghouse. The SNCR system shall reduce nitrogen oxides (NO_x) in the flue gas stream to elemental nitrogen (N_2) through the injection of ammonia (NH_3) in the boiler. A dry scrubber shall remove SO_2 and other acid gases from the flue gas stream through the injection of a lime slurry into a reaction vessel. The lime slurry reacts with the acid gases to form calcium based salts which are removed downstream by a baghouse. Reagent will be injected into the flue gas stream, which may adsorb volatilized mercury or compounds of mercury from the flue gas stream; the particles are removed downstream by a baghouse. Through physical filtration, the baghouse collects and removes particulate matter and calcium based salts from the flue gas that accumulate on the fabric filter media.

- 5. Useful Life:
- 7. Energy:
- 9. Emissions:

- 6. Operating Costs:
- 8. Maintenance Cost:

Contaminant	Rate or Concentration

10. Stack Parameters

- a. Height: ft. b. Diameter: ft.
- c. Flow Rate: ACFM d. Temperature: °F.
- e. Velocity: FPS

E. Describe the control and treatment technology available (As many types as applicable, use additional pages if necessary).

1. See Attachment III

- a. Control Device: b. Operating Principles:
- c. Efficiency:¹ d. Capital Cost:
- e. Useful Life: f. Operating Cost:
- g. Energy:² h. Maintenance Cost:
- i. Availability of construction materials and process chemicals:
- j. Applicability to manufacturing processes:
- k. Ability to construct with control device, install in available space, and operate within proposed levels:

2.

- a. Control Device: b. Operating Principles:
- c. Efficiency:¹ d. Capital Cost:
- e. Useful Life: f. Operating Cost:
- g. Energy:² h. Maintenance Cost:
- i. Availability of construction materials and process chemicals:

¹Explain method of determining efficiency.

²Energy to be reported in units of electrical power - KWH design rate.

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

3.

a. Control Device:

b. Operating Principles:

c. Efficiency:¹

d. Capital Cost:

e. Useful Life:

f. Operating Cost:

g. Energy:²

h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

4.

a. Control Device:

b. Operating Principles:

c. Efficiency:¹

d. Capital Costs:

e. Useful Life:

f. Operating Cost:

g. Energy:²

h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

F. Describe the control technology selected:

See Attachment IV

1. Control Device:

2. Efficiency:¹

3. Capital Cost:

4. Useful Life:

5. Operating Cost:

6. Energy:²

7. Maintenance Cost:

8. Manufacturer:

9. Other locations where employed on similar processes:

a. (1) Company:

(2) Mailing Address:

(3) City:

(4) State:

¹Explain method of determining efficiency.

²Energy to be reported in units of electrical power - KWH design rate.

ATTACHMENT III

1.
 - a. Control Device: Dry Scrubber
 - b. Operating Principles: Acid gas neutralization with lime slurry
 - c. Efficiency:
 - i) 95% HCl removal by weight or 25 ppm_{dv} @ 7% O₂, both over an 8-hour average.
 - ii) 80% SO₂ removal by weight or 30 ppm_{dv} @ 7% O₂, both over a 24-hour average.
 - d. Capital Cost: \$6,817,000 (includes bond burden)
 - e. Useful Life: 20 years
 - f. Operating Cost: \$1,455,300
 - g. Energy: \$2,358,750 kWh/yr
 - h. Maintenance Cost: \$80,600
 - i. Availability of Materials
 - Construction and Process
 - Chemicals: Readily Available
 - j. Applicability to Manufacturing Processes: Not Applicable
 - k. Ability to construct with control device, install in available space and operate within proposed levels: Site and design are adequate

2.
 - a. Control Device: Baghouse (also known as fabric filter)
 - b. Operating Principles: Fabric filtration and removal of particulate matter.
 - c. Efficiency: 0.010 gr/dscf @ 7% O₂
 - d. Capital Cost: See PSD Permit Application Section 4.0. Best demonstrated control technology applied with top down BACT level of control.
 - e. Useful Life: 20 years
 - f. Operating Cost: See above, 2d. Capital Cost
 - g. Energy: See above, 2d, Capital Cost
 - h. Maintenance Costs: See above, 2d, Capital Cost
 - i. Availability of Construction
 - Materials and Process
 - Chemicals: Readily Available
 - j. Applicability to Manufacturing Processes: Not Applicable
 - k. Ability to construct with control device, install available space, and operate within proposed levels: Site and design are adequate.

ATTACHMENT III (cont'd.)

3. a. Control Device: Electrostatic Precipitator (ESP)
b. Operating Principles: Dry collection by electrically charging particles on oppositely charged surfaces.
c. Efficiency: 0.010 gr/dscf @ 7% O₂
d. Capital Cost: See PSD Permit Application Section 4.0
e. Useful Life: 20 years
f. Operating Cost: See above, 3d. Capital Cost
g. Energy: See above, 3d, Capital Cost
h. Maintenance Costs: See above, 3d. Capital Cost
i. Availability of Construction
Materials and Process
Chemicals: Readily Available
j. Applicability to Manufacturing Processes: Not Applicable
k. Ability to construct with control device, install available space, and operate within proposed levels: Site and design are adequate.
4. a. Control Device: Selective Non-catalytic Reduction System
b. Operating Principles: Nitrogen oxide reduction to elemental nitrogen with ammonia or other nitrogen based compound
c. Efficiency: 45% NO_x removal
d. Capital Cost: See PSD Permit Application Section 4.0. Best demonstrated control technology applied with top down BACT level of control.
e. Useful Life: 20 years
f. Operating Cost: See above, 4d. Capital Cost
g. Energy: See above, 4d. Capital Cost
h. Maintenance Costs: See above, 4d. Capital Cost
i. Availability of Construction
Materials and Process
Chemicals: Readily Available
j. Applicability to Manufacturing Processes: Not Applicable
k. Ability to construct with control device, install available space, and operate within proposed levels: Site and design are adequate.

ATTACHMENT IV

1. a. Control Device: Dry Scrubber
b. Efficiency: i) 95% HCl removal by weight or 25 ppm_{dv} @ 7% O₂, both over an 8-hour average
ii) 80% SO₂ removal by weight or 30 ppm_{dv} @ 7% O₂, both over a 24-hour average
c. Capital Cost: \$6,817,000 (includes bond burden)
d. Useful Life: 20 years
e. Operating Cost: \$1,455,300
f. Energy: \$2,358,750 KWh/yr
g. Maintenance Cost: \$80,600
h. Manufacturer: Not yet selected
i. Other locations where employed on similar processes: Kent County
1500 Scribner Avenue N.W.
Grand Rapids, MI 49504
2. a. Control Device: Baghouse (also known as fabric filter)
b. Efficiency: 0.010 gr/dscf @ 7% O₂
c. Capital Cost: See PSD Permit Application Section 4.0. Best demonstrated control technology applied with top down BACT level of control.
d. Useful Life: 20 years
e. Operating Cost: See above, B.3, Capital Cost
f. Energy: See above, B.3, Capital Cost
g. Maintenance Cost: See above, B.3, Capital Cost
h. Manufacturer: Not yet selected
i. Other locations where employed on similar processes: Kent County
1500 Scribner Avenue N.W.
Grand Rapids, MI 49504
3. a. Control Device: Selective Non-catalytic Reduction System
b. Efficiency: 45% NO_x reduction
c. Capital Cost: See PSD Permit Application Section 4.0. Best demonstrated control technology applied with top down BACT level of control.

ATTACHMENT IV (cont'd.)

- d. Useful Life: 20 years
- e. Energy: See above, C.3, Capital Cost
- f. Energy: See above, C.3, Capital Cost
- g. Maintenance Cost: See above, C.3, Capital Cost
- h. Manufacturer: Not yet selected
- i. Other locations where employed
on similar processes:
 - Stanislaus County
 - P.O. Box 642
 - Modesto, CA 95353

 - SERRF
 - 333 W. Ocean Blvd.
 - Long Beach City Hall
 - Long Beach, CA 90802

(5) Environmental Manager:

(6) Telephone No.:

(7) Emissions:¹

Contaminant

Rate or Concentration

(8) Process Rate:¹

b. (1) Company:

(2) Mailing Address:

(3) City:

(4) State:

(5) Environmental Manager:

(6) Telephone No.:

(7) Emissions:¹

Contaminant

Rate or Concentration

(8) Process Rate:¹

10. Reason for selection and description of systems:

¹Applicant must provide this information when available. Should this information not be available, applicant must state the reason(s) why.

SECTION VII - PREVENTION OF SIGNIFICANT DETERIORATION

A. Company Monitored Data

1. _____ no. sites _____ TSP _____ () SO₂* _____ Wind spd/dir

Period of Monitoring _____ / _____ / _____ to _____ / _____ / _____
month day year month day year

Other data recorded _____

Attach all data or statistical summaries to this application.

*Specify bubbler (B) or continuous (C).

2. Instrumentation, Field and Laboratory

- a. Was instrumentation EPA referenced or its equivalent? Yes No
- b. Was instrumentation calibrated in accordance with Department procedures?
 Yes No Unknown

B. Meteorological Data Used for Air Quality Modeling

- 1. 5 Year(s) of data from 01 / 01 / 82 to 12 / 30 / 86
month day year month day year
- 2. Surface data obtained from (location) Ft. Myers (Page Field)
- 3. Upper air (mixing height) data obtained from (location) Tampa International Airport
- 4. Stability wind rose (STAR) data obtained from (location) Not Used

C. Computer Models Used

- 1. Industrial Source Complex (ISC) Version Modified? If yes, attach description.
Date 90346
- 2. VISCREEN Modified? If yes, attach description.
- 3. _____ Modified? If yes, attach description.
- 4. _____ Modified? If yes, attach description.

Attach copies of all final model runs showing input data, receptor locations, and principle output tables.

D. Applicants Maximum Allowable Emission Data

Pollutant	Emission Rate ***	
TSP	<u>1.83</u>	grams/sec
SO ²	<u>14.08</u>	grams/sec

E. Emission Data Used in Modeling

Attach list of emission sources. Emission data required is source name, description of point source (on NEDS point number), UTM coordinates, stack data, allowable emissions, and normal operating time.

F. Attach all other information supportive to the PSD review.

G. Discuss the social and economic impact of the selected technology versus other applicable technologies (i.e., jobs, payroll, production, taxes, energy, etc.). Include assessment of the environmental impact of the sources.

H. Attach scientific, engineering, and technical material, reports, publications, journals, and other competent relevant information describing the theory and application of the requested best available control technology.

*** Based on 100% of nominal capacity (1800 TPD) at 5,000 Btu/lb of reference waste.

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SECTION 1.0
SUMMARY OF THE PROJECT AND IMPACTS

1.0 SUMMARY OF THE PROJECT AND IMPACTS

1.1 INTRODUCTION

For several years, Lee County has been investigating alternative methods for long-term solid waste disposal. The County began its investigation in 1979, after the State of Florida enacted legislation (Chapter 403.706, Florida Statutes) requiring the County to submit solid waste resource recovery and management plans. The current solid waste disposal method of sanitary landfilling is becoming inadequate as a primary disposal method due to environmental and siting constraints. Land areas in the region which are suitable for landfills are quickly diminishing.

In accordance with Florida law, the County intends to reduce the amount of waste requiring disposal by 30 percent through an aggressive recycling program. However, this still leaves 70 percent of the waste which must be disposed of. Studies commissioned by Lee County since 1987 have concluded that a mass-burn energy recovery system is the most prudent long-term primary solid waste disposal method for the waste which remains after recycling.

Lee and Hendry Counties have entered into an agreement that provides for the use of an integrated waste management system. The system will consist of an aggressive recycling program, the energy recovery facility (the "Facility") described in this document, and a new regional landfill to be constructed in Hendry County. These facilities will serve the solid waste disposal needs of both Lee and Hendry counties. The sanitary landfill/ashfill in Hendry County and the recycling program will be permitted separately from the energy recovery facility. The power produced by the combustion of refuse will be sold to the Florida Power & Light Company (FP&L). Revenues from the sale of this energy will help offset the cost of owning and operating the Facility.

A site selection report was completed on February 6, 1990 which evaluated a number of potential sites for the development of the Facility. The Board

of County Commissioners ultimately chose a site on Buckingham Road, off State Route 82, as the location for the Lee County Energy Recovery Facility (ERF). The general location of this site is shown in Figure 1-1.

1.2 FACILITY DESCRIPTION

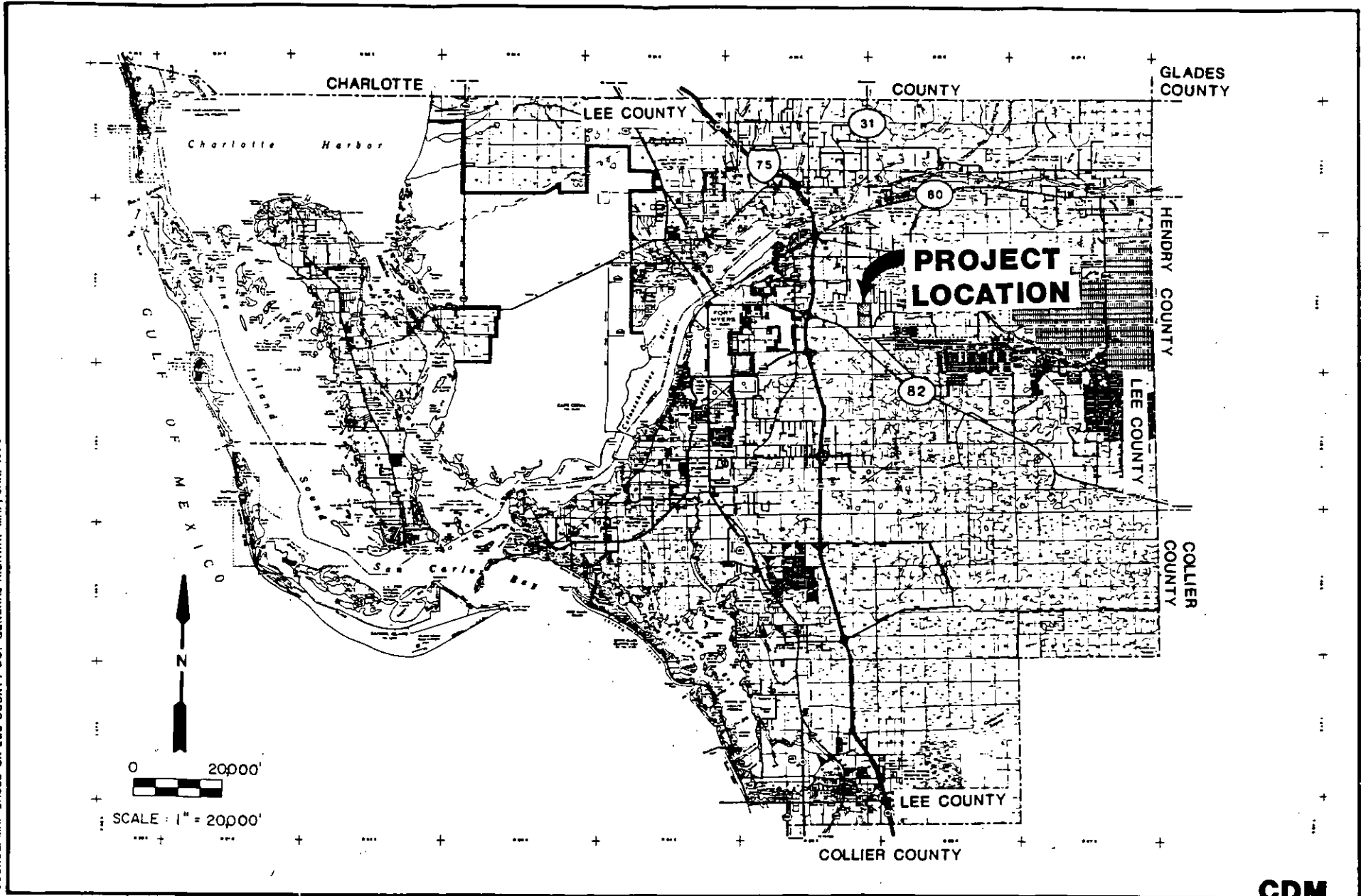
After evaluating several technologies, the County has concluded that an energy recovery facility incorporating a mass-burn technology and operated by a full-service vendor under contract to the County would best fit its present and foreseeable needs. The energy recovery facility is anticipated to have a nameplate generating capacity of approximately 30 megawatts (MW), using 1,200 tons per day (tpd) of municipal solid waste (MSW) as fuel. However, certification for an ultimate site capacity of about 45 MW, capable of processing 1,800 tpd of MSW, is being sought in anticipation of future solid waste disposal requirements. The energy produced would be used to satisfy internal power demands, with the surplus being sold to an electric utility.

When determining the appropriate size of the Facility, the County assumed that it would exceed the state recycling goal of 30 percent by 1994. The Facility is sized to handle the waste that will remain after this higher percentage is removed for recycling.

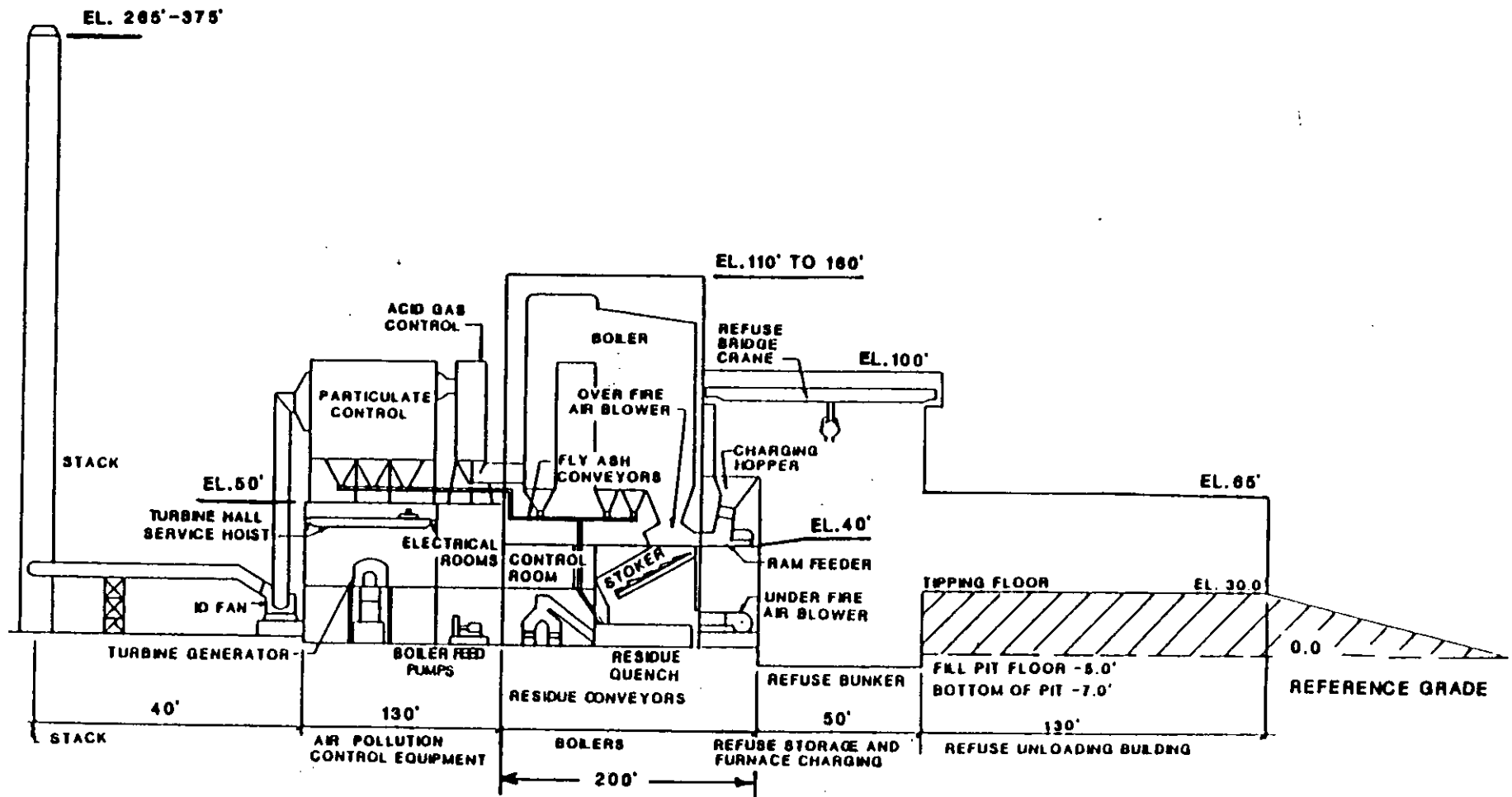
Because the proposed Facility will use mass-burn technology, there will be no complex preprocessing of wastes at the Facility prior to combustion. Sludge from wastewater treatment plants and any materials, such as construction waste, containing asbestos or other potentially hazardous materials, will not be accepted at the Facility. Inadvertently delivered oversized items will be separated from the incoming refuse by an overhead crane.

A conceptual schematic diagram of the Facility is presented in Figure 1-2. The figure shows a stoker waterwall combustor design, which uses a fixed combustion chamber, in which the waste is combusted as

SOURCE: MAP BASED ON LEE COUNTY DOT GENERAL HIGHWAY MAP, JAN. 1976



General Location Map - Lee County Energy Recovery Facility



NOTE

O.O REFERENCE GRADE IS 20 TO 25 FEET ABOVE MSL. ALL DIMENSIONS ARE APPROXIMATE.
 NOT TO SCALE.

FIGURE 1-2

it moves over a stoker grate. The specific combustor design used at the Facility will depend on the vendor selected.

An 1,800-tpd facility based on a stoker waterwall design would consist of three 600-tpd combustor units. Each combustor unit would have its own flue with a pollution control system train. The total of three flues would be grouped together in a single stack shell.

Truck transport will be used to deliver municipal solid waste (MSW) to the Facility and to remove ash residue from the Facility. MSW would be dumped into the refuse bunker directly from packer trucks. All waste will be stored inside the fully enclosed building prior to combustion. No waste will be visible from the outside. The waste will be kept under negative air pressure by withdrawing combustion air from the storage pit area. As a result, fugitive dust and odors will be contained within the building, and drawn into the furnace, where they will be eliminated or removed from the air stream. The overhead cranes will mix MSW in the bunker and load the four or five charging hoppers as required. Each combustor train will be equipped with a dry scrubber and fabric filter (baghouse) for acid gas and particulate air emission control. Injection of reagent (to be specified by the selected vendor) may provide additional control of mercury emissions.

A dry scrubber is a flue gas chamber into which lime slurry is injected to react with acidic compounds in the flue gases. Pebble lime is mixed with water to form a lime slurry which is injected into the vessel through spray nozzles or a rotary atomizer. The water in the slurry evaporates, cooling the flue gases, while the lime reacts with SO_2 , HCl , and other acidic compounds. The salts formed by this reaction and any residual lime are collected in the particulate control device.

Injection of reagent into the flue gas stream to help control mercury emissions will be either before or after the dry scrubber. Mercury vapor which does not condense onto particulate matter can be adsorbed by the reagent, which is removed downstream by the particulate control device.

A fabric filter collects particulate matter by filtering flue gases through a fabric filter media. Multiple fabric filters are contained in a series of modular units which compose the total fabric filter system. Initial collection forms a thick porous cake of collected particulate on the filters. This cake then acts as the filter collection medium, with the fabric filter serving to support the particulate cake. As the cake builds, the pressure drop across the fabric filter also increases. Periodically, the cake is removed by reversing the air flow of each modular unit, blowing a pulse of compressed air through the filters, or shaking the filters, depending on the type of filter unit employed. The fabric filter for this Facility will be designed to achieve an emission limitation for particulate matter of 0.010 grains per dry standard cubic foot (gr/dscf) corrected to 7 percent O₂. The flue gas will be drawn through the fabric filter by an induced draft fan which will be located between the stack and the fabric filter.

Bottom ash from the furnace and fly ash from the fabric filters will be mixed prior to removal from the Facility. Ash will comprise approximately 10 percent of the volume and 25 percent of the weight of the MSW processed by the facility. The ash will be quenched with water prior to transport to a landfill in Hendry County. The ash handling area is fully enclosed. Emissions of particulate matter are not likely to be generated during the handling of the wet ash, but any such emissions will be controlled through a particulate control device before building air is vented to the atmosphere.

1.3 GOOD ENGINEERING PRACTICE STACK HEIGHT EVALUATION

The 1977 Clean Air Act Amendments sought to require that pollutant emission limitations were not affected by the stack height which exceeds good engineering practice (GEP) or by any other dispersion technique. The GEP stack height was that "height necessary to insure that emissions from the stack do not result in excessive concentrations of any air pollutant in the immediate vicinity of the source as a result of atmospheric downwash, eddies, and wakes which may be created by the source itself, nearby structures, or nearby terrain obstacles" (PL 95-11). The Act does not

restrict the actual height of any stack; it only limits the theoretical stack height used in determining a source's allowable emission rate for pollutants regulated under the Act.

The U.S. Environmental Protection Agency (EPA) promulgated regulations to implement Section 123 of the Clean Air Act on July 8, 1985 (50 FR 27892). The GEP stack height is the greater of 65 meters or the height calculated from:

$$H_g = H + 1.5L$$

where:

H_g = the maximum GEP stack height

H = the height of the structure

L = the lesser dimension (height or maximum projected width)
of the structure

This formula is applicable to any structure located within five times dimension "L," but not exceeding 0.8 km, of the proposed stack. The height and width of a structure is based on the frontal area of the structure projected onto a plane perpendicular to a line originating from the stack and following the direction of the wind. The stack height may be less than the maximum GEP height if excess concentrations do not result due to aerodynamic downwash and/or would not result in a violation of applicable ambient air quality standards.

The location of the proposed Facility on the site, shown in Figure 2-6 of Volume I of this application, is in a relatively flat rural environment; thus, only the furnace and boiler building is within the area of influence of the plume. This structure is anticipated to be a squat building, one for which the height is the lesser dimension in comparison with the width. The selected vendor will be required to construct a stack of GEP height. Therefore, of all the vendor designs under consideration, the one which would produce the shortest boiler building, and the shortest resulting GEP stack,

was selected for the dispersion modeling analysis. This represents a conservative scenario and will produce the greatest ground-level concentrations; thus, it will be the worst case assumed for dispersion modeling. Of the boiler building designs likely to be proposed, the shortest one is 110 feet tall. The GEP stack height equation, as applied to this Facility, is two and one-half times the building height. The GEP stack height for this building is calculated to be 275 feet. Because the stack height will be set equal to the GEP stack height, the effects of downwash do not need to be considered in predicting ground-level concentrations.

1.4 BOILER OPERATING CONDITIONS

The energy recovery facility will fire at design capacity when processing 1,800 tpd of 5,000 Btu/lb reference waste. This firing rate is based on the average higher heating value (HHV). The waste firing rate will be adjusted as the heat content of the waste changes. This variability occurs as the plant maintains the heat load to the boiler by providing a constant heat release in the combustor. When the HHV is low (higher moisture and ash fractions, lower combustibles fraction), more waste will be processed (up to 2,605 tpd at 110 percent of the design heat release). Likewise, when the HHV is high, less waste will be processed.

The boiler operating conditions selected for modeling were based on identifying minimum, maximum, and typical load conditions, as well as identifying high and low values of the HHV. These are shown in Section 6.4.

Auxiliary burners will be used primarily during start-up and shut-down to assure that furnace temperatures sufficient to achieve good combustion are maintained. The propane gas fired burners will also be used if combustion temperatures fall below a predetermined set point when firing refuse with a low heat content. Because combustion of propane gas results in the release of lower NO_x and CO on a pound per million Btu basis than the combustion of refuse, the operation of the auxiliary burner during start-up, shut-down, or operation for temperature maintenance would result in the release of pollutants no greater than when firing refuse alone.

1.5 AIR QUALITY IMPACT ASSESSMENT

An air quality impact assessment was conducted on pollutant emissions from the Lee County ERF. The Industrial Source Complex (ISC) dispersion model was used to predict the potential air quality impacts in accordance with the modeling protocol (dated May 9, 1990, and revised June 6, 1991) approved by the Florida Department of Environmental Regulation (DER). The refined dispersion modeling analysis was conducted using surface meteorological data from the Ft. Myers Airport (Page Field), and mixing height meteorological data from Tampa International Airport, both for the five-year period from 1982 to 1986. The Fort Myers/ Tampa data are the most representative data that are available of conditions at the Facility site. They were provided by Mr. Thomas Rogers of DER for use in this permit application.

Two worst-case operating conditions for the stoker waterwall design were selected on the basis of screening modeling (see Section 6.4) for the prediction of maximum air quality impacts:

- o 1,800-tpd throughput with a refuse heat content of 5,000 Btu/lb (design capacity, or 100 percent of design heat release) for long-term (annual average) periods; and
- o 1,650-tpd throughput with a refuse heat content of 6,000 Btu/lb for short-term (24 hours or less) periods. (This condition results in the minimum flue gas flow rate which was coupled with the maximum emission rates calculated at 110 percent of design heat release.)

A comparison was conducted of the maximum predicted ground-level concentrations and the background concentrations to the Florida and National Ambient Air Quality Standards. This comparison demonstrated that the Lee County ERF would not violate ambient air quality standards. In fact, maximum ground-level concentrations due to the Facility alone would be no more than 0.97 percent of any of the standards. When Facility concentrations are added to existing background pollutant concentrations, the resulting maximum concentration would be no more than 60 percent of any of the standards. A

comparison between the maximum air quality impacts to the PSD Class II increments demonstrates that the Lee County ERF would have an insignificant impact on Class II increment consumption, by consuming no more than 2.8 percent of any applicable increment.

The predicted pollutant ground-level concentrations are compared to PSD de minimis monitoring levels in Table 6-8. The highest predicted impacts are below the de minimis monitoring levels. Therefore, in accordance with 40 CFR 52.21(i)(8), the DER may exempt the Facility from pre-construction monitoring requirements. In light of the modeling results shown in Table 6-8, DER (December 5, 1990) concurred that pre-construction monitoring is not required.

An analysis was also conducted of Facility impacts at the nearest Class I (pristine) air quality area: the Everglades National Park, 92 kilometers to the southeast of the Facility. The results show that no more than 3.2 percent of any Class I increment would be consumed there, and that visibility (clarity of the air) at this area would not be impaired. A similar analysis was conducted for the Big Cypress National Preserve, which although not an officially designated Class I Area, is a sensitive area nearer to the site: about 61 kilometers to the southeast. The modeled results for this location show that the Facility would consume no more than 4.4 percent of any Class I increment, and would not impair visibility. A detailed discussion of air quality impacts from the Facility is provided in Section 6.0.

The proposed Lee County ERF maximum expected emission rates, based on results obtained from Best Available Control Technology (BACT) analyses are summarized in Table 1-1. The basis for these emission rates is described in Section 4.0, Emission Control Technology Evaluation, and in Attachment A of this Volume, Emission Factor Support Document.

TABLE 1-1

LEE COUNTY ENERGY RECOVERY FACILITY

SUMMARY OF PROPOSED MAXIMUM EXPECTED STACK EMISSION RATES BASED
ON RESULTS OBTAINED FROM BACT ANALYSES

Pollutant	Emission Rate and Associated Averaging Time*
Carbon Monoxide (CO)	(a) 100 ppm _{dv} @ 7% O ₂ , 4-hr (0.099 lb/MMBtu) (b) 400 ppm _{dv} @ 7% O ₂ , 1-hr (0.395 lb/MMBtu)
Nitrogen Oxides (NO _x)	(a) 180 ppm _{dv} @ 7% O ₂ , 24-hr (0.292 lb/MMBtu) (b) 220 ppm _{dv} @ 7% O ₂ , 1-hr (0.356 lb/MMBtu)
Sulfur Dioxide (SO ₂)	(a) 80% reduction by weight of uncontrolled SO ₂ emissions or 30 ppm _{dv} @ 7% O ₂ , both 24-hr (b) 66 ppm _{dv} @ 7% O ₂ , 24-hr (0.149 lb/MMBtu) (c) 82.5 ppm _{dv} @ 7% O ₂ , 3-hr (0.186 lb/MMBtu)
Particulate Matter (TSP or PM ₁₀)	0.010 gr/dscf @ 7% O ₂ (0.0194 lb/MMBtu)
VOC (non-methane HC)	37.3 ppm _{dv} @ 7% O ₂ , (0.0210 lb/MMBtu)
Lead (Pb)	6.0 x 10 ⁻⁴ lb/MMBtu
Beryllium (Be)	1.35 x 10 ⁻⁷ lb/MMBtu
Fluorides (as HF)	5 ppm _{dv} @ 7% O ₂ (0.0035 lb/MMBtu)
Mercury (Hg)	8.0 x 10 ⁻⁴ lb/MMBtu
Sulfuric Acid Mist (H ₂ SO ₄)	0.0358 lb/MMBtu
Hydrogen Chloride (HCl)	(a) 95% reduction by weight of uncontrolled HCL emissions or 25 ppm _{dv} @ 7% O ₂ , both 8-hr (b) 50 ppm _{dv} @ 7% O ₂ , 8-hr (0.0643 lb/MMBtu)

TABLE 1-1
(continued)

Pollutant	Emission Rate and Associated Averaging Time ^a
Arsenic (As)	9.1×10^{-6} lb/MMBtu
<u>Dioxins/Furans (Total tetra-octa PCDD & PCDF)</u>	<u>30 ng/dscm @ 7% O₂</u> (2.54×10^{-8} lb/MMBtu)

SOURCE: Camp Dresser & McKee Inc., 1991 (see Section 4.0 and Attachment A of this volume).

^aCompliance with these proposed emission rates is to be based on either CEM measurement data and/or compliance stack testing data, as appropriate for the given pollutant.

SECTION 2.0
REGULATORY REVIEW

2.0 REGULATORY REVIEW

2.1 APPLICABLE REGULATIONS

Air quality regulations promulgated by the U.S. EPA and the Florida Department of Environmental Regulation (DER) define ambient air quality standards and regulate the sources of air contaminants in order to achieve and maintain these ambient standards. The Lee County ERF will be subject to the following rules and regulations.

- o Prevention of Significant Deterioration (PSD)
- o New Source Performance Standards (NSPS)
- o National Emission Standards for Hazardous Air Pollutants (NESHAP)
- o Florida DER Rules (Chapter 17-2, Florida Administrative Code) governing air pollution
- o Federal Aviation Administration (FAA) Regulations governing stack height

In many cases, the Florida DER air pollution rules reflect the standards established by EPA. For those cases where the Florida rules represent a more restrictive requirement, the Florida regulation has been applied.

2.2 PREVENTION OF SIGNIFICANT DETERIORATION

In general, a PSD permit application must contain the following basic components.

- o A complete description of the nature and operation of the source.
- o A Best Available Control Technology (BACT) review and application.

- o An analysis of existing ambient air quality.
- o An impact assessment demonstrating that emissions from the new source will not cause a violation of ambient air quality standards or PSD increments.
- o An assessment of the source's impact on air quality-related values including soils, vegetation, and visibility.

2.2.1 SOURCE APPLICABILITY

The proposed Facility is a major stationary source subject to PSD review because: (1) it is a combustion facility that is capable of burning more than 250 tons per day (tpd) of waste, and (2) at least one (or more) of the PSD-regulated pollutants will be emitted at a rate that exceeds 100 tons per year (tpy). Emission rates for both PSD-regulated pollutants and additional non-regulated pollutants (i.e., metals and trace organic compounds such as toxic equivalent dioxin) were developed for the proposed Facility. The rationale for the selected pollutant emission factors is presented in Attachment A.

PSD requirements apply to new major sources or major modifications located in areas which have been designated attainment or unclassified for a particular pollutant. New major sources proposing to locate in nonattainment areas are also subject to DER's New Source Review requirements. Lee County has been designated as in attainment or unclassified for all PSD-regulated pollutants (see Section 5.1), so New Source Review would not apply.

2.2.2 POLLUTANT APPLICABILITY

Under the PSD program, if the potential annual emission rate exceeds EPA's PSD significant emission rates designated in 40 CFR Part 52.21, then a best available control technology (BACT) analysis and air quality modeling need to be conducted for each affected pollutant for the PSD permit application.

Table 2-1 compares projected annual Facility emission rates, presented in Section 3.0, with the corresponding EPA PSD significant emission rates, and identifies those pollutants for which BACT analyses must be performed. The detailed approaches and considerations for performing BACT analyses are presented in Section 4.0. As shown in Table 2-1, formal PSD analyses (including a BACT analysis) are required for nitrogen oxides, sulfur dioxide, carbon monoxide, particulate matter including PM_{10} , volatile organic compounds, lead, beryllium, mercury, fluorides, sulfuric acid mist, and arsenic.

The maximum annual emission rates presented in Table 2-1 were calculated assuming that each combustor operates 365 days per year at 100 percent load. This throughput would be equivalent to combusting 657,000 tpy (1,800 tpd) of MSW. This assumption is conservative, because the Facility is expected to have an annual availability factor of approximately 85 percent of its nameplate capacity due to scheduled and unscheduled downtime. In addition to BACT analyses for applicable PSD pollutants, an air quality modeling analysis, an assessment of existing background air quality levels, and additional impact analyses are included.

An air quality modeling analysis is performed to show that applicable Florida and National Ambient Air Quality Standards (FAAQS and NAAQS), and PSD increments, will be met. Table 6-8 (see Section 6.6) lists the NAAQS, which have been adopted by Florida, as well as the more stringent Florida standards for sulfur dioxide, and the PSD increments to be considered in this evaluation. Approaches employed and results obtained from the PSD modeling studies are presented in Section 6.0.

Section 7.0 presents the additional impact analysis required as part of the PSD review. An impact analysis is performed to ascertain the potential impact of modeled Facility emissions on soils, vegetation, and visibility.

The PSD regulations establish mandatory Class I, or pristine, areas in the United States. The regulations require that any major source proposing to locate near (generally accepted to be within 100 kilometers) a Class I Area have an assessment performed of the source's effect on visibility

TABLE 2-1

PSD POLLUTANT APPLICABILITY FOR THE LEE COUNTY
ENERGY RECOVERY FACILITY

PSD Pollutant	EPA Significant Emission Rates (tpy) ^a	Proposed Facility Emission Rate (tpy) ^b	Need for Formal PSD Analysis (X)
Carbon Monoxide	100	324	X
Nitrogen Oxides	40	959	X
Sulfur Dioxide	40	490	X
Particulate Matter (total)	25	64	X
Particulate Matter (PM ₁₀)	15	64	X
Ozone (as volatile organic compounds)	40	69	X
Lead	0.6	2.0	X
Asbestos	0.007	—*	
Beryllium	4.0x10 ⁻⁴	4.4x10 ⁻⁴	X
Mercury	0.1	2.6	X
Vinyl Chloride	1	—*	
Fluorides	3	11.5	X
Sulfuric Acid Mist	7	118	X
Hydrogen Sulfide (H ₂ S)	10	—*	
Total Reduced Sulfur (including H ₂ S)	10	—*	
Reduced Sulfur Compounds (including H ₂ S)	10	—*	
Hydrogen Chloride	NA ^c	212	
Arsenic	AER ^d	0.03	X
Total Dioxins and Furans ^c	NA ^c	8.3x10 ⁻⁵	
Benzene	AER ^d	—*	
Radionuclides	AER ^d	—*	
Radon 222	AER ^d	—*	

^a SOURCE: FAC 17.2, Part V, Table 500.2, or 40 CFR 52.21.

^b Emission rates (annual average basis) are based on 100 percent load and continuous unit availability using the expected maximum emission rates for appropriate averaging periods as discussed in Attachment A. The Facility is assumed to be firing at a rate of 7.5×10^{-8} Btu/hr, and burning 1,800 tpd of MSW with a reference waste higher heating value (HHV) of 5,000 Btu/lb, resulting in 657,000 tpy of MSW being combusted by the Facility.

^c Not applicable. These pollutants are not regulated under the PSD regulations, but are provided to DER for review. These pollutants have been included in the New Source Performance Standards for municipal waste combustors.

TABLE 2-1
(continued)

^d Any emission rate. These pollutants (benzene, radionuclides, arsenic, and radon 222) are regulated by the Clean Air Act under the NESHAPS program, and any emission rate is considered a significant emission rate. In September 1991, EPA plans to propose regulations to implement changes to the PSD/NSR program. According to a March 11, 1991 policy memo prepared by John Seitz, EPA's OAQPS Director, Section 112(b)(6) PSD/NSR analysis (includes the NESHAPS pollutants). However, pursuant to the 1986 North County remand decision, the BACT analysis should consider all pollutants, including Title III hazardous air pollutants for which national standards have been set (previously subject to PSD), in determining which control strategy is best.

* Emission rates for these pollutants are negligible because these emissions are not expected from an MSW combustion environment or are not considered to be part of an MSW stream (e.g., asbestos).

(clarity of the air) at the Class I Area, and on Class I increment consumption. The Everglades National Park, a designated Class I Area, is 92 kilometers from the Facility site. A visibility impacts analysis and Class I increment consumption demonstration for this and other sensitive areas is presented in Section 7.0.

2.3 NEW SOURCE PERFORMANCE STANDARDS

The Florida Administrative Code, Chapter 17-2, Part VI, incorporates the federal New Source Performance Standards (NSPS) by reference. EPA originally promulgated standards of performance for new municipal incinerators on December 23, 1971. These standards are contained in 40 CFR 60, Subpart E. On February 11, 1991, the U.S. EPA promulgated revised NSPS for new, modified, or reconstructed municipal waste combustors (56 FR 5488). The new NSPS (40 CFR 60, Subpart Ea) will become effective on August 12, 1991, and will affect those municipal waste combustors that commence construction or modification after December 20, 1989, and that have a unit with a capacity to combust at least 250 tpd. The Lee County Facility, with three units of 600 tpd each, will be governed by these NSPS. The NSPS contain requirements that the affected units use best demonstrated control technology, maintain good combustion practices, have certified operators, and meet the emissions standards shown in Table 2-2. The NSPS also set standards for stack testing and reporting.

On November 15, 1990, the Clean Air Act (CAA) Amendments of 1990 became law, and they included in Title III, Hazardous Air Pollutants, a new Section 129 that applies to a range of solid waste incinerators. The following CAA deadlines for EPA to promulgate air emission standards and other requirements were imposed in Section 129:

- solid waste incineration units with capacity to combust greater than 250 tpd of municipal solid waste (MSW) - by November 15, 1991.
- solid waste incineration units with capacity to combust equal to or less than 250 tpd of MSW, and units combusting hospital waste, medical waste, and infectious waste - by November 15, 1992.

TABLE 2-2

NEW SOURCE PERFORMANCE STANDARDS
FOR MUNICIPAL WASTE COMBUSTORS^a

Pollutant	<u>Emission Standard</u>	Basis
Particulate Matter	0.015 gr/dscf (@7% O ₂) 10% opacity (6-min. avg.)	Fabric filter
Hydrogen Chloride	95% reduction or 25 ppm _{dv} (@7% O ₂)	Spray dryer plus fabric filter
Sulfur Dioxide	80% reduction or 30 ppm _{dv} (@7% O ₂), <u>daily block geometric</u> average	Spray dryer plus fabric filter
Nitrogen Oxides	180 ppm _{dv} (@7% O ₂), <u>daily block arithmetic</u> average	Selective Non-catalytic Reduction (SNCR) and/or good combustion practice
Carbon monoxide	100 ppm _{dv} (@7% O ₂), 4-hour block average (stoker waterwall)	Good combustion practice
Total Dioxins and Furans	30 ng/dscm (@7% O ₂)	Good combustion practice, spray dryer plus fabric filter

SOURCE: 56 FR 5488, February 11, 1991.

^aThis is a summary of emissions standards for new facilities with unit capacity throughputs of more than 250 tons per day. There are also combustion parameters, operator certification, and stack test requirements.

- solid waste incinerator units combusting commercial or industrial waste - by November 15, 1993 (proposed rule); by November 15, 1994 (promulgated rule).
- a schedule for the promulgation of standards for all other possible categories of solid waste incineration units - by May 15, 1992.

Promulgated numerical emission standards are to reflect the maximum degree of reduction in emissions of air pollutants (particulate matter, sulfur dioxide, hydrogen chloride, nitrogen oxides, carbon monoxide, lead, cadmium, mercury, and dioxins and dibenzofurans) that EPA determines is achievable. Developed standards will apply to both new and existing units and be based, in part, on costs, energy requirements, and any non-air quality health and environmental impacts. EPA may distinguish among classes, types (including mass-burn, refuse derived fuel, modular, and other types of units), and sizes of units within a category in establishing such standards.

Other CAA provisions discuss "maximum achievable control technology" (MACT) and emission standards provisions contained in Section 301 of the same Title (which amends Section 112(d) for hazardous air pollutants), and will not apply to solid waste incineration units regulated under Section 129, except that EPA could set future emission standards based on residual risk considerations. Solid waste incineration units are also exempt from the CAA Title IV acid deposition control provisions; that is, they are not considered to be a "utility unit" provided that more than 80% of the unit's annual average fuel consumption on a Btu basis is from a fuel other than a fossil fuel. Finally, through November 15, 1991, ash from solid waste incineration units burning MSW will not be regulated by EPA, pursuant to Section 3001 of the Solid Waste Disposal Act.

The new NSPS for municipal waste combustors, which resulted from a consent decree, represent one of the first sets of rules issued under the new CAA. Section 129 of the CAA did not affect the adoption of these final standards and guidelines; however, the CAA requires that these standards and guidelines be modified by November 15, 1991, to be fully consistent with

Section 129. A number of additions to or revisions of the final promulgated NSPS may result; as a minimum, EPA is required to include the addition of numerical emission limits for mercury, cadmium, and lead.

On December 16, 1987, EPA promulgated revised standards of performance for industrial-commercial-institutional steam generating units. These standards are contained in 40 CFR 60, Subpart Db and set emissions limitations for particulate matter, as well as nitrogen oxide and sulfur dioxide, for steam generating units having heat input capacities greater than 100 million Btus per hour. The nominal heat input rating for the proposed Facility's combustors is approximately 250 million Btu/hr for a 600-tpd unit.

40 CFR Section 60.43b(c)(1) limits particulate matter emissions from each unit firing primarily municipal type solid waste (having an annual capacity factor for auxiliary fuels of 10 percent or less) to 0.1 pounds per million Btus of heat input. The Facility will comply with this limit by emitting no more than 0.0194 pounds per million Btu. Section 60.43b(e) limits the opacity of the exhaust gases from the units. Specifically, it prohibits the discharge of gases exhibiting greater than 20 percent opacity (six-minute average), except for one six-minute period per hour of not more than 27 percent opacity. The Facility will comply with this limit. The particulate matter and opacity standards apply at all times, except during periods of start-up, shut-down, or malfunction.

Section 60.44b(d) sets a nitrogen oxide emission standard of 0.2 pounds per million Btu of heat input which would be applicable to the Facility's combustors should the annual capacity factor for any unit firing propane exceed 10 percent. This standard applies at all times including periods of start-up, shut-down, or malfunction. The annual capacity factor is defined as the actual heat input to the unit resulting from the firing of the auxiliary fuels during a calendar year to the total potential heat input to the unit had it operated 8,760 hours per year at maximum steady state design heat input capacity. For the proposed Facility, propane gas will be used during start-up and shut-down situations, which are expected

to occur infrequently, and as a supplemental fuel on limited occasions when decreased combustor temperature conditions occur due to causes such as high moisture content wastes.

Based on the Facility design MSW feed rate of 1,800 tons per day, the Facility could fire up to 6.57×10^{11} Btu/year of auxiliary fuel before reaching 10 percent of the design heat input. Under no circumstances should the annual capacity factor for the propane gas fired in each of the Facility's combustors exceed 10 percent. Therefore, the 0.2 pounds per million Btu of heat input NO_x limitation will not be applicable. The Facility is expected to fire approximately 1.05×10^{10} Btu/yr of propane gas for start-up, shut-down, and maintaining proper furnace combustion temperature, or 0.16 percent of the annual design heat input.

40 CFR, Section 60.42b, sets forth emission limitations for sulfur dioxide. However, such limitations only apply to facilities which combust coal or oil, which is not the case for the proposed Facility.

2.4 NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS

Pursuant to Section 112 of the Clean Air Act, the U.S. EPA originally promulgated National Emission Standards for Hazardous Air Pollution (NESHAPS) on April 6, 1973. These standards are contained in 40 CFR 61. Some of the PSD pollutants identified in Table 2-1 are also regulated under NESHAPS. 40 CFR Subpart C, Section 61.32, contains a stationary source limitation for facilities firing beryllium-containing industrial waste of 10 grams over a 24-hour period, or a 30-day ambient air incremental impact of 0.01 ug/m^3 . Subpart E, Section 61.50 regulations for mercury do not apply since the proposed Facility will not combust or dry wastewater treatment plant sludge. Other NESHAPS, such as Subpart F for vinyl chloride, and Subparts N, O, and P for inorganic arsenic emissions, do not apply to municipal waste combustion facilities.

The proposed maximum expected beryllium emission factor of 1.35×10^{-6} pounds per ton of MSW fired results in a projected beryllium emission rate of 1.1 grams over a 24-hour period at design capacity, which is below the

applicable NESHAPS of 10 grams for 24 hours. In addition, as shown in Section 6.6, the proposed Facility maximum 24-hour average ground-level concentration of 2.29×10^{-6} ug/m³ is below the applicable 0.01 ug/m³, 30-day limitation. This standard also applies only to those combustion facilities which would accept beryllium-containing industrial waste, which will not be the case for the proposed Facility.

2.5 FEDERAL AVIATION ADMINISTRATION NOTIFICATION REQUIREMENTS

The Federal Aviation Administration (FAA) requires a Notice of Proposed Construction or Alteration for any proposed structure affecting navigable air space. Structures 200 feet or taller above ground are subject to the FAA notification requirements (CFR Sections 77.13, 77.23). The stack for the Lee County Facility will be at least 275 feet above ground elevation. The Notice of Proposed Construction or Alteration for the Facility was filed with the FAA on April 4, 1990. The FAA acted on the notice on September 10, 1990, and determined that the proposed Facility stack will not be a hazard to air navigation if it is 295 feet tall (or less), and marked and lighted in accordance with FAA Advisory Circular 70/7460-1, Chapters 3, 4, 5, and 9.

2.6 DER AIR POLLUTION CONTROL REGULATIONS

The Florida Administrative Code, Chapter 17-2, for the most part has incorporated federal regulations for each of the air programs previously discussed. Some slight differences which are applicable to this study do exist, however.

2.6.1 EMISSION LIMITATIONS

Florida sets a specific limitation that incinerators emit no objectionable odor. The proposed Facility will comply with this requirement by storing all waste prior to combustion inside the fully enclosed ERF. The building will be kept under negative pressure by withdrawing combustion air from the storage pit area. Odors from the refuse will be drawn into the furnace, and will be destroyed in the combustors, and/or vented through the stack.

The general opacity rule found in Florida Administrative Code (FAC) Rule 17-2.610 does not apply to a source for which either a specific particulate standard or a specific opacity standard is provided elsewhere in the rules. Because the energy recovery facility is subject to the specific particulate standard in FAC 17-2.600(1)(c), the general opacity standard does not apply, although it is anticipated that a specific opacity limit will be a condition of the permit.

2.6.2 AMBIENT AIR QUALITY STANDARDS

The Florida Ambient Air Quality Standards (FAAQS) contained in FAC 17-2.300 are more stringent than the National Ambient Air Quality Standards (NAAQS) for sulfur dioxide. The 24-hour average SO_2 FAAQS is 260 ug/m^3 (versus an NAAQS of 365 ug/m^3), and the annual average FAAQS is 60 ug/m^3 (versus 80 ug/m^3). The predicted maximum ground-level concentration due to the Facility would be less than one percent of either of these standards. When combined with existing background SO_2 concentrations, the maximum concentration would be no more than 22 percent of either standard (see Section 6.6).

2.6.3 PERMIT REQUIREMENTS

Site certification to construct and operate an air pollution source can be obtained from DER by the owner of a new energy recovery facility prior to construction, in accordance with FAC 17-2, Part V, and the Florida Electric Power Plant Siting Act, Section 403.501 et. seq., Florida Statutes. On October 27, 1986, EPA published a notice allowing DER to review applications and issue PSD construction permits to sources subject to the Power Plant Siting Act (PPSA) (51 FR 37972). This notice was effective as of July 1, 1986, when the Florida Legislature amended the PPSA to allow the concurrent issuance of PSD construction permits and site certification.

SECTION 3.0
AIR POLLUTANT EMISSIONS

3.0 AIR POLLUTANT EMISSIONS

3.1 INTRODUCTION

The combustion of refuse to produce energy in the boilers of energy recovery facilities results in the emission of some air pollutants as a consequence of several mechanisms and processes. Emissions generated in the system either depend upon the composition of the waste stream or reflect the character of the combustion process. The quantity of each compound released also depends on whether or not it is controlled through the use of air pollution control technology.

The discussion of emission factors and rates presented in this section focuses primarily on those pollutants of public health and regulatory concern. The review compares the proposed Facility's emission rates estimated by the applicant's consultant, CDM, with recently permitted energy recovery facilities in Florida. The emission estimates for the Lee County ERF are based on stack testing data from existing facilities, and are discussed in greater detail in Attachment A.

Emission of acid gases will be minimized through the use of a dry scrubber, while particulate matter will be controlled through the use of a fabric filter. Use of the dry scrubber-fabric filter will also serve to minimize emission of trace metals and organic compounds. Emission of mercury may be further reduced through the injection of a reagent, to be determined by the vendor. Composition-dependent emissions are minimized by controlling the composition of the waste stream (e.g., trace metals, SO₂, HCl, and HF). Identifiable contaminants, such as those found in asbestos-containing construction material and other hazardous waste, will not be accepted at the Facility.

Emissions such as carbon monoxide, oxides of nitrogen, hydrocarbons, and trace organic compounds are principally influenced by the combustion process. Combustion controls and post combustion flue gas NO_x control will be employed to minimize these emissions.

3.2 COMBUSTION OF MUNICIPAL SOLID WASTE

Waste composition is an important consideration in developing emission estimates, especially any unique or unusual aspects that would prohibit the use of emissions data obtained from similar operating facilities. The understanding of combustion chemistry is not always sufficient to allow the calculation of emission rates based on waste composition alone. Reference waste composition is typically used in combustion calculations to predict flue gas flow rates, which are used to calculate pollutant emission rates from empirical flue gas concentrations. Table 3-1 shows an ultimate analysis of refuse expected to be processed at the Lee County ERF.

MSW is a heterogeneous mixture of materials, and the physics and chemistry of its combustion is very complex. Broadly speaking, describing the combustion process involves chemical reaction kinetics and equilibrium, combustor fluid mechanics, and heat transfer rates. The applicant's consultant, CDM, has developed a computer model which performs mass-balance modeling of the combustion process for a "reference waste." Model results can then be used to estimate pollutant emission rates of the particulate and gaseous products of combustion. Emissions of products of combustion include nitrogen oxides, carbon monoxide, volatile organic compounds, hydrogen chloride, and sulfur dioxide. These are calculated using the output from this model. The model output is contained in Attachment D to this Volume. The results are corroborated with monitoring test data from comparable facilities.

Other compounds present in the flue gas are mainly a function of the amount of the compounds or elements present in the waste itself. This is true for trace metals and some trace organic compounds. For these emissions, reasonable upper limit emission factors are predicted on the basis of empirical data obtained from other similar sources.

3.3 COMPARISON TO OTHER PERMITTED FACILITIES

In order to determine the air quality impacts of the Lee County ERF, estimates of pollutant emissions must be established. The emission factors

TABLE 3-1
REFERENCE WASTE ULTIMATE ANALYSIS
(as received)

Waste Category	Nominal Percent by Weight (dry basis)
Total Inerts	26.36
Carbon	35.94
Hydrogen	4.79
Nitrogen	0.63
Sulfur	0.13
Chlorine	0.50
Oxygen	<u>31.65</u>
TOTAL	100.00
Moisture	20.70
Higher Heating Value (HHV)	5,000 Btu/lb

SOURCE: Camp Dresser McKee Inc., 1990.

(in terms of mass of pollutant per mass of refuse burned) contained in this section are based on numerous literature sources which were reviewed to obtain current emission data from representative energy recovery facilities that incorporate similar technology. "Criteria" pollutants are those for which National Ambient Air Quality Standards (NAAQS) have been established. "Non-criteria" pollutants do not have ambient air quality standards. Both "criteria" and "non-criteria" pollutants known to be emitted from energy recovery facilities burning refuse are quantified in this section.

Data have been compiled on emissions from several existing mass-burn MSW energy recovery facilities, and through research activities conducted by such agencies as EPA. These were reviewed to determine their applicability for use in predicting emission factors for various pollutants.

To compare the data presented in these studies and reports, it was necessary to convert all emission rates to uniform units of measure. Usually, data from stack testing activities appear as pollutant concentrations in the stack gas [e.g., parts per million (ppm)]. From the relationship of the flue gas flow rate to the waste burning rate, pounds of pollutant emitted per ton of refuse fired (lb/ton) can be calculated. If the Btu value of the refuse is known, it is also possible to describe pollutant emission rates as pounds of pollutant emitted per million Btu of heat input (lb/MMBtu).

The maximum expected emission factors (expressed as lb/ton of refuse and lb/MMBtu of heat input) for the Lee County ERF are shown in Table 3-2. The numbers presented in Table 3-2 are based in part on the available stack testing data from representative existing facilities. The selected emission factors represent reasonable upper bound estimates projected for the Lee County ERF. A more detailed description of the basis for the emission factors shown in Table 3-2 is presented in Attachment A.

The emission factors for the Lee County ERF are compared to other energy recovery facilities recently permitted in Florida in Table 3-3. Because the Lee County ERF will incorporate acid gas scrubbers and high efficiency fabric filters, the emissions of sulfur dioxide, sulfuric acid mist,

TABLE 3-2

CONTROLLED EMISSION FACTORS
FOR THE LEE COUNTY ENERGY RECOVERY FACILITY

Pollutant	Emission Factor	
	lb/ton Refuse	lb/MMBtu*
Particulate Matter	0.194	0.0194
Sulfur Dioxide (24-hour)	1.49	0.149
(3-hour)	1.86	0.186
Nitrogen Oxides (as NO ₂)		
(24-hour)	2.92	0.292
(1-hour)	3.56	0.356
Carbon Monoxide		
(4-hour)	0.99	0.099
(1-hour)	3.95	0.395
Non-Methane Hydrocarbons		
(1-hour)	0.211	0.0211
Lead	0.006	6.0x10 ⁻⁴
Sulfuric Acid Mist	0.358	0.0358
Hydrogen Chloride	0.643	0.0643
Fluoride (as HF)	0.035	0.0035
Beryllium	1.35x10 ⁻⁶	1.35x10 ⁻⁷
Mercury	8.0x10 ⁻³	8.0x10 ⁻⁴
Inorganic Arsenic	9.1x10 ⁻⁵	9.1x10 ⁻⁶
Asbestos	**	**
Vinyl Chloride	**	**
Total Reduced Sulfur	**	**
Reduced Sulfur Compounds	**	**
Benzene	**	**
Radionuclides	**	**
Dioxin (Total tetra-octa PCDD & PCDF)	2.54x10 ⁻⁷	2.54x10 ⁻⁸

SOURCE: Camp Dresser McKee Inc., 1991 (see Emission Factor Support Document, Attachment A of this volume).

*Based on a higher heating value of 5000 Btu/lb.

**Negligible emission rate, the numerical value of which is strongly dependent on the composition of the refuse incinerated. Lee County municipal solid waste is not expected to contain these compounds.

TABLE 3-3

COMPARISON OF ESTIMATED EMISSION FACTORS TO
PERMITTED VALUES AT OTHER REGIONAL MASS-BURN FACILITIES
(lb/ton of refuse)^a

Pollutants	Lee	Pasco ^b	Hillsborough ^c	North Broward ^d	Pinellas 3 ^e	Palm Beach ^f	Bay County ^b	South Broward ^g
Particulate matter	0.194	0.309	0.42	0.42	0.5	0.33	0.56	—
Sulfur dioxide (24-hr)	1.49	2.15	8.5	2.79*	4.08	7.7	2.8	2.79
Nitrogen oxides (24-hr)	2.92	6.17	6.4	5.04	6.1	4.0	2.2	5.0
Carbon monoxide (4-hr)	0.99	0.470	1.8	0.81	1.58	12.0	11.4	0.8
Hydrocarbons (1-hr)	0.211	0.202	0.2	0.12	0.3	0.20	0.232	—
Lead	0.006	0.0067	0.02	0.018	0.067	0.005	0.0036	0.018
Mercury	0.008	0.0077	0.004	0.0083	0.01	0.003	0.00171	—
Beryllium	1.35x10 ⁻⁶	1.30 x 10 ⁻⁶	1.31x10 ⁻⁵	8.4x10 ⁻⁶	1.3x10 ⁻⁶	9.0x10 ⁻⁶	48x10 ⁻⁶	—
Arsenic	9.1x10 ⁻⁵	8.74x10 ⁻⁵	—	—	—	—	—	—
Fluorides	0.035	0.077	0.06	0.16	0.1	0.04	—	—
Sulfuric acid mist	0.358	0.344	1.38	0.42	—	0.0004	—	—
Hydrogen chloride	0.643	1.22	4.0	—	4.0	3.5	—	—

^aNote that the heat content (Btu/lb) of the reference waste for each facility differs. Relative emission rates will change if converted to a lb/MMBtu basis.

^bPasco County, Power Plant Site Certification, PA 87-23, August 23, 1988.

^cHillsborough County, Power Plant Site Certification, PA 83-19 - Requested Modification May 1, 1987.

^dNorth Broward, Power Plant Site Certification, February 1, 1986.

^ePinellas County Unit 3, Power Plant Site Certification, PA 83-18 and an August 87, telephone conversation with the DER.

^fPalm Beach, Power Plant Site Certification, February 11, 1986, per telephone conversation with Barry Andrews DER, October 8, 1987.

^gSouth Broward, August 87 telephone conversation with the Florida DER.

*Based on a SO₂ upper limit of 0.31 lb/MMBtu and a refuse heat content of 4,500 Btu/lb, telephone conversation with Barry Andrews of DER, August 26, 1987.

hydrogen chloride, and particulate matter will be the same or lower than those for any other permitted energy recovery facility in Florida. The emission limits for sulfuric acid mist from the Pasco County, Broward County, and Hillsborough County facilities were deleted from the final permits for those facilities because EPA Region IV determined there was no reliable testing method for this pollutant. Because the Lee County ERF will be employing a dry scrubber which will effectively minimize sulfuric acid emissions, an emission limitation for sulfuric acid mist should not be required.

Minor short-term variations in emissions can be expected due to the heterogeneous nature of MSW. Therefore, the short-term emission rates presented in Table 3-4 and expressed in pounds per hour are based on the postulated worst-case operating condition at 110 percent of design heat release: 1,650 tpd at 6,000 Btu per pound waste. The annual emission rates presented in Table 3-4 are higher than the expected annual averages because the Facility will likely operate at less than 100 percent of its design annual capacity due to both scheduled and unscheduled down-time.

TABLE 3-4
ESTIMATED EMISSION RATES FOR THE LEE COUNTY ERF

Pollutant	Controlled Emission Rate	
	Tons/year ^a	Pounds/hour ^b
Particulate Matter (PM)	<u>64</u>	<u>16.0</u>
Sulfur Dioxide (SO ₂)	<u>490</u>	<u>123^c</u>
Nitrogen Dioxide (NO ₂)	<u>959</u>	<u>241^c</u>
Carbon Monoxide (CO)	<u>324</u>	<u>81.7^d</u>
Hydrocarbons (VOC)	<u>69</u>	<u>17.4</u>
Lead (Pb)	<u>2.0</u>	<u>0.495</u>
Arsenic (As)	<u>0.03</u>	<u>7.51x10⁻³</u>
Mercury (Hg)	<u>2.6</u>	<u>0.66</u>
Beryllium (Be)	<u>4.4x10⁻⁴</u>	<u>1.11x10⁻⁴</u>
Fluoride (as HF)	<u>11.5</u>	<u>2.89</u>
Sulfuric Acid (H ₂ SO ₄)	<u>118</u>	<u>29.5</u>
Hydrogen Chloride (HCl)	<u>212</u>	<u>53.0</u>
Dioxin (Total tetra-octa PCDD & PCDF)	<u>8.3x10⁻⁵</u>	<u>2.1x10⁻⁵</u>

SOURCE: Camp Dresser McKee Inc., 1991 (see Emission Factor Support Document, Attachment A of this volume, for basis for emission factors).

^aAnnual emission rate based on 100 percent of the design heat release rate firing 1,800 tpd of reference waste at 5,000 Btu/lb.

^bShort-term maximum emission rates based on 110 percent of design heat release rate (lb/MMBtu), 1,650 tpd throughput of 6,000 Btu/lb waste.

^cNO_x and SO₂ lb/hr emission rates based on Table 3-2 24-hour average value for lb/MMBtu.

^dCO lb/hr emission rate based on Table 3-2 4-hour average value for lb/MMBtu.

SECTION 4.0

EMISSION CONTROL TECHNOLOGY EVALUATION

4.0 EMISSION CONTROL TECHNOLOGY EVALUATION

4.1 DESCRIPTION OF BACT REVIEW

The proposed Facility is considered a major stationary source and is subject to PSD review since it will emit quantities above the PSD significant emission rate for particulate matter (PM), sulfur dioxide (SO₂), carbon monoxide (CO), nitrogen oxides (NO_x), lead (Pb), fluorides (as HF), mercury (Hg), beryllium (Be), volatile organic compounds (VOC), arsenic (As), and sulfuric acid mist (H₂SO₄). Consequently, the Facility will be subject to the Best Available Control Technology (BACT) evaluation for the pollutants which are subject to Prevention of Significant Deterioration (PSD) review.

In accordance with EPA's present policy of determining BACT (EPA, December 1987, May 1989, and March 1990), the analysis involves the identification of all applicable emission control alternatives for the pollutants subject to PSD review and any others requested by the governing regulatory agency. The alternatives are evaluated using a "top down" approach where they are ranked in descending order of effectiveness. A "top down" analysis first examines the most stringent or "top" alternative to determine if technical considerations or energy, environmental, or economic impacts justify a conclusion that it is not BACT. If the most stringent or "top" technology is determined not to be BACT using this methodology, then the next most stringent alternative is considered until BACT is determined. If no available control strategy is better than the one which the applicant has proposed, the applicant must still consider countervailing non-air environmental impacts (this point was noted in EPA's 1978 guidelines for determining BACT and 1980 PSD workshop handbook, and was reiterated in a May 1989 EPA draft document on "top down" BACT). Equipment with similar control capabilities do not require an evaluation. For those pollutants which have applicable air pollutant emission standards [e.g., New Source Performance Standards (NSPS)], BACT needs to be at least as stringent.

4.1.1 ENERGY IMPACTS

Where additional control equipment is required (such as scrubbers for SO₂ and HCl control), the cost of the energy consumed by the equipment is determined. If the best method to control a pollutant is proper furnace operation or the hardware design features of the Facility (such as controlling CO by properly distributing the over- and under-fire combustion air, and furnace temperature maintenance), then no additional costs for energy will be incurred to control the pollutant.

As in the economic analysis described below, energy impacts (million Btu or kwh/year) have been determined for applicable pollution control strategies to complete the BACT engineering and economic evaluations in the subsequent subsections. An incremental analysis would not apply in a "top down" BACT analysis if only a single control case has been considered to be the "top" level of control.

4.1.2 ECONOMIC IMPACTS

Where control equipment is required, the capital and annual operating costs, and the total and incremental control effectiveness (in dollars per ton of pollutant removed), were determined. If the best method to control a pollutant is proper furnace operation or the proper design of the Facility, then no additional capital or operating costs would be incurred to control the pollutant.

When performing a "top down" BACT economic analysis, the cost-effectiveness of each control strategy is determined by dividing the total annual cost of each strategy by the amount of emissions controlled by each strategy. Similarly, incremental cost-effectiveness is determined by dividing the incremental annual costs by the incremental emission reductions. This procedure was identified in EPA's 1980 PSD workshop handbook. The incremental cost-effectiveness value is a measure of comparing residual emissions of one control alternative to another control alternative with higher emission reduction potential. This value is especially important when evaluating the reasonableness of emission control costs. The analysis would not apply in a "top down" BACT analysis if the "top" or LATER control is selected.

4.1.3 ENVIRONMENTAL IMPACTS

The applicable environmental impacts for each control alternative were completed using the "top down" BACT approach. The potential environmental impacts considered in the BACT analysis concentrated on those not involving air quality since they are discussed separately as noted below. Both beneficial and adverse impacts were evaluated.

Using the proposed stack parameters, EPA-approved dispersion modeling was performed for the evaluated pollution control strategy. The impacts on air quality are determined by comparing the dispersion modeling results, the ground level concentrations (GLC), to the PSD allowable increments, National Ambient Air Quality Standards (NAAQS), and Florida Ambient Air Quality Standards (FAAQs) where applicable. A refined dispersion modeling analysis was performed for the proposed air pollution control system and is included in Section 6.0 of the permit application.

4.1.4 POLLUTANT APPLICABILITY

The initial Facility will have a throughput capacity of 1,200 tons per day (tpd); however, the site certification, BACT evaluation, and air quality analyses have been performed for an 1,800-tpd Facility in anticipation of future solid waste disposal requirements. The County currently has not contracted a full-service vendor to design the Facility, thus the required BACT analysis evaluates individual emission and throughput capacity differences of the combustor technology design.

The proposed Facility will have a mass-burn stoker waterwall combustor design. The Facility will have two combustors, each with a throughput capacity of 600 tpd, and ultimately an additional combustor of identical capacity (i.e., certification for 1,800 tpd).

On February 11, 1991, EPA published revised New Source Performance Standards (NSPS) for regulating air emissions from Municipal Waste Combustors (MWC) in the Federal Register (56 FR 5488). The intent of the standards is to require new MWCs to control emissions to the level achievable by applying the best demonstrated system. Pollutants regulated

under the proposed standards include: (1) MWC organics which impose a limit for dioxin/furan and CO emissions; (2) MWC trace metals which impose a limit for PM and opacity; (3) MWC acid gases which impose a limit for HCl and SO₂; and (4) Nitrogen Oxides (NO_x). The control level required for these pollutants is differentiated in the proposed rule by the size of the MWC. More stringent control requirements exist for those MWC plants that combust more than 250 tpd of refuse. The emissions limits are described in Section 2.3.

The PSD regulations state, in 40 CFR Part 52.21, that any major source must perform a formal BACT analysis for each PSD pollutant emitted in quantities greater than the PSD significant emission rates. The PSD significant emission rates and the total projected emissions from the Facility are shown in Table 4-1.

BACT requirements apply only to pollutants emitted in areas designated as in attainment with respect to the NAAQS/FAAQS. The proposed Facility site is located in an area that has been designated as being in attainment or unclassified for NO_x, PM, Pb, CO, SO₂, and ozone. PSD regulated pollutants without established NAAQS are also subject to a formal BACT analysis if emissions exceed certain thresholds. From Table 4-1, the following regulated pollutants, with or without established NAAQS, are projected to be emitted in quantities greater than the designated PSD significant emission rates: PM, NO_x, SO₂, CO, Pb, Be, Hg, HF, VOCs, As, and H₂SO₄.

As a result of an EPA ruling promulgated on July 1, 1987, a PSD significant emission level and NAAQS for PM was developed to include only those particles with an equivalent aerodynamic diameter of less than or equal to 10 microns (meter x 10⁻⁶) (PM₁₀). Thus, the BACT analysis for PM includes a dual review of PM₁₀ and total suspended particulates (TSP). As shown in Table 4-1, the Facility will emit PM emissions in excess of both the TSP significant emission level, 25 tpy, and the significant emission level for PM₁₀, 15 tpy. For purposes of this BACT analysis, it is conservatively assumed all emitted TSP is PM₁₀.

Control technology reviews using the BACT methodology were performed on several other pollutants specified either in the NSPS, under the PSD

TABLE 4-1

LEE COUNTY ENERGY RECOVERY FACILITY - 3 UNITS, 1800 TPD FACILITY
BACT SUMMARY
COMPARISON OF THE PROJECTED EMISSION RATES
TO PSD SIGNIFICANCE VALUES AND PROPOSED CONTROL TECHNOLOGY

Pollutant	PSD Significant Emission Rate (tpy)	Proposed BACT Emission Rate ^a (lbs/ton) (tpy)	Proposed Control Technology
Carbon Monoxide (CO) ^b (stoker waterwall)	100	0.987 <u>324</u>	Furnace Design & Proper Operation
Nitrogen Oxides (NO _x) ^c	40	<u>2.92</u> <u>959</u>	<u>Thermal DeNO_x</u>
Sulfur Dioxide (SO ₂) ^d	40	1.49 <u>490</u>	Dry Scrubber/Fabric Filter, least stringent 80% removal by weight or 30 ppmdv @ 7% O ₂ , both over a 24-hour block average
Particulate Matter (PM)	25 (TSP) 15 (PM ₁₀)	0.194 <u>64</u>	Fabric Filter - 0.010 gr/dscf @ 7% O ₂
Ozone (VOC) ^e (stoker waterwall)	40	0.21 <u>69</u>	Furnace Design & Proper Operation
Lead (Pb)	0.6	6.0x10 ⁻³ <u>2.0</u>	Dry Scrubber/Fabric Filter
Asbestos ^f	0.007	Nil <u>Nil</u>	
Beryllium (Be)	0.0004	1.35x10 ⁻⁶ <u>4.4x10⁻⁴</u>	Dry Scrubber/Fabric Filter
Fluorides (as HF) ^g	3	0.035 <u>11.5</u>	Dry Scrubber/Fabric Filter
Mercury (Hg)	0.1	8.0x10 ⁻³ <u>2.6</u>	Dry Scrubber/Fabric Filter
Vinyl Chloride ^f	1	Nil <u>Nil</u>	
Sulfuric Acid Mist (H ₂ SO ₄)	7	0.358 <u>118</u>	Dry Scrubber/Fabric Filter

TABLE 4-1
(continued)

Pollutant	PSD Significant Emission Rate (tpy)	Proposed BACT Emission Rate ^a (lbs/ton) (tpy)		Proposed Control Technology
Hydrogen Sulfide ^f	10	Nil	Nil	
Total Reduced Sulfur ^f	10	Nil	Nil	
Hydrogen Chloride (HCl) ^h	NA ⁱ	0.643	<u>212</u>	Dry Scrubber/Fabric Filter, least stringent of at least 95% removal by weight or 25 ppmdv @ 7% O ₂ ; both over an 8-hr average
Arsenic (As)	AER ^j	9.1x10 ⁻⁵	<u>3.0x10⁻²</u>	Dry Scrubber/Fabric Filter
Total tetra-octa PCDD & PCDF	NA ⁱ	<u>2.54x10⁻⁷</u>	<u>8.3x10⁻⁵</u>	Furnace Design, Proper Operation, Dry Scrubber and Fabric Filter
Benzene ^f	AER ^j	Nil	Nil	
Radionuclides ^f	AER ^j	Nil	Nil	
Radon 222 ^f	AER ^j	Nil	Nil	
MWC Emissions	___ ^k	___ ^k	___ ^k	Dry Scrubber/Fabric Filter

^a Assumes 100 percent annual facility availability at the design capacity of 1800 tpd; however, the accepted industry standard for on-line availability of an energy recovery facility is 85 percent. The tpy emission rates have been rounded off.

^b The mass-burn stoker waterwall combustor design is the basis of this CO emission rate. The BACT tpy emission rate is based on 100 ppmdv @ 7% O₂, 4-hr block average, as required by the NSPS, which differentiates among combustor design with a 400 ppmdv @ 7% O₂, maximum 1-hr average allowance.

^c The mass-burn stoker waterwall combustor design is the basis of this NO_x emission rate. The BACT tpy emission rate is based on 180 ppmdv @ 7% O₂ over a 24-hr average, as required by the NSPS, with a 220 ppmdv @ 7% O₂, maximum 1-hr average allowance.

TABLE 4-1
(continued)

- ^d The proposed BACT tpy emission rate is based on 66 ppm_{dv} @ 7% O₂ over a 24-hr average from a 330 ppm_{dv} @ 7% O₂ scrubber inlet SO₂ concentration with 80% removal; there is a 82.5 ppm_{dv} @ 7% O₂ maximum 3-hr average from 330 ppm_{dv} @ 7% O₂ scrubber inlet SO₂ concentration with 75% removal allowance.
- ^e The mass-burn stoker waterwall combustor is the basis of this VOC emission rate expressed as non-methane hydrocarbons. The BACT tpy emission rate is based on 37.3 ppm_{dv} at 7% O₂ hourly average concentration.
- ^f A negligible emission rate was assigned to these pollutants since they are not typically found in the flue gas of refuse combustors or are not characteristic of a refuse waste stream. Representative stack test data are not available to support their presence in the flue gas of MWCs.
- ^g The BACT tpy emission rate for HF is based on 5 ppm_{dv} at 7% O₂ hourly average concentration.
- ^h The proposed BACT tpy emission rate is based on 50 ppm_{dv} @ 7% O₂ over an 8-hr average from a 1,000 ppm_{dv} @ 7% O₂ scrubber inlet HCl concentration with 95% removal.
- ⁱ Not applicable. These pollutants are not regulated under the PSD regulations, but were provided for review to the Florida Department of Environmental Regulation (FDER). Recently, these pollutants were included in the NSPS with emission limitations assigned to organics (specifically PCDD and PCDF), metals via particulate control, and acid gases (specifically HCl and SO₂). The indicated total dioxins/furans (tetra-octa isomers) BACT emission rate is 30 ng/dscm at 7% O₂.
- ^j Any emission rate (AER). These pollutants (i.e., benzene, radionuclides, arsenic, radon 222) are regulated by the Clean Air Act under NESHAPS, and any emission is considered a significant emission rate. Footnote "f" also applies except for arsenic. In September 1991, EPA plans to propose regulations to implement changes to the PSD/NSR program. According to a March 11, 1991 policy memo prepared by John Seitz, EPA's QA/QPS Director, Section 112(b)(6) under Title III of the 1990 CAA Amendments excludes the 189 air toxics listed in the law from PSD/NSR analysis (includes the NESHAPS pollutants). However, pursuant to the 1986 North County remand decision, the BACT analysis should consider all pollutants, including Title III hazardous air pollutants for which national standards have been set (previously subject to PSD), in determining which control strategy is best.
- ^k The NSPS has established new PSD de minimis emission levels for the following MWC regulated pollutants: 40 tpy for MWC acid gases (HCl and SO₂), 15 tpy for MWC metals (measured as particulate matter), and 3.5 x 10⁻⁶ tpy for MWC organics (measured as total tetra through octa dioxins and furans). 40 CFR Part 51.166(b)(23)(i) and Part 52.21(b)(23)(i) have been amended accordingly.

regulations, and at the request of FDER, or by EPA Region IV. These pollutants include: hydrogen chloride (HCl), dioxins (PCDD), and furans (PCDF). The HCl review was based on the February 1991 NSPS.

Table 4-1 also lists pollutants, regulated by the Clean Air Act, which have been assigned a negligible emission rate based on the premise that they are typically not found in the flue gas of refuse combustors. Stack test data does not support their existence. These pollutants include: hydrogen sulfide, total reduced sulfur, vinyl chloride, asbestos, benzene, radionuclides, and radon 222. A control technology review using the BACT methodology was not completed for each of these pollutants.

4.1.5 MATERIAL SEPARATION

The projected emissions from the Facility, shown in Table 4-1, were determined from an emission database developed to include emission test data from existing refuse combustion facilities (refer to Emission Factor Support Document in Attachment A of this application) and, as such, the projected emissions do not reflect any potential emission reductions which may result from the recovery of recyclable material. Since there is a lack of current EPA or other reliable data on whether material separation would lead to a demonstrable and quantifiable reduction of pollutant emissions from the Facility, no adjustments or reductions in the projected emissions were made.

4.1.6 SELECTION AND EVALUATION OF ALTERNATIVE CONTROL STRATEGIES

The alternative control strategy analysis for economic impact is based on the following factors: capital equipment cost, bond burden, amortization, and operating and maintenance costs (i.e., power, labor, maintenance, and waste disposal). Capital and operating costs for the proposed air pollution control equipment have been supplied by established manufacturers. Facility design features that affect air pollutant emissions (e.g., carbon monoxide) but are primarily related to the furnace design and operational parameters (e.g., combustor design, excess air level) were not given a direct equipment and operation cost for the purposes of this analysis.

Relative to energy, the Facility would have a positive effect since it would produce steam for electric power generation. Because energy recovery from refuse represents a resource that would be wasted if not used, other sources of energy (e.g., coal, oil, or natural gas) may be conserved as a result of generating electricity from refuse. Based on the same electric power generation rate, the Facility would produce less SO₂ emissions than a coal-fired power plant.

Environmentally, the evaluation and ultimate selection of the air pollution control equipment is based on how effectively it controls certain regulated (criteria and non-criteria) PSD pollutants and non-regulated pollutants. Environmental benefits of the proposed Facility include the reduction of traditional landfilling practices that result in non-productive land use, fugitive dust emissions, odor emissions, toxic landfill off-gases, and potential groundwater pollution. The Facility will also reduce the need for acquiring additional landfill space.

4.2 REGULATORY PERMITTING BASIS FOR THE PROPOSED EMISSION CONTROL STRATEGIES

Lee County is proposing to equip the Facility with dry scrubbers and fabric filters (also referred to as baghouses), and maintain good combustion controls to achieve the BACT determined stack emission limitations.

Each air pollution control train will be equipped with instruments to continuously monitor and record O₂, CO, SO₂, NO_x, opacity, and temperature. The monitors will ensure compliance with the proposed NSPS pollutant emission requirements. The applicable averaging time requirements for each pollutant will be demonstrated by the continuous emission monitors (CEM). The NO_x and O₂ CEMs will be located downstream from the economizer, and the SO₂ CEMs will be located upstream of the dry scrubber and downstream of the fabric filter. Due to the inaccuracy of current HCl monitors, an SO₂ monitor shall be used as a surrogate. The opacity monitor shall be properly mounted and located to measure the light transmission characteristics of the exhaust gas. A thermocouple shall be installed at the PM control device inlet, in accordance with the NSPS.

Development of the proposed control strategies is based on previously selected BACTs for other permitted facilities and the proven capabilities of various control technologies. The EPA's BACT/LAER Clearinghouse (EPA 1984, 1987b, 1988, and 1989) contains a partial list of permitted refuse combustion facilities. The emission rates and control technologies listed in the Clearinghouse (chronologically presented in Attachment C) are those which appeared in the original application for a facility, and do not necessarily represent a system's continuous performance or what control equipment presently exists (other examples of recently permitted facilities not currently in the Clearinghouse are listed in Table 4-2).

Although the Clearinghouse is a principal source of information, it is not always complete. The submittal of information from state permitting agencies to the Clearinghouse is voluntary. The Clearinghouse may not contain information on recently permitted facilities or those permitted before it was established. In addition, not all of the facilities listed as refuse combustion facilities by the Clearinghouse would necessarily be similar to the proposed Facility. A listed facility may use another fuel such as refuse-derived fuel (RDF), employ different combustion or air pollution control technologies, or operate at much lower or higher firing rates. Certain pollutant emission rates vary inversely with one another, (e.g., NO_x and CO), hence automatic reliance on the Clearinghouse for the lowest permitted values for each pollutant could result in an erroneous pollutant composite being applied in a "top down" BACT analysis.

In the past, electrostatic precipitators (ESPs) have been installed on many refuse combustion facilities for particulate control due primarily to their ability to operate at the higher gas temperatures typical of facilities that did not include a dry scrubber. This early trend is supported by Table 4-3 which shows ESPs alone to be the means of controlling particulate emissions prior to 1980. In recent years, the increased use of dry scrubbers which in effect lower flue gas temperatures and technology advancements in higher temperature fabrics have resulted in a greater acceptance of fabric filters to meet the stringent particulate emission limits of state regulations. The fabric filter's acceptance is supported by Attachment C, Table 4-2, and Table 4-3 (after 1980). Of the 40 facilities listed in Attachment C, 16 have been permitted with ESPs, 23 have been permitted with fabric filters, and one has the option of either.

TABLE 4-2

LEE COUNTY ENERGY RECOVERY FACILITY
 PERMITTING DATA FOR ADDITIONAL REFUSE COMBUSTION FACILITIES

Location	Size (tpd)	Air Pollution Control Equipment	Particulate Emissions (gr/dscf @ 12% CO ₂)	Projected Emissions (lb/ton of MSW)				BACT for CO, VOC, and NO _x
				SO ₂	NO _x	CO	P _b	
Bristol, CT	650	Dry Scr/FF	0.015	2.881	5.4	1.34	0.006	Furnace design combustion control
Bay County, FL	500	ESP	0.03	2.8	2.2	11.4	0.0036	Furnace design good operation proper excess air flow
Broward County, FL (north)	2,200	Dry Scr/ESP	0.015	4.95	5.0	0.8	0.018	Furnace design good operation
Hillsborough County, FL	1,200	ESP	0.021	8.5	6.4	1.8	0.002	Furnace design combustion control
Pinellas County, FL	3,000	ESP	0.03	4.08 ^a	6.1 ^a	1.6 ^a	0.067 ^a	Furnace design good operation proper excess air flow
Tulsa, OK	750	ESP	0.06	3.23	6.4	1.33	0.0064	Furnace design combustion controls
Millbury, MA	1,726	Dry Scr/ESP	0.03	1.88	5.29	0.79	0.0224	Combustion controls excess air flow

TABLE 4-2
(continued)

Location	Size (tpd)	Air Pollution Control Equipment	Particulate Emissions (gr/dscf @ 12% CO ₂)	Projected Emissions (lb/ton of MSW)				BACT for CO, VOC, and NO _x
				SO ₂	NO _x	CO	P _b	
Claremont, NH	100	Dry Inj Scr/FF	0.02	6.37	6.37	2.88	N/A	Furnace design combustion controls
Gloucester, NJ	575	Dry Scr/FF	0.015	2.14	5.49	3.79	0.023	Furnace design combustion controls
Marion County, OR	550	Dry Scr/FF	0.03	3.19	4.1	2.4	0.023	Furnace design combustion controls
Delaware County, PA	2,688	Dry Scr/FF	0.015	1.22	4.1	4.3	0.003	Furnace design combustion control
San Juan, PR	1,040	Dry Scr/FF	0.010	1.01	3.5	3.5	0.003	Furnace design combustion control

SOURCE: Camp Dresser & McKee Inc., 1991.

^aThe Facility consists of three 1,000-tpd mass-burn units. Permitted emissions are for the third unit.

Scr - Scrubber

FF - Fabric Filter

ESP - Electrostatic Precipitator

Dry Inj Scr - Dry Injection Scrubber

TABLE 4-3

LEE COUNTY ENERGY RECOVERY FACILITY
PARTIAL LISTING OF ADVANCED PARTICULATE CONTROL EQUIPMENT APPLICATIONS
TO MSW COMBUSTION FACILITIES
1970 TO 1988

Facility	Date	Air Pollution Control Equipment ^b	Particulate Test Data ^a gr/dscf
S.W. Brooklyn, NY	1970/71	ESP	.114/.146
South Shore, Brooklyn, NY	1970	ESP	.056
Dade County, FL	1970	ESP	.027
Braintree, MA	1970/78	ESP (1 field)	.108/.083
Montreal, Canada	1970/71	ESP	.013/.08
Chicago (NW), IL	1971/75	ESP	.025/.03
Washington, DC	1972	ESP	.0548
Harrisburg, PA	1974	ESP	.06
Quebec City, Canada	1974	ESP	.095
East Bridgewater, MA	1975	FF	.02
Pasadena, CA (pilot)	1975	FF	.008
Nashville, TN	1978	ESP	.018
Nashville, TN (pilot)	1980	FF	.008
Framingham, MA	1980	Dry Scr/FF	.02
Isogo, Japan	1980	Dry Scr/FF	.026 ^d
Kure, Japan	1981	ESP	.03
Malmö, Sweden	1982	Dry Scr/FF	.02
Saugus, MA	1983	ESP	.025
Saugus, MA (pilot)	1983	FF	.008
Gallatin, TN	1983	FF (Electrostatic)	.029
Susanville, CA	1983	FF	.01
Tsushima, Japan	1983	Dry Scr/FF	.01
Bamberg, Germany	1983	Wet Scr/ESP	.0135
Munich North, Germany	1984	Dry Scr/ESP	.0104
Neustadt, Germany	1984	Dry Scr/ESP	.0084
Lausanne, Switzerland	1984	Elec/Scr/ESP	.0208
Albany, NY-RDF	1984/86/87	3-FIELD ESP	.131/.066/.02
Niagara Falls, NY-RDF	1985/86	4-FIELD ESP	.096/.012
Westchester County, NY	1985	3-FIELD ESP	.016
Avesta, Sweden	1985	Cond. Scr/ESP	.0178 ^c
Ingolstadt, Germany	1985	Wet Scr/ESP	.02264
Quebec City, Canada (pilot)	1985	Dry Scr/FF	.0009
Copenhagen, Denmark (pilot)	1985	Dry Scr/FF	.0078
Malmö, Sweden	1985	Dry Inj. Scr/FF	.006 ^c
Nurnberg, Germany	1985	SDA/ESP	.0028
Kempten, Germany	1985	Dry Inj. Scr/FF	.0025
Hogdalen, Sweden	1985	Dry Scr/FF	.006
Linköping, Sw	1985	Dry Scr/FF	.0063 ^d
Baltimore, MD	1985	4-FIELD ESP	.003
Würzburg, Germany	1986	Dry Inj Scr/FF	.004
Tulsa, OK -- Boiler 1	1986	3-FIELD ESP	.0095
-- Boiler 2	1986	3-FIELD ESP	.0049

TABLE 4-3
(continued)

Facility	Date	Air Pollution Control Equipment ^b	Particulate Test Data ^a gr/dscf
Marion, OR -- Boiler 1	1986	Dry Scr/FF	.011
-- Boiler 2	1986	Dry Scr/FF	.0029
Montauban, France	1986	Scr/FF	.002 ^d
Oneida County, NY	1986	ESP	.0263
Zurich, Switzerland	1986	SDA/Lq. SCA ESP	.0031
Hogdalen, Sweden	1986	Dry Inj.Scr/FF	.0008
Rosenheim, Germany	1986	SDA/FF	.0056
Iserlohn, Germany	1986	Wet Scr/Cycl/ESP	.0084
N.W. Frankfurt, Germany	1986	SDA/ESP	.028
N.W. Frankfurt, Germany	1986	SDA/ESP/FF	.0056
Frankfurt, Osthafen	1986	Wet Scr/Cycl	.0168
Schwandorf, Germany	1986	Dry Inj.Scr/ESP	.021
Leverkusen, Germany	1986/87	Dry Scr/3-FIELD ESP	.0025/.0009 ^c
Commerce, CA	1987	Teller Scr/FF/ DeNO	.0043
Bay County, FL -- Boiler 1	1987	3-FIELD ESP	.0193
-- Boiler 2	1987	3-FIELD ESP	.0243
Manheim, Germany	1987	Wet Scr/ESP ^e	.0012
North Andover, MA	1987	3-FIELD ESP	.005
Rutland, VT	1988	Cond/Wet Scr/ 4-FIELD ESP	.003

SOURCE: Clarke, Marjorie J., "Debating The Virtues of ESPs," Waste Age, June 1988.

FF	- Fabric Filter (Baghouse)	ESP	- Electrostatic Presipitator
DeNO _x	- Thermal DeNO _x	Wet Scr	- Wet Scrubber
Dry Scr ^x	- Dry Scrubber ^x	Cycl	- Cyclone
Dry Inj	- Dry Lime Injection	SDA	- Spray Dryer Absorber

^aAll values are corrected to 12% CO₂ or 7% O₂, "front catch" only unless otherwise noted.

^bUnless otherwise specified, ESPs have two fields.

^cOriginal correction factor assumed to be 11% O₂, corrected to 7% O₂.

^dOriginal correction factor not known.

^eNumber of fields of ESP unknown.

It should be noted that some of the particulate data presented in Table 4-3 may not have been obtained by following EPA Method 5 particulate test procedures. The Lee County Facility will use EPA approved test procedures for compliance testing.

All of the facilities in Attachment C, except for the Long Beach, Stanislaus and Commerce refuse combustion facilities, each of which are in California, have listed combustion control and furnace design as BACT for control of NO_x . The Commerce facility permit has since been updated and is permitted with "Innovative Technology" for controlling NO_x . The Commerce facility is the first U.S. refuse combustion facility to incorporate Exxon's patented Thermal DeNO_x system (ammonia injection into the boiler) to reduce NO_x emissions. The Stanislaus and Long Beach facilities also have incorporated Exxon's ammonia injection system to control NO_x . The Commerce facility is located in a nonattainment area for NO_2 and ozone, while Stanislaus and Long Beach are in a nonattainment areas for PM, NO_2 , and ozone. Recent permit decisions made for the Huntington, NY and Pennsauken, NJ facilities will require the use of a thermal DeNO_x system. The BACT/LAER Clearinghouse compilation is normally updated either annually or bi-annually, thus it does not include some recently permitted facilities.

4.3 BACT REVIEW FOR SO_2 AND ACID GAS COMPOUNDS

4.3.1 PROPOSED CONTROL TECHNOLOGY

A growing number of state permitting agencies in the U.S. are requiring multipollutant, SO_2 , and acid gas control systems on refuse combustion facilities. As with other refuse combustion facilities, Lee County's proposed Facility will generate SO_2 and various other acid gases, including HCl, HF, and H_2SO_4 , during combustion.

The County proposes to use a dry scrubber for each of the Facility's combustors to control SO_2 and other acid gas emissions. The Facility will have three identical dry scrubber systems. Each dry scrubber system will be capable of removing: (1) 95 percent (by weight) of the uncontrolled HCl emissions or reduce HCl to a concentration of 25 ppm_{dv} at 7 percent O_2 ,

both over 8-hour averages, whichever is less stringent, and determined by compliance testing; and (2) 80 percent (by weight) of the uncontrolled SO₂ emissions over a 24-hour average (75 percent by weight over a 3-hour average) or reduce SO₂ to a concentration of 30 ppm_{dv} at 7 percent O₂ over a 24-hour average, whichever is less stringent. The dry scrubber system shall also reduce significantly the concentrations of H₂SO₄ and HF in the flue gas.

As indicated in Table 4-1, the Facility may emit the following maximum controlled annual SO₂ and other acid gas emissions: SO₂ - 490 tpy; HCl - 212 tpy; HF - 11.5 tpy; and H₂SO₄ - 118 tpy.

4.3.2 COMPLIANCE WITH APPLICABLE EMISSION STANDARDS

The intent of the recently promulgated NSPS requires MWCs to control SO₂ and HCl emissions to the level achievable by applying the best demonstrated system. The emission limitations for these acid gas pollutants as they apply to large MWC plants (those plants that have an aggregate capacity to combust greater than 250 tons per day of refuse) are presented below.

- o Sulfur dioxide (SO₂) emissions shall not exceed 30 ppm_v, corrected to 7 percent O₂ on a dry basis; or be reduced 80 percent (by weight) both measured over a daily (block) 24-hour geometric mean basis by CEMs.
- o Hydrochloric acid (HCl) emissions shall not exceed 25 ppm_v corrected to 7 percent O₂ on a dry basis; or be reduced 95 percent (by weight). Compliance demonstrated by annual performance stack tests.

It has been determined in this application that 80 percent reduction of SO₂ emissions is BACT.

The Facility shall have CEMs located upstream and downstream from the proposed dry scrubber/fabric filter to ensure that the SO₂ and HCl emission guidelines are met. Due to inaccuracy of HCl monitors, an SO₂ monitor will be used as a surrogate.

The County's planned material separation program, mandated by Florida's Solid Waste Management Act, may produce a beneficial effect on the amount of SO₂ and acid gases produced from the Facility. Since little data currently exists on whether material separation leads to a demonstrable and quantifiable reduction of SO₂ and acid gases, the projected emissions from the Facility do not recognize any potential benefits.

4.3.3 EMISSION OF GASEOUS SULFUR COMPOUNDS AND ACID GASES

Emission of Sulfur Compounds

The sulfur which contributes to pollutant emissions from refuse combustion is chemically bound to other elements in the refuse. During combustion, a fraction of these elements escapes from the furnace as gaseous sulfur compounds while the remainder leaves as bottom or fly ash. The type of sulfur compounds released from the furnace is dependent on the presence of other gaseous compounds, combustion temperatures, and chemical (oxidizing or reducing) conditions in the furnace. Furnace conditions (oxidizing or reducing) directly influence the types of sulfur compounds which may form and exit during combustion. Excess oxygen conditions, typical of a refuse combustor, generally result in the formation of SO₂ and SO₃ while reducing (oxygen deficient) conditions result in hydrogen sulfide (H₂S), carbonyl sulfide (COS) and elemental sulfur. Since the Facility will be operated under excess oxygen conditions, reduced forms of sulfur are not likely to form and their emissions, as indicated in Table 4-1, will be negligible.

Gaseous SO₂ is the predominate sulfur compound emitted during refuse combustion, with its rate of formation dependent upon the valence state and chemical bonding of the refuse sulfur content. The sulfur in refuse exists as organic sulfur and sulfates and, to a lesser extent, as sulfides. Organically bound sulfur or sulfide sulfur will oxidize to produce gaseous SO₂. The SO₂ emissions will also produce SO₃, which will either be gaseous or appear in the fly ash as sulfates.

The fraction and elemental type of sulfur contained in the refuse which is either converted to other compounds or passed through the furnace was

discussed in a technical paper by Kaiser (1968). The paper was based on refractory-wall mass-burn facilities, and states that approximately one-half of the sulfur contained in the refuse appears in the bottom ash as sulfates (expressed as SO_3). Of the remaining fraction available for oxidation to SO_2 and SO_3 , approximately one-half exits the stack as SO_2 (25 percent) and one-half further oxidizes to sulfates found in the fly ash. O'Connell (1982) reported SO_2 net conversion rates for refuse to be between 20 and 60 percent. The refuse combustion industry conservatively assumes that between 50 and 90 percent of the sulfur found in refuse is converted to sulfur emissions (SO_2 and SO_3) which could potentially exit the stack.

Emission of Acid Gases

Acid gases which are found in the flue gas of refuse combustion facilities include H_2SO_4 , HCl , and HF . Reduced visibility, metal corrosion, and the formation of acid rain or fog, have been attributed to the emission of these compounds. H_2SO_4 is produced as an indirect result of the emission of SO_2 .

The pyritic and organic sulfur in the refuse which oxidizes to SO_2 during combustion may further oxidize to SO_3 in the furnace or after exiting the stack. Once formed, a portion of the SO_3 reacts with water vapor in the flue gas or atmosphere to form H_2SO_4 . In addition, the H_2SO_4 may further react to create sulfate salts which form a particulate aerosol.

Hydrogen chloride is the predominant equilibrium chlorine product from the combustion of refuse. The excess quantity of hydrogen present during the combustion process readily reacts with the chlorine in the refuse to form hydrogen chloride. Chlorinated plastic(s) and bleached paper products are major contributors of chlorine in the refuse and, therefore, have been considered as the primary sources of HCl emissions at refuse-burning facilities. The net conversion of chlorine contained in the refuse (organic and inorganic) to HCl , as determined in a study by Kaiser and Carotti (1972) and in a Swedish study with similar findings, is approximately 60 to 65 percent. The remainder of the chlorine from the refuse exits with the bottom ash. Both studies indicate that the net yield

of HCl (percentage of the chlorine in the refuse appearing as HCl) decreases as the chlorine content of the solid waste increases.

Fluoride emissions from refuse combustion are primarily from fluorinated plastics and other fluorocarbon products such as teflons, polyvinyl fluoride films, and fluorinated aerosol propellants. The mechanisms which govern fluorine release and HF formation from refuse combustion are considered much the same as HCl due to the chemical similarities between fluorine and chlorine. Little information, however, is available on the concentration of fluorine in today's refuse.

4.3.4 DESCRIPTION OF SO₂ AND OTHER ACID GAS CONTROL ALTERNATIVES

The emissions of SO₂ and acid gases (e.g., H₂SO₄, HCl, and HF) from refuse combustion can be reduced through the application of acid gas scrubbing devices. There are three general types of acid gas scrubbers offered by the air pollution control industry applicable for waste combustion facilities: wet scrubbers, dry scrubbers, and dry injection scrubbers. Although the specific operation of each of these scrubbers differs significantly, each incorporates the use of an alkaline reagent to react with and neutralize acid gases in the flue gas stream. Wet scrubbers and dry scrubbers subject flue gas to a sorbent water solution while dry injection scrubbers inject completely dry sorbent into the flue gas.

The relative removal efficiencies of these technologies for HCl, HF, and SO₂ are shown below. As the table shows, HCl and HF are generally better controlled than SO₂ because they are highly reactive acids. The higher removal efficiencies of dry scrubbers and wet scrubbers, in contrast to the dry injection scrubber, can be attributed to their lower operating temperatures and to their liquid-gas contact which provides better mass transfer of gaseous pollutants to the absorbing interface.

<u>Scrubber Device</u>	<u>Pollutant (% Removal)</u>		
	<u>HCl</u>	<u>HF</u>	<u>SO₂</u>
Wet Scrubber	95-99	99	80-90
Dry Scrubber	90-99	99	70-90
Dry Injection Scrubber	70-99	98	40-85

The removal efficiencies shown in the above table are based on data contained in several reports including: EPA's report to Congress (USEPA, 1987a); reports by Marjorie Clarke of the New York City Department of Sanitation (Clarke, 1986, 1987a, and 1987b); the California Air Resources Board (Carb 1984); and the USEPA's BACT/LAER Clearinghouse (USEPA, 1984, 1987b, 1988, and 1989). A scrubber's ability to achieve consistent and continuous control of these pollutants is better represented by the values in the lower end of the control efficiency ranges noted above.

These acid gas scrubbing devices were each evaluated on the basis of their technical feasibility and the associated environmental, energy, and economic impacts of controlling SO₂, HCl, and other acid gas emissions. A comprehensive description and technical evaluation of each technology are presented in the following sections.

Wet Scrubbers

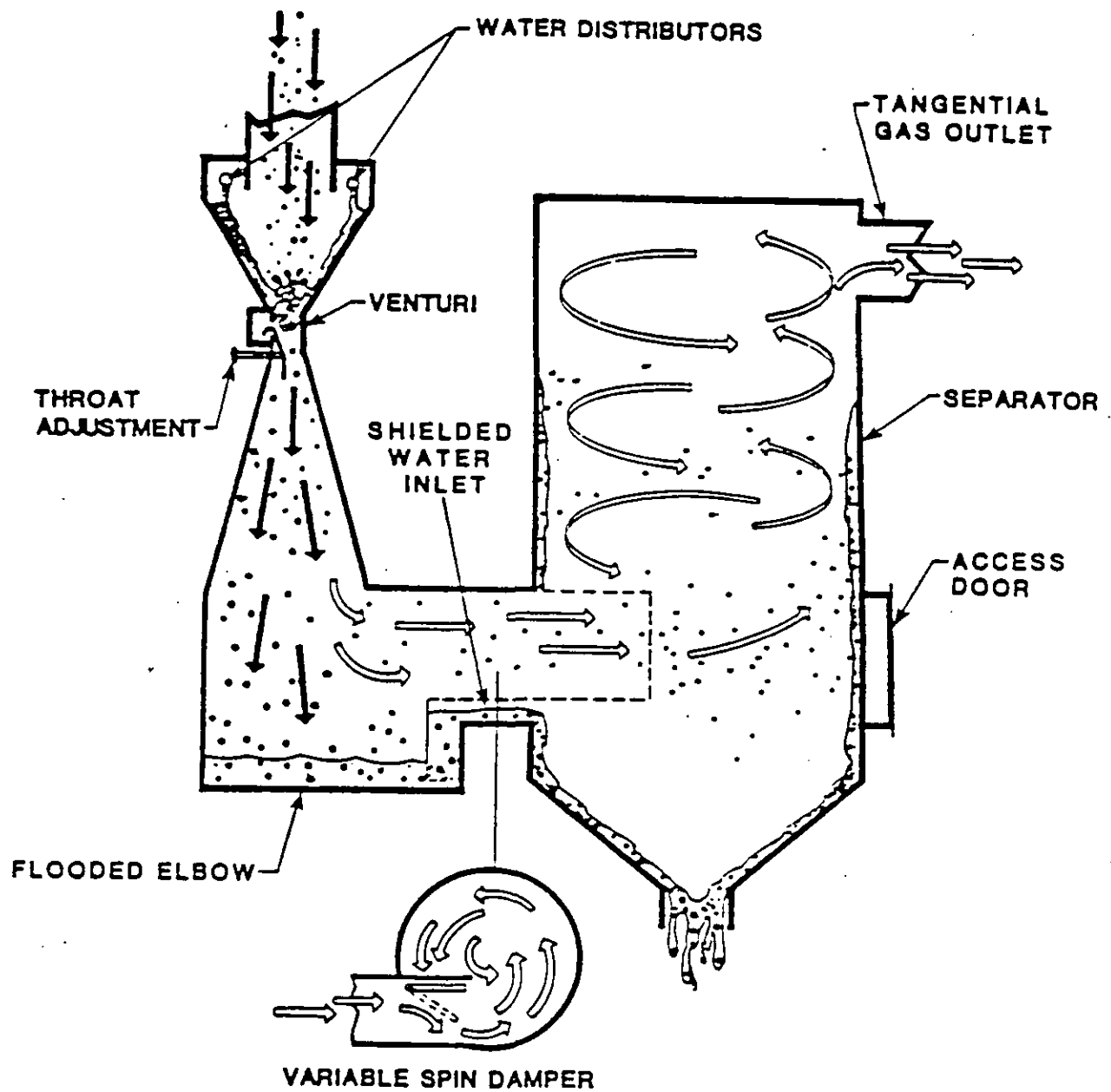
Wet scrubbers have been used on refuse combustion facilities in the past primarily as particulate control devices; however, they can also be designed to provide effective acid gas control. Acid gas wet scrubbers differ from particulate matter removal wet scrubbers in several ways. The dominant mechanism by which particulate is collected in a wet scrubber is inertial impaction of the particulates with the fluid, which is dependent on the pressure drop across the unit. Thus, particulate control wet scrubbers are typically high energy units with large pressure drops. In contrast, the process which governs the overall rate of acid gas absorption and control in a wet scrubber is the diffusion of an acid gas molecule into a liquid alkaline droplet for a reaction to occur. The design of an acid gas wet scrubber reflects this governing process since the emphasis is to increase the contact time of the liquid and gas.

Wet scrubbers for acid gas control use an alkaline liquid which may consist of either caustic soda (sodium) solution or a lime slurry (calcium) to scrub the flue gases. In larger systems, the use of a lime slurry is common since the cost of the alkali favors using the less expensive lime instead of caustic soda in spite of the higher capital costs involved. Lime slurry systems react with the SO_2 and other acid gases to form calcium based salts which require clarifying, thickening, and vacuum filtering to avoid a concentration build-up of precipitated salts in the system. Sodium based systems produce a liquid waste with highly soluble sodium based salts which may require the use of large, carefully contained, holding pond(s) or wastewater treatment plants. The holding pond(s) are used to evaporate and concentrate the dissolved salts, thus they are feasible in warmer climates.

Many types of wet scrubber hardware may be used to remove acid gases. The most common devices in use are the packed tower, impingement tray scrubber, and the venturi scrubber. Figure 4-1 shows a wet venturi which uses Brownian motion, chemical reaction, and inertial impaction to remove acid gas pollutants as well as particulate matter.

Wet scrubbers have been used on a few European refuse combustion facilities to control acid gases, while those used on past U.S. facilities of the 1960s and 1970s were operated as particulate collection devices. European refuse combustion facilities equipped with wet scrubbing systems include the Kiel and Krefeld facilities in Germany. Acceptance testing data for the original wet scrubber at Kiel show HCl and SO_2 control efficiencies of 98.0 percent and 80.9 percent, respectively (Feindler and Grimm, 1982). At the Krefeld facility, control efficiencies of 99.7 percent for HCl and 96.2 to 98.3 percent for SO_2 have been achieved (Beaumont Environmental, 1986).

The major advantage of an acid gas wet scrubber system over either a dry scrubber or a dry injection scrubber system is its high abatement efficiency. Data on a limited number of European installations show that acid gas wet scrubbers are very efficient and can achieve removal rates for SO_2 and acid gases that are greater than or equal to those of dry scrubbers (Ellison, 1988).



SOURCE: Sly Manufacturing Co.

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FIGURE 4-1
 WET VENTURI SCRUBBER

Although wet scrubbers may provide very effective SO₂ and other acid gas control, the technology has several significant disadvantages which discourages its use on refuse combustion facilities. In addition to the extensive and expensive liquid effluent treatment required, wet scrubbers produce a saturated gas which increases the potential for corrosion of wet scrubber internals and downstream equipment. It also creates an aesthetically displeasing visible water vapor plume. The Kiel refuse combustor in West Germany has a wet scrubber which confirms these corrosion problems. The facility has been reported to have experienced severe corrosion of the wet scrubber's internals and the stack.

In addition to the aesthetically displeasing water vapor plume produced by the wet scrubber, localized acid deposition may result in the vicinity of the stack during periods of unfavorable meteorological conditions, such as, cool weather or high relative humidity. Since a wet scrubber system has a lower operating temperature than a dry scrubber or dry injection scrubber, the plume produced is less buoyant. Lower temperature results in reduced plume rise which will increase GLCs at equivalent emission concentrations. Reheating the stack gases prior to their exit will reverse this effect, but will decrease the Facility's net energy production and impose a significant economic disadvantage.

Presently, there are no refuse combustion facilities planned in the U.S. with a wet scrubber for acid gas control. The major reasons cited for this include:

- o High wastewater treatment requirement resulting in increased energy and utility operating costs.
- o Liquid effluent from the wet scrubber which requires pretreatment to meet regulatory requirements before discharge to a municipal sewer.
- o Problems associated with the disposal of wet sludges resulting from the process. Extensive sludge thickening and dewatering equipment is required.

- o Corrosion, scaling, and fouling of scrubber internals. Costly acid corrosion resistant construction materials are required for the scrubber and downstream equipment. These materials include high nickel chromium alloys, such as those in the Hastelloy and Inconel series, which are extremely expensive.
- o Visible water vapor plume under most meteorological conditions, especially during periods of high relative humidity.
- o A relatively low stack gas temperature resulting in reduced buoyancy. This reduced buoyancy results in lower plume rise and poorer plume dispersion of the residual pollutants. Hence, the potential for increased GLCs exists.

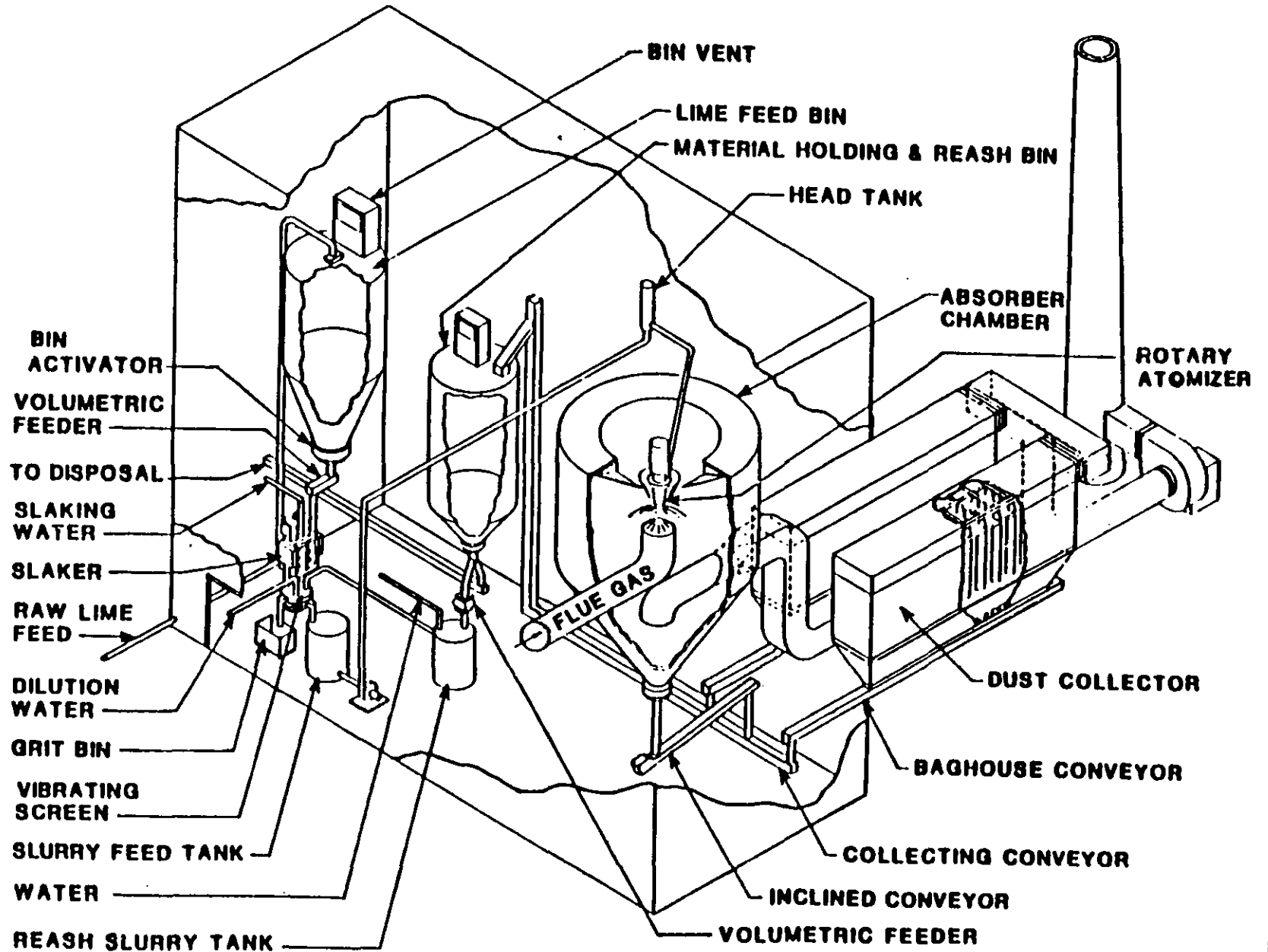
Because of these significant technical disadvantages, the wet scrubber alternative is not considered a viable means of acid gas control, and no further analysis of this option was performed. A more detailed analysis of various control options focuses on those technologies with fewer restricting features.

Dry Scrubbers

Dry scrubbers, also referred to as wet-dry, spray dryer, semi-dry, or spray dry scrubbers, offer an effective and practical means of controlling acid gas emissions from refuse combustion facilities. During operation of a dry scrubber system, the flue gases from the boiler are introduced into an absorbing chamber where the gases are contacted by a finely atomized alkaline lime slurry. Acid gases are absorbed by the slurry mixture and the alkaline component reacts with the gases to form salts. Evaporation of the water produces a finely divided particle of mixed salt and unreacted alkali and a flue gas having a lower temperature. A portion of the dry powder drops to the bottom of the scrubber vessel while the flue gases, containing the remaining powder with reacted acid gas salts and the particulates generated during refuse combustion, are delivered to the particulate collector (baghouse or ESP) for removal. A typical dry scrubber system is shown in Figure 4-2.

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FIGURE 4-2
 DRY SCRUBBER



Source: Niro Atomizer, Inc.

To form the lime slurry, pebble lime (CaO) is hydrated by slaking with water [$\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca}(\text{OH})_2$]. The slurry and any additional cooling water which may be required is then pumped to nozzles or to a rotary atomizer located inside the scrubber's contact chamber. The slurry contains greater than the stoichiometric quantity of lime required to neutralize the SO_2 and acid gases in the flue gas.

Most dry scrubbers used to date have employed either a rotary-type atomizer or a dual fluid nozzle with an external or internal mixing design. Experience shows that each system has pros and cons; however, both are capable of meeting performance specifications.

In the absorbing chamber, the water in the slurry droplets is rapidly evaporated by the hot flue gases. The reduction in flue gas temperature provided by the evaporating water has been shown to be a major factor influencing the removal of acid gases. Studies such as the 1986 Environment Canada Study (R. Klicius et al., 1987) have shown that SO_2 and other acid gas removal efficiencies are significantly higher when the scrubber is operated at temperatures approaching the saturation temperature of the flue gas.

As a result of the scrubbing process a dry, free-flowing powder is produced consisting of unreacted lime, salts (most prevalent being CaCl_2 , CaSO_3 , and CaSO_4), and fly ash. The largest of these dry particles are separated by gravity from the gas in the absorbing chamber and fall to the bottom. The smaller particles are carried to a particulate control device for separation from the flue gas. It is imperative that a flue gas cleaning system which uses a dry scrubber for acid gas removal also include a downstream particulate control device to remove suspended fly ash, calcium salts, and unreacted lime which result from the scrubbing process. The collected fly ash from the dry scrubber and particulate control device are combined with the bottom ash or residue from the Facility. The use of lime by a dry scrubber changes the characteristics of the combined bottom ash and fly ash since its alkaline nature increases pH.

4.4 BACT REVIEW FOR PARTICULATE MATTER (PM)

4.4.1 PROPOSED CONTROL TECHNOLOGY

The County proposes to use a fabric filter (baghouse) system with a particulate outlet grain loading of 0.010 gr/dscf corrected to 7 percent O₂ (front half catch), as measured by EPA Method 5 (40 CFR Part 60), to control the emission of particulate matter (PM) from each combustor/boiler train at the Facility. PM is defined for the purpose of this BACT analysis as total suspended particulate matter (TSP) and particulate having an equivalent aerodynamic diameter of less than 10 microns (PM₁₀). The proposed fabric filter control system will effectively and efficiently reduce fly ash generated from refuse combustion and reaction products generated by the dry scrubber system (e.g., calcium sulfate and calcium chloride). The fabric filter will also reduce trace heavy metals and organic compounds which have been theorized to preferentially absorb onto fine PM.

At design operating conditions, the Facility shall emit a maximum controlled annual PM emission of 64 tpy. It was conservatively assumed that all emitted PM from the Facility shall be PM₁₀.

A fabric filter particulate control system will also be used for the dry scrubber lime silo(s), and will be designed to achieve an outlet particulate loading of 0.015 grains per actual cubic foot (gr/acf).

4.4.2 COMPLIANCE WITH APPLICABLE EMISSION STANDARDS

The Facility's fabric filter system shall be more stringent than the current federal emission standards for particulates (NSPS) set at 0.08 gr/dscf @ 12 percent CO₂, and the recently promulgated NSPS for MWCs, which will become effective on August 12, 1991, set at 0.015 gr/dscf @ 7 percent O₂. The fabric filter system for the Facility shall be designed to obtain the BACT determined outlet grain loading for PM of 0.010 gr/dscf corrected to 7 percent O₂.

4.4.3 RATIONALE FOR PROPOSED BACT DETERMINATION

Particulate matter (PM) is emitted as a result of incomplete combustion of fuel as well as the entrainment of noncombustible inert matter in the flue gases. Particulate emissions may be solid or condensable substances. Solid PM generally consists of noncombusted inert matter, inorganic oxides, unburned combustibles, and heavy metals. A fraction of the vapor phase trace organics which were not completely converted to CO₂ and H₂O during the combustion process and the vaporized heavy metals make up the condensable portion of PM. In addition, it has been theorized that trace heavy metals and organic compounds adsorb and/or condense onto the fine particulate fraction since they are very porous and have an extremely large surface area. These gas-solid particulate adsorption reactions have also been postulated as a possible dioxin formation theory; however, the interpretation of recent experimental evidence suggests a different conclusion. In a study by Dickson and Karasek (1987), particle size surface area was not an important factor in producing trace organics such as dioxin. The study involved a series of laboratory experiments with various fly ash samples and pentachlorophenol as the known precursor.

The size and quantity of particulates emitted from refuse combustion depend upon such factors as flue gas residence time, underfire air velocity through the combustor system, oxidizing/reducing conditions within the furnace, temperature, flue gas mixing, boiler tube spacing, boiler configuration, flue gas velocity, and the chemistry of the fuel which is burned. If combustion takes place at higher temperatures and with the proper quantity of oxygen, the result will be more complete combustion of the fuel and a decreased particle mass. High combustion temperatures and long residence times allow for more complete burning of organic particles with a commensurate decrease in particle size. Boiler configuration (180 degree turns) and decreased gas velocity will allow the larger, heavier particles to fall out of the flue gases as they pass through the boiler. The various operating and design parameters cause the particles in the flue gas to have a large distribution range (0.10 micron to more than 500 micron). The submicron range, less than 1.0 micron, may be retained in the

lungs and is of public health concern. EPA has addressed the necessity of controlling those particles which are smaller than 10 microns, referred to as PM_{10} , and requires their review in determining BACT. The PM_{10} emitted from the Facility is difficult to quantify since limited fractional collection efficiency data on refuse combustion facilities exists, thus the air quality modeling and BACT analysis conservatively assumes the particulate emissions to be all PM_{10} .

4.4.4 DESCRIPTION OF PARTICULATE CONTROL TECHNOLOGY ALTERNATIVES

Particulate matter may be removed from the combustion gases by various types of air pollution control devices. Technologies which have been used on refuse combustors include fabric filters (also referred to as baghouses), ESPs, and wet scrubbers. One of the initial particulate control devices used on U.S. refuse combustion facilities was a wet venturi scrubber. During the 1970s and early 1980s, however, ESPs were the more predominantly used particulate control device on refuse combustion facilities. The shift to ESPs was mainly due to the inability of the wet scrubber to meet the stringent particulate emission control requirements initially set by the NSPS (0.08 gr/dscf), and then further decreased by various states.

The recent trend for U.S. refuse combustion facilities is to install fabric filters instead of ESPs. The application of fabric filters has been made possible by the installation of acid gas scrubbers which decrease flue gas temperature excursions to limits which are acceptable for the bag fabric, and make the possibility of a fire due to incandescent particles igniting the fabric negligible. The trend of using a fabric filter rather than an ESP is due to a combination of factors. Although both of these technologies may be designed and operated to achieve the same outlet grain loading, it is theorized that the fabric filter is better able to control the finer PM emitted which have been theorized as a source for trace heavy metal and organic emissions.

Electrostatic Precipitators (ESPs)

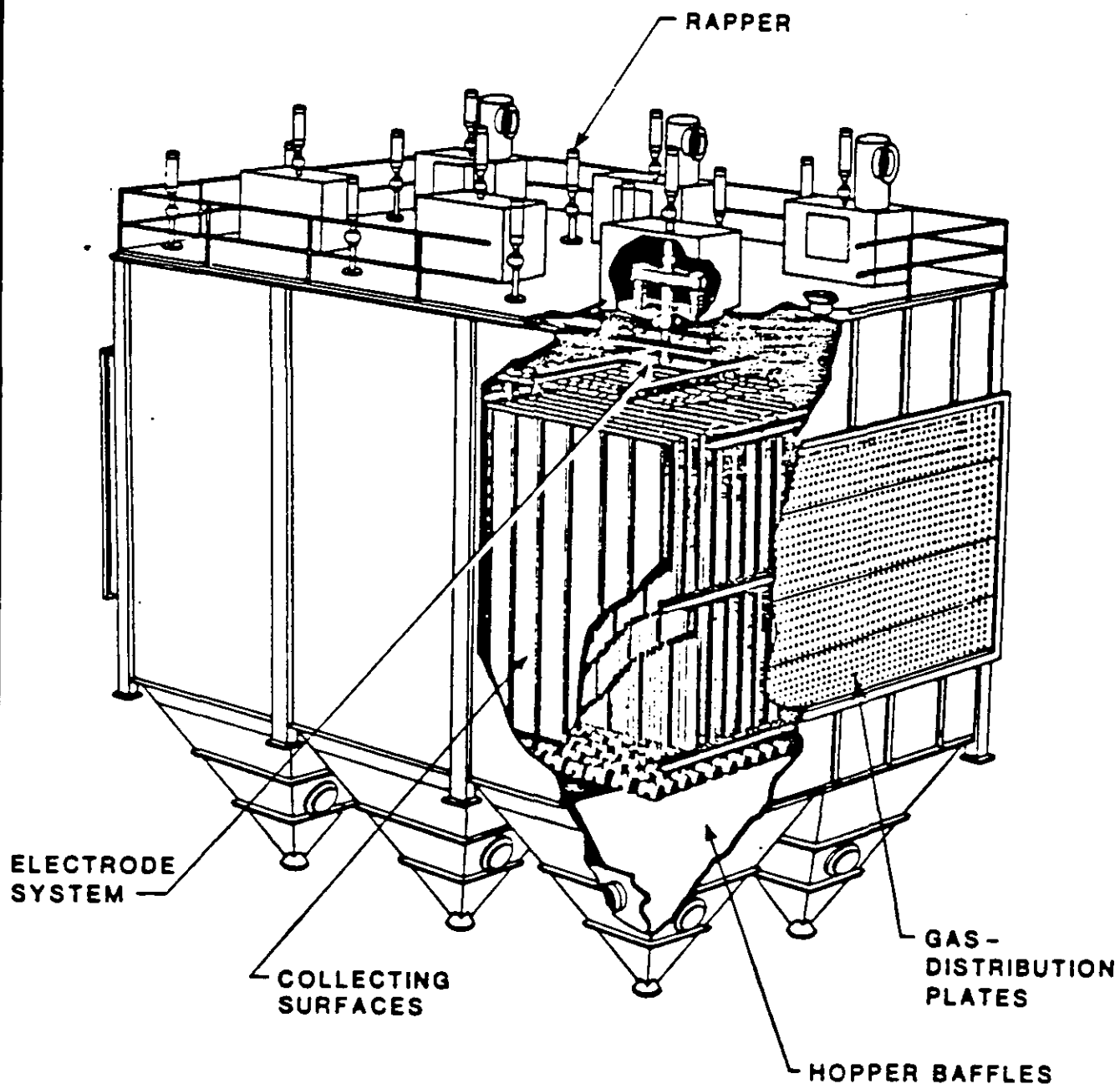
An ESP uses an electrostatic field for precipitating or removing entrained solid or liquid particles from gas streams by particle ionization. An ESP consists of an alternating array of negatively-charged wires or grids and grounded collection plates.

Particulate collection is accomplished by applying a high voltage across the negative electrodes, thereby establishing a corona around it. The corona ionizes the PM entrained in the gas stream, thereby negatively charging the particles. The charged particles precipitate out of the gas stream by migration to the grounded collection plates where they are deposited. Precipitated PM is removed from the collecting electrode plate by "rappers" with a sharp, hammer-like blow or vibration to cause the collected dust to dislodge and fall into the ash hoppers below.

Re-entrainment of the collected PM is inhibited by the electrostatic field, properly designed collection plates, the agglomerated particulate mass, and low flue gas velocities through the ESP. Proper design of the rapping mechanisms and collecting plates, and the maintenance of uniform and sufficient low gas velocities, are also required for optimum ESP operation. A typical ESP is shown in Figure 4-4.

The collection efficiency of ESPs is very high, normally designed to exceed 99 percent, which is primarily a function of flue gas flow rate and humidity, strength of the electrostatic field, residence time of the flue gas in the electrostatic field, resistivity, particle size, inlet grain loading of the particulates being removed, and surface area of the collection electrodes. Collection efficiency may be enhanced by installing additional stages of precipitation in series (fields) and optimizing the gas flow rates, and/or increasing the specific collection plate area (SCA) of the electrodes.

The critical property affecting the performance of ESPs is the resistivity (the reciprocal of conductivity) of the particulate to be collected. If the resistivity is excessive, then the particulate cake acts to reduce the



SOURCE: Joy Manufacturing Co.

LEE COUNTY, FLORIDA
 Energy Recovery Project
 Application for Power Plant Site Certification
 Camp Dresser & McKee Inc

FIGURE 4-4
 ELECTROSTATIC PRECIPITATOR

effective field strength within the ESP by retaining its charge, thus building an insulating layer around the collecting plates. The insulating layer decreases current flow from the discharge electrodes to the collection plates, thereby reducing collection efficiencies. If the resistivity is too low, the charge on the dust cake dissipates quickly. Thus, without the cake attraction forces to hold them, the surface particles are re-entrained by the gas, increasing outlet emissions.

Advantages of ESPs are:

- o Demonstrated high collection efficiency.
- o Ability to operate over a wide range of gas temperatures.
- o Minimal gas pressure drop across the ESP results in lower power consumption by the flue gas mover (such as an induced draft fan).
- o No liquid effluents requiring treatment are generated since the PM is, unlike the wet scrubber, collected dry.
- o Longest operating record on refuse combustion facilities.
- o High reliability with low maintenance.
- o Capability to operate in a relatively high humidity gas stream.
- o Efficiency increases if operated at gas flow rates which are lower than design (good response to turndown).

Some of the disadvantages are:

- o Changes in flue gas properties and particle size distributions may adversely affect collection efficiencies.
- o Some particles are not efficiently removed by a precipitator because of extremely high or low resistivity.

- o ESPs cannot effectively remove gaseous heavy metals unless they condense prior to entering the unit.
- o Changes in the chemical composition of the fuel may reduce ESP performance by altering particle resistivity.
- o ESP collection efficiencies decrease in the 0.1 to 1.0 micron range (CARB, 1984). This may be mitigated by increasing the number of fields to three, four, or even five.
- o Special precautions are required to safeguard personnel from the high voltage present in the ESP units. High voltage sparks could cause fires if the collected particulate is combustible or if a combustible gas were to enter the ESP.
- o There is a potential for corrosion of the ESP internals if the flue gas temperature falls below the dew point of the acid gases.

ESPs have been used in the United States for more than 50 years on a wide variety of applications. Many of the modern municipal refuse combustion facilities use ESPs for particulate emission control. Some major refuse combustion facilities equipped with ESPs are located in Harrisburg, PA; Chicago, IL; Nashville, TN; Norfolk, VA; Westchester County, NY;; Hillsborough County, FL; Saugus, MA; Baltimore, MD; Tampa, FL; Dade County, FL; Tulsa, OK; Bay County, FL; and Pinellas County, FL. Throughout the U.S. and the world, refuse combustion facilities are successfully utilizing, with high reliability, ESPs for the efficient control of PM.

An ESP or a fabric filter is technically capable of meeting the recently promulgated NSPS limitation of 0.015 gr/dscf corrected to 7 percent O₂. Although both technologies are capable of meeting stringent particulate control levels, the fabric filter is theorized to better control fine PM, as well as the pollutants which are believed to be found on these

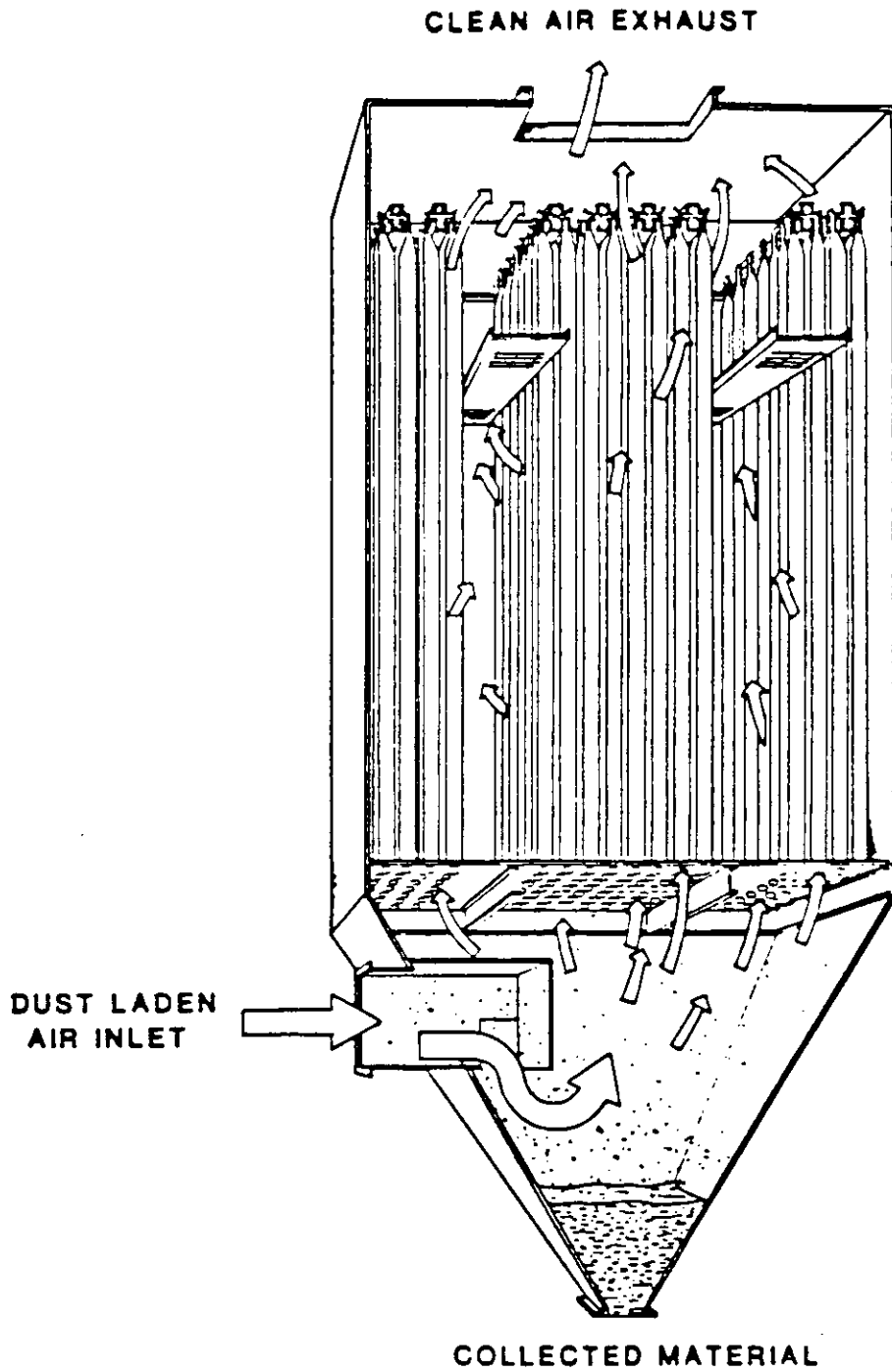
particles. These pollutants, trace heavy metals and organic emissions, are believed to have a preference towards the finer PM as they condense and/or adsorb.

Fabric Filters (Baghouses)

Fabric filters, also referred to as baghouses, have the capability of producing high removal efficiencies under the varying inlet conditions encountered from refuse combustion. The stringent particulate emission limitations of today have had a significant impact on the use of the fabric filter as a particulate control device. Fabric filters have been used for years on a variety of sources and, more recently, have been applied to refuse combustors.

The basic components of a fabric filter include a filter medium (bag) made of various cloth fabrics with special coatings or laminates, bag support systems (cages or rings), a gas tight enclosure or shell, collection hoppers, and a mechanism to remove accumulated particulate. A typical fabric filter is shown in Figure 4-5. Operation involves allowing a particulate laden gas stream to enter the lower portion of the fabric filter near the collection hoppers and then flow upward through the gas-tight enclosure on the inside or outside of the bags, depending upon the fabric filter design used. Cleaning of the bags takes place periodically, and usually incorporates one of three mechanical processes: (1) reverse air cleaning, (2) vibration or shaking of the bags, and (3) pulse air jets. The bags are gently cleaned in a manner that leaves the primary dust cake on the bags after the cleaning process. Particulate matter removed from the bags falls by gravity into a dust hopper for removal and ultimate disposal.

Several parameters used in the design and sizing of a fabric filter include the particular process application, air-to-cloth ratio (A/C), cleaning method, filter media, particulate characteristics, and pressure drop. The A/C ratio is defined as the volumetric flow rate expressed as cubic feet per minute divided by the filter cloth area expressed in square feet, resulting in a velocity value expressed in feet per minute. Higher pressure drops result in increased power consumption by the prime air mover



SOURCE: Micropul Corporation

LEE COUNTY, FLORIDA
Energy Recovery Project
Application for Power Plant Site Certification
Camp Dresser & McKee Inc

FIGURE 4-5
FABRIC FILTER OPERATION

(such as an I.D. fan). To avoid these problems the maximum pressure drop across the filter media is normally limited to between 6.0 and 8.0 inches of H₂O.

There are three fundamental types of fabric filter designs based on the cleaning method: (1) reverse air, (2) shaker, and (3) pulse jet units. A discussion of each type is included herein.

Reverse Air Fabric Filters. Reverse air fabric filters are characterized by low A/C ratios and collect PM on the inside of the filter bags. The flue gas is first introduced through a manifold into the hopper section of the bag compartments. The gas then flows upward and into the inside of the filter bags to the outside. Once the collected material builds up to a point where the flow (pressure drop) is too great, the filter bags are cleaned using a low energy reverse air cleaning process. The air flow is periodically reversed, causing the bag to slightly collapse, thus dislodging the filter cake and allowing the collected particulate to fall into the collection hoppers for disposal.

Shaker Unit Fabric Filters. A second type of fabric filter is a shaker unit which is not typically used on refuse combustion facilities. These units, like reverse air, have low A/C ratios and also collect the PM on the inside of the bags. To clean the filter bags, the top portion of the bag is mechanically shaken to release the dust cake to the hoppers below. The mechanical shaking causes excessive stress on the type of bags employed on fabric filters and could cause short bag life because of reduced structural integrity.

Pulse Jet Unit Fabric Filters. Pulse jet units generally have A/C ratios which are higher than those of reverse air and shaker units. In contrast to reverse air and shaker units, the gas flow in a pulse jet fabric filter flows from the outside of the filter bag to the inside. Consequently, the PM is collected on the outside of the filter bags. When the cleaning process is initiated, a module compartment is taken off-line and bags are cleaned one row at a time with a high pressure burst (pulse jet) of compressed air into

the open end of the bag. This action causes the bag to flex away from the supporting cage releasing the PM from the outside of the bag. The dust then falls into the collection hoppers below.

Lee County will select either a pulse jet or a reverse air fabric filter to control PM at the proposed Facility. The system will be designed to accept flue gases from the proposed scrubbing system at not only the normal operating flue gas temperature of approximately 260°F, but also at temperatures in excess of 500°F. The fabric filter's ability to continuously accept flue gases at the higher temperature ensures that it will not sustain damage in the event of scrubber failure since the boiler gas exit temperature is less than 500°F.

Advantages and Disadvantages

The Facility is proposing to use a fabric filter to control the PM generated during combustion. Some advantages of using this technology are presented below.

The advantages are:

- o The dry collection of particle matter by physical filtration.
- o The ability to attain high collection efficiencies.
- o Because it is a physical filtration device, it is less sensitive to process variations (inlet particulate loading, particle size distribution, variability in waste composition, variability in flue gas flow rates, and particulate resistivity).
- o The ability to perform unit maintenance, such as bag replacement without having to shut down the combustion system.
- o Fabric filters are more easily adaptable should more stringent emission limitations be mandated.

- o The potential for additional SO₂ and other acid gas scrubbing by the unreacted alkaline sorbent (lime) which is removed from the flue gas and builds up on the bag surface.

The disadvantages are:

- o High sensitivity to relative humidity. The formation of a hard crust on the filter fabric, "cementation" of the bags, can occur in a highly humid gas stream with low temperatures. Cemented bags must be replaced which causes down-time and high maintenance costs.
- o Inability to accept high temperature gases. Loss of structural integrity of the bags from temperature surges above 550°F (288°C) can reduce bag life and cause lost operating time and high maintenance costs.
- o Susceptibility of the filters and metal surfaces to chemical attack and corrosion by condensed acid gases should temperatures fall below the acid gas dew point.
- o High gas pressure drop across the fabric filter results in higher energy consumption by the gas mover (induced draft fan).
- o Long-term reliability of fabric filters on U.S. refuse combustors has not been demonstrated.

Wet Scrubbers

Wet venturi scrubbers were discussed in Section 4.3 as an acid gas and SO₂ control technology; however, they had also been used on some of the earlier refuse combustors as a particulate control technology. During the 1970s and early 1980s, ESPs were used instead primarily due to the wet scrubber's inability to meet the more stringent particulate emission control requirements set by the existing NSPS and the individual states.

Currently there are no new refuse combustion facilities being designed in the U.S particulate emissions, as indicated by the following list of disadvantages.

- o High operating costs from electrical consumption (ESPs and fabric filters use less energy).
- o Liquid effluent from the wet scrubber requires pretreatment to meet regulatory requirements before discharge to a municipal sewer.
- o A saturated steam plume visible under most meteorological conditions.

Because of these significant disadvantages, the wet venturi scrubber alternative is not considered a viable means of particulate control, and no further analysis of this option was performed.

Evaluation of PM Control Alternatives

The proposed PM control strategy for the Facility, a fabric filter, offers similar control capabilities to an ESP with both systems being able to meet, at a minimum, the proposed NSPS for particulates. A fabric filter is considered to be better capable of removing finer particulates (PM_{10}) than other technologies and the condensable heavy metals and trace organics which are believed to prefer the finer particulate. In addition, use of a fabric filter should promote additional removal of SO_2 and other acid gases. Particle size fractional removal efficiency studies on fabric filters and ESPs to support these conclusions have primarily come from the combustion of coal and not refuse.

The recently promulgated NSPS conclude that a fabric filter is the best demonstrated technology for controlling particulate emissions from large MWC plants. These standards will require all MWC plants to meet a particulate emission limit of 0.015 gr/dscf corrected to 7 percent O_2 .

An evaluation of recently permitted refuse combustion facilities in the BACT/LAER Clearinghouse, refuse combustion facility test data, and

technical data from the NSPS background documents indicate a potential for achieving a more stringent particulate limitation than that in the NSPS. A fabric filter designed to achieve a limitation of 0.010 gr/dscf corrected to 7 percent O₂ is considered the most stringent or "top" particulate control strategy. In agreement with the current EPA "top down" BACT methodology, since the Facility shall install the "top" particulate control strategy designed at the "top" control level (i.e., 0.010 gr/dscf @ 7 percent O₂), an impact analysis of energy, economic, and environmental criteria was not completed.

4.4.5 BACT DETERMINATION OF TOTAL SUSPENDED PARTICULATE MATTER (TSP)

The NAAQS for TSP has been rescinded and replaced with a standard for particles with an equivalent aerodynamic diameter of less than 10 microns (PM₁₀). However, the PSD increments for TSP remain. To address the requirements for permitting particulate emissions based on two indicators, EPA has established a transition policy. Because both TSP and PM₁₀ are regulated under the Clean Air Act, the transition policy requires that the BACT analysis be performed for both.

Past applications on other refuse combustion facilities in the U.S., as well as numerous others in Europe and Japan, and the recent increase in the number of U.S. facilities permitted with fabric filters demonstrate confidence in the fabric filter to effectively control particulates. In addition to controlling inert PM, the fabric filter can also control other non-criteria pollutants which are present in solid or particulate form. As previously discussed, the use of a dry scrubber with the fabric filter has shown the increased possibility of acid gas control and a subsequent decrease in reagent consumptions when compared with an ESP.

The information and analysis presented on the fabric filter is adequate and sufficient to determine that it be BACT in controlling PM. The fabric filter for the Facility shall be designed and guaranteed by the County to achieve an outlet loading of 0.010 gr/dscf @ 7 percent O₂. This control level is more stringent than the limitation set forth in the NSPS of 0.015 gr/dscf @ 7 percent O₂.

Secondary Sources

In addition to the PM emitted from the furnace, the Facility will have two secondary sources of particulate emissions. These sources are located at the top of the lime storage silo vent(s) and at the ash handling building vent. The vents are minor particulate emission points and the methods used to control them are discussed below.

Facility design has not yet progressed to the point where the exact number of lime storage silos is known. Depending on the vendor's preferred design, the Facility will likely have either one or two lime silos for pebble lime (CaO) storage. The lime storage capacity will likely be the same and independent of the number of silos used.

The pebble lime silo is a storage vessel for lime and is used by the dry scrubbers to control SO₂ and acid gas emissions. Particulate lime emissions will occur from the silo(s) when lime is loaded by a pneumatic conveying truck equipped with a pneumatic unloading system. The loading of lime causes the air in the silo(s) which contains entrained lime dust emissions to be displaced through a silo roof vent. Each lime silo will have a dedicated vent fabric filter (slaker dust collector) mounted on its roof to control lime dust emissions to 0.015 grains per actual cubic foot (gr/acf) during loading periods. The fabric filter(s) will be designed to discharge collected dust directly back into the storage bin.

The deliveries of lime to the silos will be made approximately every seven days. In normal practice, the truck operator will require about 1 to 1.5 hours to unload the pebble lime and about five minutes to clear the trailer hoppers and piping of any residual lime. The air flow rates during the transfer process are estimated to be between 250 and 1,000 ACF per minute. Assuming that the lime will be unloaded at the higher air flow rate, the maximum total hourly emission is estimated at 0.129 pounds per hour of particulate matter. If a maximum of four truck deliveries, each requiring 2.0 hours of duration, are made per week, the maximum annual emission rate (irrespective of whether one or two silos are used) would be approximately 54 pounds per year of particulate matter (0.027 tpy).

Particulate emissions from the ash handling building vent are expected to be negligible. The ash handling building will be maintained under negative pressure, and a fabric filter will be mounted on the top of the building and vented to the atmosphere to control fugitive particulate emissions. The outlet grain loading from the fabric filter shall be 0.015 grains per actual cubic foot (gr/acf). The fabric filter shall be designed to have a maximum hourly emission rate of 1.6 pounds per hour of particulate matter which calculates to 7.01 tpy assuming continuous operation. Since this represents a conservative design calculation, actual tpy emissions should be considerably lower.

The ash handling practices at the Facility will limit the resuspension of ash residue. Ash residue from the furnace exit (bottom ash) and the air pollution control system (fly ash) are combined and quenched with water (20 to 30 percent by weight H₂O) to prevent fugitive emissions. This ash handling practice is successfully performed at most modern refuse combustion facilities.

4.4.6 BACT DETERMINATION OF PM₁₀

In a July 1987 EPA ruling on PM, the NAAQS for TSP was rescinded and replaced with a standard for particles with an equivalent aerodynamic diameter of less than 10 microns (PM₁₀). This standard was promulgated because it represents the fraction of the emitted PM which is inhalable, and it is a better indicator of a potential impact on human health. The ruling on PM₁₀ requires major stationary sources, such as the Facility, to consider the application of BACT for PM₁₀ emissions.

The regulation seeks to establish an emission limitation, but it is contingent upon the availability of emission factor and control efficiency data. The regulation, however, states "Where a quantifiable PM₁₀ emission limit is not yet feasible, the Administrator intends to allow the use of TSP based emission limitations, provided that the reduction of PM₁₀ emissions-- and not just PM emissions--has been considered to the extent possible in the BACT determination."

The amount of PM_{10} expected from the Facility is difficult to quantify due to the limited data available. Published particle size distribution is available, however, from three mass-burn facilities located abroad—Tsushima, Japan; Munich North, West Germany; and Wurzburg, West Germany—and from a refuse-derived fuel (RDF) facility in Biddeford, Maine. The data from these facilities, shown in Table 4-10, are based on cascade impact measurements on acid gas scrubber/fabric filter air pollution control systems except for Munich North which employs an ESP.

An analysis comparing the uncontrolled or controlled PM emissions from mass-burn boilers with RDF fired boilers has not been documented. The particle size data from these processes are not expected to be appreciably different although inlet loading may be greater for RDF firing. The particle size data from RDF would be expected to be of the same or smaller size.

From the limited available particle size data given in Table 4-10, there does not appear to be any distinct advantage to either an ESP or a fabric filter for controlling PM_{10} emissions. Both are considered to be viable PM_{10} control devices. The observed variations in mass fraction by particle size data for the facilities employing fabric filters (Tsushima, Wurzburg, and Biddeford) may be attributed to differences in sampling and analytical methods used at each site or to the operating baghouse conditions during testing. Although the percentage of PM_{10} emitted from the Facility is expected to be similar to the Biddeford, Maine facility, the air quality modeling analysis conservatively assumes that the particulate emissions will be 100 percent PM_{10} .

The control for PM_{10} as well as TSP at the Facility will be through the use of a fabric filter. As discussed in Section 4.4, the past application of fabric filters on refuse combustion facilities in the United States, Canada, Europe, and Japan, and the recent increase in those which are being either permitted or proposed in the U.S. demonstrates confidence in its ability to effectively control PM. An increase in the number of refuse combustion facilities which are proposing to use fabric filters can be partly attributed to the theory that they can more effectively control the emission of submicron particulate PM_{10} . The finer PM is believed to

TABLE 4-10

LEE COUNTY ENERGY RECOVERY FACILITY
PARTICLE SIZE DISTRIBUTION DATA

Tsushima, Japan Particle Mass Size Fraction (Microns) %		Munich, North Germany Particle Mass Size Fraction (Microns) %		Wurzburg, Germany Particle Mass Size Fraction (Microns) %		Biddeford, Maine					
						Run 1 Particle Mass Size Fraction (Microns) %		Run 2 Particle Mass Size Fraction (Microns) %		Run 3 Particle Mass Size Fraction (Microns) %	
<0.6	0.0	<0.4	9.1	<0.47	52.6	<0.63	2.4	<0.63	2.4	<0.63	5.5
0.6	0.0	0.4	10.1	0.58	1.0	1.0	0.8	1.0	2.9	1.0	4.3
1.0	0.0	0.7	16.2	0.9	0.5	1.25	0.5	1.25	1.4	1.25	3.1
1.6	6.3	1.1	10.1	1.7	2.0	2.0	3.9	2.0	4.8	2.0	6.8
3.2	28.7	2.3	8.1	2.9	3.6	2.5	3.9	2.5	3.8	2.5	1.8
5.0	15.0	3.7	6.0	4.3	1.5	6.0	26.3	6.0	49.9	6.0	33.9
7.3	23.7	5.4	4.8	6.3	1.0	10.0	21.5	10.0	30.6	10.0	22.6
10.8	17.5	8.0	7.4	>12.0	37.8	15.0	23.1	15.0	4.2	15.0	14.7
17.5	8.8	12.9	9.1	—	—	20.0	17.6	20.0	0.0	20.0	7.3
>17.5	0.0	>12.9	19.1	—	—	>20.0	0.0	>20.0	0.0	>20.0	0.0
% Mass Fraction PM ₁₀		% Mass Fraction PM ₁₀		% Mass Fraction PM ₁₀		% Mass Fraction PM ₁₀		% Mass Fraction PM ₁₀		% Mass Fraction PM ₁₀	
	87.2 ^a		75.5 ^a		61.8 ^a		59.3		95.8		78.0

SOURCE: Combustion Engineering, Inc., 1989.

^aApproximation based on linear interpolation.

contain a greater concentration of heavy metals and trace organics. This theory is shared by many state regulatory agencies which require its use on refuse combustion facilities.

Consequently, the information and BACT analysis presented on the fabric filter is adequate and sufficient to determine that it also be BACT in controlling PM_{10} . The fabric filter for the Facility shall be designed and guaranteed to achieve an outlet loading of 0.010 gr/dscf corrected to 7 percent O_2 . This control level is more stringent than the limitation set forth in the recently promulgated NSPS of 0.015 gr/dscf @ 7 percent O_2 . A review of the EPA's BACT/LAER Clearinghouse shows currently permitted particulate control limits for refuse combustion facilities to be in agreement with the proposed control level for the Facility.

4.5 BACT REVIEW FOR TRACE HEAVY METAL EMISSIONS

4.5.1 PROPOSED CONTROL TECHNOLOGY

Lee County proposes that a fabric filter and a dry scrubber be BACT for regulated and non-regulated trace heavy metals. The Facility's fabric filter shall be designed and guaranteed to achieve an outlet loading of 0.010 gr/dscf corrected to 7 percent O_2 . The maximum projected emission rates for these pollutants are listed in Table 4-1 of this document.

4.5.2 COMPLIANCE WITH THE APPLICABLE STANDARDS

The Facility's emissions of regulated heavy metals (e.g., Hg, Pb, Be, and As) shall be below their applicable NAAQS or NESHAPS federal requirements, and pose no adverse potential health risks.

The NSPS require the control of metal emissions from MWCs by limiting particulate emissions to 0.015 gr/dscf @ 7 percent O_2 . The standards conclude that this would ensure good control of metals, and would be a more practical approach than setting individual limits for every metal.

The County's planned material separation program, mandated by Florida's Solid Waste Management Act, may produce a beneficial effect on the amount

of heavy metal emissions emitted from the Facility. Since little data currently exists on whether material separation leads to a demonstrable and quantifiable reduction of trace heavy metal emissions, the projected emissions from the Facility do not recognize any potential benefits.

The Facility will have an additional reagent injection control system, which may further reduce the mercury emissions. The reagent to be used has not been determined, but could be activated carbon, sodium sulfide, or some other compound. Mercury vapor which is not condensed onto particulate matter in the dry scrubber can be adsorbed onto the injected reagent particles, which are removed downstream by the fabric filter. This is an innovative technique currently being developed and tested and for which little reliable data on removal efficiencies exist. Therefore, this additional mercury control system is not being proposed as BACT, and the projected mercury emissions from the Facility do not include any additional reductions beyond what can be achieved by the dry scrubber/fabric filter system alone.

4.5.3 RATIONALE FOR PROPOSED BACT DETERMINATION

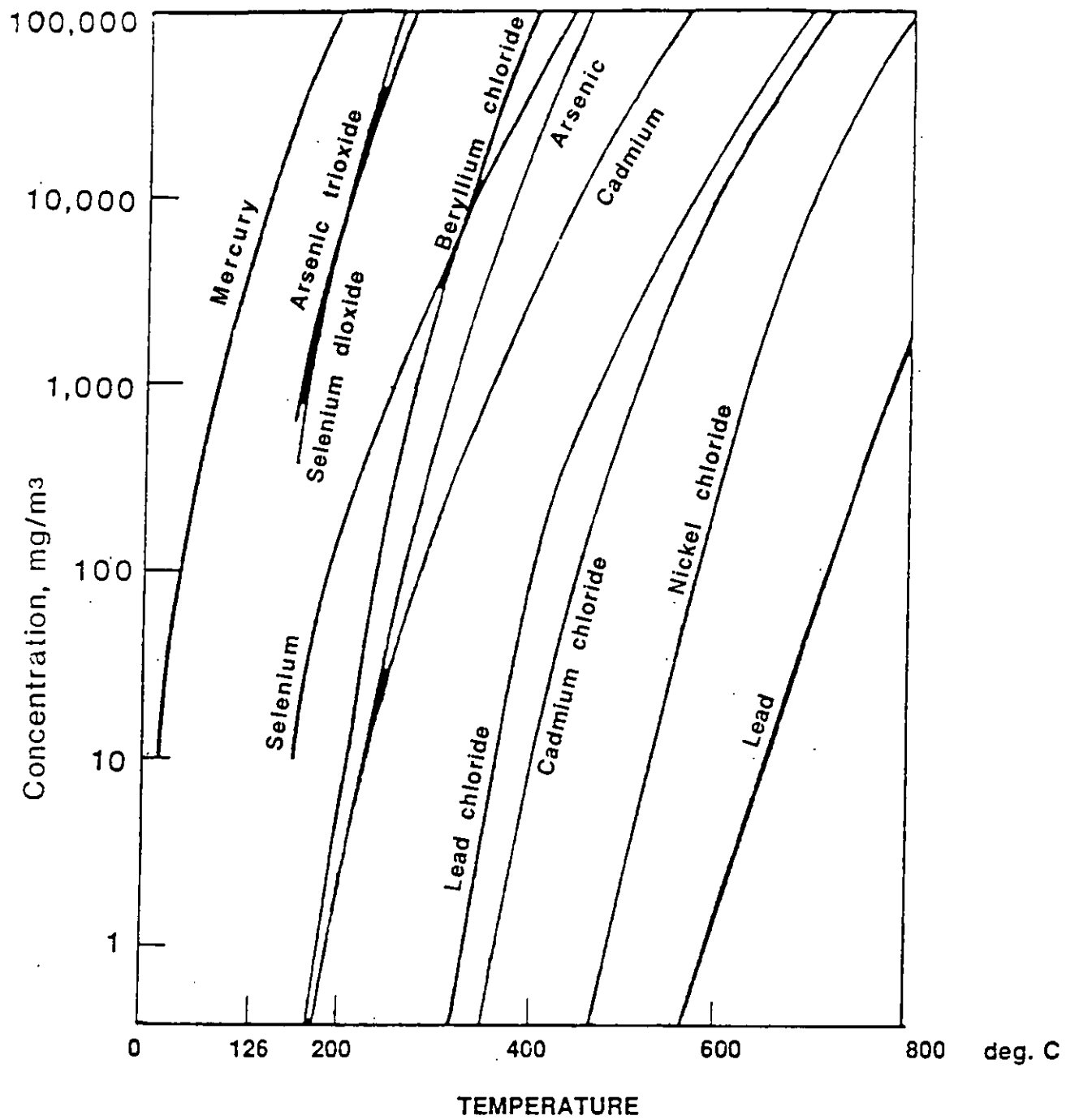
Many metals and metallic compounds are found throughout municipal refuse in various forms. Metals such as silver (Ag), chromium (Cr), lead (Pb), tin (Sn), and zinc (Zn) are used in metallic surface coatings and processes including electroplating, galvanizing, and soldering, and as stabilizers in plastics. Inks and paint pigments used for color on paper, fabric, and plastic substrates may also include such metals as cadmium (Cd), Cr, and Pb. Discarded batteries could be primary sources of mercury (Hg) and may also be a source of Pb, nickel (Ni), and Cd.

The combustion of refuse at the Facility will result in the trace emission of various metals. The quantity and characteristics of these pollutants depend on the composition of the waste, chemical and physical properties of the trace metals, operational features of the combustion process, and performance of the particulate and acid gas control devices. Trace heavy metals and their compounds found in the incombustible (inert) waste fraction may change phase, volatilize in their elemental forms, or form new compounds (e.g., sulfates, oxides, and chlorides) during the combustion

process. These compounds are not, however, destroyed by the combustion process and may leave the furnace as particulate (adsorbed and/or condensed onto fly ash), vapor, or in the bottom ash residue.

The metals and metallic compounds in the flue gas will enter the proposed particulate control device (baghouse) as solids, liquids, or vapors, depending on what temperature the flue gas has been cooled to by the proposed dry scrubber. The vaporized metal portion, if cooled to its saturation temperature, will condense and form a collectible liquid or solid. Figure 4-6 illustrates various heavy metals as they would appear in the flue gas and their relative theoretical concentrations as a function of saturation temperature. The Facility's dry scrubber will be designed to lower the flue gas temperature to approximately 260°F (127°C) before entering the fabric filter. Figure 4-6 suggests that most metal and metal compounds shall have condensed before reaching this temperature and will likely be collected by the Facility's fabric filter. The more volatile Hg, As, and selenium (Se) metal and metal compounds will be more difficult to control at this temperature.

Test data from a slipstream at the Quebec City, Canada, and Marion County, Oregon refuse combustion facilities confirm the arguments that flue gas temperature and an efficient air pollution control system (dry scrubber/particulate control device) are critical in the removal of heavy metals. Test reports from the Quebec City study, discussed earlier in the dry scrubber description of Section 4.3, indicate that over 99 percent removal (with the exception of Hg) of heavy metals [e.g., Zn, Cd, Pb, Cr, Ni, antimony (Sb), and As] by a dry scrubber/fabric filter control system was achieved. These tests indicated that Hg removal was approximately 95 percent, however, a lower percent reduction appears to be a more reasonable based on recent data evaluation. The high Hg removal efficiency data observed from the Quebec City test is believed to be due to the ash having an unusually high carbon content. Mercury is believed to adsorb onto fly ash more readily if it contains carbon. Table 4-11 presents heavy metal removal efficiency test data across the dry scrubber/baghouse system at the Marion County, Oregon refuse combustion facility. The Tsushima, Japan refuse combustion facility is also equipped with a scrubber/baghouse and



32 285 392 752 1112 1472 deg. F

┌
└ Approximate Temperature of flue gas before baghouse

SOURCE: Moeller, J.T., Jorgenson, C, And Fallenkamp, F., Feb 1983
 "Dry Scrubbing Of Toxic Incinerator Flue Gas By Spray Adsorption"

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FIGURE 4-6
SATURATION TEMPERATURE OF
METAL COMPOUNDS

TABLE 4-11

LEE COUNTY ENERGY RECOVERY FACILITY
INLET AND OUTLET HEAVY METAL EMISSION DATA
ACROSS THE DRY SCRUBBER/FABRIC FILTER AIR POLLUTION
CONTROL SYSTEM AT THE MARION COUNTY FACILITY

Substance	Inlet Concentration ($\mu\text{g}/\text{Nm}^3$)	Outlet Concentration ($\mu\text{g}/\text{Nm}^3$)	Removal Efficiency (percent)
Pb	21,408	25	99.88
Cd	1,170	3.4	99.71
Cr	465	0.2	99.96
Ni	93	3.2	96.56

SOURCE: APCA Paper: Annual Meeting June 21-26, 1987.

^aThese concentrations have been corrected to 12 percent CO₂ and are from testing at the economizer outlet.

NOTE: Average of three tests for TSP were 0.011 and 0.003 gr/dscf at 12 percent CO₂ excluding condensibles for units 1 and 2, respectively, during source testing from December 5, 1987.

has demonstrated a removal efficiency of over 99 percent for a total of 12 heavy metals at a baghouse outlet temperature of about 410°F (210°C) (also with the exception of Hg).

The trace heavy metals from the proposed Facility which are being reviewed include Pb, Hg, Be, and As. The EPA PSD regulated pollutants, Pb, Hg, and Be, are subject to the BACT requirements of the PSD regulations since their maximum projected annual emissions are greater than the PSD significant emission limits. The pollutant As is regulated by the Clean Air Act under the NESHAPS regulations. Thus, under the PSD requirements, any emission is considered significant and subject to the BACT requirements.

Of those metals which are being reviewed, As and Hg are two of the more volatile metals and are more difficult to control after being volatilized by combustion. The volatility of these metals results from the low boiling point temperatures of many of their compounds. As discussed, portions of these as well as other trace metals are expected to condense and/or adsorb onto PM as the flue gas temperature decreases. The dry scrubber will aid in their removal by cooling the gas stream, thus allowing for condensation and/or adsorption to occur. The fabric filter will then be able to remove a portion of these condensed metals.

4.5.4 BACT DETERMINATION

A fabric filter designed with an outlet loading of 0.010 gr/dscf corrected to 7 percent O₂ is proposed as BACT for PM (TSP and PM₁₀), and is proposed as BACT for trace heavy metals from the Facility when used in conjunction with a dry scrubber.

The maximum Pb emission rate from the Facility is estimated to be 6.0 x 10⁻³ pounds per ton of refuse which equates to 2.0 tpy with 100 percent availability. From the air quality analysis, this emission rate results in an incremental GLC of 0.012 µg/m³ for a 24-hour average. Since the NAAQS for Pb is 1.5 µg/m³ for a 3-month period, the Facility 24-hour maximum GLC for Pb, being a more conservative measure, is approximately 0.8 percent of the standard. Therefore, the Facility is expected to have a minimal impact on ambient air quality with respect to Pb.

The maximum Be emission rate from the Facility is estimated to be 1.35×10^{-6} pounds per ton of refuse which equates to 4.4×10^{-4} tpy. The resulting incremental GLC of Be from the Facility is estimated to be $2.79 \times 10^{-6} \mu\text{g}/\text{m}^3$ for a 24-hour averaging time. Although no NAAQS exists for Be, the National Emission Standard for Hazardous Air Pollutants (NESHAP) for Be is based on an acceptable concentration of $0.01 \mu\text{g}/\text{m}^3$ for a 30-day averaging period (40 CFR 61.32) for facilities combusting beryllium containing industrial waste, which does not apply to the Facility. Therefore, the Facility is expected to have a minimal impact on ambient air quality with respect to Be since its more conservative GLC, with respect to average time, is substantially less than the NESHAP requirement.

The Hg emissions are typically not well controlled by particulate control devices. As indicated in the recently promulgated NSPS, observed Hg removal efficiencies vary widely among MWCs. The maximum expected Hg emission rate from the Facility is estimated to be 8.0×10^{-3} pounds per ton of refuse which equates to 2.6 tpy of Hg with 100 percent availability. From the air quality analysis, this emission rate results in an incremental GLC of 0.017 $\mu\text{g}/\text{m}^3$ for a 24-hour average. The NESHAP for mercury (when co-firing with sludge which is not the case for this Facility) is based on an acceptable concentration of $1.0 \mu\text{g}/\text{m}^3$ for a 30-day averaging period (40 FR 48302, October 14, 1975). The Facility is expected to have a minimal impact on ambient air quality for Hg since its more conservative GLC, with respect to averaging time, is less than the NESHAP requirement.

The maximum As emission rate from the Facility is estimated to be 9.1×10^{-5} pounds per ton of refuse which equates to 3.0×10^{-2} tpy. The pollutant, As, does not have a NAAQS and, although it is regulated by the Clean Air Act under NESHAP, it is applicable only to glass manufacturing plants, primary copper smelters, and metallic arsenic production facilities. The Facility's emission of As is expected to have a minimal impact on ambient air quality, and the control of particulate to 0.010 gr/dscf corrected to 7 percent O_2 is determined to be BACT.

BACT for these heavy metals is a dry scrubber/fabric filter with the fabric filter having a maximum outlet grain loading of 0.010 gr/dscf corrected to 7 percent O_2 .

4.6 BACT REVIEW FOR BY-PRODUCTS OF COMBUSTION (CO, VOCs, NO_x)

As a part of EPA's Report to Congress on the Municipal Waste Combustion Study (EPA, 1987a), a set of combustion strategy elements termed "good combustion practices" were developed to minimize emissions of trace hydrocarbons which include PCDD and PCDF from MWCs. The report identified the components of good combustion practices and made "preliminary recommendations" on the values (i.e., combustion, temperature, overfire air, flue gas oxygen, and CO concentration) of these individual components. The following practices have been reviewed by trade and professional organizations such as the American Society of Mechanical Engineers and the American Boiler Manufacturers Association.

<u>Practice</u>	<u>Mass-Burn Preliminary Target</u>
Design temperature	1,800°F at fully mixed height.
Underfire air control	At least four separately adjustable plenums. One each under the drying and burnout zones, and at least two separately adjustable plenums under the burning zone.
Overfire air capacity	40 percent of total air.
Overfire air injector design	That required for penetration and coverage of furnace cross-section.
Auxiliary fuel capacity	That required to meet start-up temperature and 1,800°F criteria under part-load operations.
Excess Air	6 to 12 percent excess oxygen (dry basis).
Turndown restrictions	80 to 110 percent of design; lower limit may be extended with verification tests.

<u>Practice</u>	<u>Mass-Burn Preliminary Target</u>
Start-up procedures	On auxiliary fuel to design temperature.
Use of auxiliary fuel	On prolonged high CO or low furnace temperature.
Carbon monoxide in flue gas (continuous monitor)	50 ppm on four-hour average corrected to 12 pursuant CO ₂ .
Furnace temperature (continuous monitor)	Minimum of 1,800°F (mean) at fully mixed height across furnace.
Adequate air distribution	Verification test.

Although the combustion optimization strategy recommends preliminary values for carbon monoxide and hydrocarbon compounds, combustion optimization is expected to have little beneficial impact on acid gas and particulate matter emissions, and may increase emissions of NO_x and metals. EPA's recently promulgated NSPS recognizes emission levels for specific pollutants (e.g., CO) that differentiate among combustion technology designs, as opposed to the preliminary levels determined in EPA's 1987 Report to Congress.

4.6.1 BACT DETERMINATION FOR NITROGEN OXIDES (NO_x)

Proposed Control Technology

BACT for NO_x depends, in part, on combustor design. The recently promulgated NSPS recognize this by identifying several different control technology bases for the NO_x emissions limitation, such as use of post-combustion control and/or combustor design. Because the County has chosen a mass-burn stoker waterwall design, it will include Selective Non-Catalytic Reduction (SNCR) flue gas technology, consistent with the NSPS, to remove 45 percent of the NO_x emissions from the flue gas. This control level is based on short-term testing and continuous emission monitoring data from three MWC plants in California with SNCR as indicated

in the proposed NSPS background documents. The recently promulgated NSPS indicate that SNCR at 45 percent NO_x removal is the best demonstrated flue gas control technology for stoker waterwall units.

The County's planned material separation program, mandated by Florida's Solid Waste Management Act, may reduce the amount of NO_x emissions emitted from the Facility. Data to demonstrate any potential benefits is currently limited and not sufficient, thus no adjustment or reduction was made to the Facility's projected NO_x emissions (see Table 4-1).

Compliance with Applicable Emission Standards

The Facility's NO_x emissions will be below the applicable NAAQS/FAAQS requirements, and will meet the final promulgated NSPS requirements for MWCs. The NSPS gives daily average a NO_x emission limitation of 180 ppmdv @ 7 percent O₂. Properly located and installed NO_x CEMs will comply with the NO_x monitoring requirements established in the NSPS.

4.6.2 EMISSION OF NITROGEN OXIDES

Nitrogen oxides (NO_x) are products of all air-oxidized combustion processes including refuse combustion. The predominant form of NO_x which is produced during combustion is nitric oxide (NO); nitrogen dioxide (NO₂) is also produced in lesser amounts. Upon exiting the stack essentially all of the NO formed during combustion is further oxidized to form NO₂. The resulting NO₂ is a brownish-red gas which, in the presence of sunlight and hydrocarbons, can react to form ozone (photochemical smog) and other secondary pollutants.

NO_x emissions are classified according to the source of the nitrogen from which the NO_x is formed. Nitrogen from combustion air produces "thermal NO_x," while that which originates from organically bound components in refuse produces "fuel NO_x." Though the precise mechanisms involved in converting fuel nitrogen to NO_x are not completely understood, the relative quantities of fuel NO_x and thermal NO_x produced are known to be functions of furnace design, refuse composition, and plant operating conditions.

The two major factors affecting the formation of thermal NO_x are the oxygen concentration present in the combustion zone and the flame temperature. The rate of NO_x formation has been shown to be linearly dependent on the oxygen concentration when temperature is constant. Additionally, NO_x formation tends to increase significantly with increasing temperature (at temperatures approximately above $2,100^\circ\text{F}$) in the presence of O_2 . In addition to these characteristics, NO_x formation increases linearly with increasing residence time at temperatures conducive to thermal NO_x formation (Russell and Roberts, 1984).

The mechanisms involved in the formation of fuel NO_x appear to be very complex and are not yet well understood. Studies have correlated the rate of fuel nitrogen conversion with the fuel oxygen-to-nitrogen ratio (Singer, 1981). In addition, fuel NO_x formation is dependent on underfire and overfire combustion air, total excess air rates, and mixing of the fuel and combustion air (CARB, 1984).

Local combustion conditions in the combustor, specifically how and at what temperature combustion air and refuse are mixed, directly affect the levels of thermal and fuel NO_x produced. NO_x levels from various refuse combustors are given in Table 4-12. The data summarize test results from recently constructed refuse combustion facilities which employ mass-burn stoker waterwall and mass-burn rotary waterwall design (EPA, August 1989). Average NO_x emissions from mass-burn waterwall facilities were approximately 236 ppm corrected to 7 percent O_2 .

Current combustion practices emphasize furnace operation at high temperatures with thorough mixing to minimize emission of organic compounds (PCDD/PCDF). Consequently, NO_x emissions tend to be higher from modern facilities (EPA, May 1987). Also, NO_x is one of the more difficult and expensive pollutants to control from the combustion process because of the low reactivity and low solubility of NO which comprises 95 percent or more of the total uncontrolled NO_x (Brna et al., 1988).

TABLE 4-12

LEE COUNTY ENERGY RECOVERY FACILITY
AVERAGE NO_x EMISSIONS FROM RECENTLY CONSTRUCTED
REFUSE COMBUSTION FACILITIES

Facility ^a	Unit Size, tpd	Test Date	Percent O ₂	NO _x ppm	NO _x ppm @ 7% O ₂
<u>Mass-Burn Rotary Waterwall:</u>					
Gallatin	100	02/81	9.1	124.2	146.1
Kure	165	11/80	12.0	105.6	164.9
<u>Mass-Burn Stoker Waterwall:</u>					
Peekskill	750	11/85	11.7	156.7	236.3
Hampton 2	100	06/88	9.5	194.7	238.6
Marion County 2	275	06/87	9.6	196.9	244.3
Long Beach (deNO _x off)	460	11/88	10.2	52.4	68.2
Commerce (deNO _x off)	300	06/87	10.0	121.0	154.3
Baltimore 3	750	01/85	11.1	136.3	193.7
Baltimore 2	750	01/85	12.1	122.3	193.9
Alexandria	325	12/87	9.4	171.3	207.8
Claremont 2	100	05/87	11.4	144.9	210.2
Peekskill	750	04/85	NR	NR	218.3
Hampton 1	100	06/88	11.0	156.3	219.2
Nashville Thermal	360	NR	10.6	164.0	221.4
Baltimore 1	750	01/85	12.0	141.8	222.0
Millbury 2	750	02/88	10.5	169.3	225.7
Millbury 1	750	02/88	10.3	177.5	233.7
Claremont 1	100	05/87	12.2	161.0	258.8
Wurzburg	330	12/85	NR	NR	260.7
Marion County 2	275	09/86	10.6	211.8	284.9
Pinellas County	1,000	02/87	9.2	240.8	285.7
Stanislaus 1 (deNO _x off)	400	12/88	NR	NR	297.0 ^b
Stanislaus 2 (deNO _x off)	400	12/88	NR	NR	304.0 ^b
Quebec City	250	03/85	11.6	205.4	314.0
Tulsa 1	375	06/86	9.2	308.5	367.7
Tulsa 2	375	06/86	8.6	328.2	372.2

SOURCE: EPA NSPS Background Document, Control of NO_x Emissions, August 1989.

^a The number following the site name indicates the combustor train number. It is provided if different combustor trains were evaluated as part of the same test. (Presume data from the other combustor trains were not available to report.)

^b ppm NO_x at 12 percent CO₂.

NR = Not Reported

4.6.3 DESCRIPTION OF NO_x CONTROL TECHNIQUES

Emissions of NO_x from refuse combustion can potentially be reduced by three methods: reducing the refuse nitrogen content (material separation); minimizing the quantity of NO_x produced during combustion (combustion modification); and reducing the quantity of NO_x in the post combustion flue gas stream (flue gas controls).

Table 4-13 is a summary of the potential NO_x control techniques which may be used at refuse combustion facilities. The information also presents the current status and the projected control efficiency of each method.

Summarizing, since current EPA or other data on material separation is not sufficient, combustion modifications and flue gas controls for minimizing NO_x emissions were the only NO_x controlling methods evaluated. Each method was evaluated using "top down" BACT methodology. A comprehensive description and technical evaluation of each technology is presented in the following paragraphs.

Flue Gas NO_x Controls

Flue gas controls appear to offer the greatest potential for reducing NO_x emissions from combustion processes, though their application on refuse combustion facilities has been limited. The controls which have been applied to combustion processes are selective catalytic reduction (SCR) and selective non-catalytic reduction (SNCR). The SNCR process involves the intimate contact of a nitrogen containing reagent such as ammonia (NH₃) or urea with flue gas NO_x in the boiler through the use of injectors located in the boiler's wall. Like SNCR, the SCR technology also injects NH₃ into the flue gas, however, the reaction of NH₃ with NO_x occurs at a lower temperature and is enhanced by using a catalyst bed.

SCR - The SCR process reduces NO to water and elemental nitrogen by injecting anhydrous NH₃ into the flue gas and then passing the flue gas through a catalyst bed. The function of the catalyst is to effectively lower the activation energy of the NO in its decomposition reaction to N₂.

TABLE 4-13

LEE COUNTY ENERGY RECOVERY FACILITY
ALTERNATE NO_x CONTROL TECHNIQUES

Control Method	Percent Reduction	Status
<u>Flue Gas Controls:</u>		
1) Selective catalytic reduction	25-80	Not yet applied successfully on a refuse combustion facility in the U.S., and significant technical disadvantages associated with application.
2) Selective non-catalytic reduction (SNCR, for example Thermal DeNO _x)	30-50	Somewhat successful, but with limited application, as explained in text.
3) Wet flue gas denitrification (FGDn)	Unknown	Not yet applied successfully to refuse combustion facility.
<u>Combustion Modification:</u>		
1) Staged combustion/low excess air	30-60	Effective. The percent reduction values in the high end of the range represent those of a mass-burn rotary waterwall combustor.
2) Gas (pilot program) reburning	10-60	Has shown considerable promise on pilot programs. Not yet applied to a full-scale refuse combustion facility.
3) Flue gas recirculation	10-20	Somewhat effective.
Material Separation	Unknown	Not demonstrated.

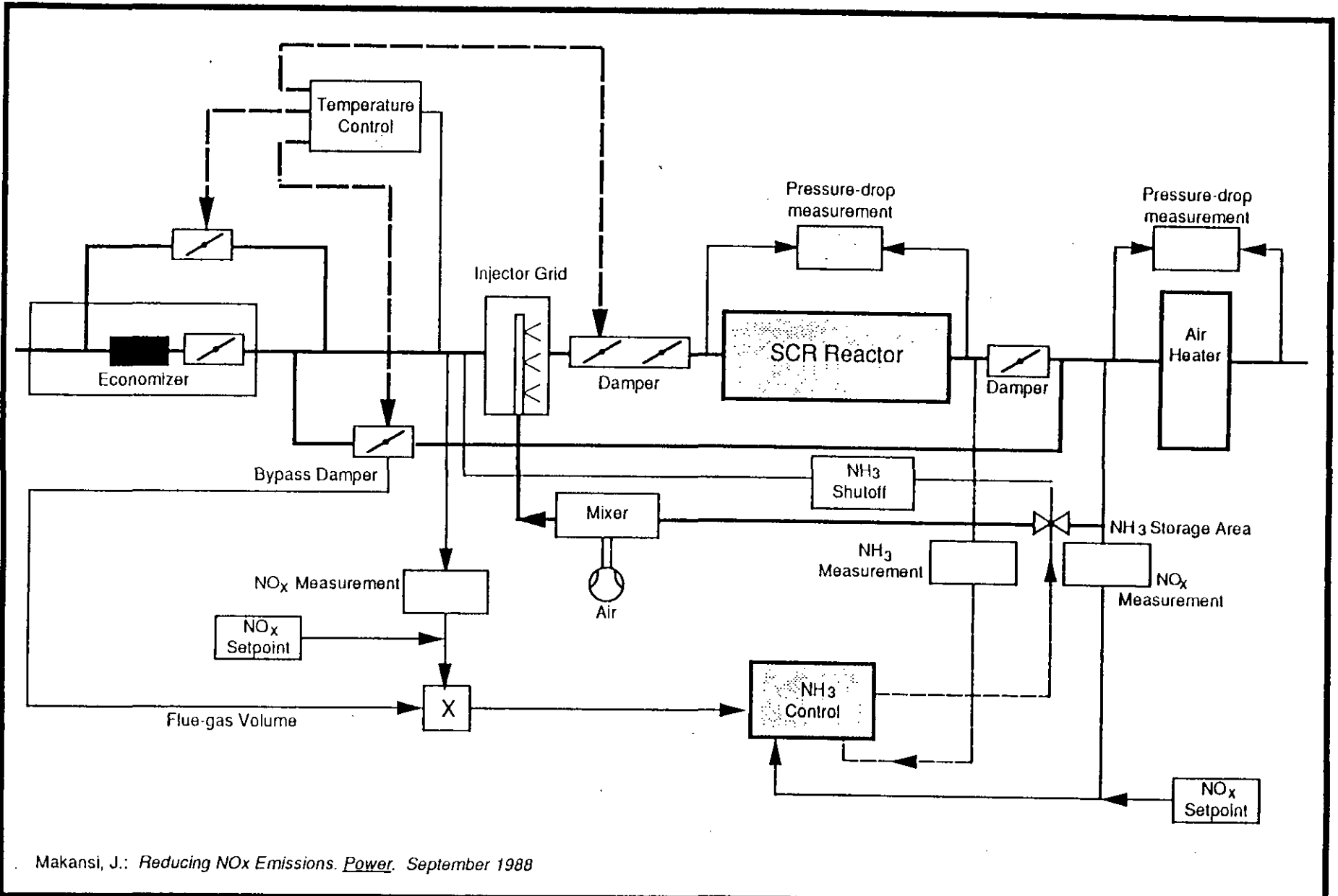
This lower energy allows the reaction to proceed in a lower and broader temperature range than would otherwise be possible. The optimum temperature for NO_x reduction using SCR is between 288 and 399°C (550 and 750°F) (Hahn, 1986). Lower temperatures yield slow reaction rates; higher temperatures result in a shortened catalyst life.

In a typical SCR system, anhydrous NH_3 is injected into the flue gas stream and allowed to pass through a catalyst bed located, depending on the application, just downstream of the economizer or after the air pollution control equipment. Figure 4-7 presents a typical SCR process which would likely be applied on a fossil fuel boiler. Important parameters for successful NO_x removal using the SCR technology include adequate mixing of the flue gas with NH_3 , as well as control of the NH_3 injected based on inlet NO_x concentration and removal rate (Makansi, 1988).

Currently, there is considerable worldwide commercial experience with SCR technology on oil, gas, and coal-fired boilers. Depending on the application, removal efficiencies of up to 90 percent have been achieved (Makansi, 1988). SCR experience on refuse combustors, on the other hand, is extremely limited with no applications in the United States.

Application of SCR technology to refuse combustors is difficult mainly due to the acid gas content and relatively high particulate grain loading of the flue gas. These flue gas components erode the catalyst and substrate material as well as poison or blind the catalyst rendering the bed ineffective for NO_x removal. If these problems are to be avoided, then the SCR reactor must be located downstream of the air pollution control equipment, however, the gas is then below the optimal SCR temperatures. Therefore, SCR operation with the catalyst bed after the pollution control equipment would have significant economic disadvantages since it would require reheating of the flue gas prior to entering the bed (Radian, 1989).

Although there are no refuse combustors in the United States which employ SCR technology, it is currently being used to control NO_x emissions from two refuse combustors in Japan and is being installed at a facility in West Germany. The Tokyo-Hikarigaoka facility was retrofitted with an SCR system



Makansi, J.: *Reducing NO_x Emissions. Power. September 1988*

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FIGURE 4-7
 SCHEMATIC OF A TYPICAL SCR PROCESS

designed to achieve a NO_x removal efficiency of 51 percent. The system, operating since December of 1986, has not always been able to meet its design removal efficiency. Test data (see Table 4-14) show control efficiencies ranging from 25 to 57 percent. The Twatsuki refuse combustor was equipped with SCR technology in February of 1987. This system was designed for a control efficiency of 80 percent but has performed with an average efficiency of 77 percent (Mitsubishi, 1987). The first West German SCR installation associated with a refuse combustor is currently under construction on the Martin Munich-South plant.

The SCR technology currently offers the greatest potential for controlling NO_x emissions from refuse combustion facilities; however, its application has been limited due mainly to technical difficulties. A more detailed discussion of the technical disadvantages associated with the SCR technology are presented as follows.

- o Emission of Unreacted NH_3 - A small amount of residual ammonia will be emitted as the result of SCR operation. This "ammonia slip" is likely to increase over time as the catalyst loses activity, thus increasing quantities of NH_3 must be injected into the boiler to maintain the desired NO_x removal. If the SCR system is installed downstream of the air pollution control (APC) system, the APC system cannot be relied on to remove residual NH_3 .
- o Potential for Undesirable Side Reactions - The catalyst used to enhance the conversion of NO to nitrogen and water tends to convert SO_2 to SO_3 which may further react with residual NH_3 and water to form ammonium bisulfate and ammonium sulfate. These solids can foul and plug downstream equipment (if the catalyst is installed upstream of pollution control equipment) or create a blue haze plume (Makansi, 1988). Also, in refuse combustion applications there exists the potential for ammonium chloride formation which is difficult to remove with current air pollution control technologies and has caused a visible plume (Russell and Roberts, 1986).

TABLE 4-14

LEE COUNTY ENERGY RECOVERY FACILITY
OBSERVED CONTROL EFFICIENCY ASSOCIATED WITH SCR
INSTALLATIONS AT TWO REFUSE COMBUSTORS IN JAPAN

Facility	Reactor Inlet Temp (°C)	No. Emissions (ppm) ^a		Removal Efficiency(%)
		Inlet	Outlet	
Twatsuki	196	123	30.2	75.4
	198	129	25.6	80.2
	204	129	29.4	77.2
	198	195	38.0	70.2
	202	173	26.2	84.9
	205	138	41.2	70.2
	202	110	15.0	86.4
	205	100	16.0	84.0
	200	130	30.0	76.9
	207	120	45.0	62.5
	200	160	36.0	77.5
	203	130	29.0	77.7
	Tokyo-Hikarigaoka	248	96	63.0
248		95	47.0	50.5
246		106	79.0	25.5
244		104	60.0	42.3
245		93	42.0	57.1
246		101	47.0	53.5

SOURCE: Mitsubishi, 1987.

^aCorrected to 12 percent CO₂.

- o Poisoning and Degradation of the Catalyst by Particulate - Particulate matter in the flue gas generated by refuse combustors will erode the catalyst and substrate material. In addition, constituents of particulate matter, particularly the metals, may poison the catalyst. Both catalyst erosion and poisoning dramatically reduce the life of the catalyst resulting in lower NO_x removal efficiencies and high catalyst replacement costs. These problems are avoided if the catalyst bed is installed after the pollution control equipment; however, flue gas reheating is necessary at a significant economic disadvantage.
- o Disposal of Toxic Catalysts - Most of the catalysts which are currently available for SCR applications are made of various metals including copper, chromium, nickel, molybdenum, cobalt, platinum, and vanadium, and may be considered hazardous waste (Makansi, 1988).
- o High Cost of SCR Technology - Both initial capital cost and annual operating costs for SCR technology are high. The available catalysts are extremely expensive, and when replaced can cost 50 percent or more of the initial total capital cost (Russell and Roberts, 1986). In addition, because the application of SCR on a refuse combustor requires locating the catalyst bed downstream of the air pollution control system, reheating of the flue gas stream is required. This reheat is a significant economic disadvantage and can account for as much as eight percent of the heat released from the furnace (Clarke, 1989).

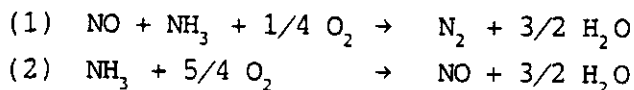
Currently, new and improved catalysts are being studied to remedy the major disadvantages of applying the SCR technology to refuse combustors. Until the time when such catalysts are introduced, SCR will remain a very impractical and expensive NO_x control method for refuse combustors.

In conclusion, due to the significant disadvantages, the SCR technology can not be considered as a viable means of controlling NO_x emissions from refuse combustors. Therefore, in accordance with the "top down" BACT

methodology, the technology is determined not to be feasible on MWCs and no further analysis on this technology was performed.

SNCR - The SNCR technology is currently the only other commercially available NO_x flue gas control technology. The process involves the contact and reaction of flue gas NO_x with NH₃ or another nitrogen based compound such as urea. Currently, commercially available SNCR processes are offered by Exxon and Fuel Tech under the tradenames of "Thermal DeNO_x" and "NOxOUT," respectively. The proposed NSPS technical support document on NO_x identifies these SNCR processes; however, the EPA focused only on Thermal DeNO_x.

In Exxon's Thermal DeNO_x process, anhydrous NH₃ is injected into the hot flue gas with either air or steam acting as a carrier gas (see Figure 4-8). The following two reactions govern the NO_x control process:



Critical to the success of the SNCR process is the prevailing flue gas temperature at the point of NH₃ injection. Over the optimum temperature range of approximately 870 to 980°C (1,600 to 1,800°F), the first reaction dominates and NO is reduced without any further NO production. At temperatures above 980°C (1,800°F), the second reaction becomes more significant, and at temperatures above 1,200°C (2,200°F), the second reaction dominates creating more NO than is reduced. In addition, at flue gas temperatures below 870°C (1,600°F), the rate of both reactions slows down such that NH₃ does not react, and instead passes through the system and potentially into the ambient atmosphere.

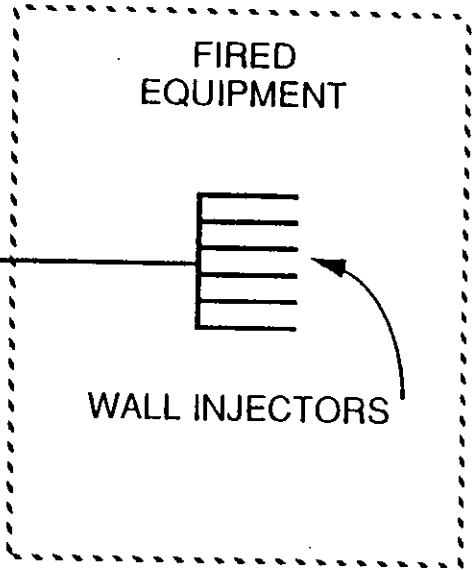
Fuel Tech's NOxOUT is a relatively new technology in which urea, instead of NH₃, is fed to the boiler as a 50 percent-by-weight solution cut with water to maintain the required volumetric flow rate to give adequate distribution across the boiler. NO_x control is affected using essentially the same net chemistry as Exxon's Thermal DeNOx. The overall reaction between urea and NO can be expressed as follows:

LIQUID AMMONIA

AMMONIA
EVAPORATOR

CARRIER FLUID

STEAM or AIR

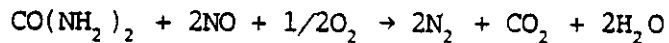


TWO ZONES/FURNACE

Makansi, J. Traditional Control Processes Handle New Pollutants.
Power. October, 1987.

LEE COUNTY
ENERGY RECOVERY FACILITY
Application for Power Plant Site Certification
Camp Dresser & McKee Inc

FIGURE 4-8
GENERAL SCHEMATIC OF THE THERMAL DeNO_x PROCESS



The NOxOUT reaction takes place at a temperature range similar to that of Thermal DeNO_x (i.e., approximately 870 to 980°C); however, NOxOUT's technology manufacturer claims to be able to expand the temperature range to 700°C (1,300°F) with the use of a proprietary urea additive.

While the chemistry of the urea reaction with NO_x is not understood as well as the NH₃ reactions, some experts feel that the mechanics of the urea injection process may have some advantages over NH₃ injection. Urea/water injection parameters such as droplet size and concentration can be more easily matched to furnace temperature, thus this method may have better load-following capability.

The manufacturer of the NOxOUT technology claims to achieve NO_x removal efficiencies similar to, if not greater than, those achieved by Exxon's Thermal DeNO_x process, and to operate at a wider flue gas temperature range without effecting efficiency. To date, the NOxOUT process has been only tested on a limited number of MWCs worldwide. The Millbury, MA mass-burn stoker waterwall combustor was tested in August of 1989 for only one week with the NOxOUT technology and obtained removal efficiency results comparable to the Thermal DeNO_x process. The purpose of the test was to determine overall NO_x removal efficiencies, and no data was obtained to support the manufacturer's claim of being able to operate over a wider flue gas temperature range without effecting efficiency. Claims made by the NOxOUT manufacturer can not be supported without long-term operating data on full-scale and representative MWCs. Since Fuel Tech's NOxOUT technology has not been installed and proven on a refuse combustor and only limited short-term data exists, the remainder of the SNCR analysis concentrates on Thermal DeNO_x.

Thermal DeNO_x has been commercially applied to both utility and industrial boilers burning fuels such as wood waste, oil, coal, and used tires. Virtually all of the installations are located in the United States (California), Japan, and West Germany. The process was installed on an oil-fired utility boiler rated at 230 MW in Los Angeles, California during

1985 and showed varying removal efficiency with boiler load. NO_x concentration reductions from 28 to 45 percent were observed at 160 MW, while higher efficiencies of 30 to 53 percent were observed at the maximum boiler load of 230 MW (ESA, 1986). Below 160 MW, temperatures at the NH_3 injection zones were too low to support the NH_3 -NO reaction, and resulted in unacceptably high ammonia emissions. Therefore, NH_3 was injected into the boiler at loads above 160 MW.

Thermal De NO_x has been installed on several refuse combustion facilities in Japan and recently on three facilities in southern California—Commerce, Stanislaus, and Long Beach. All three California facilities are located in nonattainment areas for NO_2 and/or ozone and Thermal De NO_x represents lowest achievable emission rate (LAER) technology. The Commerce facility was the first U.S. refuse combustor installation to use the SNCR technology and was permitted as an "Innovative Technology."

In many applications, and especially refuse combustion, the major limitation of the SNCR technology is the fact that the chemistry works well only in a very narrow temperature range. While the chemistry is capable of achieving very high NO_x reductions at its ideal optimum temperature, in application it must be used on a flue gas whose temperature varies. In practice, flue gas temperature variations make the NO_x reduction that the SNCR technology can provide significantly less than could be achieved at optimum temperatures.

The adverse effect of temperature variations on NO_x removal is of particular concern in the application of SNCR on refuse combustion. The BTU content of refuse is far more variable than that of fossil fuels. If a fossil fuel fired unit is operated at a constant fuel rate, then the rate at which heat is released is also constant, and the temperature in the unit is more uniform than that observed from refuse combustors. A refuse combustor operated at a constant feed rate will have a variable rate of heat release, and therefore the temperature at any given point will vary considerably. In short, temperature variations will adversely affect the NO_x reduction achieved by the SNCR process.

The BTU content of refuse varies from one ton to the next, and even within a single ton of refuse there are regions of varying BTU content. Thus, when the refuse burns, it does not produce a combustion gas of uniform temperature, but rather a random mixture of hot and cool gases. As combustion gases pass the point at which NH_3 or other nitrogen containing reactant is injected from the SNCR process, temperature variations from one point in the injection plane to another continuously occur.

The composition of the gas stream also determines the effectiveness of the SNCR process. The presence of CO, above approximately 100 ppm, adversely effects SNCR chemistry. The presence of CO in the combustion gases causes a shift and reduction in the effective NO_x/NH_3 reaction temperature range. The CO interference adversely effects the NO_x percent reduction that would have otherwise been expected. Further, the presence of injected NH_3 in the combustion gas can retard and/or inhibit the final oxidation of CO to CO_2 , thereby potentially leading to increased CO stack emissions. This phenomenon occurs because the critical step in CO oxidation, $\text{CO} + \text{OH} \rightarrow \text{CO}_2 + \text{H}$, is retarded because NH_3 competes effectively for OH via the reaction $\text{NH}_3 + \text{OH} \rightarrow \text{NH}_2 + \text{H}_2\text{O}$ (Lyon, 1987).

Although the SNCR technology was installed, due to nonattainment conditions, at three refuse combustion facilities in California, the technology presents several environmental and technical disadvantages for use on a refuse combustion system. These disadvantages are as follows.

- o Residual NH_3 or other nitrogen containing reactant may react with acid gases in the boiler to form by-product ammonium salts. Two of the salts formed, ammonium sulfate and ammonium bisulfate, could potentially cause fouling and corrosion problems in the boiler. A third salt, ammonium chloride, forms a visible blue-white plume downstream of the facility stack and has been witnessed at all three facilities in California (EPA, August 1989). The formation of a visible ammonium chloride plume has also been reported at Japanese refuse combustion facilities, particularly at the Kawasaki facility.

- o The process inhibits and/or halts the oxidation of CO emissions. During testing at the Commerce facility, increased CO emissions were observed during operation of the Thermal DeNOx system.
- o Residual reactant emissions (ammonia or other nitrogen containing compounds) are emitted as a result of the SNCR process.
- o Achieving and maintaining the required reaction temperature is difficult in refuse combustion applications. If the temperature range is not maintained, then efficiency is effected.
- o Storage of large amounts of anhydrous ammonia, which is a hazardous substance, on the site.

Wet Flue Gas Denitrification (FGDn) - FGDn systems may be divided into at least four major process systems: (1) absorption-reduction, (2) oxidation-absorption, (3) absorption-oxidation, and (4) oxidation-absorption-reduction (OAR). Absorption-reduction has only been bench-scale or pilot-scale tested on emissions from oil-fired units. Oxidation-absorption and absorption-oxidation are even less developed than absorption-reduction. Therefore, OAR, a derivative of an already established flue gas desulfurization system, shall be the only FGDn technique examined further.

OAR operates by injecting oxidizing agents such as ozone (CARB, 1984) into the flue gas upstream of wet scrubbers. The relatively insoluble NO oxidizes to the more soluble NO₂ which, when in solution, reduces to N₂ by consuming some of the absorbed SO₂.

It is possible to modify conventional flue gas desulfurization systems that use water soluble SO₂ absorbents by adding oxidizing agents which circulate with the scrubber fluid. Simultaneous NO_x and SO₂ removal efficiencies as high as 90 percent may be achieved (CARB, 1984). Such modified flue gas desulfurization systems may be applicable to refuse-fired boilers (Beaumont, 1986). For example, a municipal refuse/sewage sludge combustor at the Krefield Plant in West Germany is equipped with a two-field ESP upstream of a multi-stage acid gas wet scrubbing tower. As reported by

Beaumont, test results have shown 97.0 percent SO₂ removal and 63.9 percent NO₂ removal using Na₂CO₃ as the reagent. Other performance data are scarce because few commercial scale refuse-fired boilers are equipped with these systems.

Disadvantages of these systems stem from the cost of the oxidizing agents, wastewater treatment associated with wet scrubber effluent, and flue gas reheat requirements. The oxidation-absorption-reduction processes have not been demonstrated on a wide-scale to be technically reliable nor economically sound, and therefore cannot be considered BACT.

Combustion Modifications

Combustion modification techniques can be used to reduce the conversion rate of fuel nitrogen to NO_x and suppress thermal NO_x formation as well. Three methods—staged combustion/low excess air, flue gas recirculation (FGR), and natural gas reburning—are means to reduce NO_x emissions.

Staged Combustion/Low Excess Air - These techniques may be used separately or together to control NO_x emissions. During staged combustion, air and fuel mixtures are combusted in two separate zones. In one zone, the fuel is fired with less than a stoichiometric amount of air thereby preventing the oxidation of fuel bound nitrogen. This creates a fuel rich local zone in the regions of the primary flame. The second zone is an air rich zone where the remainder of the combustion air is introduced to complete the combustion of the fuel. The heat in the primary flame zone is not as intense as with normal firing because combustion is incomplete. The air mixed with fuel is sub-stoichiometric in the NO_x forming region of the flame, thus creating a low NO_x condition (Joseph and Beachler, 1981).

Similar to staged combustion, combustor operation at low excess air reduces the oxygen available in the NO_x forming region of the flame, thereby inhibiting the formation of thermal NO_x.

Staged combustion reduces NO_x emissions by a combination of several factors. First, a lack of available oxygen for NO_x formation in the fuel

rich stage is due to off-stoichiometric firing. Second, the flame temperature may be lower in the first stage than with single-stage combustion. Third, the peak temperature in the second stage (air rich) is lower. This slow combustion air and fuel (refuse) mixing process assists in converting fuel bound nitrogen to molecular nitrogen rather than NO_x .

A mass-burn rotary waterwall design incorporates staged combustion techniques along with low excess air to achieve NO_x emissions which are much lower than those from a mass-burn stoker waterwall design. The overfire air in the rotary combustor enters with very low radial velocity and slowly mixes with hot fuel gases coming up from the burning bed. The volatile fuel fragments, including volatile fuel nitrogen components, are driven from the bed early--near the entrance to the barrel--and then must flow down the barrel toward the radiant chamber. The overfire air mixes slowly and the more slowly evolving fuel fragments are constantly being added to the gases, giving an opportunity for the fuel-bound nitrogen to be converted to N_2 .

The County has selected a vendor which designs and builds stoker waterwall combustor systems, rather than rotary waterwall combustor systems. Therefore, the inherent NO_x -reducing features of the rotary waterwall design will not be incorporated into the proposed Facility.

FGR - In FGR, a portion of the flue gas stream is extracted and returned to the furnace. The system consists of an FGR fan assembly, air apportioning and mixing system, and necessary ductwork. Because the recirculated flue gas is relatively cool, the bulk furnace temperature decreases, resulting in a reduced thermal NO_x formation. FGR reduces NO_x emissions by lowering the flame temperature and reducing available oxygen. Although FGR is a technique designed to reduce thermal NO_x , the system can also aid in slightly reducing fuel NO_x by providing a means of staging the combustion process.

To date, FGR has been employed on a limited basis on refuse combustion facilities in the United States; however, FGR has been applied on refuse combustion facilities in Japan and Europe by ducting cool flue gas from a

point after the air pollution control device back to the underfire air fan. Results from tests conducted at the 660-tpd Volund refractory wall furnace at the Kita refuse combustion facility in Japan indicated that 10 to 25 percent NO_x emission reductions were achievable (Radian, 1989). This level of NO_x reduction was achieved by recirculating an amount of flue gas equivalent to 20 percent of the combustion air. Other full-scale applications of FGR technology include the Copenhagen Amager and Copenhagen West facilities, where flue gases from 293 to 349°C (560 to 660°F) are recirculated to the furnace from the exit of the ESPs with successful results (Clarke, 1989).

The disadvantages of using FGR technology for controlling of NO_x emissions from refuse combustion facilities include the following.

- o Recirculation of the cooled flue gas stream reduces the boiler efficiency by decreasing the furnace gas temperature, and could cause unstable combustion.
- o Reduced flame temperature and dilution of available oxygen may result in conditions which are conducive to higher emissions of incomplete combustion.

Little data is available to support that FGR will substantially improve NO_x control when used in conjunction with the proposed combustion technologies. Thus, FGR is not considered BACT for this Facility.

Natural Gas Reburning - Gas reburning is a NO_x control technique that overlaps combustion modification techniques. Low excess air (LEA) is provided at the combustor grate, with recirculated flue gas introduced above the grate. Natural gas is added to this LEA zone to generate a fuel-rich zone. Air is supplied above the fuel-rich zone to complete combustion. This process is designed to reduce NO_x formation without increasing CO emissions.

Natural gas reburning is a new technology being evaluated by the Gas Research Institute for possible use on refuse combustors. The goal of gas

reburning is to achieve up to 75 percent NO_x reduction. To date, most of the data on natural gas reburning are for pulverized coal-fired boilers. (Radian, 1989).

Gas reburning has achieved 10 to 60 percent reduction of NO_x emissions on a pilot facility. This new technique has not been demonstrated on a full-scale refuse combustor at this time. Although the technology is promising, it can not be considered as BACT.

4.6.4 EVALUATION OF NO_x CONTROL TECHNIQUES

The NO_x control techniques discussed earlier indicate that the SCR technology can be considered the "top" control method; however, it is not considered to be a viable BACT alternative. An evaluation of the SCR technology revealed that it has not been applied and demonstrated successfully on a refuse combustion facility in the U.S., and its application presents significant technical and economic disadvantages as stated in the proposed NSPS. Hence, the SCR is not considered BACT.

The application of SNCR can be considered the next "top" or most stringent NO_x control technique. The SNCR thermal DeNOx technology has been operating on several refuse combustion facilities in Japan and on three in Southern California. As discussed in the SNCR description above, the technology has certain operating limitations and the potential for operating problems, such as temperature variability sensitivity, formation of corrosive salts, and increased CO emissions. However, the technology has been shown to achieve approximately 45 percent reduction on refuse combustors. The technology has also been determined by the EPA, as discussed in the NSPS, to be the best demonstrated technology for meeting the NSPS NOx emission level of 180 ppm_{dv} (24-hour average). SNCR is determined to be BACT for NOx emissions from the proposed Facility.

[NOTE: Eleven pages of material have been deleted here.]

4.6.5 BACT DETERMINATION FOR NO_x

The analysis presented on the different NO_x control techniques and technologies indicates that SCR has the potential of achieving LAER, however, its application on MWCs has significant operating and economic disadvantages. As stated in this analysis and reiterated in the recently promulgated NSPS, the performance of SCR technology on MWCs, as opposed to oil or gas fired combustors, is detrimentally effected by catalyst "poisoning." The flue gases from MWCs contain acid gases, metals, and high particulate loadings which poison the expensive catalyst causing it to be less effective and to require frequent replacement. SCR technology is not considered BACT.

As concluded by EPA in issuing the final NSPS (see Federal Register, February 11, 1991, p. 5490), SNCR or achievement of NO_x emission levels comparable to the use of SNCR represents best demonstrated technology for reducing NO_x emissions. The evaluation of the different NO_x control techniques and technologies presented herein concurs with the NSPS conclusion. The County has decided that for its mass-burn stoker waterwall design, the best demonstrated technology, SNCR, would be installed at the LAER emission control level of 45 percent.

In accordance with the "top down" BACT methodology established by an EPA draft memorandum in December 1987 and May 1989, since the proposed Facility shall implement "top" determined NO_x control techniques and no outstanding issues regarding collateral environmental impacts exist, no further analysis is required. As stated, these NO_x control techniques, as they apply to the specified combustor design, are determined to be BACT.

The Facility's NO_x emissions will be below the applicable NAAQS/FAAQs requirements, and will meet applicable final promulgated NSPS requirements for MWCs. The Facility's NO_x emissions will be monitored through the use of properly located and installed CEMs.

4.6.6 BACT DETERMINATION FOR CARBON MONOXIDE (CO)

Proposed Control Technology

As discussed in Section 4.1 under Pollutant Applicability, the Facility will have a mass-burn stoker waterwall design consisting of three units each of 600 tpd.

The combustors will be designed to minimize CO emissions. In agreement with the recently promulgated NSPS, the BACT emission rate for a mass-burn stoker waterwall design is 100 ppm_{dv}, corrected to 7 percent O₂ and based on a four-hour block average as measured by CEMs. Table 4-1 lists the CO emission concentration and its respective tpy emission rate.

The Facility's combustor design shall have a combustion air control system which provides the necessary oxygen and turbulence to allow the combustible gases to mix thoroughly with oxygen and prevent stratification of the unburned gases. In addition to combustion air control, furnace temperatures will be maintained at a minimum of 1,800°F to provide for optimum burn-out of combustion gases.

The Facility shall be equipped with properly located thermocouples and CEMs for CO and O₂ to monitor and record the combustion conditions for optimizing combustion efficiency and ultimately controlling CO.

Compliance with Applicable Emission Standards

The Facility's CO emissions, regardless of which combustor technology is selected, will be below the applicable NAAQS/FAAQs requirements and shall meet the recently promulgated NSPS requirements for MWCs.

Rationale for Proposed BACT Determination

Carbon monoxide (CO) is formed by incomplete oxidation of carbon compounds during combustion. The source of carbon compounds during combustion are the refuse, pyrolysis products formed near the fuel bed, or intermediate

combustion products. The emission of relatively high concentrations of CO is largely dependent on the underfire air dispersion to the combustor, the underfire/overfire air ratio, the design of the overfire air jets, and furnace combustion temperature. Careful operation of the furnace is essential to maintain good combustion conditions. Thus, furnace operators will be fully trained to avoid potential combustion problems. A low CO concentration is a good indication that the furnace is achieving a high combustion efficiency, while a high CO concentration may indicate poor combustion and a potential increase in the level of trace organic emissions.

Specific add-on technologies for controlling CO in the flue gas have not been incorporated into any present-day refuse combustion designs. CO emissions are controlled in modern refuse combustion facilities using commonly employed combustion control measures (i.e., control of the combustion air to obtain a furnace temperature high enough to achieve a good burn-out of volatilized hydrocarbons, optimal placement of the overfire air grates jets, the use of high-pressure air to promote good mixing, and turbulence of unburned furnace gases with overfire air). Using these control measures, while continuously monitoring CO and O₂ to ensure good combustion, provides adequate control of CO, and no additional controls are normally employed. In addition, oxidation of CO to CO₂ increases the heat released by combustion; thus allowing CO to exit the combustion system is a loss of energy. Economically, a modest incentive exists to maintain CO at a minimum.

BACT Determination

Since no add-on CO control technologies have been incorporated into present-day refuse combustion facilities, the combustors' design and combustion control techniques are determined to be BACT for CO emissions.

4.6.7 BACT DETERMINATION FOR VOLATILE ORGANIC COMPOUNDS (VOCs)

Proposed Control Technology

The mass-burn technology proposed for the Facility shall be designed to minimize emissions of VOCs. The combustor's combustion air control system

will provide the necessary oxygen and turbulence to allow the combustible gases to mix thoroughly with oxygen and prevent stratification of the unburned gases. In addition to combustion air control, the furnace will be designed to maintain the combustion temperature at a minimum of 1,800°F to provide for optimum burn-out of organic compounds in the combustion gases.

The Facility shall be equipped with properly located and mounted thermocouples and CEMs to monitor and record the combustion conditions for optimum combustion efficiency and ultimately VOC control.

4.6.8 COMPLIANCE WITH APPLICABLE EMISSION STANDARDS

The Facility's combustor design and operation is proposed as BACT. Because the area in which the Facility is to be located is in attainment of the ambient air quality standards for ozone, an emission limitation more stringent than BACT is not warranted.

Rationale for Proposed BACT Determination

Like carbon monoxide, VOCs are the products of incomplete combustion and consist of a wide variety of organic compounds. The furnace combustor and combustion air control systems of modern refuse combustion facilities are designed to maintain elevated oxygen levels, and therefore provide for a near complete burn-out of combustible organic compounds, thus limiting the formation of VOCs. As discussed in the BACT determination for CO, VOCs will be controlled by ensuring that adequate excess air and furnace temperature are maintained, and overfire air jets are properly located to produce adequate mixing of overfire air (O₂) with VOCs.

BACT Determination

Based on the design and past operation of mass-burn combustor technologies, the Facility will emit a maximum (100 percent availability) of 69 tpy of VOCs. The proposed tpy emission rate is conservatively based on a maximum hourly average concentrations of 37.3 ppmdv of non-methane hydrocarbons (NMHC) expressed as CH₄ corrected to 7 percent O₂.

Since no add-on control system to reduce VOC emissions is currently available or has been incorporated in a refuse combustion facility, it is proposed that good furnace design and combustion control be employed at the Facility for the control of VOCs.

4.7 BACT REVIEW FOR TRACE ORGANIC COMPOUNDS

There are a number of organic compounds which have been measured in the flue gas from refuse combustion facilities as a result of incomplete or inefficient combustion of carbon compounds. Compounds measured include dioxins, furans, and polynuclear aromatic hydrocarbons (PAHs). These compounds may exit from the stack either in the vapor phase or condensed and/or adsorbed onto particulate matter. Although dioxins and furans comprise only a small portion of the many types of organics emitted from refuse combustion facilities, environmental concern is currently focused on these compounds.

Dioxin and furan are used as generic terms for two groups of closely related chemical compounds called polychlorinated dibenzo-p-dioxins (PCDD or dioxin) and polychlorinated dibenzofurans (PCDF or furan).

Structurally, they are similar with each composed of two benzene rings, joined by either two oxygen atoms (PCDD) or one oxygen atom (PCDF). Their release into the environment is of particular concern because of the potentially high toxicity of certain isomers. Tests data indicates that of the 75 PCDD and 135 PCDF isomers, 45 and 71, respectively, have been detected in refuse combustion emissions. The chemical, physical, and toxicological properties of each isomer vary according to their chemical structure. In general, the most toxic isomers are those with four chlorine atoms located at the lateral positions in the molecule. Consequently, attention and research have focused on 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD).

PAHs are a class of pollutants emitted as products of incomplete combustion, and are characterized by multiple-fused benzene rings. These pollutants include both non-carcinogenic compounds, such as naphthalene,

and carcinogenic compounds, such as benzo-a-pyrene. Data on PAH emissions from mass-burn waterwall combustion facilities are limited. However, data from other types of combustion facilities suggests more than 90 percent of the total PAHs emitted are low toxicity compounds such as naphthalene. Thus, the remainder of this discussion will focus on PCDD and PCDF emissions.

Numerous quantitative emission tests have been conducted for PCDD and PCDF from refuse combustion since 1977 when Olie reported their occurrence in the fly ash of three refuse combustion facilities in the Netherlands. Tests on refuse combustion facilities have been conducted mainly in the United States, Canada, Italy, France, West Germany, Sweden, and Japan, with results showing considerable emission variations. These variations have been attributed to a variety of factors including sampling protocol, analytical techniques, furnace design, and control technology design. Differences in furnace operation, control technology performance, and waste composition are also considered to have contributed to variations in PCDD/PCDF emissions. The exact affects of these design and operating parameters on PCDD/PCDF emissions have yet to be determined.

In an attempt to quantify the affects of design and operating parameters on PCDD/PCDF emissions, many studies have been performed to explain the mechanisms involved in the formation of PCDDs and PCDFs from combustion sources. Currently, four theories have been detailed in the literature explaining the mechanism for PCDD/PCDF emissions. The first theory suggests that PCDD and PCDF enter the refuse combustion process as trace components of the waste stream. This mechanism would require any dioxins entering the processing system to pass through the combustor unchanged. Because the flame temperatures found in refuse combustion facilities are capable of destroying 99 percent or more of PCDD/PCDF, this scenario is considered unlikely. Thus, the primary source of PCDD/PCDF emissions from refuse combustion facilities is most likely not the waste stream, rather, it is believed the compounds are formed during the combustion process. (Daly, 1985).

The second theory hypothesizes the production of PCDDs and PCDFs from precursors with similar structures such as PCBs and chlorophenols which undergo a modest chemical change during combustion. Although this theory is supported by laboratory studies, no evidence exists to support this for full-scale combustion facilities (Daly, 1985).

A third theory proposes that dioxins and furans are formed via "de novo" synthesis when a variety of unrelated organic materials become chlorinated during the combustion process. Synthesis from materials which are closely related to PCDD and PCDF, such as PAHs, would have simple reaction mechanisms. However, a full spectrum of plausible combustion intermediate chemistry could be proposed which would eventually lead to the synthesis of PCDD and PCDF.

The fourth and most recent theory explaining the formation of PCDD/PCDF was first suggested by Eiceman in 1982 and was supported by Vogg, Metsger, and Stieglitz in 1986. The theory presumes that dioxin and furan synthesis occurs between chemical precursors and chlorine donors on the fly ash surface rather than in the gaseous phase as suggested by the "de novo" theory. PCDD/PCDF precursors are believed to adsorb onto elemental carbon in the fly ash. Oxidation of the elemental carbon may then serve as a basis for the mechanism of PCDD/PCDF formation which is believed to be catalyzed by CuCl_2 found in the fly ash matrix. Because these reactions are expected to occur in the cooler downstream temperatures, this theory has been used to explain elevated PCDD/PCDF concentrations at the stack outlet of facilities such as the Pinellas County, Florida municipal waste combustor. Emission tests performed in 1987 measured an average uncontrolled PCDD/PCDF concentration of 69 ng/dscm and an average stack concentration of 132 ng/dscm (EER, 1988). The average ESP inlet temperatures for the Pinellas facility ranged from 523°F to 553°F. The Vogg studies indicate PCDD/PCDF formation at temperatures between 428°F and 752°F with a peak at 572°F.

In summary, theories on the mechanism of PCDD/PCDF formation include escape of PCDD/PCDF from the refuse during combustion, synthesis from structurally related precursors in the gas phase, and low temperature catalytic

formation from precursors in the fly ash matrix. Thus, control of dioxin and furan emissions should focus not only on the maximum destruction of PCDD/PCDF in the furnace, but also on the destruction of their precursors, including PCBs, PAHs, and Chlorophenols.

Currently, the most effective means of PCDD/PCDF emission control is the optimization of combustion conditions to minimize formation and to maximize destruction of PCDD/PCDF and their precursors. Well operated modern facilities have achieved PCDD/PCDF emissions levels which approach or are below the detection limit. Recent studies on facilities such as Hamilton, Ontario; Issy, France; and Pittsfield, Massachusetts have produced a data base from which correlations between combustion parameters and PCDD/PCDF emissions are being developed. In two studies prepared for EPA (May 1987 and August 1988), Seeker, Lanier, and Kilgroe analyzed the existing emission data base, and interviewed the major furnace designers in the United States and Europe. They then combined this information with trace organic formation and destruction theory to define combustion control strategies for PCDD/PCDF and other trace organics. The initial strategy which has been developed addresses three elements of combustion practice: design, operation, and verification.

The strategy for optimization of refuse combustor design requires consideration of combustion temperatures, air flow, and mixing. In their good combustion practices, EPA recommends a mean temperature of 1,800°F and a minimum temperature of 1,650°F at the fully mixed height of the furnace (May 1987). These temperatures were selected not only to ensure destruction of PCDD/PCDF, but also to ensure destruction of organic precursors which can undergo chlorination downstream of the combustor. An additional temperature recommendation of less than 450°F at the economizer exit was added in the most recent EPA document (September 1988). This economizer exit temperature is intended to minimize PCDD/PCDF formation via the low temperature catalytic mechanism. In addition to the two temperature requirements, EPA has made recommendations for the design of underfire and overfire air streams to ensure an even distribution of oxygen in the refuse stream and optimal mixing of combustion gases.

Verification recommendations are used to alert operators to possible operation and control problems. Parameters which should be continuously monitored include flue gas oxygen and carbon monoxide levels, as well as furnace and economizer exit temperatures. In 1987, EPA issued an operational guidance document for new refuse combustors which was intended to serve as an interim tool to be used in BACT determinations. This guidance specifies that combustion controls are a necessary part of BACT for new refuse combustors.

It has been suggested that a dry scrubber and a highly efficient particulate control device may be used to remove the small concentrations of PCDD/PCDF which form in spite of efficient combustion controls. Studies show condensed PCDD/PCDF and other trace organics bind to the high surface areas of fine particulates in the flue gas. Thus, PCDD/PCDF emissions should be reduced by maximizing particulate control. Use of a dry scrubber results in the reduced flue gas temperatures required for condensation of toxic organics onto the fly ash. A high efficiency ESP or fabric filter will then remove any PCDD/PCDF with the collected particulate matter.

Data on full scale tests have shown the effectiveness of a high efficiency baghouse with a dry scrubber (Martin, 1986) in removing PCDD and PCDF from the flue gas. A recent study performed by Environment Canada at the Quebec City refuse combustion facility showed high pollutant capture using a dry scrubber/fabric filter system. The Quebec City slipstream test data indicate that the removal of PCDD and PCDF approached 100 percent for a fabric filter inlet gas temperature of 284°F (140°C). The overall removal efficiencies for other trace organics (chlorobenzenes, chlorophenols, PCBs, and PAHs) were 99 percent or more at 284°F (140°C). Table 4-18 shows similar dioxin removal efficiencies at the Marion County, Stockholm-Hogdalen, and Malmo facilities.

In addition to removing particulates on which PCDD/PCDF have formed, use of a high efficiency particulate control device will also aid in the control of dioxin and furan emissions by removing particles on which precursors have bound and other particulate matter, thus preventing the possibility of PCDD/PCDF formation reactions taking place downstream of the fabric filter. The dry scrubber/baghouse control scheme proposed for the Facility will be

TABLE 4-18

LEE COUNTY ENERGY RECOVERY FACILITY
DIOXIN REDUCTION ACROSS THE DRY SCRUBBER/FABRIC
FILTER SYSTEMS AT THE MARION COUNTY, STOCKHOLM-HOGDALEN
AND MALMO FACILITIES*

Facility	Inlet Concentration [ng TCDD-equiv. (Eadon et al)/Nm ³ @12%CO _R]	Outlet Concentration	Removal Efficiency (percentage)
Marion County Boiler #1 (one test) Sept. 1986	3.21	0.123	96.2
Stockholm-Hogdalen Boiler #3 (one test) August 1986	4.98	0.116	97.7
Stockholm-Hogdalen Boiler #3 (two tests) March 1986	2.20 2.60	0.179 < 0.427	91.9 > 83.6
Malmo Boiler #1 (one test) Spring 1986	≥ 3.60	< 0.094	≥ 97.4
Malmo Boiler #2 (one test) Spring 1986	≥ 10.80	< 0.094	≥ 99.1

*Preliminary data from the U.S. EPA and Radian Corporation.

Hahn, Jeffrey L. et.al. "Recent Air Emission Test Data From Several Waste-To-Energy Facilities Utilizing Martin GMBH Stoker Combustion Systems and Advanced Air Pollution Control Equipment." APCA 80th Annual Meeting, 1988.

used in conjunction with combustion control techniques to minimize the quantity of PCDD/PCDF which is transferred to the ash.

A final PCDD/PCDF control strategy which has been suggested is the source separation of chlorinated plastic products from the waste stream. This strategy assumes that a reduction of HCl levels in the flue gas will reduce the chlorination of PCDD/PCDF precursors. Studies have been performed which specifically examine the effect of chlorinated plastics on PCDD/PCDF emissions. A study done by Karasek in Paris found no increase in fly ash levels of PCDDs when three times the normal level of PVC was fed to a well operated refuse combustor (Steisel et al., 1985). Results of a similar test on the Pittsfield, Massachusetts facility also found no correlation between quantities of PVC fed with the refuse and PCDD/PCDF formation. The studies conclude that in well designed facilities, operated under optimal combustion conditions, the quantity of chlorine in the refuse is far in excess of the quantity of chlorine required to produce the very small concentrations of PCDD/PCDF which are emitted. Thus, although removal of all plastics would amount to a 50 percent reduction in the chlorine fed, the quantity of chlorine remaining would still be far greater than the concentrations of PCDD/PCDF formed (Visalli, 1987).

At this time, material separation of chlorinated plastics as a method of PCDD/PCDF control has been neither scientifically validated nor demonstrated on a refuse combustion facility in the United States. For this reason, material separation will not be considered further in this analysis.

The emissions of PCDD, PCDF, and other trace organics will be controlled by proper design and operation of the furnace and combustion control system. The furnaces at the Facility will be designed to maintain the combustion gases at or above 1,800°F (982°C). Overfire air will be added in the quantities, locations, and velocities sufficient to cause turbulent mixing of the combustion gases. Finally, flue gas constituents, such as CO, O₂, and CO₂, as well as the combustion temperature will be continuously monitored to maximize the combustion efficiency of the furnaces. If PCDD/PCDF emissions are not destroyed in the furnace, they will be further

controlled by lowering the flue gas temperature with a dry scrubber, allowing the dioxins and furans to condense and/or adsorb onto particulate and then capturing the particulate with a highly efficient particulate control device (fabric filter). A proposed BACT emission rate of 30 ng/dscm corrected to 7 percent O₂ for total dioxin (total tetra-octa PCDD/PCDF) has been determined. The emission of PCDD and PCDF from the Facility will meet the final promulgated NSPS requirements for MWCs.

In summary, BACT for PCDD, PCDF, and other trace organics shall be the optimization of combustion conditions by proper design and operation of the furnace. In addition to combustion controls, a dry scrubber and a highly efficient fabric filter will be installed. The fabric filter will be designed to meet the outlet grain loading requirement of 0.010 gr/dscf corrected to 7 percent O₂. It has been estimated that 8.3 x 10⁻⁵ tpy of total PCDD/PCDF will be emitted from the Facility.

4.8 SUMMARY OF BACT DETERMINATIONS

Following EPA's current policy, the preceding "top down" BACT analysis was completed for site certification of an 1,800-tpd Energy Recovery Facility in Lee County, Florida.

A dry scrubber was determined to be BACT (as supported by the NSPS "best demonstrated technology") following the "top down" methodology for acid gases. The BACT control level for SO₂ was determined to be 80 percent removal by weight or 30 ppm_{dv} corrected to 7 percent O₂ (whichever is less stringent), both over a 24-hour average. The BACT control level for HCl was determined to be 95 percent removal by weight or 25 ppm_{dv} corrected to 7 percent O₂ (whichever is less stringent), both over an 8-hour average. Additional references to these pollutants and other acid gases are found in Section 4.3.

Using the same methodology, the analysis concluded for PM that either an ESP or a fabric filter was BACT; however, the County has decided to use a fabric filter at the outlet grain loading of 0.010 gr/dscf corrected to 7 percent O₂, which is considered equivalent to a LAER particulate control

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level. The fabric filter is considered by the EPA in the NSPS to be the "best demonstrated technology."

The application of a dry scrubber in conjunction with a fabric filter was determined to be BACT for metals, in particular, Hg, Be, and Pb.

Numerous NO_x control technologies were identified in the analysis involving both flue gas add-on controls and combustion modification controls. For the mass-burn stoker waterwall combustor design, SNCR was determined to be BACT at a 45 percent control level.

BACT for VOCs, CO, and organics was determined to be proper furnace design and operation, and combustion control techniques.

A comparison and summary of the BACT determined control technologies and emission rates to the PSD significant emission values is presented in Table 4-1. Supporting emission data and calculations are also presented in the Emissions Factor Support Document (Attachment A).

SECTION 5.0
EXISTING AMBIENT AIR QUALITY
AND
METEOROLOGY

5.0 EXISTING AMBIENT AIR QUALITY AND METEOROLOGY

5.1 NATIONAL AND FLORIDA AMBIENT AIR QUALITY STANDARDS

The U.S. Environmental Protection Agency (EPA) has established ambient standards for certain criteria pollutants as mandated by the Clean Air Amendments of 1970 (P.L. 91-604). These standards, known as the National Ambient Air Quality Standards (NAAQS), are set at two levels. Primary standards define levels that are necessary to protect the public health. Secondary standards define levels that are intended to protect the public welfare. The pollutants regulated under NAAQS are sulfur dioxide (SO₂), particulate matter (as particles with an equivalent aerodynamic diameter of less than 10 microns, PM₁₀), carbon monoxide (CO), ozone (O₃), nitrogen dioxide (NO₂), and lead (Pb).

On July 1, 1987, EPA promulgated final rules that replaced the TSP ambient air quality standards with standards for PM₁₀ as an indicator of potential impacts to the public health and welfare from particulate matter (52 FR 24634). The PM₁₀ ambient air quality standards were promulgated because they represent a direct measure of inhalable particulate matter and relate more closely than TSP to potential impacts on human health. A reference method for sampling ambient concentrations of PM₁₀ was established and included in the regulations as Appendix J. EPA also promulgated Appendix K which describes the rule for applying the statistically-based PM₁₀ standard. The new particulate standard became effective on July 31, 1987. On October 5, 1989, EPA proposed new Prevention of Significant Deterioration (PSD) PM₁₀ increments that would replace the existing TSP increments; however, the implementation date for this change has not been established and the current TSP increments are still in effect. (A more detailed discussion of PSD increments for particulate matter is presented in Section 6.8.)

The Florida Ambient Air Quality Standards (FAAQS) are a single set of standards that incorporate both the federal primary and secondary standards. The FAAQS for SO₂ annual and 24-hour averaging periods are more stringent than the national standards. The Florida standards for

particulate matter are expressed as TSP. The demonstration of compliance with ambient air quality standards was based on the more stringent of the NAAQS or FAAQS for each pollutant. The NAAQS and the corresponding FAAQS, as defined in the Florida Administrative Code (F.A.C.) 17-2.300, are presented in Table 5-1.

Each state has been given the primary responsibility for maintaining air quality by submitting a State Implementation Plan (SIP) to EPA. The state has defined geographic areas as attainment or nonattainment for the NAAQS based on ambient monitoring data in those areas. Areas that cannot be defined due to the lack of ambient air data are designated as unclassifiable. Areas designated unclassifiable are treated as attainment until further information becomes available.

To implement the PM_{10} standard, EPA has promulgated a transition policy. To avoid disruption of the existing particulate control program, the existing State Implementation Plan for TSP will remain in effect until a PM_{10} SIP is approved by EPA. The existing regulations will continue to be enforced during the transition period. The area designations of attainment or nonattainment for TSP will also remain. When the EPA approves the state control strategy sufficient to attain or maintain the PM_{10} NAAQS, it will also approve area redesignations based on PM_{10} attainment. An area designation for particulate matter based on TSP must be retained until EPA promulgates PM_{10} increments because the PSD increments depend on the existence of attainment area designations.

5.1.1 ATTAINMENT STATUS FOR CRITERIA POLLUTANTS

The NAAQS attainment status for portions of Lee, Hendry, Glades, and Charlotte counties within 30 km of the site is summarized in Table 5-2 (other regional counties are included for comparison). Florida as a whole is in attainment of the standards for sulfur dioxide (SO_2) and total suspended particulate (TSP). For ozone (O_3), carbon dioxide (CO), and nitrogen dioxide (NO_2), counties in the 30-km area cannot be classified or are in attainment of the standards. The standard for lead (Pb) has also been met at all lead monitoring stations in the state.

TABLE 5-1

 STATE AND FEDERAL AIR QUALITY GUIDELINES AND STANDARDS
 (Units: ug/m³)

Pollutant	Averaging Period	NAAQS/FAAQs ^a		De Minimis ^b Monitoring	Significant Impact Level ^c	PSD Increments ^b	
		Primary	Secondary			Class II	Class I
Sulfur Dioxide	3-hour	—/1,300	1,300	—	25	512	25
	24-hour	365/260	—	13	5	91	5
	Annual	80/60	—	—	1	20	2
Total Suspended Particulate Matter	24-hour	—	—	10	—	37	10
	Annual	—	—	—	—	19	5
PM ₁₀	24-hour	150	150	10	5	30 ^e	8 ^e
	Annual ^d	50	50	—	1	17 ^e	4 ^e
Nitrogen Dioxide	Annual ^d	100	100	14	1	25	2.5
Carbon Monoxide	1-hour	40,000	40,000	—	2,000	—	—
	8-hour	10,000	10,000	575	500	—	—
Lead	Quarterly	1.5	1.5	0.1	—	—	—
Ozone	1-hour	235	235	—	—	—	—

^a17-2.300, FAC, as last officially amended in July 1990. Where standards are not shown with a "/", the NAAQS and FAAQS are the same.

^b40 CFR 52.21(i)(8).

^c40 CFR 51.151.

^dAnnual arithmetic mean.

^eProposed EPA standard (54 FR 41218; October 5, 1989).

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TABLE 5-2

NAAQS ATTAINMENT STATUS FOR SELECT COUNTIES WITHIN
THE SOUTHWEST FLORIDA INTRASTATE AQCR

County	SO ₂	PM	NO ₂	CO	O ₃
Charlotte	A	A	U/A	U/A	U/A
Collier	A	A	U/A	U/A	U/A
De Soto	A	A	U/A	U/A	U/A
Glades	A	A	U/A	U/A	U/A
Hendry	A	A	U/A	U/A	U/A
Highlands	A	A	U/A	U/A	U/A
Lee	A	A	U/A	U/A	U/A
Sarasota	A	A	U/A	U/A	U/A

SOURCE: FAC 17-2.410 (September 13, 1990) 40 CFR 81.310 (revised February 1, 1990).

Abbreviations: A = In attainment status for the specific pollutant.
U = Cannot be classified for the specific pollutant.

5.2 AVAILABLE AMBIENT MONITORING DATA

This application uses available Florida ambient air monitoring reports for 1988 through 1990 to develop background concentrations of PSD criteria pollutants in the vicinity of the Facility. This period represents the most recent three-year period for which complete ambient monitoring data is available. Because there are few monitoring stations within Lee County, monitors outside of the county are also considered for determining background concentrations for some pollutants.

Monitoring sites are typically selected:

- o To determine the highest concentration expected in a given area,
- o To determine representative concentrations in areas of high population densities,
- o To determine ambient pollutant impacts of significant sources, and
- o To determine general background concentration levels.

For these reasons, most available monitoring sites in southern Florida are located in areas of heavy urban or industrial growth such as Broward, Dade, and Hillsborough counties. Therefore, many sites in the Florida monitoring network will be overly conservative when used to estimate background levels at the Facility site, which is more rural. Table 5-3 shows the monitoring stations used in this analysis by county and criteria pollutant. A map showing the associated counties is presented on Figure 5-1.

Preliminary background concentrations from representative monitors are listed in Table 5-4. The criteria pollutants TSP, SO₂, and O₃ are measured in Lee County at the Fort Myers Water Storage Tank on Princeton Street. This monitoring station's purpose is to measure maximum concentrations and population exposures. For the remaining criteria pollutants without local monitoring data (CO, PM₁₀, Pb, and NO₂), background concentration monitors from the nearest areas were used as available.

TABLE 5-3

AMBIENT AIR MONITORS SPECIFIED BY
COUNTY AND CRITERIA POLLUTANTS
(1988-1990)

County	Pollutant						
	SO ₂	TSP	NO _x	CO	O ₃	Pb	PM ₁₀
Broward				X		X	X
Dade						X	
Hillsborough			X	X		X	X
Lee	X ^a	X			X		
Manatee	X						
Pinellas				X			
Sarasota	X						

SOURCE: "Comparison of Air Quality Data with National Ambient Air Quality Standards," Florida Department of Environmental Regulation, 1988-1990.

^a Discontinued in 1988.

TABLE 5-4

AMBIENT MONITORING DATA USED TO DERIVE
BACKGROUND CONCENTRATIONS FOR THE LEE COUNTY
ENERGY RECOVERY FACILITY

Pollutant	Monitoring Site	Averaging Time	Maximum Measured Concentration		
			1988	1989	1990
CO	Hillsborough County/ Davis Island	1-hr High (ppm)	4	4	5
		2nd High (ppm)	4	4	5
		8-hr High (ppm)	2	2	3
		2nd High (ppm)	2	2	2
	Pinellas County/ Largo	1-hr High (ppm)	6	5	6
		2nd High (ppm)	5	5	5
		8-hr High (ppm)	4	3	3
		2nd High (ppm)	3	3	3
	Broward County/ Pompano Beach	1-hr High (ppm)	6	9	5
		2nd High (ppm)	5	8*	5
		8-hr High (ppm)	3	4	3
		2nd High (ppm)	2	4*	3
Pb	Broward County/ <u>Ft. Lauderdale</u>	Max Qtr (ug/m ³)	0	0	0
	Dade County/ <u>Miami</u>	Max Qtr (ug/m ³)	<u>0.1</u>	<u>0.1*</u>	0
NO ₂	Hillsborough County/ Ybor City	Annual Arithmetic Mean (ug/m ³)	40	<u>42*</u>	—
TSP	Lee County/Fort Myers Water Storage Tank, Princeton Street	24-hr High (ug/m ³)	55	71	57
		2nd High (ug/m ³)	49	58	52
		Annual Arithmetic Mean	30	<u>31*</u>	<u>31</u>
		Annual Geometric Mean	29	<u>29</u>	<u>30</u>
	Lee County/Fort Myers Backup Monitor, Water Storage Tank, Princeton Street	24-hr High (ug/m ³)	63	74	58
		2nd High (ug/m ³)	60*	58	48
		Annual Arithmetic Mean	31	<u>31</u>	<u>30</u>
		Annual Geometric Mean	29	<u>29</u>	<u>29</u>
SO ₂	Lee County/Fort Myers Water Storage Tank, Princeton Street	3-hr High (ug/m ³)	86 ^a	—	—
		2nd High (ug/m ³)	75 ^a	—	—
		24-hr High (ug/m ³)	24 ^a	—	—
		2nd High (ug/m ³)	24 ^a	—	—
		Annual Mean (ug/m ³)	5 ^a	—	—

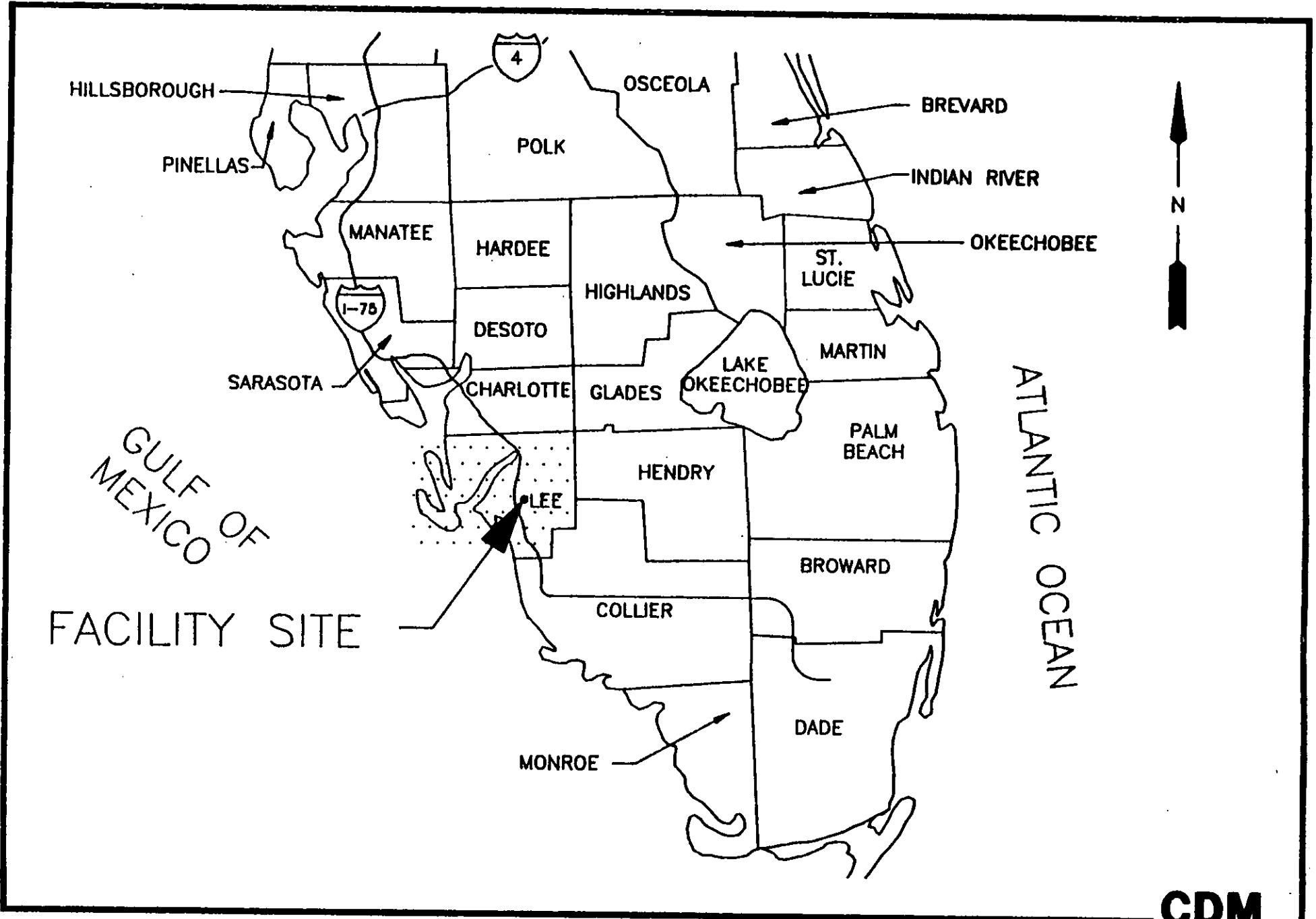


FIGURE 5-1

Study Area Location Map

CDM

TABLE 5-4
(continued)

Pollutant	Monitoring Site	Averaging Time	Maximum Measured Concentration		
			1988	1989	1990
SO ₂	Manatee County/ County Dam	3-hr High (ug/m ³)	—	—	—
		2nd High (ug/m ³)	—	—	—
		24-hr High (ug/m ³)	54	25	—
		2nd High (ug/m ³)	42	24	—
		Annual Mean (ug/m ³)	9*	6	—
	Sarasota County/ Verna Well Field	3-hr High (ug/m ³)	396	182	103
		2nd High (ug/m ³)	199*	145	98
		24-hr High (ug/m ³)	68	48	45
		2nd High (ug/m ³)	54*	46	43
		Annual Mean (ug/m ³)	8	8	8
O ₃	Lee County/Fort Myers Water Storage Tank, Princeton Street	1-hr High (ppm)	.102 ^b	.104	.088
		2nd High (ppm)	.101*	.097	.080
PM ₁₀	Hillsborough County/ Davis Island	24-hr High (ug/m ³)	64	60	50
		2nd High (ug/m ³)	58*	51	46
		Annual Arithmetic Mean	30*	30	30
	Broward County/ 500 SW 14th Court #12 Ft. Lauderdale	24-hr High (ug/m ³)	—	40	34
		2nd High (ug/m ³)	—	36	29
		Annual Arithmetic Mean	—	21	16

SOURCE: "Comparison of Air Quality Data with National Ambient Air Quality Standards," Florida Department of Environmental Regulation, 1988-1990.

^aDiscontinued during the year.

^bOzone monitoring site relocated from the water storage tank to Cape Coral about October/November 1988.

*Represents maximum long-term or maximum second-highest short-term concentration to be used as background in modeling analyses.

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5.3 SELECTION OF BACKGROUND POLLUTANT CONCENTRATIONS

The criteria pollutant background concentrations proposed for use in the refined modeling analysis for the Facility are summarized in Table 5-5. The methodology employed to calculate representative pollutant background concentrations is described below.

For each pollutant, the annual average background concentration has been set equal to the highest annual average concentration observed during the last three years. For each pollutant and each short-term averaging period, the background concentration has been set equal to the highest of the second-highest concentrations observed during the last three years, pursuant to EPA guidance. Values from monitors closest to the Facility site were chosen as representative of background concentrations at the Facility site.

The CO monitors closest to Lee County designated as background or population exposure monitors (and not near major roadways) are Hillsborough County/Davis Island Coast Guard Station, Pinellas County/Largo, and Broward County/Pompano Beach. Maximum second-highest concentrations, shown for CO on Table 5-5, are 8 ppm and 4 ppm for averaging times of one hour and eight hours, respectively. These ambient concentrations are approximately 23 percent of the one-hour CO standard (35 ppm) and 44 percent of the eight-hour CO standard (9 ppm).

Like CO, lead monitoring is concentrated near areas of major vehicular traffic outside Lee County. However, the Broward County/Ft. Lauderdale and Dade County/Miami sites are designated as background lead monitoring sites. Of the data for these two sites, given on Table 5-4, only Dade County/Miami recorded a maximum quarterly average of 0.1 ug/m^3 . This concentration is less than 7 percent of the quarterly lead standard of 1.5 ug/m^3 . Since the recent trend for lead concentrations is distinctly downward due to the phase-out of lead additives in gasoline, 1989 concentration data should conservatively represent current conditions.

TABLE 5-5

PROPOSED BACKGROUND CONCENTRATIONS FOR CRITERIA POLLUTANTS
EMITTED BY THE LEE COUNTY ENERGY RECOVERY FACILITY

Pollutant	Averaging Period	Monitor Site	Background Concentration ($\mu\text{g}/\text{m}^3$)	AAQS ^a ($\mu\text{g}/\text{m}^3$)	Background Concentration as Percent of NAAQS
PM ₁₀ ^b	24-Hour	<u>Davis Island, Hillsborough County</u>	<u>58</u>	150	<u>38.7</u>
	Annual	Davis Island, Hillsborough County	30	50	60.0
SO ₂	3-Hour	<u>Verna Wellfield, Sarasota County</u>	<u>199</u>	1,300	<u>15.3</u>
	24-Hour	<u>Verna Wellfield, Sarasota County</u>	<u>54</u>	260	<u>20.8</u>
	Annual	<u>County Dam, Manatee County</u>	<u>9</u>	60	<u>15.0</u>
NO ₂	Annual	Ybor City, Hillsborough County	<u>42</u>	100	<u>42.0</u>
CO (ppm)	1-Hour	<u>Pompano Beach, Broward County</u>	<u>9200</u>	<u>40,000</u>	<u>23.0</u>
	8-Hour	Davis Island, Hillsborough County	<u>4600</u>	<u>10,000</u>	<u>46.0</u>
Pb	3-Month	<u>Miami, Dade County</u>	0.1	1.5	6.7

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TABLE 5-5
(continued)

SOURCE: "Comparison of Air Quality Data with National Ambient Air Quality Standards," Florida Department of Environmental Regulation, 1988-1990.

^aMore stringent of federal or state standard (see Table 5-1).

^bTSP standard has been replaced with PM_{10} standard (52 FR 24634, July 1987). The State of Florida adopted these PM_{10} standards in May 1988 (17-2.300, FAC).

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The nearest continuous NO₂ monitoring station is in Hillsborough County at Ybor City designated as maximum concentration monitor. The maximum annual measurement for 1988 through 1990 at the two continuous Hillsborough County monitoring sites, given on Table 5-5, is 42 ug/m³. This concentration is 42 percent of the annual NO₂ standard of 100 ug/m³.

Most particulate monitoring data up to this time has been measured as total suspended particulates (TSP). TSP measurements are available from several monitoring stations in the Lee County area. The two Fort Myers monitors nearest the site, at the water storage tank on Princeton Street and the back-up monitor at the same location, are shown.

The TSP standard, however, has been replaced with the PM₁₀ standard (July 1987). The state of Florida adopted these PM₁₀ standards in May 1988. Florida started PM₁₀ monitoring at three stations in 1986, increased the network to 15 stations in 1988, and currently has a network of 31 stations. The Broward County/Ft. Lauderdale and Hillsborough County/Davis Island monitoring sites are nearest to the Lee County site.

The maximum second-highest 24-hour concentration shown on Table 5-5 is 58 ug/m³ which is 38.7 percent of the standard of 150 ug/m³. The maximum annual arithmetic mean is 30 ug/m³ which is 60 percent of the annual standard of 50 ug/m³ for PM₁₀.

The SO₂ monitoring station in the immediate Facility site area, located at the Fort Myers water storage tank on Princeton Street, was discontinued in 1988, probably due to the consistently low SO₂ concentrations monitored there. The next closest background sites shown are the Manatee County/Manatee County Dam and Sarasota County/Verna Well Field, over 100 km from the proposed Facility. Even though the Sarasota County/Verna Well Field monitoring station is over 100 km away, it is the nearest location with the latest three consecutive years (1988-1990) of SO₂ monitoring data. Sarasota County is just south of the Tampa Bay metropolitan area, which contributes to SO₂ concentrations 1.5 times as high as those previously recorded in Lee County. Therefore, it very conservatively represents the ambient SO₂ concentrations at the Facility site.

Maximum second-highest 3-hour and 24-hour and maximum annual SO₂ concentrations used to represent Ft. Myers, given in Table 5-5, are 199 ug/m³, 54 ug/m³, and 9 ug/m³, respectively. These concentrations are 15.3 percent, 20.8 percent, and 15.0 percent of the 3-hour, 24-hour, and annual SO₂ standards of 1300 ug/m³, 260 ug/m³, and 60 ug/m³, respectively.

Ozone is not directly emitted into the atmosphere, but results from a series of complex photochemical reactions. Ozone measurements are available from the Ft. Myers water treatment plant. The maximum second-highest one-hour concentration, shown on Table 5-4 for this site, is 0.101 ppm (198 ug/m³). This concentration is 84 percent of the one-hour O₃ standard of 235 ug/m³.

Arsenic, beryllium, fluorides, and mercury are PSD-regulated pollutants which the Facility is expected to emit in quantities exceeding the review threshold for a formal PSD analysis (see Table 2-1, Section 2.0 of this Volume). Identification of background concentrations is required as part of a formal PSD analysis. Because ambient air quality standards have not been established for these pollutants, the state and local air monitoring station network does not include monitoring of background concentrations of these pollutants. On the basis of pollutant emission inventory data provided by DER (Tom Rogers, DER, letter dated August 29, 1988, and subsequent conversation with Max Linn, DER, June 19, 1990), there are no industrial sources within 10 kilometers of the site likely also to be sources of arsenic, beryllium, fluorides, or mercury. Therefore, it is assumed that background concentrations of these pollutants are comparable to normal rural backgrounds.

5.4 AVAILABLE METEOROLOGICAL DATA

Mr. Thomas Rogers, Environmental Administrator for the Bureau of Air Monitoring and Assessment of DER, has indicated that surface wind, temperature, and cloud cover information from the National Weather Service (NWS) station at the Fort Myers Page Field Airport is most representative for the site. He has also indicated that upper air data from the NWS station at Tampa International Airport in Tampa, Florida should be used to

estimate mixing heights. The Fort Myers station is about 10 miles southwest of the Facility site. The Tampa station, which is the closest upper air NWS station, is about 90 miles northwest of the Facility. The Fort Myers/Tampa data are the most representative data that are available of conditions at the Facility site.

Accordingly, the hourly meteorological data from these two weather stations for recent available years (1982 to 1986) have been provided by Mr. Rogers for use in this permit application (Thomas Rogers, 1989). The climatology and local meteorology of the Fort Myers area are discussed in Section 2.3.7 of Volume I, and wind roses for all years (1982 to 1986) and seasons, as well print-outs of the meteorological data, are provided in Attachment B of this volume.

SECTION 6.0
AIR QUALITY ANALYSIS

6.0 AIR QUALITY ANALYSIS

6.1 OVERVIEW

The purpose of this section is to present the predicted air quality impacts for the Lee County Energy Recovery Facility (ERF) in accordance with the protocol sent to DER on May 9, 1990. These pollutant concentrations were estimated using EPA guideline dispersion models and techniques discussed with and approved of by the Florida Department of Environmental Regulation prior to starting the analyses. The results obtained from the detailed modeling analysis have demonstrated that impacts from the Lee County ERF:

- o Will not violate any Florida or National Ambient Air Quality Standards (FAAQS or NAAQS);
- o Will not significantly consume total suspended particulate (TSP), sulfur dioxide (SO₂), or nitrogen oxide (NO_x) PSD Class II increments;
- o Will not significantly consume TSP, SO₂, or NO_x PSD Class I increments at the Everglades National Park; and
- o Will not significantly impact or prevent reasonable further progress toward attainment of NAAQS and FAAQS in SO₂ and TSP nonattainment areas elsewhere in the state.

Therefore, the proposed Facility will be in compliance with all applicable Florida and federal guidelines and standards regulating air quality impacts from energy recovery facilities.

Section 6.0 is organized to provide a logical progression from the development of emissions source characteristics to the presentation of modeled pollutant impacts associated with the Facility.

A summary of source parameters for potential operating conditions including stack parameters, exhaust gas conditions, and pollutant emission rates is

presented in Section 6.2. The selection of a dispersion model and presentation of the screening modeling protocol used to evaluate impacts from potential operating conditions is included in Section 6.3.

Two levels of air quality impact assessment were conducted: a screening modeling analysis, and a detailed modeling analysis. Section 6.4 presents the results of the screening analysis, and identifies the operating conditions (i.e., 110 percent of design thermal load for short-term impact, and 100 percent of design thermal load for annual average impacts) that result in the highest ground-level impacts. Air quality impacts from these worst-case operating conditions are then evaluated using more detailed modeling techniques that require five years of hourly meteorological data and an extensive receptor grid. The results of the detailed analysis are presented in Section 6.5, and include a comparison of predicted impacts to the de minimis pre-construction monitoring levels. A demonstration of compliance with the FAAQS and NAAQS, based on the results for the detailed modeling analysis, is presented in Section 6.6. Section 6.7 assesses the potential impacts from non-criteria pollutants (i.e., those pollutants not regulated under the FAAQS and NAAQS). Section 6.8 provides a demonstration of facility compliance with PSD Class I and Class II increments.

6.2 SOURCE CHARACTERISTICS

The Lee County ERF will have a design capacity of 1,800 tons per day (tpd) of reference waste with a higher heating value (HHV) of 5,000 Btu per pound of waste (which was modeled in this application). The primary source of pollutant emissions is the Facility stack, from which combustion process gases and particulate matter are emitted to the atmosphere. Potential secondary sources of pollutant emissions include the ash residue handling building and a lime silo servicing the acid gas scrubbers. These minor secondary sources of emissions will be enclosed and controlled through the use of particulate control devices. Secondary source emissions and impacts are discussed in Section 7.6. No significant quantifiable fugitive emissions will be generated from the proposed Facility.

The refuse received at the Facility will be combusted in three mass-burn stoker waterwall combustor units of 600 tpd each. At the design charging rate for reference waste, each 600-tpd combustor unit will have a heat release of 250 million Btu/hr (MMBtu/hr). Combustion temperatures will be in excess of 1,800°F. The exhaust gases from the boiler of each unit will pass through a dry scrubber and a fabric filter to collect particulate matter.

Each combustor unit (furnace and boiler) will be equipped with a separate acid gas scrubber followed by a fabric filter to collect particulate matter. The dry scrubber will be designed to remove sulfur dioxide (SO₂) at an efficiency of 80 percent or 30 ppm_{dv} corrected to 7 percent O₂, whichever is less stringent (24-hour average). Hydrogen chloride (HCl) will likewise be removed at an efficiency of 95 percent or 25 ppm_{dv} corrected to 7 percent O₂, whichever is less stringent (eight-hour average). The baghouse will be designed to result in a particulate emission not to exceed 0.010 grains per dry standard cubic foot corrected to 7 percent O₂ (gr/dscf @ 7% O₂).

The stack flues from each of the three units will be co-located and enclosed in a single stack shell (hereinafter referred to as the "stack"). The stack is assumed, for the dispersion modeling, to be 275 feet above the stack base elevation. This stack height is equal to the good engineering practice (GEP) stack height defined for a squat building with a building height of 110 feet. These are the minimum stack and building heights, respectively, of the designs under consideration. The proposed stack will be sufficiently high to avoid building aerodynamic wake and cavity effects. The method for determining the GEP stack height is outlined in Section 1.3.

Each flue for the stoker waterwall design facility will have an inside diameter of approximately six feet and two inches. An effective flue diameter of 10 feet and eight inches was calculated from the total volumetric flow rate that maintains an exit velocity (of 65 feet per second) in the effective flue equal to that of the single six-foot, two-inch flue.

These "equivalent diameter" calculations are in accordance with U.S. EPA stack regulation provisions contained in 40 CFR 51.100 in that the stack is being originally designed to have merged flues. The combining of flue gas streams from a stack with multiple flues to form a single larger plume is also a real and observable phenomenon. The calculation of an effective diameter is thus allowable and correct because it accounts for this phenomenon without artificially increasing flue gas velocities and plume height.

While the Facility will have a design capacity of 1,800 tpd, the actual throughput will vary depending upon the season and planned maintenance activities. Each unit at the Facility could process waste at a rate between 50 and 110 percent of the nominal charging rate. The refuse heat content will also vary to some degree throughout the year. Operating conditions representing a broad range of possible refuse throughput for each of the combinations are presented in Table 6-1 and were modeled (Section 6.4) for their potential air quality impacts. The two postulated worst cases (those which produced the highest normalized ground-level concentrations) were then modeled for a range of possible waste heat contents. The source parameters for these cases are shown in Table 6-1.

The emission rates presented in Table 6-2 are based on the design heat release of the Lee County ERF. The emission rates used in the detailed air quality modeling analyses are normalized and adjusted relative to the design heat release. Thus, the ground-level concentration for any pollutant can be obtained by multiplying the emission rate (in grams per second) from Table 6-2 by the normalized ground-level concentrations (i.e., the X/Q values) predicted by the air quality dispersion model and presented in later sections.

TABLE 6-1

SOURCE PARAMETERS OF 14 POTENTIAL
OPERATING CONDITIONS FOR THE LEE COUNTY ERF

Facility Throughput (tpd)	Number of Units ^a	Total Heat Content (Btu/lb)	Total Heat Release (MMBtu/hr)	Normalized Emission Rate ^b (g/s)	Stack Height (m)	Exit Temp. (K)	Exit Velocity (m/s)	Effective Stack Diameter ^c (m)
1,980	3	5,000	825	1.10	83.82	388.7	21.8	3.26
1,800	3	5,000	750	1.00	83.82	388.7	19.8	3.26
1,350	3	5,000	563	0.75	83.82	388.7	14.9	3.26
900	3	5,000	375	0.50	83.82	388.7	9.9	3.26
1,200	2	5,000	500	0.67	83.82	388.7	19.8	2.66
600	1	5,000	250	0.33	83.82	388.7	19.8	1.88
1,650	3	6,000	825	1.10	83.82	388.7	21.6	3.26
1,500	3	6,000	750	1.00	83.82	388.7	19.7	3.26
1,125	3	6,000	563	0.75	83.82	388.7	14.7	3.26
750	3	6,000	375	0.50	83.82	388.7	9.8	3.26
2,604	3	3,802	825	1.10	83.82	388.7	23.3	3.26
2,367	3	3,802	750	1.00	83.82	388.7	21.2	3.26
1,775	3	3,802	563	0.75	83.82	388.7	15.9	3.26
1,183	3	3,802	375	0.50	83.82	388.7	10.6	3.26

SOURCE: Camp Dresser & McKee Inc., 1991.

^aNumber of combustor units assumed to be in operation for this case.^bNormalized with respect to the nominal operating case (i.e., 1,800 tpd at 5,000 Btu/lb = 750 MMBtu/hr).^cSample calculations of effective diameter for three flues of equal diameter: Define the effective stack diameter for three flues as $D = (3A/3.14159)^{0.5}$, where A is the combined area for three 6'2" diameter flues (e.g., $D = 3.26$ m for $A = 119.79$ ft²). The gas exit velocity for the effective diameter stack is equal to that for each individual flue.

TABLE 6-2

ANNUAL AVERAGE EMISSION RATE OF POLLUTANTS FOR THE
LEE COUNTY ENERGY RECOVERY FACILITY

Pollutant ^c	Controlled Emission Rate ^a	
	(lb/hr)	(g/s)
Particulate Matter (as TSP or PM ₁₀)	<u>14.6</u>	<u>1.83</u>
Sulfur Dioxide (SO ₂)		
(annual)	<u>112</u>	<u>14.08</u>
<u>(24-hour)</u>	<u>112</u>	<u>14.08</u>
(3-hour)	<u>140</u>	<u>17.6</u>
Nitrogen Dioxide (NO ₂)	<u>219</u>	<u>27.59</u>
Carbon Monoxide (CO)		
(8-hour)	<u>74</u>	<u>9.33</u>
(1-hour)	<u>296</u>	<u>37.3</u>
Hydrocarbons (VOC)	<u>15.8</u>	<u>1.98</u>
Lead (Pb)	<u>0.45</u>	<u>0.057</u>
Fluoride (as (HF))	<u>2.63</u>	<u>0.331</u>
Sulfuric Acid (H ₂ SO ₄)	<u>26.9</u>	<u>3.38</u>
Hydrogen Chloride (HCl)	<u>48.2</u>	<u>6.08</u>
Mercury (Hg)	<u>0.6</u>	<u>0.076</u>
Beryllium (Be)	<u>1.01x10⁻⁴</u>	<u>1.28x10⁻⁵</u>
Arsenic (As)	<u>6.83x10⁻³</u>	<u>8.6x10⁻⁴</u>
Dioxin (<u>Total tetra-octa PCDD & PCDF</u>)	<u>1.91x10⁻⁵</u>	<u>2.40x10⁻⁶</u>

SOURCE: Camp Dresser & McKee Inc., 1991.

^a Emission rates are based on 100% of the nominal capacity (i.e., 1,800 tpd at 5,000 Btu/lb) and continuous operation of the air pollution control system during reference waste firing. System availability is rated 100% (8,760 hrs/yr) for the modeling exercise. The lb/hr emission rates shown are rounded and may not convert precisely to the g/s emission rates shown. See Tables 3-2 and 3-3.

^b Assumes total NO_x emissions are emitted as NO₂.

^c Dioxins and hydrogen chloride are not PSD regulated pollutants (40 CFR 52.21).

NOTE: g/s conversion is calculated without using rounded numbers.

6.3 MODELING METHODOLOGY

Computer-based mathematical dispersion models approved by DER and EPA were used to evaluate air quality impacts due to emissions from the Lee County ERF. Input data to these dispersion models were conservatively specified in order to prevent an under-estimation of impacts. A screening modeling analysis was used to simulate plume dispersion under a variety of possible meteorological and operating conditions, thereby identifying maximum pollutant ground-level concentrations. A detailed modeling analysis was performed to determine the maximum pollutant concentrations for the worst-case operating condition using recorded meteorological and site terrain data.

6.3.1 INDUSTRIAL SOURCE COMPLEX MODEL

The UNAMAP Version Date 90346 of EPA's Industrial Source Complex Short-Term Model (ISCST) was the sole model used in the air quality impact analysis. It was developed for EPA for the purpose of estimating impacts from industrial sources which may have complex geometries and multiple emission sources. It is the EPA-recommended impact assessment technique for regions comprised of "flat terrain," that is, where all terrain within the modeled site region is below stack-top elevation. Within 30 kilometers of the site, no terrain was found to exceed stack-top elevation. Therefore, ISCST was selected as the model most appropriate for the characteristics of the proposed source and surrounding site dispersion environment.

The ISCST model is a steady-state Gaussian plume dispersion model which can be used to assess pollutant concentrations from a wide variety of sources associated with an industrial complex. For this study, the ISCST model was used to calculate ground-level concentrations for all regulated pollutant concentration averaging periods. ISCST uses sequential hourly meteorological data to compute one-hour average concentrations. Average concentrations (for 3-hour, 8-hour, 24-hour, and annual periods) are computed as arithmetic averages of blocks of successive hourly concentrations.

6.3.2 ISC MODEL OPTIONS

An ISCST simulation of the Lee County ERF air quality impacts required an input of source parameters, receptor coordinates with terrain heights, and representative meteorological data. The ISCST model includes options or switches which may be selected to simulate the impacts from the Lee County ERF. The modeling options used in the dispersion analysis conformed to DER procedures and EPA modeling guidance as presented in the "Guideline on Air Quality Models -- Revised" (EPA, 1986) and included:

- o Final plume rise. The ISC program is capable of evaluating the dispersion of a plume based on either final plume rise or transitional plume rise with distance. Final plume rise is the preferred option unless building wake effects are a possibility [i.e., if the stack height is not equal to a good engineering practice (GEP) stack height] or terrain above stack-tip occurs closer to the stack than the distance at which final plume height is realized.

The stack elevation included in the Lee County ERF design is a GEP stack height, and the terrain elevation does not exceed stack-top within the study area. Therefore, plume dispersion was evaluated based on final plume rise.

- o Stack-tip downwash. This option was selected to allow modification of the stack height to account for downwash induced by the stack tip (Briggs, 1974) when the ratio of gas exit velocity to stack-top wind speed is less than 1.5.
- o Buoyancy induced dispersion. The ISC model was programmed to increase the dispersion coefficients at the point of plume release to account for buoyancy enhancement of the plume from turbulent mixing and air entrainment, hence greater initial dispersion volume than without buoyancy. This option was selected as representative of actual conditions.

- o Calm-processing. The model employed an EPA calm-processing routine (CALMPRO) to calculate blocked concentrations when there are "calm" hours of preprocessed data with wind speeds of 1 meter per second occurring with directional persistence. Calm hours are assigned a 1 m/s wind speed by the RAMMET preprocessor when the observed wind speed is less than 2 knots and the wind direction persists from the previous hour. Calm hours are treated as missing hours by CALMPRO. Short-term and long-term concentrations are estimated in an EPA prescribed manner to account for calms (EPA, 1986).

- o Pollutant Half-Life. Recent EPA guidance suggests including a half-life of four hours for modeling of SO₂ dispersion in urban areas. This pollutant half-life option was not included in the present analysis because the study area is categorized as rural. Conservative estimates of SO₂ impacts will result.

These assumptions and conditions established the basis for evaluating air quality impacts from the Lee County ERF.

Land Use Classification

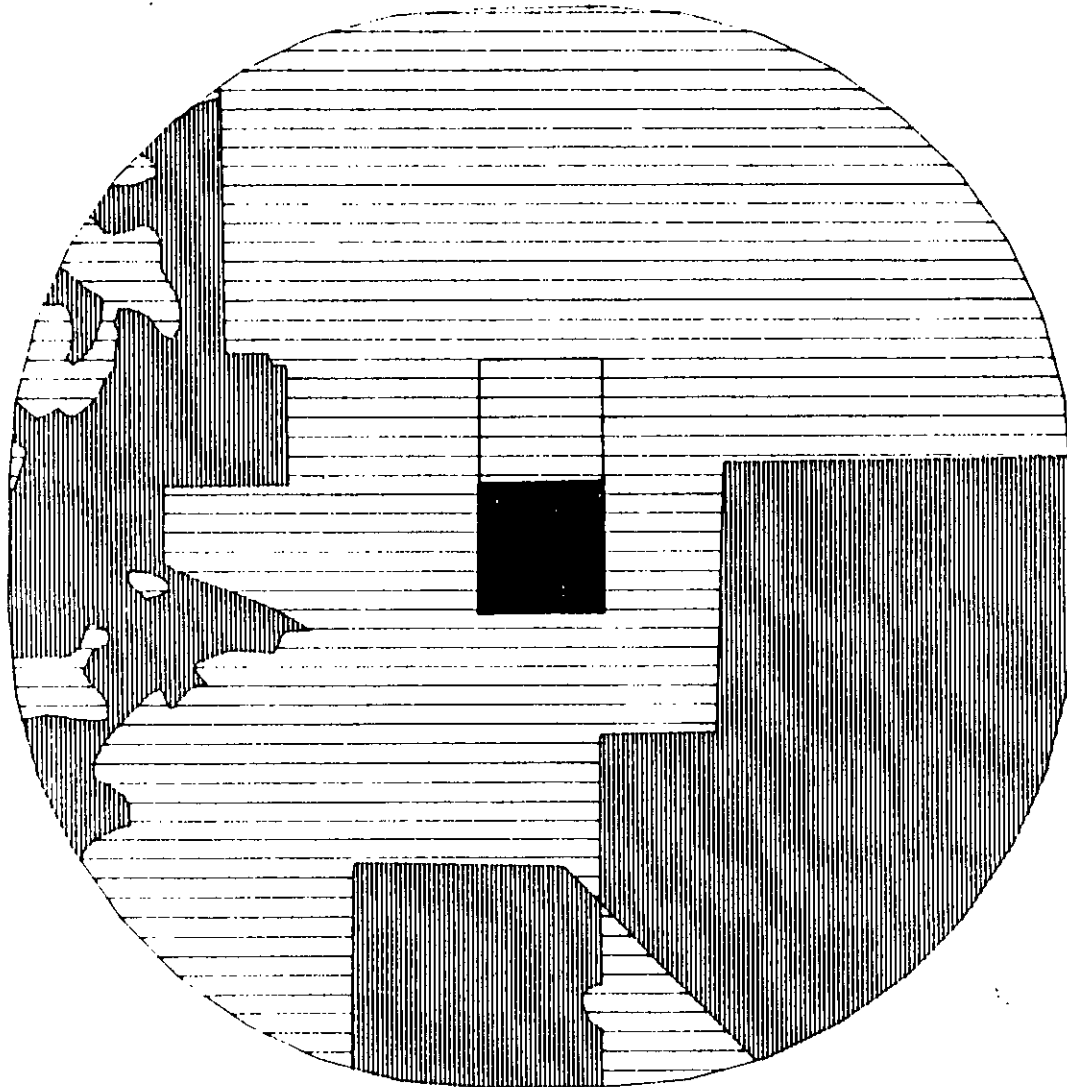
The dispersion environment was classified as rural based on a quantitative review of land use designations within a three-km (1.9 miles) radius of the proposed stack, and a comparison of the land use with Auer (1978) land use criteria. The Lee County land use map was used as the basis for calculation of total "urban" and "rural" areas in the three-km study area. This map shows existing land use designations, as well as areas where future development is permitted, but is not currently intensively developed. Use of this map, therefore, tends to favor inclusion of some currently "rural" areas into "urban" classifications, and is a very conservative approach. The map was digitized, using ARC/INFO geographic information systems (GIS) software. ARC/INFO computes total area for each designated land use type. The digitized version of the Lee Plan Future

Land Use Map (adopted by the Board of County Commissioners, January 31, 1989, effective March 1, 1989) is shown in Figure 6-1. The following land use categories were assigned the "urban" designation, in accordance with Auer (1978): intensive development, central urban, urban community, industrial, general commercial, and industrial commercial. The following land use categories were designated "rural": rural, open lands, resource protection areas, new community, suburban, outlying suburban, and park. ARC/INFO computed the total resulting land use areas to be 37 percent urban and 63 percent rural. Therefore, the dispersion models were executed in the rural mode, incorporating dispersion coefficients developed by Turner (1970) and recommended by EPA for regulatory applications in rural areas (EPA, 1986).

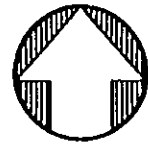
Dispersion Meteorology

The rate of plume dispersion as defined with the ISCST model is determined by a set of atmospheric variables including wind speed, wind direction, ambient temperature, depth of the mixing layer, and the ambient turbulence level (i.e., atmospheric stability). These variables vary as functions of space and time. The selection of acceptable meteorological data representative of the site dispersion environment is necessary to correctly characterize downwind concentrations from the proposed source.

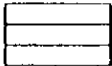


Digitized meteorological data are available from the National Climatic Data Center (NCDC) which archives regular observations made at National Weather Service (NWS) stations. The refined modeling analysis used a recent five-year period of meteorological data provided by Mr. Thomas Rogers of DER (DER, 1989) as representative of the Lee County site. Surface data are from Ft. Myers (Page Field), and upper air data are from Tampa International Airport—both for the years 1982 to 1986. Surface data consist of hourly observations of wind speed, wind direction, temperature, cloud cover, and several other parameters. Mixing height is calculated from twice daily upper air soundings which measure atmospheric temperature profiles. Rural mode wind profile exponents and mixing heights were applied based on the above discussion on land use classification.

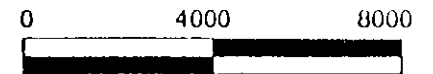


NORTH



LEGEND

-  RURAL (61%)
-  URBAN (37%)
-  SITE (2%)



Scale in Feet

LEE COUNTY
 ENERGY RECOVERY FACILITY
 Application for Power Plant Certification
 Camp Dresser & McKee Inc.

FIGURE 6-1
 AUER LAND USE CLASSIFICATION

6.4 SCREENING ANALYSIS

An air quality screening analysis was conducted to identify the Facility operating condition from Table 6-1 that produced the worst-case ground-level pollutant concentrations in the vicinity of the proposed Facility. The screening dispersion modeling is performed on the basis of simplified meteorology, and a single wind direction over composite worst-case terrain. EPA-approved dispersion modeling options and inputs for screening analyses are presented in Table 6-3. The modeling procedures are consistent with the "Guideline on Air Quality Models — Revised" (EPA, 1986) and "Guideline for Air Quality Maintenance Planning and Analysis, Volume 10 (Revised): Procedures for Evaluating Air Quality Impacts of New Stationary Sources" (EPA, 1977).

A total of 14 operating conditions for waste throughput and waste heat content were identified for screening dispersion modeling in two steps. In the first step, waste heat content was held constant (at the design reference waste value of 5,000 Btu/lb), and a range of throughput levels was analyzed for the combustor technology under consideration. The range consisted of 50, 75, 100, and 110 percent of the design waste throughput for the Facility.

Dispersion model parameters for these conditions are listed in Table 6-1 in Section 6.2. The two worst cases (those which produced the highest normalized ground-level concentrations in this first round of screening dispersion modeling) were then selected for analysis of the effects on flue gas flow rate of varying the waste heat content. The dispersion model parameters for these cases are shown in Table 6-1. The screening results for the 110 and 100 percent cases are shown in Table 6-4 by stability class. (Results for the 75 and 50 percent cases were much lower and therefore have not been shown.)

Table 6-4 shows that the operating condition which produces the greatest impacts is a Facility throughput of 1,650 tpd of waste with a higher heating value of 6,000 Btu/lb. Since the heat release for this case can only be tolerated by the combustors for short periods, and is only expected

TABLE 6-3

LEE COUNTY ENERGY RECOVERY FACILITY
SCREENING MODELING OPTIONS ISCST

Option Description	EPA Dispersion Model ISCST
1. Land Use Classification	Rural
2. Wind Profile Exponents	Rural Default
3. Vertical Potential Temperature Gradient	Default
4. Stack-Tip Downwash	Yes
5. Gradual Plume Rise	No
6. Bouyancy-Induced Dispersion	Yes
7. Pollutant Half-Life	No/Infinite
8. Decalm	NA
9. Meteorology	PTPLU-based Meteorological Conditions ^a (footnote ^b)
10. Receptors	(A) <u>Worst-case elevation</u>
11. Receptor Elevation	
12. Sector Averaging	No
13. Terrain Adjustment Factor	Full
14. Anemometer Height (ft)	20
15. Non-stable Mixing Height (m)	5,000

SOURCE: Camp Dresser & McKee Inc., 1991.

NA = Not Applicable

^a Meteorology Stability Class	Wind Speed (m/s)
A	0.5,0.8,1.0,1.5,2.0,2.5,3.0
B	0.5,0.8,1.0,1.5,2.0,2.5,3.0,4.0,5.0
C	1.0,2.0,2.5,3.0,4.0,5.0,7.0,10.0,12.0,15.0
D	1.0,1.5,2.0,2.5,3.0,4.0,5.0,7.0,10.0,12.0,15.0,20.0
E	2.0,2.5,3.0,4.0,5.0
F	2.0,2.5,3.0,4.0,5.0

^b ISCST Receptors x (km)	Increment (km)
0.1-2.0	0.1
2.2-4.0	0.2
4.5-10	0.5
11-15	1.0

TABLE 6-4

LEE COUNTY ERF SCREENING ANALYSIS RESULTS
FOR VARIOUS OPERATING LOADS
(Concentrations in $\mu\text{g}/\text{m}^3$ using Normalized Emission Rate)

Stoker Waterwall Design Cases						
Throughput (tpd)	<u>1,650^a</u>	<u>1,980</u>	<u>2,604</u>	<u>1,500</u>	<u>1,800^b</u>	<u>2,367</u>
Heat Content (Btu/lb)	6,000	5,000	3,802	6,000	5,000	3,802
Normalized ^c Emission rate (g/s)	1.1	1.1	1.1	1.0	1.0	1.0
Stability Class	Maximum Normalized ^c 1-Hour-Average Concentrations and Downwind Distance (km) from Stack					
A	<u>1.130</u> (0.8)	<u>1.126</u> (0.8)	<u>1.088</u> (0.8)	<u>1.105</u> (0.7)	<u>1.100</u> (0.7)	<u>1.044</u> (0.7)
B	<u>0.750</u> (1.4)	<u>0.747</u> (1.4)	<u>0.716</u> (1.4)	<u>0.727</u> (1.3)	<u>0.724</u> (1.3)	<u>0.692</u> (1.3)
C	<u>0.630</u> (2.0)	<u>0.628</u> (2.0)	<u>0.602</u> (2.0)	<u>0.606</u> (2.0)	<u>0.604</u> (2.0)	<u>0.581</u> (2.0)
D	<u>0.338</u> (3.2)	<u>0.336</u> (3.2)	<u>0.321</u> (3.2)	<u>0.326</u> (3.2)	<u>0.324</u> (3.2)	<u>0.311</u> (3.2)
E	<u>0.297</u> (15.0)	<u>0.296</u> (15.0)	<u>0.285</u> (15.0)	<u>0.283</u> (15.0)	<u>0.282</u> (15.0)	<u>0.273</u> (15.0)
F	<u>0.089</u> (15.0)	<u>0.088</u> (15.0)	<u>0.083</u> (15.0)	<u>0.087</u> (15.0)	<u>0.086</u> (15.0)	<u>0.082</u> (15.0)

SOURCE: Camp Dresser & McKee Inc., 1991.

^a Selected for short-term (24 hours and less) refined analysis.

^b Selected for long-term (annual) refined analysis.

^c Normalized to 1,800 tpd at 5,000 Btu/lb. Assumes a dry scrubber and baghouse.

to exist for short periods of time, this operating condition was applied to dispersion modeling for pollutants with averaging time standards of 24 hours and less. An additional operating case was selected to represent the worst case for pollutants with annual average standards: 1,800 tpd of waste at 5,000 Btu/lb (the design condition). The location of maximum impacts for the individual atmospheric stability classes are provided in Table 6-4.

6.5 DETAILED MODELING ANALYSIS

A detailed dispersion modeling analysis was conducted for the Lee County facility worst-case operating conditions (with the emission rate normalized to the design operating condition) to resolve the maximum impacts over a 1,681-receptor rectangular grid for each year of the 1982 to 1986 sequential hourly meteorological data base. EPA's ISCST dispersion model was used to model Facility impacts for 1-, 3-, 8-, 24-hour, and annual average concentrations. All average concentrations are computed as block averages of 1-hour concentrations. The ISCST detailed modeling options are listed in Table 6-5. All high and highest, second high impacts for each averaging period were included in a "refined analysis" in which they were analyzed with fine resolution grids to further resolve the location and magnitude of the predicted pollutant concentrations for the five-year period. These concentrations were compared to the NAAQS and FAAQS. The modeling results demonstrate that the Facility has a less than significant impact for all criteria pollutants.

6.5.1 RECEPTOR GRIDS

A rectangular "coarse" grid with 500-meter spacing for detailed modeling was developed based on the screening modeling results, and on guidance contained in Guidelines on Air Quality Models (EPA, 1986). The grid was extended outward from the stack location to 10 km in each of the four directions. Screening modeling had indicated that maximum impacts were likely to occur within five km (see Table 6-4). Half-kilometer spacing of gridlines in each direction was initially used. Receptor points were placed at each gridline crossing, for a total of 1,681 receptors. Terrain

TABLE 6-5

LEE COUNTY ENERGY RECOVERY FACILITY
 DETAILED MODELING OPTIONS FOR ISCST

Option Description	ISCST
1. Land Use Classification	Rural
2. Wind Profile Exponents	0.07, 0.07, 0.10, 0.15, 0.35, 0.55 (rural default)
3. Vertical Potential Temperature Gradient	Default
4. Stack-tip Downwash	Yes
5. Gradual Plume Rise	No
6. Buoyancy-Induced Dispersion	Yes
7. Half-Life	Infinite
8. Decalm (CALMPRO) ^a	Yes (internal)
9. Meteorology	1982-1986 Sequential-hourly
10. Receptors 21 km x 21 km 500-m spacing	Rectangular Grid
11. Terrain	Yes: all terrain is below stack-top elevation
12. Terrain Adjustment Factors	NA
13. Anemometer Height (m)	6.10

NA = Not Applicable

^aThe CALMPRO algorithm is either "hardwired" within the model (i.e., internal) or it is manually applied to the modeled concentrations (i.e., external).

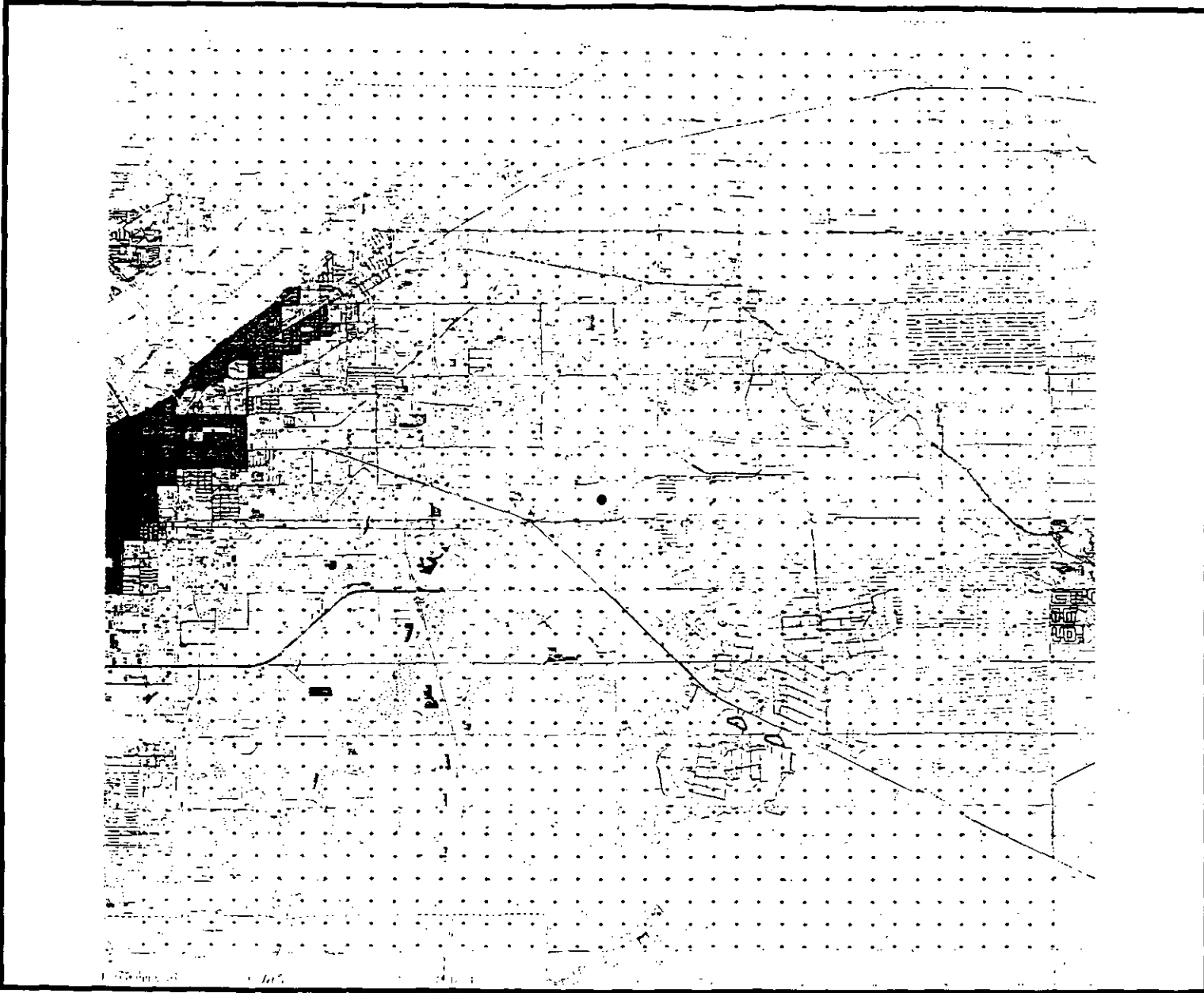
elevations were selected for each receptor point from the appropriate U.S. Geologic Survey (USGS) topographic maps (7.5-minute quadrangles) of the area. The maximum terrain within 250 meters of each receptor was assigned to that receptor. The coarse grid study area and receptor points are shown in Figure 6-2.

Fine resolution grids (with 100-meter resolution) were centered around the receptor locations where the highest, and the highest of the second-highest normalized ground-level impacts for each pollutant averaging period occurred for each of the five years. The purpose of this exercise was to account for the possibility that the highest and highest, second-highest impacts may "flip-flop" when going from a coarse to a fine grid. Fine grids spanned at least a 1.1-km square area centered on each coarse-grid receptor. Terrain corresponding to the fine grid spacing (i.e., highest within 50 meters of each receptor) was employed in the analysis. All five years of meteorological data were re-run for the modeling of each grid. The resultant predicted highest, second highest short-term and maximum long-term modeled fine resolution grid concentrations were used in the comparison of Facility impacts to ambient standards and increments for regulated pollutants.

Additional discrete receptors were positioned at the nearest boundary of the nearest PSD Class I area, the Everglades National Park, 88 km from the Lee County facility. At the request of the National Park Service (NPS, 1990), receptors were also placed at the nearest boundary of the Big Cypress National Preserve, 61 km from the Lee County facility. The Big Cypress National Preserve is considered sensitive to air quality impacts because of its pristine nature and the presence of unusual or endangered plant species (NPS, 1990). Four receptors were placed along the nearest boundary of each area. A detailed discussion of Class I area impacts is presented in Section 7.4.

6.5.2 DETAILED MODELING RESULTS

Results of the ISCST detailed coarse-grid modeling results are tabulated in Table 6-6. These are the highest and the highest of the second-highest



NORTH



LEGEND

● STACK LOCATION

LEE COUNTY
ENERGY RECOVERY FACILITY
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FIGURE 6-2
COURSE GRID RECEPTOR ARRAY

TABLE 6-6

MAXIMUM COARSE GRID GROUND-LEVEL CONCENTRATIONS
FOR THE LEE COUNTY ENERGY RECOVERY FACILITY

	Averaging Period	Rank ^a	Normalized Ground-Level Concentrations ($\mu\text{g}/\text{m}^3$)				
			1982	1983	1984	1985	1986
<u>ISCST</u>	1-hour ^b	H	<u>1.45</u>	1.33	1.22	<u>1.30</u>	1.20
		HSH	<u>1.05</u>	<u>1.18</u>	<u>1.20</u>	<u>1.14</u>	<u>1.09</u>
	3-hour ^b	H	<u>0.679</u>	<u>0.626</u>	<u>0.664</u>	<u>0.640</u>	<u>0.820</u>
		HSH	<u>0.499</u>	<u>0.531</u>	<u>0.596</u>	<u>0.586</u>	<u>0.556</u>
	8-hour ^b	H	<u>0.339</u>	<u>0.395</u>	<u>0.497</u>	<u>0.528</u>	<u>0.459</u>
		HSH	<u>0.302</u>	<u>0.311</u>	<u>0.401</u>	<u>0.334</u>	<u>0.342</u>
	24-hour ^b	H	<u>0.142</u>	<u>0.162</u>	<u>0.197</u>	<u>0.197</u>	<u>0.173</u>
		HSH	<u>0.101</u>	<u>0.125</u>	<u>0.178</u>	<u>0.150</u>	<u>0.130</u>
	Annual	H	<u>0.0099</u>	<u>0.0125</u>	<u>0.0127</u>	<u>0.0100</u>	<u>0.0117</u>

SOURCE: Camp Dresser & McKee Inc., 1991.

^aAbbreviations: H = Highest
HSH = Highest, Second-Highest

^bThe short-term (24 hours and less) average normalized ground-level concentrations were computed with a 1.1 g/s normalized emission rate, thereby already including the 110% load factor assumed for short-term emissions (1.0 g/s was used for the annual average case). Therefore, to compute actual ground-level concentrations for each pollutant, select the 100% load emission rate for each pollutant from Table 6-2 for all applicable averaging times to multiply with the normalized concentrations shown above.

NOTE: All values for each averaging period were resolved further in the fine grid analyses.

predicted concentrations for the two worst-case operating conditions: (1) 110 percent of design thermal load for all short-term (24 hours and less) averaging times; and (2) 100 percent of design thermal load for annual averages. The predicted normalized impacts for the Facility stack emissions have been plotted to illustrate their distribution in the vicinity of the proposed site. Figures 6-3, 6-4, and 6-5 show the normalized unitized impacts predicted for annual, 24-hour, and 3-hour block-averaged periods, respectively. In each case, the distribution of impacts shown is based upon the specific year in which the limiting impact (highest annual average concentration or highest, second-highest short-term concentrations) was predicted.

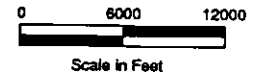
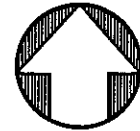
The results of the fine grid analyses are summarized in Table 6-7. Comparisons to the significant impact levels, de minimis monitoring guidelines, and air quality standards are based on the results of the fine grid modeling. The limiting short-term (i.e., 1-, 3-, 8-, and 24-hour) impacts are based on the highest, second-highest (HSH) concentrations for comparisons to the significant impact levels, NAAQS and FAAQS, and PSD increments. However, the highest concentrations were used conservatively for comparison to the de minimis monitoring guidelines (although EPA Region IV and DER do allow the use of HSH concentration). Limiting annual average impacts are based on the highest concentration predicted for the five years of meteorological data. The highest 24-hour concentration was also used as a conservative estimate of the quarterly lead impact and the 30-day average beryllium impact.

Predicted Air Quality Impacts

Ground-level concentrations were modeled for the pollutants anticipated to be emitted by the Lee County facility. The predicted pollutant ground-level concentrations are compared to PSD de minimis monitoring levels and significant impact levels (SIL) in Table 6-8. The predicted concentrations are determined by multiplying the 100 percent load pollutant emission rate (in grams per second) in Table 6-2 by the normalized ground-level concentration estimates (which include the load adjustment factors for the short-term averaging periods) presented in Table 6-7 for



NORTH

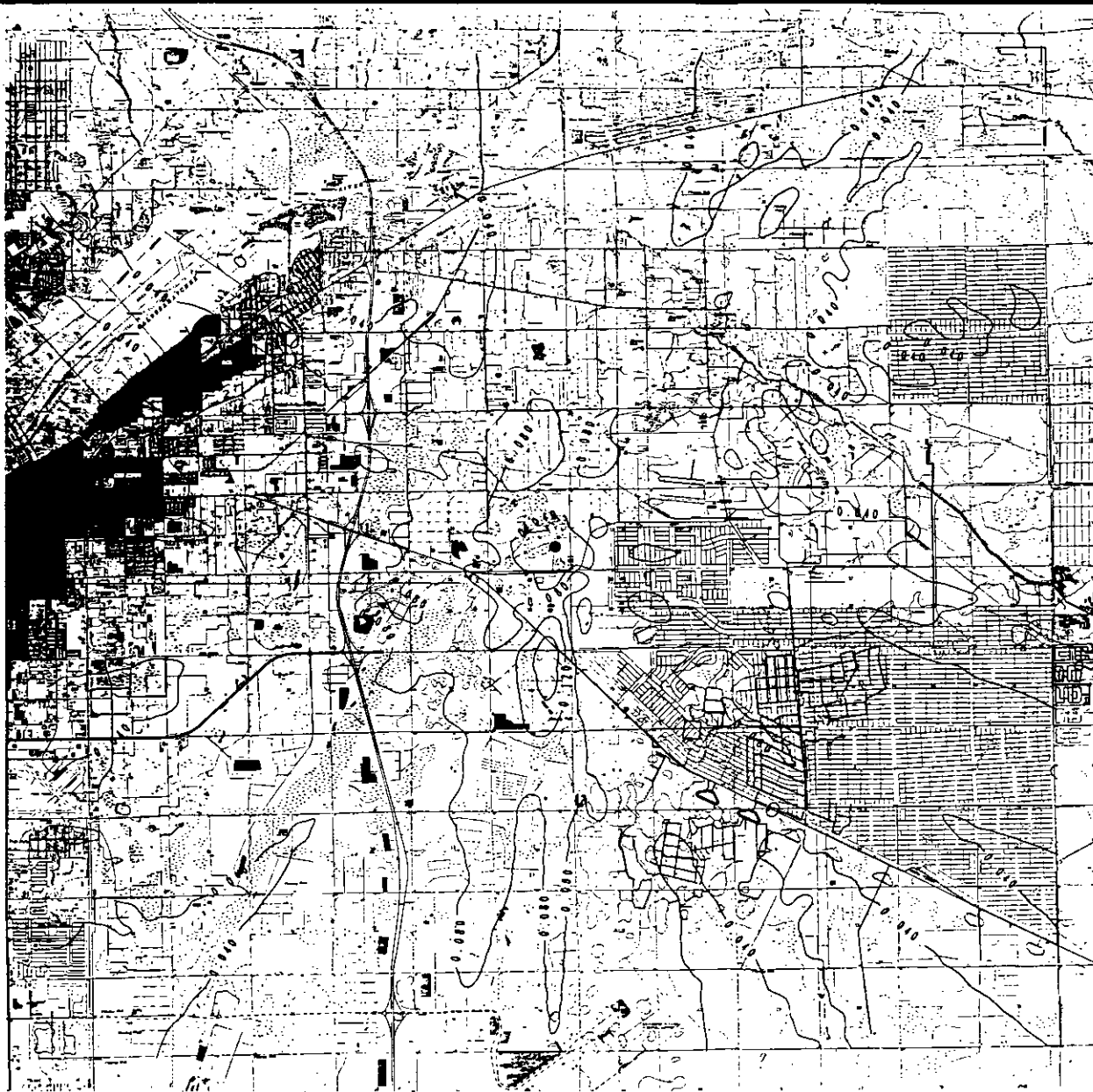


LEGEND

0.000 NORMALIZED
CONCENTRATIONS
IN MICROGRAMS
PER CUBIC METER

LEE COUNTY
ENERGY RECOVERY FACILITY
Application for Power Plant Certification
Camp Dresser & McKee Inc.

FIGURE 6-3
NORMALIZED GROUND-LEVEL
CONCENTRATION ISOPLETHS:
HIGHEST ANNUAL AVERAGE (1984)



NORTH



0 8000 12000



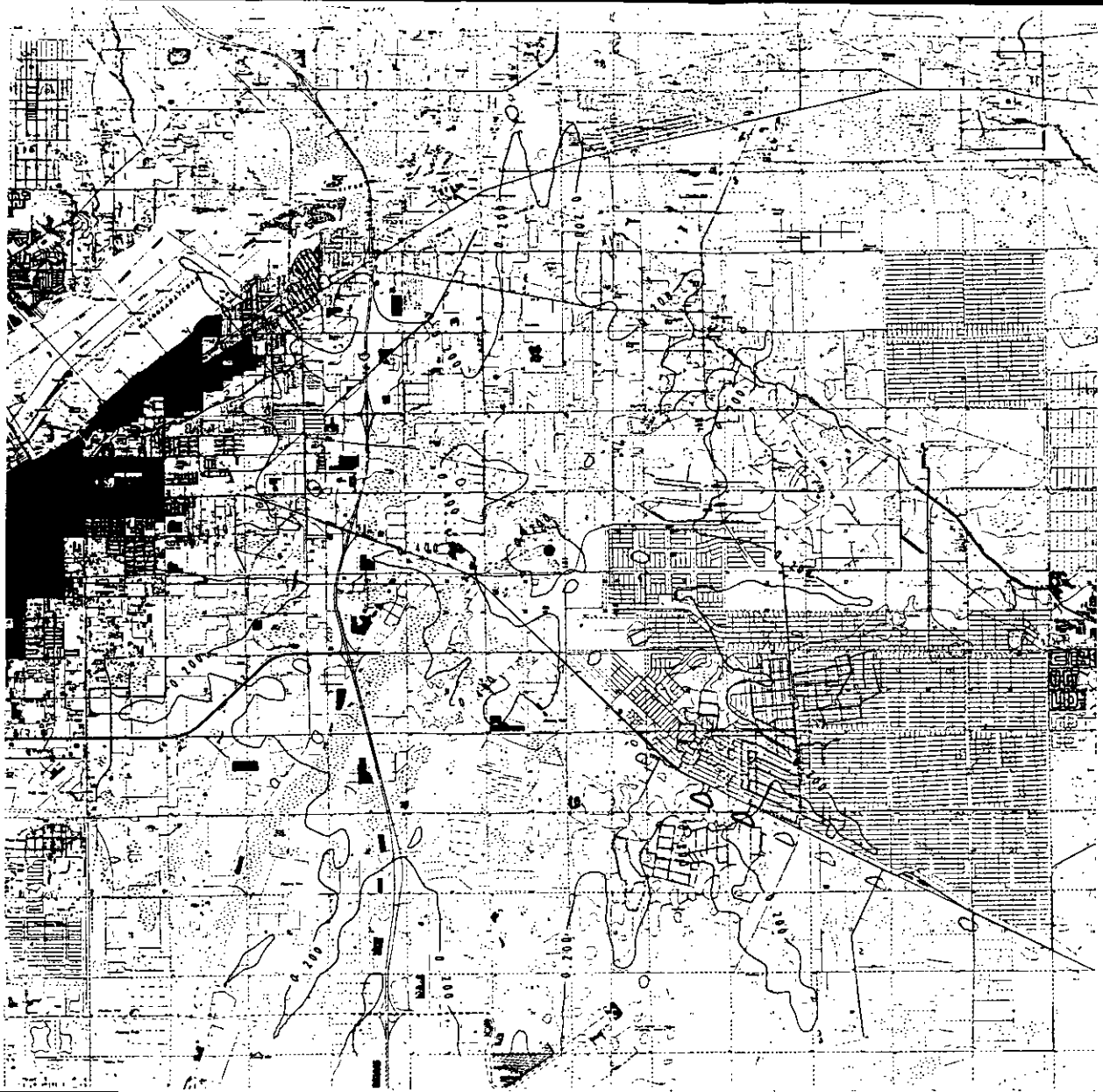
Scale in Feet

LEGEND

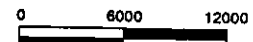
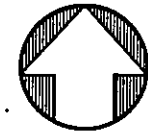
0.000 NORMALIZED
CONCENTRATIONS
IN MICROGRAMS
PER CUBIC METER

LEE COUNTY
ENERGY RECOVERY FACILITY
Application for Power Plant Certification
Camp Dresser & McKee Inc.

FIGURE 6-4
NORMALIZED GROUND-LEVEL
CONCENTRATION ISOPLETHS:
HIGH, SECOND HIGH 24-HOUR AVERAGE



NORTH



Scale In Feet

LEGEND

0.000 NORMALIZED
CONCENTRATIONS
IN MICROGRAMS
PER CUBIC METER

LEE COUNTY
ENERGY RECOVERY FACILITY
Application for Power Plant Certification
Camp Dresser & McKee Inc.

FIGURE 6-5
NORMALIZED GROUND-LEVEL
CONCENTRATION ISOPLETHS:
HIGH, SECOND HIGH 3-HOUR AVERAGE

TABLE 6-7

-MAXIMUM NORMALIZED GROUND-LEVEL CONCENTRATIONS
 BASED ON THE FINE GRID ANALYSES
 FOR THE LEE COUNTY ENERGY RECOVERY FACILITY

Averaging X/Q Period	Rank ^a	Normalized Ground Level Concentration ($\mu\text{g}/\text{m}^3$)	Receptor Location ^b Grid Coordinates		Meteorological Period		
			Distance East (m)	Distance North (m)	Year	Day	Period Ending
1-hour	H	<u>1.928</u>	700	500	1982	200	13
	HSH	<u>1.258</u>	300	-700	1986	195 120	13 12
3-hour	H	<u>0.896</u>	0	800	1986	121	5
	HSH	<u>0.708</u>	-600	500	1986	161	4
8-hour	H	<u>0.535</u>	-100	-1,800	1984	229	2
	HSH	<u>0.433</u>	-100	-1,800	1984	228	2
24-hour	H	<u>0.218</u>	-100	-1,800	1984	229	1
	HSH	<u>0.179</u>	0	-2,100	1984	230	1
Annual	H	<u>0.0132</u>	-700	-2,700	1984	N/A	N/A

SOURCE: Camp Dresser & McKee Inc., 1991.

^aAbbreviations: H = Highest
 HSH = Highest, Second-Highest
 N/A = Not Applicable

^bReceptor grid coordinates in meters north and east (south and west are presented as negative numbers) relative to Lee County facility stack.

NOTE: The short-term (24 hours and less) average normalized ground-level concentrations were computed with a 1.1 g/s normalized emission rate, thereby already including the 110% load factor assumed for short-term emissions (1.0 g/s was used for the annual average case). Therefore, to compute actual ground-level concentrations for each pollutant, select the 100% load emission rate for each pollutant from Table 6-2 for all applicable averaging times to multiply with the normalized concentrations shown above.

TABLE 6-8

LEE COUNTY ENERGY RECOVERY FACILITY
COMPARISON OF MAXIMUM PREDICTED CONCENTRATIONS OF
REGULATED POLLUTANTS TO SIGNIFICANT IMPACT AND
DE MINIMIS MONITORING LEVELS
(concentrations in $\mu\text{g}/\text{m}^3$)

Pollutant	Averaging Period	Rank ^a	Maximum Predicted Concentration ^b	Significant Impact Level	PSD De Minimis Monitoring Level
Sulfur Dioxide (SO_2)	Annual	H	<u>0.19</u>	1	—
	24-hour	H	3.1	—	13
		HSH	<u>2.52</u>	5	—
	3-hour	H	15.8	—	—
HSH		<u>12.5</u>	25	—	
Nitrogen Dioxide (NO_2)	Annual	H	<u>0.36</u>	1	14
Particulate Matter (as TSP or PM_{10})	Annual	H	<u>0.024</u>	1	—
	24-hour	H	0.40	—	10
HSH		<u>0.33</u>	5	—	
Carbon Monoxide (CO)	8-hour	H	5.0	—	575
		HSH	<u>4.0</u>	500	—
	1-hour	H	71.9	—	—
HSH	<u>46.9</u>	2,000	—		
Lead (Pb)	3-month	H	<u>0.012^c</u>	—	0.1
Mercury (Hg)	24-hour	H	<u>0.017</u>	—	0.25
Beryllium (Be)	24-hour	H	<u>2.79×10^{-6}</u>	—	1×10^{-3}
Fluorides (as HF)	24-hour	H	<u>0.072</u>	—	0.25

SOURCE: Camp Dresser & McKee Inc., 1991.

^a Abbreviations: H = Highest concentration
HSH = Highest, second-highest concentration

^b Location and time-of-occurrence for maximum impacts (by rank) are provided in Table 6-7.

^c The de minimis monitoring level for lead is a quarterly-averaged value. The 24-hour highest average concentration was substituted as a conservative estimate of the quarterly value.

NOTE: No significance guideline level is exceeded.

the appropriate averaging time. The highest predicted impacts are below the de minimis monitoring levels. Therefore, in accordance with 40 CFR 52.21(i)(8), the DER may exempt the Facility from pre-construction monitoring requirements. In light of the modeling results shown in Table 6-8, DER concurred (December 5, 1990) that pre-construction monitoring is not required.

The significant impact levels (SIL) are concentrations below which a Facility would not be considered to cause or contribute to a violation of the NAAQS (40 CFR 51.165(b)(2)). Table 6-8 shows that maximum predicted impacts for all regulated pollutants emitted by the Lee County facility are below the corresponding SILs. Therefore, no further impact analysis of predicted cumulative effects of this Facility with other nearby major sources is required, based on U.S. EPA guidance.

6.6 COMPARISON WITH AMBIENT AIR QUALITY STANDARDS

The purpose of the following analysis is to demonstrate that the proposed Facility will not cause or contribute to an exceedance of NAAQS/FAAQs. As shown in Section 6.5, the Facility has an insignificant impact for all criteria pollutants based on the modeling period 1982 to 1986. To conservatively demonstrate compliance with the NAAQS/FAAQs, the highest second-highest short-term, or highest annual modeled impacts of the Facility are added to the ambient background concentrations derived in Table 5-5. The comparison, presented in Table 6-9, is made with the more stringent of the federal or state standard.

The Facility impacts alone are very small in comparison to the ambient air quality standards. All Facility impacts consume less than 1.0 percent of the corresponding NAAQS/FAAQs. The highest 24-hour average lead impact is 0.012 ug/m³, or 0.8 percent of the Florida quarterly standard. This percentage is inherently conservative because the highest 24-hour average concentration was used to estimate the quarterly impact. The highest, second-highest 3-hour and 24-hour SO₂ concentrations represent only 0.96 percent and 0.97 percent of the respective FAAQS. The highest annual SO₂ impact is only 0.3 percent of the FAAQS. The highest second-highest total

TABLE 6-9

COMPARISON OF PREDICTED IMPACTS FROM THE LEE COUNTY ENERGY RECOVERY FACILITY
AND AMBIENT BACKGROUND CONCENTRATIONS TO THE NAAQS/FAAQS
(concentration in $\mu\text{g}/\text{m}^3$)

Pollutant	Averaging Time	Rank ^a	NAAQS/FAAQS ^b	Facility Impact	Facility Impact as Percent of Standard	Ambient Background Concentration	Total Impact	Total Impact as Percent of Standard
Sulfur Dioxide	3-Hour	HSH	1,300 (1300)	12.5	0.96	199	211.5	16.3
	24-Hour	HSH	260	2.52	0.97	54	56.52	21.7
	Annual	H	60	0.19	0.3	9		15.3
Nitrogen Dioxide	Annual	H	100 (100)	0.36	0.4	42	42.4	42.4
Particulate Matter (as PM_{10})	24-Hour	HSH	150 (150)	0.33	0.2	58	58.3	38.9
	Annual	H	50 (50)	0.024	0.05	30	30.0	60.0
Carbon Monoxide	1-Hour	HSH	40,000	47.0	0.12	9200	9247	23.1
	8-Hour	HSH	10,000	4.0	0.04	4600	4604	46.0
Lead	3-Month	H	1.5 (1.5)	0.012 ^c	0.8	0.1	0.11	7

SOURCE: Camp Dresser & McKee Inc., 1991.

^aAbbreviations: H = Highest
HSH = Highest Second-Highest

^bThe more stringent of federal or state standard is given. Secondary standards are shown in parentheses.

^cHighest 24-hour average concentration used to conservatively estimate 30-day or 3-month average concentration.

PM₁₀ 24-hour concentration is 0.2 percent of the 150 ug/m³ ambient standard, whereas the highest annual PM₁₀ concentration is 0.05 percent of the annual ambient standard of 50 ug/m³. The modeled highest annual NO₂ concentration is 0.4 percent of the FAAQS. Predicted highest second-highest carbon monoxide concentrations for one- and eight-hour averaging periods consume only 0.12 and 0.04 percent of their respective NAAQS/FAAQS.

The tabulated total impacts shown in Table 6-9 suggest that the NAAQS/FAAQS will be maintained by substantial margins. The largest estimated total concentration as a percent of its NAAQS/FAAQS is obtained by adding the estimated PM₁₀ annual impact and the monitored background concentration. The total annual PM₁₀ impact is 60 percent of the FAAQS; however, the impact from the Facility alone is only 0.05 percent of the standard. While the total highest second-highest 24-hour PM₁₀ impact is 39 percent of the FAAQS, the impact from the Facility alone is 0.33 ug/m³, or 0.2 percent of the FAAQS.

The highest total annual impact for nitrogen dioxide is 42 percent of the standard, whereas the impact for the Facility alone is only 0.4 percent of the FAAQS. The 3-hour, 24-hour, and annual total impacts for sulfur dioxide are all less than 22 percent of their respective NAAQS/FAAQS. The total three-month lead impact consumes only seven percent of the lead standard, while the total carbon monoxide one- and eight-hour impacts consume less than 46 percent of their respective NAAQS/FAAQS.

6.7 ASSESSMENT OF NON-CRITERIA POLLUTANT IMPACTS

In the context of this discussion the term "non-criteria pollutant" is used as a general term for all pollutants listed in Table 6-10. These pollutants do not have FAAQS or NAAQS, and the Florida Department of Environmental Regulation has not officially adopted a set of Acceptable Ambient Levels (AALs) applicable to energy recovery facilities for the assessment of acceptable ground-level concentrations.

TABLE 6-10

MAXIMUM PREDICTED CONCENTRATION OF NON-CRITERIA POLLUTANTS
 RESULTING FROM LEE COUNTY ERF EMISSIONS

Pollutant ^a	Averaging Period	Highest Concentration (ug/m ³)	ACGIH TLV ^b (ug/m ³)	North Carolina AAL ^c (ug/m ³)	Kentucky AAL ^d (ug/m ³)
Mercury (Hg)	8-hour	4.1×10^{-2}	50	—	2.38
	24-hour	1.7×10^{-2}	—	0.6	—
	Annual	1.0×10^{-3}	—	—	—
Beryllium (Be)	8-hour	6.85×10^{-6}	2.0	—	BR
	24-hour	2.79×10^{-6}	—	—	—
	Annual	1.69×10^{-7}	—	4.1×10^{-3}	—
Fluorides (as HF)	1-hour	0.638	—	250	—
	8-hour	0.177	2,000	—	—
	24-hour	0.072	—	30	49,070
	Annual	4.37×10^{-3}	—	—	—
Sulfuric Acid Mist (H ₂ SO ₄ aqueous)	1-hour	6.52	—	100	—
	8-hour	1.81	1,000	—	23.8
	24-hour	0.737	—	12	—
	Annual	0.045	—	—	—
Arsenic (As)	8-hour	4.6×10^{-4}	200	—	BR
	24-hour	1.87×10^{-4}	—	—	—
	Annual	1.14×10^{-5}	—	2.3×10^{-4}	—
Hydrogen Chloride ^e	1-hour	11.7	—	700	167
	8-hour	3.25	7,000	—	—
	24-hour	1.33	—	—	—
	Annual	0.083	—	—	—
Dioxins ^e (Total tetra-octa TCDD & PCDF)	Annual	3.17×10^{-8}	—	3.0×10^{-6}	BR

TABLE 6-10
(continued)

SOURCE: Camp Dresser & McKee Inc., 1991.

^aAsbestos, vinyl chloride, and hydrogen sulfide are regulated (40 CFR 52.21) pollutants with nil emission rates from the proposed Lee County RRF. Therefore, the resulting ambient impacts are nil, and are not listed.

^bAmerican Conference of Governmental Industrial Hygienists, Threshold Limit Values and Biological Exposure Indices for 1989-1990.

^cAcceptable Ambient Levels, North Carolina Administrative Code, Title 15A, Chapter 2, Subchapter 2D, effective May 1, 1990. 15-minute averaging times for the standards of acid gases have been applied to one-hour average Facility concentrations.

^d"Y" values from Kentucky Air Regulation 401KAR63:022, "New or Modified Sources Emitting Toxic Air Pollutants." The "Y" values are a function of the number of Facility operating hours per week, assumed, in this case, to be 168. The fluoride standard shown is an approximation of the actual standard, 60 ppm for a 2-month averaging period, from Appendix A of Regulation 401KAR53:010.

^eHydrogen chloride and dioxins are not regulated under the Clean Air Act or NESHAPS, and thereby are not PSD regulated pollutants.

^fNot specified as 2,3,7,8 - TCDD toxic equivalents. Standard applicable after May 1, 1991.

BR - BACT required if emission rate exceeds review threshold.

6.7.1 ASSESSMENT METHODS

Guideline concentrations for short- and long-term periods, including industrial toxicological limits (eight-hour time-weighted averages) and threshold levels (24-hour and annual averages), from states which have air toxics management programs as part of their air pollution control regulations are listed in Table 6-10. These are compared with modeled ground-level concentrations of mercury, beryllium, hydrogen fluoride, sulfuric acid mist, arsenic, and hydrogen chloride.

Threshold limit values (TLVs) adopted by the American Conference of Governmental Industrial Hygienists (ACGIH) are presented for comparison with eight-hour average concentrations from the Facility. These limits are normally intended for use in the practice of industrial hygiene for eight-hour work day and 40-hour work week exposures, and not for estimating the toxic potential of continuous, uninterrupted exposures. It is believed that nearly all workers may be repeatedly exposed day after day to a TLV without adverse effects (Plunkett, 1976). The ACGIH TLV values are the most complete listing of quantified acceptable exposure levels available. Of the eight states in the U.S. EPA Region IV (Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee), only North Carolina and Kentucky have toxic air pollutant acceptable ambient levels (AALs) adopted into their state air pollution control regulations (Sam Amersum and Sandra Burckhead North Carolina Division of Environmental Management, June 11, 1991) (Marjorie Mullen, Environmental Engineering Technologist, Principal, Kentucky Department of Environmental Protection, June 11, 1991). South Carolina has revised draft AALs, which were adopted year (1991) (John Hursey, Environmental Engineer, South Carolina Department of Health and Environmental Control, June 11, 1991).

Tennessee is currently in the process of reviewing EPA 1990 CAA list of 189 air toxics to update their air toxic guidelines. These guidelines will assess impacts based on 5 to 10 percent of the ACGIH TLVs as an eight-hour standard which should be adopted by July, 1991. (Ron Redus, Environmental Specialist, Tennessee Air Pollution Control Division, June 11, 1991).

Alabama uses guidelines based on the ACGIH TLVs. The predicted one-hour

screening concentrations are compared to the TLV divided by a factor of 40. The annual average concentrations, using the ISCLT model, are compared to TLV divided by a safety factor of 420. Each pollutant must comply with at least one of these guidelines (Jeff Walker, Alabama Department of Environmental Management, June 11, 1991). Georgia has air toxic guidelines which compare most pollutant impacts to acceptable ambient concentrations (AACs), based on the standards set forth by the Occupational Safety and Health Administration (OSHA). Any values not specifically shown as AACs are compared to ACGIH standards. Both sets of guideline values are a function of the number of hours per week emissions would occur, and are divided by a safety factor of 300 for known human carcinogens, or by 100 for non-carcinogens. The Georgia AACs are set as 24-hour averages (Jean Drew, Chemical Engineer, Georgia Department of Natural Resources, June 11, 1991).

Mississippi uses toxic air pollutant guidelines which compare annual predicted ambient concentrations to one percent of the TLVs. Proposed new guidelines would change this approach to compare the 24-hour predicted concentrations to one percent of the TLVs. For pollutants which are known carcinogens, a risk assessment is also required. Where carcinogenic pollutant concentrations are found to be within a certain risk value range, permit approval is assessed on a case-by-case basis, taking into consideration actual population exposure (Eliot Berkerstaff, Environmental Engineer, Air Planning Division, Mississippi Department of Natural Resources, June 12, 1991).

Florida is in the process of developing draft "no-threat" levels for toxic air pollutants. It is expected that these will become policy guidelines within the next month (July, 1991) (John Glunn, DER, June 6, 1991), although it is the Applicant's understanding that DER does not intend them to be applied to energy recovery facilities. Table 6-10 shows modeled maximum Facility ground-level concentrations of non-criteria pollutants in comparison with the ACGIH TLVs, and with the adopted standards established in North Carolina and Kentucky.

6.7.2 COMPARISON WITH ACGIH TLVs AND AALs

Highest impacts of non-criteria pollutants listed in Table 6-10 are substantially less than the ACGIH TLVs and the two sets of AALs. The proposed Lee County ERF emissions will not likely pose a health significant risk to the surrounding population because the ground-level concentrations do not exceed acceptable levels for short- or long-term periods, as established by agencies with established regulations and air toxics research and management programs.

6.8 COMPARISON WITH PSD INCREMENTS

The Lee County energy recovery facility is a major source of SO₂, NO₂, and TSP emissions as defined in 40 CFR 52.21(b)(1)(i), and as presented in this application in Table 2-1. As such, it is subject to a PSD increment consumption analysis to ensure compliance with all PSD increments. Lee County and all adjacent counties are designated as PSD Class II areas (FAC 17-2.440), except for the southwestern tip of Collier County, which is occupied by part of the Everglades National Park. The Everglades is the only PSD Class I area within 100 km of the proposed Facility. The closest border of this Class I Area is 88 km (or 55 miles) to the south-southeast. At the request of the National Parks Service (NPS, 1990), the Big Cypress National Preserve, 61 km (about 38 miles) southeast of the proposed Facility, was treated as an air quality-sensitive area. Estimated maximum ground-level pollutant concentrations from the Facility were modeled for receptors along the nearest boundaries of both parks, and compared to Class I area significant impact levels (SILs) and PSD increments.

The following sections discuss impacts on these areas, classified as in attainment of the FAAQS and NAAQS. A discussion of Facility impacts in non-attainment areas is presented in Section 7.7.

6.8.1 PSD CLASS II AREAS

The baseline date for TSP and SO₂ was triggered for the entire state of Florida on December 27, 1977 [FAC 17-500(4)(b)(2.c)]. The major source

baseline data for NO₂ was set nationally on February 8, 1988 (53 FR 4061, October 17, 1988). All new sources and modifications subject to PSD review after these dates are assumed to be PSD-increment consuming sources. On October 5, 1989, EPA proposed to revise the maximum allowable increases for particulate matter (54 FR 41218). The proposed increments would define maximum allowable increments in concentrations of PM₁₀ for Class I, II, and III areas. These changes are proposed because EPA believes that the increments for particulate matter should be measured by the same pollutant indicator as the NAAQS. The implementation date for this change from TSP to PM₁₀ based increments has not been set, and may take 21 to 25 months to become effective once the date is set. Therefore, the TSP increments currently in effect will be used; comparison with proposed PM₁₀ increments will be discussed.

Ground-level impacts predicted for the Lee County energy recovery facility are shown in Table 6-8 to be below the significant impact levels for each applicable averaging period at all modeled receptors within PSD Class II areas for the 1982 to 1986 period. Therefore, additional modeling to determine the effect of other PSD sources on the available Class II increments is not required. However, as a post-baseline source of SO₂, NO₂, and TSP, the Facility is considered to consume PSD increments for these pollutants for the applicable averaging periods.

All dispersion modeling for the PSD Class II area was based on five years (1982 to 1986) of hourly meteorological data, and on the worst-case operating conditions and Cartesian receptor grid discussed in Section 6.5.

Modeling Results

No PSD Class II increment is exceeded by any of the modeled pollutants. Each pollutant consumes less than three percent of its PSD increment. The highest annual SO₂ impact, shown in Table 6-11, is 1.0 percent of the allowable increment. The highest, second-highest SO₂ impacts are 2.4 and 2.8 percent of the 3-hour and 24-hour increments, respectively. The highest annual TSP impact is 0.13 percent of the allowable increment, and the highest, second-highest 24-hour impact is 0.9 percent of the TSP

TABLE 6-11

COMPARISON OF IMPACTS FROM THE LEE COUNTY ENERGY RECOVERY FACILITY
TO PSD CLASS II INCREMENTS

Pollutant	Averaging Period	Rank ^a	Maximum Impacts from Facility (ug/m ³)	PSD Class II Increment	Maximum Impact as a Percent of Increment
Sulfur Dioxide (SO ₂)	Annual	H	0.19	20	1.0
	24-hour	HSH	<u>2.52</u>	91	<u>2.8</u>
	3-hour	HSH	<u>12.5</u>	512	<u>2.4</u>
Total Suspended Particulate Matter (TSP)	Annual	H	0.024	19	0.13
	24-hour	HSH	<u>0.33</u>	37	<u>0.9</u>
Particulate ^b Matter (PM ₁₀)	Annual	H	0.024	17 ^c	0.14
	24-hour	HSH	<u>0.33</u>	30 ^c	<u>1.1</u>
Nitrogen Dioxide (NO ₂)	Annual	H	<u>0.36</u>	25	<u>1.4</u>

SOURCE: Camp Dresser & McKee Inc., 1991.

^aAbbreviations: H = Highest
HSH = Highest, Second-Highest

^bConservative estimate assuming all TSP is in the form of PM₁₀.

^cProposed EPA standard (54 FR 41218; October 5, 1989).

allowable increment. The highest annual nitrogen dioxide impacts are 1.4 percent of the PSD increment.

The highest annual PM_{10} ground-level impact for the Class II areas is 0.024 ug/m^3 , or 0.14 percent, of the proposed Class II PSD increment of $17 ug/m^3$. The highest, second-highest 24-hour PM_{10} impact is 0.33 ug/m^3 , or 1.1 percent, of the proposed increment of $30 ug/m^3$.

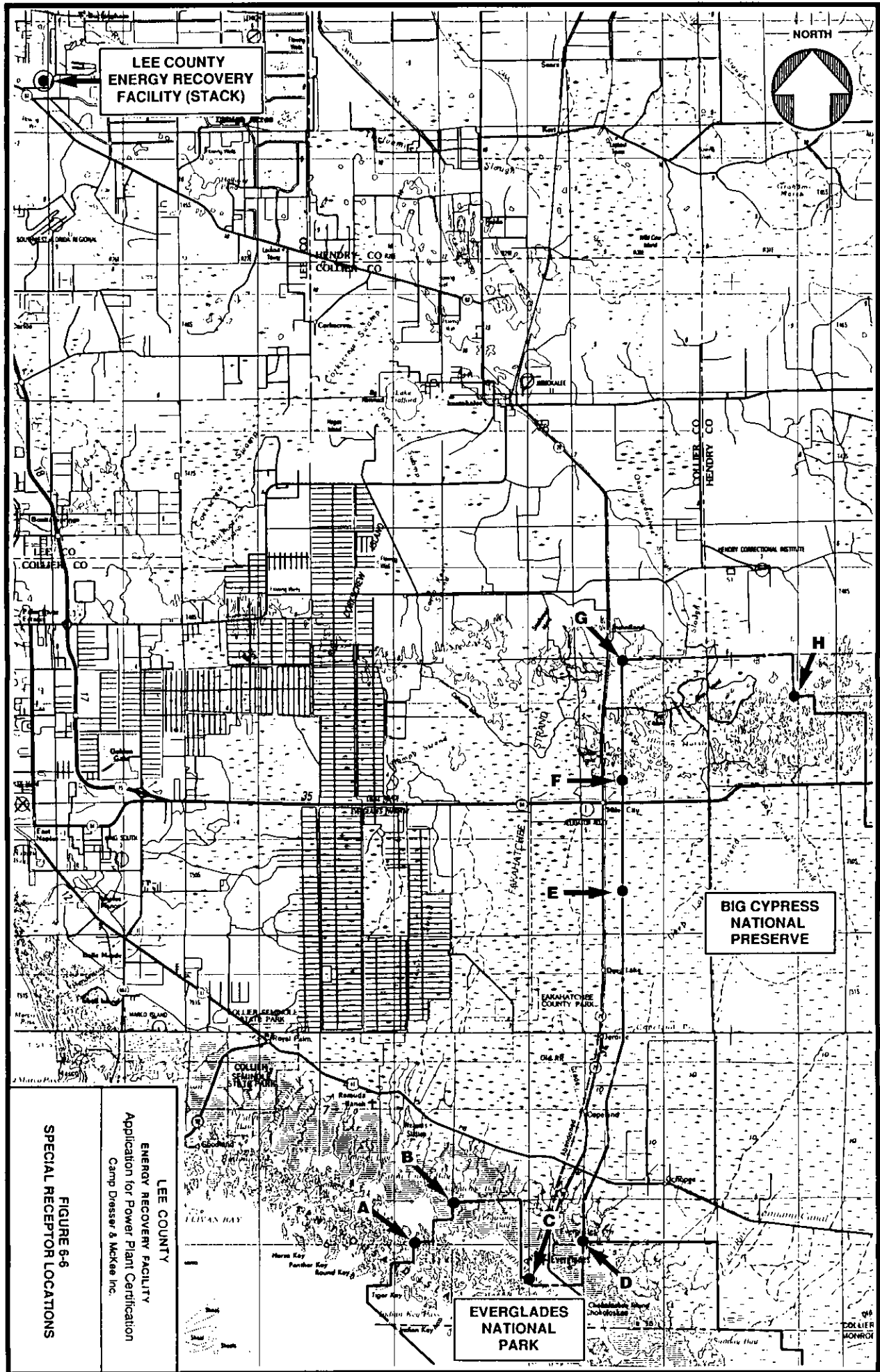
6.8.2 PSD CLASS I AND SPECIAL RECEPTOR AREAS

The Federal PSD regulations, FAC Section 17-2.440, and 40 CFR 52.21, require that a proposed source subject to PSD review conduct a dispersion modeling analysis of its impacts on any PSD Class I areas located within a 100 km radius. In this case, there is one applicable formal Class I area, the Everglades National Park, located 88 km south-southeast of the proposed Facility. At the request of the National Park Service (NPS, 1990), impacts at Big Cypress National Preserve, a Class II area located 61 km southeast of the Facility, are also modeled. As a conservative comparison, highest annual and highest short-term impacts at both areas are compared to Class I area SILs and PSD increments.

The air quality impact analysis was conducted using ISCST to demonstrate that the proposed Lee County Facility would not have a significant impact, or produce an exceedance of an allowable PSD increment. The modeling is consistent with the procedure outlined in Section 6.5, except for the use of the receptor grid. A set of discrete receptors, shown on Table 6-12 and in Figure 6-6, was placed along each park boundary closest to the proposed Facility. Receptors were spaced at a resolution of between two and five azimuth degrees from the Facility stack, and each was assigned a ground-level elevation of five feet (msl).

Modeling Results

The special receptor modeling results are presented in Table 6-13. The highest annual and highest 24-, 8-, 3-, and 1-hour normalized concentrations are given along with the date, time, and specific receptor point at which the impact occurred.



LEE COUNTY
ENERGY RECOVERY
FACILITY (STACK)



BIG CYPRESS
NATIONAL
PRESERVE

EVERGLADES
NATIONAL
PARK

LEE COUNTY
ENERGY RECOVERY FACILITY
Application for Power Plant Certification
Camp Dresser & McKee Inc.
FIGURE 6-6
SPECIAL RECEPTOR LOCATIONS

- A** [Location on Hawk Key]
- B** [Location on Panther Key]
- C** [Location on Round Key]
- D** [Location on Tiger Key]
- E** [Location on Hawk Key]
- F** [Location on Panther Key]
- G** [Location on Round Key]
- H** [Location on Tiger Key]

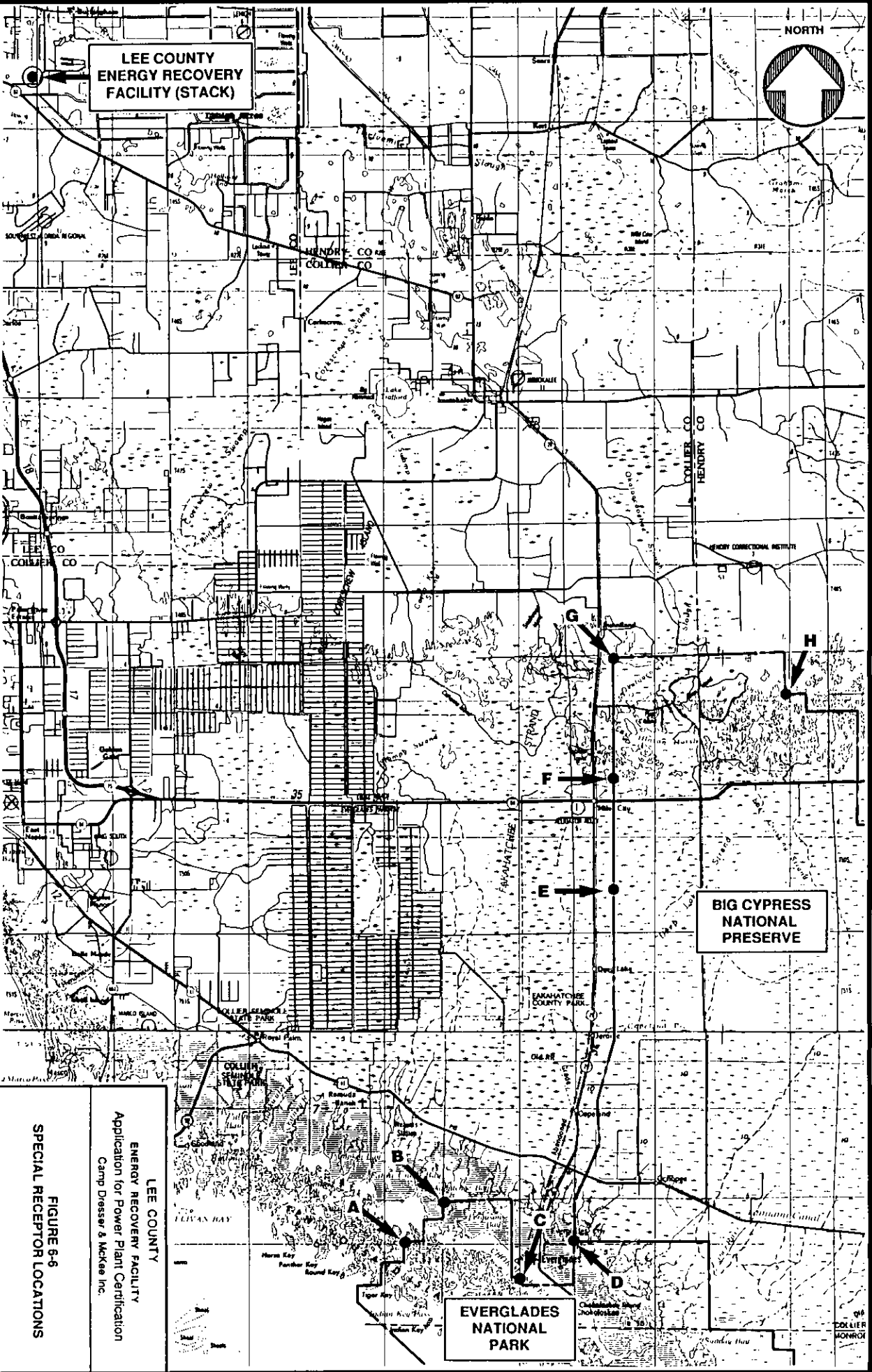


TABLE 6-12

SPECIAL DISCRETE RECEPTOR LOCATIONS
USED IN THE PSD INCREMENT CONSUMPTION ANALYSIS

Special Receptor	Distance Relative to Facility (km)	Receptor Coordinates		Assigned Elevation (ft, msl)	Reference Letter
		UTM-East (km)	UTM-North (km)		
Everglades	90	452	2,860	5	A
National Park	88	454	2,863	5	B
(Class I Area)	95	460	2,858	5	C
	95	464	2,860	5	D
Big Cypress	74	467	2,886	5	E
National	67	467	2,894	5	F
Preserve	61	467	2,903	5	G
	72	480	2,901	5	H

SOURCE: Camp Dresser & McKee Inc., 1991

Maximum predicted concentrations for the Everglades and Big Cypress National Preserve are compared to significant impact levels and Class I PSD increments in Table 6-14. All of the impacts are below the corresponding SILs. The impacts are also well below the Class I PSD increments.

At the Everglades National Park, the maximum 3- and 24-hour SO_2 impacts are 3.2 and 2.4 percent of their PSD increments, respectively. The maximum annual SO_2 , TSP, PM_{10} , and NO_2 impacts are all less than 0.5 percent of their allowable increments, and the maximum 24-hour impacts for TSP and PM_{10} are each approximately 0.2 percent of the PSD increments.

At Big Cypress National Preserve, the SO_2 maximum impacts are 4.4 and 3.6 percent of the 3- and 24-hour Class I PSD increments, respectively. The maximum annual SO_2 , TSP, PM_{10} , and NO_2 impacts are each less than 1.0 percent of the corresponding Class I PSD increments. The maximum 24-hour TSP and PM_{10} impacts are 0.2 and 0.3 percent of their corresponding Class I PSD increments.

TABLE 6-13
SPECIAL RECEPTOR MODELING RESULTS

Averaging Period	Receptor	Reference Letter	Maximum Normalized Concentration ^a ($\mu\text{g}/\text{m}^3$)	Day	Period	Year
Annual	Everglades ^b	B	<u>0.00042</u>	—	—	1986
	Big Cypress ^c	H	<u>0.00057</u>	—	—	1983
24-hour	Everglades	A	<u>0.00849</u>	7	1	1984
	Big Cypress	G	<u>0.01290</u>	11	1	1983
8-hour	Everglades	A	<u>0.02279</u>	123	1	1986
	Big Cypress	G	<u>0.03158</u>	157	3	1986
3-hour	Everglades	A	<u>0.04558</u>	123	1	1986
	Big Cypress	G	<u>0.06191</u>	154	3	1985
1-hour	Everglades	A	<u>0.08313</u>	47	19	1984
	Big Cypress	H	<u>0.12636</u>	16	19	1984

SOURCE: Camp Dresser & McKee Inc., 1991.

^aHighest annual and highest short-term values shown.

^bThe Everglades National Park, Class I area, 88 km south-southeast of the proposed Lee County Facility at the nearest point.

^cBig Cypress National Preserve, 61 km southeast of the proposed Lee County Facility at the nearest point.

TABLE 6-14

COMPARISON OF MAXIMUM CONCENTRATIONS
AT SPECIAL RECEPTOR LOCATIONS
TO CLASS I SIGNIFICANT IMPACT LEVELS AND PSD INCREMENTS
(concentrations in $\mu\text{g}/\text{m}^3$)

Pollutant	Averaging Time	Maximum Predicted Concentration		Class I Significant Impact Level ^c	PSD Class I Increments	Impact as % of PSD Increment	
		Everglades ^a	Big Cypress ^b			Everglades	Big Cypress
SO ₂	Annual	0.006	0.008	(1) ^d	2	0.3	0.4
	24-hour	0.120	0.182	1	5	2.4	3.6
	3-hour	0.802	1.090	(25) ^d	25	3.2	4.4
TSP	Annual	0.0008	0.001	(1) ^d	5	0.02	0.02
	24-hour	0.016	0.024	1	10	0.2	0.2
PM ₁₀	Annual	0.0008	0.001	(1) ^d	4 ^e	0.02	0.03
	24-hour	0.016	0.024	1	8 ^e	0.2	0.3
NO ₂	Annual	0.012	0.016	(1) ^d	2.5	0.5	0.6

SOURCE: Camp Dresser & McKee Inc., 1991.

^a Everglades National Park, Class I area.

^b Big Cypress National Preserve, Class II area.

^c FAC 71-2.100(170)

^d Class II value is given. Class I value is not available.

^e Proposed EPA Standard (54 FR 41218; October 5, 1989).

NOTE: No Class I Significant Impact Level is exceeded.

REVISED 6/28/91

SECTION 7.0
ADDITIONAL IMPACT ANALYSES

7.0 ADDITIONAL IMPACT ANALYSES

7.1 INTRODUCTION

This section describes the analysis performed to assess the impact of the Lee County ERF on Air Quality Related Values (AQRVs) as required under the PSD regulations. The AQRVs assessed are:

- o Visibility in Class I areas within 100 km of the Lee County ERF,
- o Impacts from growth indirectly related to the Facility, and
- o The potential for impacts to soil and vegetation.

Air quality impacts from criteria pollutants in the Everglades National Park Class I Area and the Big Cypress National Preserve are also presented. Other issues addressed in this section include an assessment of secondary sources from the Lee County ERF and an analysis of predicted impacts within pollutant non-attainment areas.

7.2 VISIBILITY IMPACTS

Visibility impairment can be quantified by determining the spectral light intensity at a given location in the atmosphere with known aerosol and pollutant concentrations. Visibility impairment includes such things as the reduction of visual range, the perceptibility of plume shapes and haze layers, atmospheric discoloration, and plume-modified visual contrast of distant objects. These effects are caused by changes in light intensity as a result of the scattering and absorption of light (radiation) by particles and/or atmospheric aerosols. When the physical and chemical properties of the plume are known, the impact on visibility can be estimated (Latimer and Ireson, 1980).

Visual Impact Screening and Analysis (EPA 450/4-88-015) known as VISCREEN (November, 22, 1988), the EPA-approved Level I visibility computer model based on the "Workbook for Plume," was used to estimate the impact of the stack emissions from the Lee County ERF upon visibility. The National Park

Service directed that VISCREEN be used for the analysis of the Facility's potential visibility impacts at the Everglades National Park (Bud Rolofson, National Park Service, April 1990). VISCREEN is designed to identify emission sources that have the potential of adversely affecting visibility. This analysis is based on conservative assumptions of pollutant emissions, atmospheric pollutant photochemistry, and worst-case meteorological conditions that would produce maximum in-plume pollutant concentrations. If a Level I analysis shows that a source would not cause adverse visibility impairment, then a more rigorous Level II analysis would not be required. If the visibility indices shown under "Plume" predicted for the Lee County ERF are below the threshold value of 0.05, as shown under "Criteria" in the tables, then the source is presumed to have a negligible impact on visibility at those locations.

The Level I modeling technique used for the Lee County ERF assesses the in-plume concentrations of nitrogen dioxide, primary sulfates, and particulate matter to determine indices of plume contrast against the sky, the plume contrast against terrain, and changes in sky/terrain contrast caused by primary and secondary precursor pollutants. Although primary sulfate is not expected to be emitted by the Lee County ERF, the short-term emission rate for sulfuric acid (H_2SO_4) was used conservatively to represent secondary sulfate which may be formed downwind from the incinerator stack. Included as input to the analysis is the approximate distance of the source from a potentially affected Class I area, the vertical dispersion coefficient corresponding to the Pasquill-Gifford F stability category (Turner, 1970) for that distance, and Lee County ERF emission rates for NO_2 , primary sulfates as H_2SO_4 , and TSP.

The VISCREEN analysis was performed for Lee County ERF impacts on PSD Class I areas, and areas identified by the National Park Service (NPS, 1990) as "sensitive," within 100 km of the proposed site in accordance with FAC 17-2,500 (5)(e) 1. The Everglades National Park Class I area is located approximately 88 km south-southwest of the site. Big Cypress National Preserve, an area considered sensitive by the National Park Service, is located southeast of the site. Computations of the contrast parameters for

the areas are presented in Tables 7-1a and 7-1b. Results of the Level I visibility impairment analysis for each area demonstrate that all contrast parameters have values much less than the 0.05 threshold value. Thus, emissions from the Lee County ERF will not have a significant impact on visibility at the Class I and sensitive areas.

7.3 GROWTH ANALYSIS

The Lee County ERF, once operational, will employ approximately 50 persons. It is anticipated that the majority of these personnel requirements will be filled from within the local labor force. Significant in-migration to the area is therefore not anticipated. As a result, no increase in population in the area attributable to the Facility is expected to occur.

The project does not require the destruction, relocation, or alteration of any residential property in the area. In addition, since no net migration to the area is anticipated, there will be no change in demand for housing units in the area.

The construction and operation of the Lee County ERF will have a minor positive net effect on industrial and commercial development. The Facility will promote development by providing for solid waste disposal, and thereby be an integral part of the plans for development within Lee County. It is not anticipated that this effect will be significant when considered on a regional basis.

The growth analysis indicates that no net significant change in employment, populations, housing, or commercial/industrial development will be associated with the project. As a result, there will not be any significant increases in pollutant emissions indirectly associated with the Lee County ERF.

7.4 CLASS I AIR QUALITY ANALYSIS

The Class I area nearest to the Facility is the Everglades National Park located about 88 km to the south-southeast. Although the Big Cypress

TABLE 7-1a

VISUAL EFFECT SCREENING ANALYSIS FOR
LEE COUNTY ENERGY RECOVERY FACILITY
CLASS I AREA: EVERGLADES NATIONAL PARK

LEVEL-1 SCREENING

<u>Input Emissions For:</u>	<u>Emission Rate (g/s)</u>
Particulates	2.01
NO _x (as NO ₂)	30.35
Primary NO ₂	0
Soot	0
Primary SO ₄ (as H ₂ SO ₄)	3.72

Input Parameters^a

Background Ozone:	0.04 ppm
Background Visual Range:	40.00 km
Source-Observer Distance:	88.00 km
Min. Source-Class I Distance:	88.00 km
Max. Source-Class I Distance:	217.00 km
Plume-Source-Observer Angle:	11.25 degrees
Stability Factor:	6
Wind Speed:	1.00 m/s

RESULTS

Maximum Visual Impacts Inside Class I Area

<u>Backgrnd</u>	<u>Theta</u>	<u>Azi</u>	<u>Distance (km)</u>	<u>Alpha</u>	<u>Delta E</u>		<u>Contrast</u>	
					<u>Criteria^b</u>	<u>Plume</u>	<u>Criteria^b</u>	<u>Plume</u>
Sky	10	84	88.0	84	2.00	0.209	0.05	0.001
Sky	140	84	88.0	84	2.00	0.126	0.05	-0.005
Terrain	10	84	88.0	84	2.00	0.133	0.05	0.002
Terrain	140	84	88.0	84	2.00	0.035	0.05	0.001

SOURCE: VISCREEN model output.

^aDefault particle characteristics.^bScreening criteria are not exceeded.

TABLE 7-1b

VISUAL EFFECT SCREENING ANALYSIS FOR
LEE COUNTY ENERGY RECOVERY FACILITY
SENSITIVE AREA: BIG CYPRESS NATIONAL PRESERVE

LEVEL-1 SCREENING

<u>Input Emissions For:</u>	<u>Emission Rate (g/s)</u>
Particulates	2.01
NO _x (as NO ₂)	30.35
Primary NO ₂	0
Soot	0
Primary SO ₄ (as H ₂ SO ₄)	3.72

Input Parameters^a

Background Ozone:	0.04 ppm
Background Visual Range:	40.00 km
Source-Observer Distance:	61.00 km
Min. Source-Class I Distance:	61.00 km
Max. Source-Class I Distance:	125.00 km
Plume-Source-Observer Angle:	11.25 degrees
Stability Factor:	6
Wind Speed:	1.00 m/s

RESULTS

Maximum Visual Impacts Inside Sensitive Area

<u>Backgrnd</u>	<u>Theta</u>	<u>Azi</u>	<u>Distance (km)</u>	<u>Alpha</u>	<u>Delta E</u>		<u>Contrast</u>	
					<u>Criteria^b</u>	<u>Plume</u>	<u>Criteria^b</u>	<u>Plume</u>
Sky	10	84	61.0	84	2.00	0.614	0.05	0.002
Sky	140	84	61.0	84	2.00	0.412	0.05	-0.012
Terrain	10	84	61.0	84	2.00	0.528	0.05	0.007
Terrain	140	84	61.0	84	2.00	0.131	0.05	0.006

SOURCE: VISCREEN model output.

^a Default particle characteristics.^b Screening criteria are not exceeded.

National Preserve is not a Class I area, it was also included in this assessment at the request of the National Park Service. An analysis of potential impacts on these areas was performed using the ISCST dispersion model, and the same five-year meteorological data set and source input values employed for the FAAQS and PSD increment compliance demonstration in Section 6.0. The pollutants analyzed are those with specified significant impact levels, namely SO₂, TSP, NO₂, and CO.

Table 7-2 presents the results of this analysis for the averaging periods of interest. Normalized concentrations are presented in this table based on a normalized 1.0 g/s emission rate for annual concentrations and a normalized 1.1 g/s emission rate for short-term (24-, 8-, 3-, and 1-hour) concentrations. The higher short-term emission rate reflects the increased emissions from the short-term operating condition of 6,000 Btu/lb refuse at 110 percent of the design heat release operating conditions. Annual rates are based on 5,000 Btu/lb waste at 100 percent of design operating conditions. The Julian day and year of each predicted maximum are also listed. Table 7-3 details the maximum concentration and the appropriate significance level for the four pollutants at the proposed emission rates modeled for the 1982 to 1986 meteorological period. As can be noted from Table 7-3, all predicted impacts are less than 20 percent, and many are less than 1 percent of their respective Class I significant impact levels as defined in FAC 17-2.100(170). Therefore, no significant impact due to Lee County Energy Recovery Facility emissions is predicted at the Everglades National Park Class I area or at the Big Cypress National Preserve. A detailed assessment of PSD Class I increment consumption at the Everglades National Park is presented in Section 6.0.

7.5 SOILS AND VEGETATION IMPACT ANALYSIS

DER requires that an assessment be undertaken of the potential impacts of emissions from a proposed facility on soils and vegetation of commercial or recreational value [FAC 17-2.500(5)(e)]. Pollutant emissions from the Lee County ERF were used to compute potential impacts on soils and vegetation.

TABLE 7-2
SPECIAL RECEPTOR MODELING RESULTS

Averaging Period	Receptor	Reference Letter	Maximum Normalized Concentration ^a ($\mu\text{g}/\text{m}^3$)	Day	Period	Year
Annual	Everglades ^b	B	0.00042	—	—	1986
	Big Cypress ^c	H	<u>0.00057</u>	—	—	1983
24-hour	Everglades	A	0.00849	7	1	1984
	Big Cypress	G	<u>0.01290</u>	11	1	1983
8-hour	Everglades	A	0.02279	123	1	1986
	Big Cypress	G	<u>0.03158</u>	157	3	1986
3-hour	Everglades	A	0.04558	123	1	1986
	Big Cypress	G	<u>0.06191</u>	154	3	1985
1-hour	Everglades	A	0.08313	47	19	1984
	Big Cypress	H	<u>0.12636</u>	16	19	1984

SOURCE: Camp Dresser & McKee Inc., 1991.

^aHighest annual and highest short-term values shown.

^bThe Everglades National Park, Class I area, 88 km south-southeast of the proposed Lee County Facility at the nearest point.

^cBig Cypress National Preserve, 61 km southeast of the proposed Lee County Facility at the nearest point.

TABLE 7-3

MAXIMUM CONCENTRATIONS AT SPECIAL RECEPTOR LOCATIONS

Pollutant	Averaging Time	Everglades Class I Area (ug/m ³)	Big Cypress National Preserve (ug/m ³)	PSD Class I Significant Impact Level ^a
SO ₂	Annual	<u>0.006</u>	<u>0.008</u>	(1) ^b
	24-hour	<u>0.120</u>	<u>0.182</u>	1
	3-hour	<u>0.802</u>	<u>1.090</u>	(25) ^b
TSP	Annual	<u>0.0008</u>	<u>0.001</u>	(1) ^b
	24-hour	<u>0.016</u>	<u>0.024</u>	1
NO ₂	Annual	<u>0.012</u>	<u>0.016</u>	(1) ^b
CO	8-hour	<u>0.213</u>	<u>0.295</u>	(500) ^b
	1-hour	<u>3.101</u>	<u>4.713</u>	(2,000) ^b

SOURCE: Camp Dresser & McKee Inc., 1991.

^a17-2.100 (170), FAC.

^bClass II value is given. Class I value is not available.

Vegetative impacts from airborne pollutants may result from deposition on leaf surfaces as particulate matter (dry deposition), from solutions in rainfall (wet deposition), or by gaseous exchange. Airborne components may also enter vegetation through roots following deposition to soils. Accumulation of airborne pollutants in soil can also lead to changes in soil characteristics.

The vegetation in the project area includes both cultivated food crops and naturally-occurring forest, scrub, and grass land. Actively cultivated crops include tomatoes and strawberries, though the areas under cultivation include only a small percentage of the land in the project area. Some portions of the project area are also used as pasture for cattle and horses and have been extensively grazed. The majority of the area around the site includes forest and scrub dominated by slash pine growing on sandy soils of the Boca, Malabar, and Valkaris soil types (Soil Conservation Service). Dry areas are predominantly pine flat woods or palmetto prairie, while wetter areas include pine/cypress, cypress, wet pine, and wet prairie habitats. Additional detail on vegetation is provided in the Vegetation/Land Use sections of the site characterization (see Section 2.3.5, Volume I).

7.5.1 PREDICTED AIR QUALITY IMPACTS

The ground-level concentrations used in this section are the maximum annual concentrations predicted in Section 6.0. Although the maximum concentration was predicted at only a single downwind location, it will be used to conservatively demonstrate that soils and vegetation surrounding the Facility should not be adversely affected by pollutant emissions from the Facility.

To evaluate the potential impacts of air pollutants on the soils and vegetation, a Level I screening analysis, as recommended by the California Air Resources Board (CARB) for conservatively estimating pollutant deposition rates, was performed. For particulate matter, pollutants that are emitted primarily as particles, and pollutants which can condense onto or form particles, a deposition velocity of 2 cm/s was assumed. This

deposition velocity is greater than that determined in the field for SO₂ deposition on grass (0.8 cm/sec), and therefore provides a conservative estimate of potential impacts. The deposition rates were calculated by multiplying the deposition velocities by the annual ground-level concentrations at the point of maximum impact, and used to assess pollutant impacts throughout the study area.

Incremental soil concentrations were predicted by assuming that accumulation of pollutants within the first centimeter of soil would occur over the 30-year lifespan of the Facility, and that an average soil density is 1,500 kg/m³.

7.5.2 SPECIFIC POLLUTANTS

The potential impacts to soil and vegetation resulting from the Facility's pollutant emissions are discussed for the following specific compounds and materials: total suspended particulates (TSP), carbon monoxide (CO), sulfuric acid (H₂SO₄), sulfur dioxide (SO₂), nitrogen dioxide (NO₂), fluoride (F), lead (Pb), mercury (Hg), beryllium (Be), arsenic (As), and hydrogen chloride (HCl).

Total Suspended Particulates (TSP)

Particulates can adversely impact vegetation by coating foliage, thus blocking sunlight required for photosynthesis and/or interfering with gas exchange. The projected addition of particulates to ambient air by the Facility will consist entirely of relatively fine particles that will not be deposited in significant amounts. Based on the maximum concentration for TSP of 0.024 ug/m³, deposition over a 30-year period would be 0.451 g/m² and would contribute less than 31 mg/kg to the top centimeter of soil. This is a small fraction of the settleable particulate matter that naturally occurs. The predicted particulate emissions from the Facility are less than one percent of the NAAQS, and are not expected to have a significant impact either on soils or on vegetation. Chemical species attached to particulates are generally recycled as nutrients or fixed in a form unavailable to vegetation. No significant coating of foliage,

blockage of sunlight, or interference with plant gas exchange processes is expected. Particulate contribution to soils via settling from the air will be very minor, and no increase in soil depth, appearance, or texture is anticipated.

Carbon Monoxide (CO)

Plants appear to be resistant to high levels of CO. In most species tested, exposure to 115 mg/m^3 for up to three weeks did not produce visible injury (Zimmerman et al., 1983).

The proposed Facility will contribute a maximum annual average CO concentration of 0.12 ug/m^3 . Total concentrations, as a result of Facility operations, will thus be far below concentrations which would cause visible injury to vegetation.

Sulfuric Acid (H_2SO_4)

H_2SO_4 is formed when gaseous SO_3 produced by the Facility reacts with atmospheric water vapor to form acidified water vapor which can create acidic (low-pH) precipitation. The Facility will add an estimated maximum annual average of $4.45 \times 10^{-2} \text{ ug/m}^3$ of H_2SO_4 . It is not anticipated that this concentration will contribute significantly to acidic precipitation. It is very small when compared to existing concentrations from other sources such as fossil-fuel power plants. However, it is not possible to precisely predict the amount of acid deposition on plant surfaces, because: (1) H_2SO_4 aerosols are neutralized by the presence of ammonia in the atmosphere (Huntzicher et al., 1980); (2) observed effects of acid precipitation on vegetation may be positive due to fertilization impacts of sulfur, or negative due to the leaching of leaf surfaces; and (3) the impact of emissions of H_2SO_4 from a single facility on vegetation cannot be differentiated from the impacts of acid rain from background sources.

Sulfur Dioxide (SO_2)

A maximum annual ground-level concentration for SO_2 of 0.19 ug/m^3 is predicted from the Facility. This value, when added to a background level

of 6 ug/m^3 , is far below the 200-ug/m^3 threshold concentration which could cause a reduction in the relative growth rate of a pine species.

Sensitivity of plant species to SO_2 appears to vary not only with the climate of an area, but with the duration of exposure. Garsed and Rutter (1982) reported that various species of conifer (Pinus sp.) had markedly differing sensitivities to levels of SO_2 , ranging from 200 ug/m^3 for 11 months to $8,000 \text{ ug/m}^3$ for six hours. A 14 percent reduction in relative growth rate was seen in one pine species at prolonged exposures to the 200 ug/m^3 dosage level. A number of oak and pine species (e.g., black and red oak, white pine) have been reported to develop visible injury when exposed to concentrations of SO_2 between 786 and $1,572 \text{ ug/m}^3$ for three hours (Jones et al., 1974).

Nitrogen Dioxide (NO_2)

Direct deposition of nitrogen oxides from the atmosphere to soils adds nitrogen to the soil, which is beneficial to plant growth. However, some nitrogen dioxide in the atmosphere can also be converted to nitric acid, and contribute to acid precipitation. It is estimated that the impacts on increased acid deposition due to the Facility will be negligible. The Facility will produce a maximum annual NO_2 concentration of 0.36 ug/m^3 . The maximum annual ambient NO_2 concentration monitored for the project area was 40 ug/m^3 (to which the Facility would contribute less than one percent). Total concentrations will thus be far below the estimated threshold level (120 ug/m^3) of injury to certain plants, as discussed below.

The short-term injury threshold for NO_2 -tolerant species, such as corn and sorghum, has been found to be $24,400 \text{ ug/m}^3 \text{ NO}_2$ for a one-hour exposure when grown in a controlled environment (Thompson et al., 1974). Continuous exposure throughout the growth period to $470 \text{ ug/m}^3 \text{ NO}_2$ reduced size and productivity and increased senescence in tomatoes and navel oranges (Taylor et al., 1975). The concentration of NO_2 has been found to be a greater influence on the extent of injury than the length of exposure.

The greater-than-additive effect of NO_2 and SO_2 in combination on crops has been shown to vary between crop species and varieties. In a study of yield reduction in soybeans, no adverse effects were observed at atmospheric concentrations of 481 ug/m^3 SO_2 in combination with 155 ug/m^3 of NO_2 (Amundson, 1983). The results of these investigations indicate that the presence of elevated levels of NO_2 in the atmosphere in combination with SO_2 above a threshold level can lead to adverse crop response. NO_2 concentrations below 120 ug/m^3 have not been reported to produce injury in the absence of other pollutants (Thompson et al., 1974).

Fluoride (F Compounds)

Fluorides include a group of compounds such as HF, NaF, and Ca_2F formed through combination of fluorine with several elements. Fluoride emissions from high temperature furnaces can be either in the form of particulates or in a gaseous form, generally HF. The use of air pollution control equipment such as fabric filters acts to remove most particulates, and hence most fluoride emissions are as gases.

The maximum 24-hour ground-level concentration resulting from operation of the proposed Facility is estimated to be 0.072 ug/m^3 . The annual average ground-level concentration to be produced by the Facility is estimated to be $4.36 \times 10^{-3} \text{ ug/m}^3$, which is many times less than the concentration found to produce 40 ppm of fluoride in grass (discussed below). The deposition of fluorides as particulate from the Facility would result in an estimated accumulation of 0.08 gm/m^2 , which would produce a concentration in the top centimeter of soil of about 5.5 mg/kg over the 30-year lifespan of the Facility. These concentrations are not anticipated to produce adverse impacts to vegetation or grazing animals.

Fluoride is the most phytotoxic of the common air pollutants. Susceptible species can be injured at atmospheric concentrations 10 to 100 times lower (0.8 ug/m^3) than those of other major pollutants (Weinstein and Alscher-Herman, 1982). It accumulates in plants and can cause disease in herbivores which consume vegetation.

Fluorides can produce toxic side effects for vegetation and grazing animals which ingest such vegetation. Fluorosis has been shown to occur in dairy cows fed a diet containing 40 to 50 ppm of fluoride over a period of months to years. Hence, several states (Florida and New York, for example) have established standards that limit the level of fluoride in forage grown during the growing season (six months) to 40 ppm.

Exposures to high levels of fluorides generate no ill effects if the period of exposure is less than two months for young heifers, or four to six months for older animals. In Florida, cattle grazed on fields adjacent to fluoride emission sources such as phosphate plants show no ill effects if herds are routinely rotated to other fields on a monthly or bimonthly basis. The ground-level fluoride concentrations which produce a 40 ppm fluoride level in grasses will vary depending on the season, temperature, and grass species composition. Rainfall can act to wash off deposited particulate fluorides, reducing the concentration available for uptake during grazing. Canadian Forest Service data indicate that long-term ground-level fluoride concentrations in air of 0.90-1.0 ug/m³ can produce fluoride concentrations in grasses of approximately 40 ppm (Sidhu, 1978).

Lead (Pb)

Lead toxicity has not been observed in plants growing under natural conditions, except in areas adjacent to heavy emission sources. The maximum annual predicted incremental ground-level concentration of lead resulting from the Facility is 0.001 ug/m³. That is a low concentration when compared to heavy emission sources, such as freeway traffic, which can produce ground-level lead concentrations in the range of 0.1 to 1 ug/m³ on a quarterly average. Deposition as particulate is estimated at 0.019 g/m², with soil concentrations in the top centimeter estimated at 1.26 mg/kg. These levels are not significant in comparison to naturally-occurring levels in soils.

Studies have shown that soils are capable of fixing large additions of lead compounds absorbed from the atmosphere (Chapman, 1966). Natural soils typically contain 2 to 200 ppm of lead (Allaway, 1968). Lead is strongly

adsorbed in soils, therefore only minor amounts are available for uptake by vegetation.

Although lead in soils is largely unavailable to plants, the primary entry-way of lead into vegetation is through the root system (Zimdahl, 1976). Lagerwerff (1971) found that in radishes grown in an area contaminated by auto emissions, nearly all of the lead in the roots and 60 percent of the lead in the leafy growth was attributable to soil, not air.

Mercury (Hg)

Mercurial compounds emitted to the atmosphere may affect plants by either foliar adsorption or by uptake and translocation from soils (CAST, 1976). In the study cited above, the environmental concentrations of mercury which result in elevated levels in soils and vegetation are considerably greater than the 0.0010 ug/m³ annual average predicted for the Facility. Deposition as particulate would result in a maximum of 0.019 g/m² over the 30-year life of the Facility. The resulting soil concentration of mercury is conservatively estimated to be 1.26 mg/kg. Vegetative impacts are not expected to occur, nor is bioaccumulation due to this source expected to be a problem.

The accumulation of mercury by plants is more of concern due to bioaccumulation in the food chain than due to phytotoxic effects. An experiment to evaluate the uptake of Hg by bromegrass by applying 10 mg/kg of Hg to soils indicated that considerable accumulation of Hg was found in the plant root system, and only small amounts were translocated to the above-ground portions of the plant (Hogg et al., 1978). The environmental hazards associated with high levels of mercury deposition to soils at waste application sites have previously been identified as those related to ingestion of soil and plant parts by grazing animals.

Beryllium (Be)

Beryllium is toxic to plants due to poisoning of plant metabolic functions and nutrient depletion. Visible toxicity and decreases in growth rates

have been observed in bean plants grown in nutrient solutions of 3 to 5 ppm. Since Be is more strongly immobilized in calcareous soils, the sensitivity of vegetation to Be is reduced as soil pH is increased (Lisk, 1972). Beryllium content in typical soils ranges from 0.5 to 10 mg/kg (Bohn et al., 1977).

The predicted maximum annual average Be ground-level concentration resulting from the Facility's emissions is 1.69×10^{-7} ug/m³. The resulting deposition on study area soils is estimated to be 3.20×10^{-6} gm/m² over a 30-year period, which would produce a beryllium soil concentration of 2.13×10^{-4} mg/kg. This is so small compared to naturally occurring levels (0.5 to 10 mg/kg) that no toxic effects to vegetation are anticipated.

Arsenic (As)

The predicted maximum annual average arsenic ground-level concentration resulting from the Facility's emissions is 1.13×10^{-5} ug/m³. The resulting deposition on study area soils is estimated to be 2.14×10^{-4} gm/m² over a 30-year period, which would produce an arsenic soil concentration of 1.43×10^{-2} mg/kg. This is so small compared to naturally occurring levels (a mean of 4.8 mg/kg) (Shacklette, H.T., and T.G. Boerngen, 1984) that no toxic effects to vegetation are anticipated.

Hydrogen Chloride (HCl)

Gaseous HCl will be emitted from the Facility as a result of the combustion of certain chlorine containing materials contained in the refuse. HCl fallout onto soil does not pose a serious risk to vegetation. HCl disassociates in soil and the Cl which occurs in a dissolved form is generally leached from the soil with precipitation. Since it is therefore unavailable for uptake through plant roots, indirect injury to vegetation through the soil is unlikely.

The Facility would increase HCl concentrations by a 24-hour maximum of 1.3 ug/m³ and an annual average of 0.080 ug/m³. Peak and long-term concentrations are well below levels specifically documented to cause injury and those proposed as adequate for vegetation protection.

Therefore, HCl emissions are not expected to adversely impact local vegetation.

Studies of plant growth in an environment containing gaseous HCl have reported that exposures on the order of $10,000 \text{ ug/m}^3$ for one to two hours will produce plant injury. Intermittent exposure to concentrations of approximately 50 ug/m^3 was found to pose minimal risk to sensitive vegetation. It was suggested that concentrations ranging from approximately $6,000 \text{ ug/m}^3$ for 1.5 hours to 372 ug/m^3 for 120 hours or below would provide for adequate protection from HCl injury.

7.6 ASSESSMENT OF SECONDARY SOURCES

There are two secondary sources of particulate emissions associated with the Lee County facility. The vent on the top of the lime storage silo is a potential source of lime dust. The ash handling building vent is a potential source of ash residue emissions. These vents are minor point sources whose emissions are small compared to the particulate emissions from the stack and whose ambient impacts are expected to be insignificant. The nature of these sources and the manner in which they will be controlled is described below.

7.6.1 LIME SILO ROOF VENT

A lime silo(s) is included in the Facility to store the pebble lime used in the dry scrubber to control acid gas emissions. Lime is delivered in enclosed tractor-trailer trucks equipped with a dense phase pneumatic unloading system. Ambient air is used to fluidize and convey lime through pneumatic piping into the lime silo. The displaced air in the silo and air flow associated with the unloading operation are released through a roof vent into a fabric filter, which will be designed to have a particulate outlet loading of no more than 0.015 gr/acf for particles larger than one micron. The fabric filter will discharge the collected dust directly back into the storage bin.

The deliveries of lime are typically made every seven days. In normal practice, the truck operator will require about 1 to 1.5 hours to unload the lime, and about five minutes to clear the trailer hoppers and piping of any residual lime. The air flow rates during the transfer process range from 250 to 1,000 actual cubic feet per minute (ACFM). Assuming that the lime will be unloaded at the higher air flow rate, the maximum hourly emission is estimated at 0.129 pounds of particulate matter per hour. If a maximum of four deliveries each requiring 2.0 hours in duration are made per week, the annual emission rate would be approximately 54 pounds of particulate matter per year.

7.6.2 ASH HANDLING BUILDING VENT

Particulate emissions from the ash handling building are expected to be negligible. Ash from the end of the combustor grate or air pollution control equipment is quenched in a water tank and wetted to 15 to 25 percent moisture by weight. From the quench tank, the ash is conveyed to an ash handling building where the ash will enter a magnetic separator to remove ferrous material. The conveyor between the main building and the ash handling building is fully enclosed. Within the ash handling building, the ash is kept in bins until it can be taken to the ash landfill. The moisture content of the residue is maintained throughout the ash handling process to reduce resuspension of residue material. Any material that may become suspended is controlled through the use of a fabric filter on the ash handling building vent. Based on an airflow rate of 1,000 ACFM, the maximum hourly emission rate is estimated to be 0.015 gr/acf of particulate matter. This calculation represents a design value; actual emissions are expected to be considerably lower.

7.7 IMPACT WITHIN POLLUTANT NON-ATTAINMENT AREAS

In order to demonstrate that a new source will not prevent reasonable further progress toward attainment of the NAAQS, a source located outside a pollutant non-attainment area must show that it will have a less than significant impact within the non-attainment area. The Lee County ERF is not located within an area designated as non-attainment for any of the

criteria pollutants. The nearest pollutant non-attainment areas (for ozone) are located in Palm Beach, Broward, and Dade counties. Palm Beach County is located 75 km to the east, while Broward and Dade counties are 80 and 110 km to the southeast, respectively. Pinellas County, 180 km northwest from the proposed site, is designated non-attainment for SO₂.

The ground-level concentrations for SO₂, PM₁₀, CO, and NO_x at the points of maximum impact, 0.7 to 3.0 km from the Lee County ERF, are well below their respective significant impact levels. Pollutant impacts at locations 75 km or more from the proposed Facility would be far less.

SECTION 8.0

REFERENCES

8.0 REFERENCES

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SECTION 9.0
ATTACHMENTS

ATTACHMENT A
EMISSION FACTOR SUPPORT
DOCUMENT

ATTACHMENT A
EMISSION FACTOR SUPPORT DOCUMENT

A.1 INTRODUCTION

In this attachment, the emission factors for the Lee County Energy Recovery Facility (ERF) are derived based on stack testing data from existing facilities. Although several energy recovery facilities have recently received site certification, only three (Hillsborough County, Bay County, and the third unit in Pinellas County) have begun operation. Dade County has refurbished its existing facility which differs from the mass-burn technology to be employed by Lee County. Lake and Broward County facilities are still under construction. Therefore, the emission factors selected represent a reasonable upper limit of emissions based on the data available from other representative facilities.

The flue gas flow rates and composition used to calculate the following pollutant emission factors are based on the output of the BURN combustion model. BURN is a CDM proprietary mathematical model used to analyze combustion systems by specifying the operational parameters and waste characteristics. The output for this analysis, shown in Attachment D, is based on the combustion of 600 tons per day (tpd) of reference waste in a single combustor unit (furnace and boiler) with a higher heating value of 5,000 Btus per pound (Btu/lb) of refuse. The Facility would have three of these units, for a total design throughput of 1,800 tons of refuse per day.

A.2 PARTICULATE MATTER

Particulate matter generated during solid waste combustion is comprised of both unburned combustible material and inert material that was present in the solid waste. Because of the turbulent conditions in the combustor,

this material becomes entrained in the flue gas stream as fly ash. Some of this fly ash settles from the flue gas as the gas passes through the heat recovery equipment. The remainder of the fly ash is carried to the air pollution control equipment.

A.2.1 TOTAL SUSPENDED PARTICULATE MATTER

It is expected that typical particulate loadings to the air pollution control equipment will average approximately 3.0 grains per dry standard cubic foot (gr/dscf) corrected to 7 percent O₂ with transient peak loadings of up to 5.0 gr/dscf corrected to 7 percent O₂. The proposed Facility shall have a fabric filter system dedicated to each mass-burn combustor, independent of design, to control particulate emissions. The guaranteed outlet particulate loading from the baghouse is 0.010 gr/dscf @ 7 percent O₂. Emission rates and factors based on this emission limitation are calculated as follows for each combustor unit.

Basis: 0.010 grains per dry standard cubic foot
corrected to 7 percent oxygen (gr/dscf @ 7% O₂)

1. Adjust to actual O₂ as calculated by BURN

$$0.010 \text{ gr/dscf } \left(\frac{21\% - 10.0\% \text{ O}_2}{21\% - 7.0\% \text{ O}_2} \right) = 0.0079 \text{ gr/dscf actual}$$

2. Calculate the dry volumetric flow rate for the unit

$$\frac{187 \text{ moles of flue gas}}{\text{min}} \left(\frac{385.3 \text{ dry std cu ft}}{\text{mole}} \right) = 72,051 \frac{\text{dscf}}{\text{min}}$$

3. Calculate particulate emission rate per unit

$$0.0079 \frac{\text{gr/dscf (72,051)}}{\text{actual}} \frac{\text{dscf}}{\text{min}} \left(\frac{\text{lb}}{7,000 \text{ gr}} \right) \left(\frac{60 \text{ min}}{\text{hr}} \right) =$$

$$4.85 \frac{\text{lb PM}}{\text{hr}} = 21 \frac{\text{tons PM}}{\text{yr}}$$

4. Calculate particulate emission factors

$$4.85 \frac{\text{lb PM}}{\text{hr}} \left(\frac{\text{day}}{600 \text{ tons}} \right) \left(\frac{24 \text{ hr}}{\text{day}} \right) = 0.194 \frac{\text{lb PM}}{\text{ton refuse}}$$

$$0.194 \frac{\text{lb PM}}{\text{ton refuse}} \left(\frac{\text{lb}}{5,000 \text{ Btu}} \right) \left(\frac{\text{ton}}{2,000 \text{ lb}} \right) = 0.0194 \frac{\text{lb PM}}{\text{MMBtu}}$$

The Facility would consist of three 600-tpd combustor units, and so have a Facility total annual particulate matter emission rate of about 64 tons/yr.

Due to the low particulate outlet grain loading, the exhaust gases will comply with applicable state and federal opacity requirements. A continuous opacity monitor will be installed, calibrated, maintained, and operated in all of the stack's flues during Facility operation.

A.2.2 RESPIRABLE PARTICULATE MATTER

On July 1, 1987, EPA promulgated new standards for particulate matter having an effective diameter of less than 10 microns. This size range represents the respirable fraction of particulate matter and is referred to as PM_{10} . This standard is a better indicator of potential impacts to the public health and welfare from particulate matter than TSP.

Particulate size data is collected using an Anderson cascade impactor which expresses particle sizes as equivalent aerodynamic diameters. An

equivalent aerodynamic diameter is defined as the diameter of a unit density sphere with the same settling velocity as the actual particle. This allows particles of varying sizes, shapes, and densities to be evaluated on the basis of their actual aerodynamic behavior.

The distribution of particulate mass by particle size is not certain since only a limited number of samples have been taken. For this analysis, particle size data from the Biddeford, Maine waste-to-energy facility will be used to characterize particulate emissions from the Lee County facility (see Table A-1). The Biddeford, Maine data was selected because Biddeford is a modern facility employing air pollution control equipment similar to the proposed Lee County facility. Three particle size distribution analyses were conducted at Biddeford.

As presented in Table A-1, particle size data from the Biddeford, Maine Facility, which is equipped with dry scrubbers and fabric filters, shows that PM_{10} emissions ranged from 59 percent to 96 percent of total particulate matter measured. Therefore, it was assumed that all of the particulate matter from the boiler stack would be PM_{10} for the calculation of mass emission rates.

A.2.3 LIME SILO VENT EMISSIONS

The lime storage silo at the proposed Facility will receive lime from delivery trucks. Lime will be pneumatically conveyed from the delivery truck to the storage silo. During this process, particulate emissions will be generated. The lime silo will be equipped with a baghouse filter, designed for 0.015 gr/acf, to control particulate emissions. Based on the expected delivery frequency, the estimated annual emissions would be approximately 54 pounds; therefore, this intermittent source was not included in the air quality modeling for the Facility.

A.2.4 ASH HANDLING BUILDING VENT EMISSIONS

The ash handling building ventilation exhaust system will be equipped with a fabric filter designed to achieve an outlet grain loading of 0.015

TABLE A-1

LEE COUNTY ENERGY RECOVERY FACILITY
 PARTICLE SIZE DISTRIBUTION DATA FROM
 BIDDEFORD, MAINE

Run 1		Run 2		Run 3	
Particle Mass Size Fraction (Microns) %		Particle Mass Size Fraction (Microns) %		Particle Mass Size Fraction (Microns) %	
<0.63	2.4	<0.63	2.4	<0.63	5.5
1.0	0.8	1.0	2.9	1.0	4.3
1.25	0.5	1.25	1.4	1.25	3.1
2.0	3.9	2.0	4.8	2.0	6.8
2.5	3.9	2.5	3.8	2.5	1.8
6.0	26.3	6.0	49.9	6.0	33.9
10.0	21.5	10.0	30.6	10.0	22.6
15.0	23.1	15.0	4.2	15.0	14.7
20.0	17.6	20.0	0.0	20.0	7.3
>20.0	0.0	>20.0	0.0	>20.0	0.0
% Mass Fraction PM ₁₀		% Mass Fraction PM ₁₀		% Mass Fraction PM ₁₀	
	59.3		95.8		78.0

SOURCE: Combustion Engineering, Inc., 1989.

gr/acf. Fugitive particulate emissions will be controlled to levels not to exceed 7.01 tpy (based on the 0.015 gr/acf design emission rate, actual tpy emissions should be considerably lower). Due to the minor nature of the particulate emissions from this source, emissions from the ash handling building were not included in the air quality modeling.

A.3 SULFUR DIOXIDE

Sulfur dioxide (SO_2) formation is a function of the sulfur content of the fuel and the chemical form in which it occurs. Sulfur in solid waste occurs in several forms, as organic sulfur found in foods (proteins), rubber, leather, and textiles, and as inorganic sulfur found chiefly in coated papers as sulfides, sulfate, and sulfite. All of these compounds except sulfate, which typically accounts for two to three percent of the fuel sulfur content, can be converted to SO_2 during combustion. Sulfates generally do not disassociate and tend to remain in the bottom ash. During combustion, sulfur is oxidized to SO_2 , with small amounts of the SO_2 being further oxidized to sulfur trioxide (SO_3). SO_3 will combine with water droplets to form sulfuric acid. Sulfuric acid emissions are discussed separately.

A dry scrubber system will be incorporated into each of the air pollution control trains dedicated for each of the Facility's combustors to control SO_2 and other acid gases. As discussed in the BACT analysis for SO_2 , each air pollution control system will be designed to maintain an average stack outlet SO_2 concentration of 30 ppm_{dv} @ 7 percent O_2 or reduce SO_2 emissions by 80 percent (whichever is least stringent), both over a 24-hour block average as determined by CEMs.

The uncontrolled inlet SO_2 concentration of ³³⁰~~30~~ ppm_{dv} corrected to 7 percent O_2 is roughly equivalent to an upper bound refuse sulfur content of 0.25 percent with 75 percent conversion of sulfur to SO_2 . The control system will reduce this inlet concentration by 80 percent to achieve an outlet SO_2 concentration of 66 ppm_{dv} at 7 percent O_2 over a 24-hour average. Emission rates and factors based on the SO_2 emission limitation are calculated as follows for each combustor unit.

Basis: 30 parts per million on a dry volume basis
 corrected to 7 percent oxygen (ppmdv @ 7% O₂)

1. Adjust to actual O₂ calculated by BURN

$$30 \text{ ppmdv} \frac{(21\% - 10.01\% \text{ O}_2)}{(21\% - 7.0\% \text{ O}_2)} = \frac{23.6 \text{ ppmdv}}{\text{actual}}$$

2. Calculate sulfur dioxide emission rate for the unit

$$\frac{23.6 \text{ moles SO}_2}{1 \times 10^6 \text{ moles}} \frac{(187 \text{ moles flue gas})}{\text{min}} (64.07 \frac{\text{lb SO}_2}{\text{mole SO}_2})$$

$$\frac{(60 \text{ min})}{\text{hr}} = \frac{16.9 \text{ lb SO}_2}{\text{hr}} = \frac{74 \text{ tons SO}_2}{\text{yr}}$$

3. Calculate sulfur dioxide emission factor

$$16.9 \frac{\text{lb SO}_2}{\text{hr}} \left(\frac{\text{day}}{600 \text{ tons}} \right) \left(\frac{24 \text{ hr}}{\text{day}} \right) = 0.677 \frac{\text{lb SO}_2}{\text{ton refuse}}$$

$$0.677 \frac{\text{lb SO}_2}{\text{ton refuse}} \left(\frac{\text{lb}}{5,000 \text{ Btu}} \right) \left(\frac{\text{ton}}{2,000 \text{ lb}} \right) = 0.0677 \frac{\text{lb SO}_2}{\text{MMBtu}}$$

Basis: 330 parts per million on a dry volume basis
 corrected to 7 percent oxygen (ppmdv @ 7% O₂)

1. Apply 80 percent control efficiency

$$330 \text{ ppmdv SO}_2 \text{ (100\% - 80\%)} = 66.0 \text{ ppmdv SO}_2$$

@ 7% O₂
@ 7% O₂

uncontrolled
controlled

2. Adjust to actual O₂ calculated by BURN

$$67.0 \text{ ppmdv SO}_2 \text{ @ } 7\% \text{ O}_2 \left(\frac{21\% - 10.01\% \text{ O}_2}{21\% - 7.0\% \text{ O}_2} \right) = 51.8 \text{ ppmdv SO}_2 \text{ actual}$$

3. Calculate sulfur dioxide emission rate for each unit

$$\frac{51.8 \text{ moles SO}_2}{1 \times 10^6 \text{ moles}} \left(\frac{187 \text{ moles flue gas}}{\text{min}} \right) \left(64.07 \frac{\text{lb SO}_2}{\text{mole SO}_2} \right)$$

$$\left(\frac{60 \text{ min}}{\text{hr}} \right) = 37.2 \frac{\text{lb SO}_2}{\text{hr}} = 163 \frac{\text{tons SO}_2}{\text{yr}}$$

4. Calculate sulfur dioxide emission factor

$$37.2 \frac{\text{lb SO}_2}{\text{hr}} \left(\frac{\text{day}}{600 \text{ tons}} \right) \left(\frac{24 \text{ hr}}{\text{day}} \right) = 1.49 \frac{\text{lb SO}_2}{\text{ton refuse}}$$

$$1.49 \frac{\text{lb SO}_2}{\text{ton refuse}} \left(\frac{\text{lb}}{5,000 \text{ Btu}} \right) \left(\frac{\text{ton}}{2,000 \text{ lb}} \right) = 0.149 \frac{\text{lb SO}_2}{\text{MMBtu}}$$

Because SO₂ emission rates and factors using the percent removal efficiency approach result in higher calculated values, the SO₂ emission factor of 0.149 lb SO₂/MMBtu and annual emission rate of 163 tons per year are proposed for each unit in estimating impacts for averaging periods equal to or greater than 24 hours. The proposed Facility, which would consist of three 600-tpd combustor units, would have total annual SO₂ emission rate of about 490 tons/yr.

Due to variation in combustor operating conditions and refuse sulfur content, a short-term peak SO₂ concentration is projected to be 82.5 ppmdv corrected to 7 percent O₂. This short-term SO₂ outlet concentration is

used to estimate air quality impacts for a three-hour average, and is based on a control system SO₂ reduction of 75 percent. Therefore, a short-term SO₂ emission factor of 0.186 lb/MMBtu is proposed for estimating impacts for the three-hour averaging period.

A.4 PRODUCTS OF COMBUSTION

Emissions of nitrogen oxides (NO_x), carbon monoxide (CO), and volatile organic compounds (VOC) are primarily a function of combustion conditions. The quantity of pollutant produced is dependent upon the design and operation of the furnace. Modern refuse combustors are designed to maximize air and fuel mixing effectiveness and combustion completion through proper furnace design and the ability to control the combustion process. Proper design of the overfire air jets, combustion temperature, and overfire air ratio promotes oxidation of the products of incomplete combustion.

A.4.1 NITROGEN OXIDES

Nitrogen oxides (NO_x) are products of all conventional combustion processes. Nitric oxide (NO) is the predominant form of NO_x produced, with lesser amounts of nitrogen dioxide (NO₂). However, once emitted into the atmosphere, NO converts rapidly to NO₂. Hence, NO and NO₂ are referred to collectively as NO_x. The state and federal air quality standards are based on NO₂. The generation of NO_x from the combustion of refuse is a result of two formation mechanisms, thermal NO_x and fuel NO_x.

The NO_x produced by the nitrogen contained in the combustion air supply (ambient air contains 79 percent nitrogen by volume) due to the high temperatures of combustion is referred to as thermal NO_x. Thermal NO_x formation is primarily a function of furnace temperature and excess air (oxygen availability).

Fuel NO_x, on the other hand, is formed when the nitrogen in the refuse is oxidized to NO. Fuel NO_x formation is strongly affected by the local oxygen concentration present in the flame, and also by the mixing rate of

the refuse and combustion air. While the precise mechanism by which combustion air and fuel nitrogen are converted to NO_x (a function of furnace design, refuse composition, and facility operating parameters) is not completely understood, most of the NO_x emissions from modern municipal waste combustors are believed to result from the oxidation of fuel nitrogen.

Emission rate projections for NO_x are based on recent stack test data at existing stoker waterwall combustors. For example, the Tulsa, Oklahoma facility incorporates two stoker waterwall combustors each with a throughput capacity of 375 tpd of refuse. A total of ten one-hour tests, five per boiler, were completed using CEMs in June 1986. The flue gas concentration of NO_x observed from the ten tests ranged from 347 to 390 ppmdv corrected to 7 percent O_2 .

NO_x emissions were measured at the Marion County, Oregon facility in October 1986 as part of an emission compliance test program. The facility has two stoker waterwall combustors each with a throughput capacity of 275 tpd. Three one-hour tests were completed for each boiler using CEMs. Data from these tests indicated NO_x emissions ranging from 240 to 349 ppmdv corrected to 12 percent CO_2 .

Recently, uncontrolled NO_x emissions data from the Stanislaus, California facility were obtained in December 1988 as part of an emission compliance test program. The facility has two 400-tpd stoker waterwall combustors, each with selective non-catalytic reduction (SNCR) flue gas NO_x control technology. Three NO_x emission tests, each approximately one hour long, were completed for each boiler with the SNCR system shut off prior to testing. The uncontrolled NO_x emissions data ranged from 290 ppmdv to 308 ppmdv corrected to 12 percent CO_2 . The emissions projected for the stoker waterwall design take into consideration operation of the BACT determined SNCR technology having a control efficiency of up to 45 percent. Therefore, the proposed NO_x emission limitation for a stoker waterwall combustor is 180 ppmdv @ 7 percent O_2 on a 24-hour average using SNCR technology to reduce uncontrolled emissions.

The proposed Facility's NO_x emissions will be required to meet applicable final promulgated NSPS requirements for municipal waste combustors. Emission rates and factors based on the NO_x emission limitations are calculated as follows for each combustor unit.

Basis: 180 ppm_{dv} @ 7% O₂, 24-hour average

1. Adjust to actual O₂ calculated by BURN

$$\frac{180 \text{ ppm}_{dv} (21\% - 10.01\% \text{ O}_2)}{\text{@ } 7\% \text{ O}_2 (21\% - 7.0\% \text{ O}_2)} = \frac{141.3 \text{ ppm}_{dv}}{\text{actual}}$$

2. Calculate nitrogen oxides emission rate for the unit

$$\frac{141.3 \text{ moles NO}_x}{1 \times 10^6 \text{ moles}} \left(\frac{187 \text{ moles flue gas}}{\text{min}} \right) \left(\frac{46.01 \text{ lb NO}_x}{\text{mole NO}_x} \right) \left(\frac{60 \text{ min}}{\text{hr}} \right) = 72.9 \frac{\text{lb NO}_x}{\text{hr}} = 319.5 \frac{\text{tons NO}_x}{\text{yr}}$$

3. Calculate nitrogen oxides emission factors

$$72.9 \frac{\text{lb NO}_x}{\text{hr}} \left(\frac{\text{day}}{600 \text{ tons}} \right) \left(\frac{24 \text{ hr}}{\text{day}} \right) = 2.292 \frac{\text{lb NO}_x}{\text{ton refuse}}$$

$$2.92 \frac{\text{lb NO}_x}{\text{ton refuse}} \left(\frac{\text{lb}}{5,000 \text{ Btu}} \right) \left(\frac{\text{ton}}{2,000 \text{ lb}} \right) = 0.292 \frac{\text{lb NO}_x}{\text{MMBtu}}$$

The Facility, which would have three combustor units, would have a total annual NO_x emission rate of about 959 tons/yr.

Compliance with the above emission limitations through the use of continuous emission monitors may show peak short-term concentrations that are greater than the 24-hour average levels. Therefore, a one-hour allowance of 220 ppmdv @ 7 percent O₂ is requested to account for these intermittent emission levels. For stoker waterwall combustors, this short-term allowance would correspond to an uncontrolled NO_x concentration of 400 ppmdv @ 7 percent O₂ and a SNCR removal efficiency of 45 percent. The short-term emission factor allowance is 0.356 lb NO_x/MMBtu.

A.4.2 CARBON MONOXIDE

Formation of carbon monoxide (CO) in the combustor results from the inability of the combustion system to complete the burnout of the combustible gases emitted from the burning refuse bed. The admission of overfire air provides for adequate oxygen levels and gas turbulence in the combustor which promotes oxidation of CO to CO₂, thereby minimizing emissions of CO. As discussed in the BACT analyses, proper combustor design combined with careful operation will promote good combustion conditions and thereby minimize emissions of CO.

O'Connell et al. (1982) reports that a modern stoker waterwall combustor incorporating overfire air and temperature monitoring can achieve an emission rate of 1.9 pounds of CO per ton of refuse. A four-day testing program conducted by Cooper Engineers (September 1983) at the older Chicago NW facility indicates an average emission factor from all the tests of 0.67 pounds of CO per ton of refuse. The proposed CO stack concentration for stoker waterwall combustors is 100 ppmdv @ 7 percent O₂, which corresponds to a emission factor of approximately 1.0 pound of CO per ton of refuse which is typical of these observed values.

Emission rates and factors based on the NO_x emission limitations for both the rotary waterwall and stoker waterwall combustors are calculated as follows.

Basis: 100 ppm_{dv} @ 7% O₂, 4-hour average

1. Adjust to actual O₂ calculated by BURN

$$\frac{100 \text{ ppm}_{dv} (21\% - 10.01\% \text{ O}_2)}{\text{@ } 7\% \text{ O}_2 (21\% - 7.0\% \text{ O}_2)} = \frac{78.5 \text{ ppm}_{dv}}{\text{actual}}$$

2. Calculate carbon monoxide emission rate for the unit

$$\frac{78.5 \text{ moles CO} (187 \text{ moles flue gas}) (28.01 \text{ lb CO})}{1 \times 10^6 \text{ moles} \quad \text{min} \quad \text{mole CO}}$$

$$\left(\frac{60 \text{ min}}{\text{hr}} \right) = \frac{24.7 \text{ lb CO}}{\text{hr}} = \frac{108 \text{ tons CO}}{\text{yr}}$$

3. Calculate carbon monoxide emission factors

$$\frac{24.7 \text{ lb CO}}{\text{hr}} \left(\frac{\text{day}}{600 \text{ tons}} \right) \left(\frac{24 \text{ hr}}{\text{day}} \right) = 0.99 \frac{\text{lb CO}}{\text{ton refuse}}$$

$$0.99 \frac{\text{lb CO}}{\text{ton refuse}} \left(\frac{\text{lb}}{5,000 \text{ Btu}} \right) \left(\frac{\text{ton}}{2,000 \text{ lb}} \right) = 0.099 \frac{\text{lb CO}}{\text{MMBtu}}$$

The Facility, which would have three combustor units, would have a total annual CO emission rate of 324 tons/yr.

Compliance with the above emission limitations through the use of continuous emission monitors may show peak short-term concentrations that are greater than the four-hour average levels. Therefore, a one-hour allowance of 400 ppm_{dv} @ 7 percent O₂ is requested to account for these intermittent emission levels. The short-term emission factor allowance is 0.395 lb CO/MMBtu.

A.4.3 HYDROCARBONS

Volatile organic compound (VOC) emissions are also a function of the combustion conditions rather than solid waste composition. They result from poor combustion at low temperatures with insufficient oxygen, turbulence, and residence time. Burnout of VOCs are accomplished through proper mixing of overfire air with the VOC at high temperatures for an adequate residence time.

Testing performed at the Bay County, Florida facility, which incorporates combustion controls, indicated hourly average flue gas concentrations of VOC in the range of 3 to 15 ppm_{dv} @ 7 percent O₂, although recent tests from the Dutchess County, New York, facility indicated levels as high as 53 ppm_{dv} at 7 percent O₂. Stoker waterwall combustors have consistently reported lower concentrations with most values falling below 10 ppm_{dv} @ 7 percent O₂. Therefore, a one-hour average VOC stack concentration of 37.3 ppm_{dv} @ 7 percent O₂ is proposed.

Emission rates and factors based on the hourly VOC emission limitations for a single stoker waterwall combustor unit is calculated as follows.

Basis: 37.3 ppm_{dv} @ 7% O₂, 1-hour average

1. Adjust to actual O₂ calculated by BURN

$$\frac{37.3 \text{ ppm}_{dv} (21\% - 10.01\% \text{ O}_2)}{\text{@ } 7\% \text{ O}_2 (21\% - 7.0\% \text{ O}_2)} = \frac{29.3 \text{ ppm}_{dv}}{\text{actual}}$$

2. Calculate total hydrocarbons emission rate for the unit

$$\frac{29.3 \text{ moles VOC}}{1 \times 10^6 \text{ moles}} \left(\frac{187 \text{ moles flue gas}}{\text{min}} \right) \left(\frac{16.04 \text{ lb VOC}}{\text{mole VOC}} \right)$$

$$\left(\frac{60 \text{ min}}{\text{hr}} \right) = 5.3 \frac{\text{lb VOC}}{\text{hr}} = 23 \frac{\text{tons VOC}}{\text{yr}}$$

3. Calculate total hydrocarbon emission factors

$$5.3 \frac{\text{lb VOC}}{\text{hr}} \left(\frac{\text{day}}{600 \text{ tons}} \right) \left(\frac{24 \text{ hr}}{\text{day}} \right) = 0.211 \frac{\text{lb VOC}}{\text{ton refuse}}$$

$$0.211 \frac{\text{lb VOC}}{\text{ton refuse}} \left(\frac{\text{lb}}{5,000 \text{ Btu}} \right) \left(\frac{\text{ton}}{2,000 \text{ lb}} \right) = 0.0211 \frac{\text{lb VOC}}{\text{MMBtu}}$$

The Facility, which would have three combustor units, would have a total annual VOC rate of 69 tons/yr.

A.5 ACID GASES

The presence of acid gases in the combustion process is primarily a function of the composition of the refuse. Sulfides, chlorides, and fluorides in the flue gas stream are assumed to be emitted entirely as acidic compounds (i.e., sulfuric acid, hydrogen chloride, and hydrogen fluoride). Emissions of acidic compounds will be controlled through the use of a dry scrubber followed by fabric filter.

A.5.1 HYDROGEN CHLORIDE

Production of HCl depends on the quantity of chlorine in the solid waste and on the species of chlorine present. Not all of the chlorine in the solid waste will react to form gaseous HCl during combustion. Chlorine that is not volatilized or converted to HCl remains in the ash residue. The plastic component of solid waste, specifically polyvinyl chloride (PVC), is a major contributor to the generation of HCl in the stack gases. Plastics account for approximately 36 percent of the total chlorine content in solid waste (EPA, 1975). PVC, which contains 46 percent chlorine by weight, accounts for about five percent of the plastics found in solid waste. Essentially all of the PVC chlorine is converted to HCl. In addition to plastics, rubber and paper are significant sources of chlorine in solid waste.

Unabated HCl emissions vary depending on the composition of MSW. HCl emissions have been reported to vary from 100 to 1,100 ppm. The average of 18 unabated HCl flue gas concentrations from the Westchester County, New York, facility is 575 ppm_{dv} @ 7 percent O₂. The average of six runs conducted during the compliances tests for the Tulsa, Oklahoma, facility is 420 ppm_{dv} @ 7 percent O₂.

The dry scrubbing system will be designed to maintain an average outlet HCl flue gas concentration of 25 ppm_{dv} @ 7 percent O₂ or reduce uncontrolled HCl emissions by 95 percent, whichever is least stringent on an eight-hour average basis. Peak uncontrolled HCl emissions of 1,000 ppm_{dv} at 7 percent O₂ is roughly equivalent to an upper bound MSW chlorine content of 0.8 percent with a 90 percent conversion of chlorine to HCl. Emission rates and factors that correspond to these emission limitations are calculated below for each unit.

Basis: 25 parts per million on a dry volume basis
corrected to 7 percent oxygen (ppm_{dv} @ 7% O₂)

1. Adjust to actual O₂ calculated by BURN

$$\frac{25 \text{ ppm}_{\text{dv}} (21\% - 10.01\% \text{ O}_2)}{\text{@ } 7\% \text{ O}_2 (21\% - 7.0\% \text{ O}_2)} = \frac{19.6 \text{ ppm}_{\text{dv}}}{\text{actual}}$$

2. Calculate hydrogen chloride emission rate for the unit

$$\frac{19.6 \text{ moles HCl}}{1 \times 10^6 \text{ moles}} \left(\frac{187 \text{ moles flue gas}}{\text{min}} \right) \left(\frac{36.47 \text{ lb HCl}}{\text{mole HCl}} \right)$$

$$\left(\frac{60 \text{ min}}{\text{hr}} \right) = 8.0 \frac{\text{lb HCl}}{\text{hr}} = 35 \frac{\text{tons HCl}}{\text{yr}}$$

3. Calculate hydrogen chloride emission factor

$$8.0 \frac{\text{lb HCl}}{\text{hr}} \left(\frac{\text{day}}{600 \text{ tons}} \right) \left(\frac{24 \text{ hr}}{\text{day}} \right) = 0.320 \frac{\text{lb HCl}}{\text{ton refuse}}$$

$$0.320 \frac{\text{lb HCl}}{\text{ton refuse}} \left(\frac{\text{lb}}{5,000 \text{ Btu}} \right) \left(\frac{\text{ton}}{2,000 \text{ lb}} \right) = 0.0320 \frac{\text{lb HCl}}{\text{MMBtu}}$$

Basis: 1,000 parts per million on a dry volume basis
corrected to 7 percent oxygen (ppmdv @ 7% O₂)

1. Apply 95 percent control efficiency

$$1,000 \text{ ppmdv HCl} \left(\frac{100\% - 95\%}{\text{uncontrolled}} \right) = 50.0 \text{ ppmdv HCl} \left(\frac{\text{controlled}}{\text{controlled}} \right)$$

@ 7% O₂ @ 7% O₂

2. Adjust to actual O₂ calculated by BURN

$$50.0 \text{ ppmdv HCl} \left(\frac{21\% - 10.01\% \text{ O}_2}{\text{uncontrolled}} \right) = 39.3 \text{ ppmdv HCl} \left(\frac{\text{actual}}{\text{actual}} \right)$$

@ 7% O₂ (21% - 7.0% O₂)

3. Calculate hydrogen chloride emission rate for the unit

$$\frac{39.3 \text{ moles HCl}}{1 \times 10^6 \text{ moles}} \left(\frac{187 \text{ moles flue gas}}{\text{min}} \right) \left(\frac{36.47 \text{ lb HCl}}{\text{mole HCl}} \right)$$

$$\left(\frac{60 \text{ min}}{\text{hr}} \right) = 16.1 \frac{\text{lb HCl}}{\text{hr}} = 70.6 \frac{\text{tons HCl}}{\text{yr}}$$

4. Calculate hydrogen chloride emission factor

$$16.1 \frac{\text{lb HCl}}{\text{hr}} \left(\frac{\text{day}}{600 \text{ tons}} \right) \left(\frac{24 \text{ hr}}{\text{day}} \right) = 0.643 \frac{\text{lb HCl}}{\text{ton refuse}}$$

$$0.644 \frac{\text{lb HCl}}{\text{ton refuse}} \left(\frac{\text{lb}}{5,000 \text{ Btu}} \right) \left(\frac{\text{ton}}{2,000 \text{ lb}} \right) = 0.0643 \frac{\text{lb HCl}}{\text{MMBtu}}$$

The Facility, which would have three combustor units, would have a total annual HCl emission rate of about 212 tons/yr.

A.5.2 SULFURIC ACID MIST

Trace amounts of sulfur trioxide (SO_3) gas are associated with the production of SO_2 . The formation of SO_3 during combustion is dependent upon the SO_2 concentration and the combustion conditions supportive of oxidation of SO_2 to SO_3 . In the moist flue gases, gaseous SO_3 reacts with water droplets to form sulfuric acid (H_2SO_4). Emissions of sulfuric acid mist are controlled through the use of a dry scrubber and fabric filter.

The stack test data from the Tulsa, Oklahoma facility shows the ratio of the uncontrolled H_2SO_4 to SO_2 emission rates for a three-hour average were 0.168 and 0.165 for units 1 and 2, respectively. Peak one-hour $\text{H}_2\text{SO}_4/\text{SO}_2$ ratios were 0.26 and 0.22 for units 1 and 2, respectively. Using a peak one-hour $\text{H}_2\text{SO}_4/\text{SO}_2$ conversion ratio of 0.24 and the SO_2 emission rate based on a control efficiency of 80 percent, the controlled H_2SO_4 emission factor is 0.0358 lb/MMBtu or 0.358 lb/ton of refuse. This corresponds to an annual emission rate of 118 tons of H_2SO_4 per year for the total Facility.

A.5.3 FLUORIDES

Production of fluorides from solid waste combustion facilities is a function of the fluorine (F) content of the waste as well as facility operation. Production of fluorides occur primarily as a result of the combustion of fluorinated plastics and other fluorocarbon products.

The average of nine sampling runs conducted at the Westchester County, New York facility resulted in an average HF concentration of 16.4 ppm_{dv} @ 7 percent O₂. The peak HF concentration was 22 ppm_{dv} @ 7 percent O₂. Compliance testing at the Tulsa, Oklahoma facility showed that the average uncontrolled concentration from the three runs conducted on each of the two units was 6.91 ppm_{dv} @ 7 percent O₂. Controlled HF concentrations reported at the Marion County, Oregon facility were 0.51 ppm_{dv} @ 7 percent O₂.

Limited information on the removal efficiency of HF in dry scrubbing systems is available. However, if the uncontrolled HF concentrations at the Tulsa facility were representative of inlet concentrations to the scrubber at the Marion County facility, a removal efficiency of at least 90 percent, similar to that of HCl would be achieved.

As a reasonable upper limit, uncontrolled HF concentrations are estimated to be 50 ppm_{dv} @ 7 percent O₂. Assuming that the dry scrubber will remove 90 percent of the uncontrolled emissions, an outlet gas concentration of 5.0 ppm_{dv} @ 7 percent O₂ is projected. This is equivalent to 0.0035 lb HF per MMBtu or 0.035 lb per ton of MSW and an annual total Facility emission rate of 11.5 tons per year.

A.6 TRACE METALS

Because metals are present in solid waste, trace quantities of some metals will be emitted in the flue gases of the Facility. The amount of each metal emitted is a function of the quantity of the metal, in the waste stream, the properties of the metal, combustion characteristics of the Facility, and the performance of the air pollution control equipment. The concentrations of trace metals in the waste stream may vary widely over short periods of time. Emission factors used to estimate trace metal emissions for the Lee County Energy Recovery Facility are based on stack tests conducted at recently permitted facilities because combustion conditions (high temperatures and long retention times) and air pollution control equipment (dry scrubber and fabric filters) employed at these facilities affect the mechanisms of volatilization, condensation, and agglomeration which will differ from those of older facilities.

Because of the high condensation temperatures, the volatilization and condensation of elemental metals and their compounds are expected to occur primarily in the furnace. Except for metals with low boiling points, such as mercury and arsenic, any further movement of metals from the gas phase to the particulate phase is expected to be negligible. Thus, a spray dryer followed by a baghouse provides for a high degree of metals removal from incinerator exhaust gas streams (NITEP, 1986).

Emission projections of trace metals presented in Table A-2 were derived from published tests of existing municipal waste combustors equipped with similar air pollution control technology. As can be seen from the data listed in Table A-3, considerable variability is present in the data base. Because of this variability and the fact that emission limits are established on a not-to-exceed basis, maximum expected emission factors developed for the Lee County facility represent a reasonable upper limit based on the available data and engineering judgment.

A.6.1 LEAD

Lead (Pb) is widespread as a trace metal in most components of the combustible fraction of solid waste and also appears in more concentrated metallic forms in ferrous cans, general solderings, and batteries. Lead is readily volatilized during combustion. The lead vapor will later solidify in the cooler areas of the heat recovery equipment by condensing on the surface of particles in the gas stream or will form particulate itself by self-nucleation. These particles are carried in the gas stream and delivered to the air pollution control equipment. Therefore, the capture of particulate matter in the control equipment results in the capture of lead. A fraction of the lead remains as a fine particulate and will escape capture in the control devices.

A few years ago, lead was assumed to make up 9 to 11 percent of the particulate emissions. Recent stack tests of facilities with high efficiency particulate control devices have shown lead making up a much smaller fraction of the total particulate emissions. The highest

TABLE A-2

LEE COUNTY ENERGY RECOVERY FACILITY
EMISSION RATE CALCULATIONS FOR TRACE METALS

Pollutant	Emission Factor (lb/ton MSW)	Emission Factor (lb/MMBTu)	Total Facility Emission Rate (lb/hr) ^a	Total Facility Emission Rate (tons per year) ^a
Lead	6.0×10^{-3}	6.0×10^{-4}	<u>0.45</u>	<u>2.0</u>
Beryllium	1.35×10^{-6}	1.35×10^{-7}	<u>1.01×10^{-4}</u>	<u>4.4×10^{-4}</u>
Mercury	8.0×10^{-3}	8.0×10^{-4}	<u>0.6</u>	<u>2.6</u>
Arsenic	9.1×10^{-5}	9.1×10^{-6}	<u>6.83×10^{-3}</u>	<u>0.03</u>

^a Emission rates are based on 100 percent availability at nameplate design capacity (1,800 tpd at 5,000 Btu/lb reference waste), operating 8,760 hours per year.

proportion of lead found in the Westchester County, New York, facility sampling runs was 3.66 percent. Testing conducted on boiler number 1 at the Hillsborough County, Florida, facility showed the fraction of lead in the particulate was 2.8 percent.

The emission factors proposed for the Lee County Facility are 0.0006 pounds of Pb per MMBtu or 0.006 pound of Pb per ton of refuse. These factors are about three percent of the total particulate emission factor, and provide adequate margin compared to emission factors from other representative facilities presented in Table A-3. The estimated Facility total annual emission rate for lead is 2.0 tons per year.

A.6.2 BERYLLIUM

Municipal solid waste is not a "beryllium containing waste" as described by the federal regulations for hazardous air pollutants. Beryllium (Be) is present only in trace quantities in refuse. Therefore, beryllium emissions are expected to be minimal.

Beryllium is much less volatile than lead and mercury; therefore, most of this metal will be retained in the ash. Emission of beryllium from energy recovery facilities are associated with particulate emissions and will be efficiently controlled through the use of a fabric filter. Beryllium emissions from existing facilities, if detected at all, are present only in small quantities. The emission data for beryllium presented in Table A-3 show emission factors which vary over three orders of magnitude. This variation is directly related to the amount of beryllium in the waste at the time testing was conducted.

The proposed emission factor for beryllium is 1.35×10^{-7} lb of Be per MMBtu or 1.35×10^{-6} lb of Be per ton of refuse, which corresponds to an annual Facility total emission rate of Be of 4.4×10^{-4} tons per year.

A.6.3 MERCURY

Only trace quantities of mercury (Hg) and its compounds are evident in municipal solid waste. Usually only a small portion of Hg is retained in

TABLE A-3

EMISSION FACTORS IN LB/TON OF WASTE FIRED FOR SELECTED RESOURCE RECOVERY FACILITIES

Facility (name/location)	Type (Type of Comb. & Controls)	Size (tpd)	Test Date (year)	Be	Hg	As	Pb
Munich, N. Germany	MB/DS-ESP	1,060	1984	3.9×10^{-9}		3.6×10^{-6}	6.9×10^{-4}
Wurzburg, Germany	MB/DS-BH	662	1985			4.0×10^{-6}	7.8×10^{-5}
Bristol, CT	MB/DS-BH	650	1988	6.6×10^{-8}	9.0×10^{-4}	3.0×10^{-5}	2.2×10^{-4}
Biddeford, ME	RDF/DS-BH	600	1987		3.8×10^{-4}		6.6×10^{-4}
Marion Co., OR	MB/DS-BH	550	1986	2.1×10^{-8}	2.9×10^{-3}		2.9×10^{-4}
Commerce, CA	MB/DS-BH	380	1987	1.5×10^{-6}	3.2×10^{-4}	1.5×10^{-6}	1.6×10^{-5}
Mid-CT, CT	RDF/DS-BH	2,027	1988	ND	5.6×10^{-4}	ND	4.0×10^{-4}
Millbury, MA	MB/DS-ESP	1,500	1988	3.7×10^{-6}	1.2×10^{-2}	2.5×10^{-5}	2.8×10^{-3}
Bridgeport, CT	MB/DS-BH	2,250	1988	1.1×10^{-5}	3.0×10^{-3}	1.2×10^{-5}	2.3×10^{-5}
Tsuchima, Japan	MB/DS-BH	330	1983	2.0×10^{-6}	9.0×10^{-4}	2.0×10^{-6}	1.1×10^{-4}
Stanislaus, CA	MB/DS-BH	800	1988	4.9×10^{-9}	5.0×10^{-3}	1.3×10^{-5}	3.0×10^{-4}
Kent Co., MI	MB/DS-BH	625	1989	ND	1.7×10^{-3}	3.8×10^{-6}	ND
York Co., PA	MB(rotary)/ DS/BH	1,344	1990	ND	7.3×10^{-5}	ND	1.2×10^{-5}
Maximum Expected Value				1.35×10^{-6}	8.0×10^{-3}	9.1×10^{-5}	6.0×10^{-3}

* Generally based on the highest mass-burn/dry scrubber-baghouse (MB/DS-BH) stack test data to provide adequate margin (if such representative data were available to make a determination). Additional test data for other facilities also provided for specific pollutants. Conservative values determined for As and Pb to account for waste stream variations and the fact that compliance with any permitted emission rates will be based on short-term emission tests. Long-term average emission rates are expected to be lower than the maximum expected values. Results from recent stack tests indicate that the maximum expected emission factor noted above for beryllium should be achievable despite the test value reported for Bridgeport, CT; the factor selected for Hg should also be achievable.

the grate residue, as Hg is volatilized into the flue gas. As vaporized Hg passes through the boiler and air pollution control system, some Hg vapor condenses onto suspended particulate matter in the flue gas stream. Because fine particles have a high surface area to volume ratio, the fraction of Hg vapor that does condense would be preferentially associated with fine particulate matter.

Because of the lower outlet temperatures and the additional retention times between boiler outlet and fabric filter inlet, facilities incorporating a dry scrubber are assumed to have lower Hg emissions. However, a sufficient long-term data base does not exist to verify or quantify the degree of reduction that may be achieved. Some facilities equipped with just ESP particulate control have tested within the same range as those equipped with scrubber-baghouses; however, waste stream variations may have affected such tests.

The proposed emission factors for mercury are 8.0×10^{-4} lb Hg per MMBtu or 8.0×10^{-3} lb Hg per ton of refuse. These values represent some anticipated reduction of emissions compared to facilities using particulate control alone, while still representing an upper bound estimate of potential Hg emissions. The estimated annual Facility total emission rate for Hg is 2.6 tons per year.

A.6.4 ARSENIC

As with mercury emissions, arsenic (As) is expected to be emitted both as a vapor and particle. The St. Louis Demonstration (Gorman, 1977) calculated vapor metal emissions of arsenic. The study indicated that the fraction of metal in the vapor phase to metal in the particulate phase is 0.30. Because dry scrubbers are assumed to promote additional condensation and agglomeration, the vapor to particle ratio is expected to be lower and the fraction of arsenic controlled is expected to be greater.

The proposed emission factors for arsenic are 9.1×10^{-6} lb As per MMBtu or 9.1×10^{-5} lb As per ton of refuse. This value represents some anticipated reduction of emissions over facilities that do not have a dry scrubber,

while still representing an upper bound estimate of potential As emissions. The estimated annual Facility total emission rate for As is 0.03 tons per year.

A.7 DIOXINS AND FURANS

PCDD and PCDF are two groups of structurally similar chemical compounds. Each is composed of two benzene rings which are connected by either one oxygen atom (PCDF) or two oxygen atoms (PCDD). There are 75 PCDD and 135 PCDF group members (or isomers). The chemical, physical, and toxicological properties of each isomer vary relative to its chemical structure. Generally, the most toxic isomers are those which have four chlorine atoms located in the lateral positions in the molecule (attached to the carbon atoms numbered 2, 3, 7, and 8).

The total tetra-through-octa-isomer PCDD and PCDF emission rate for the Facility is based on meeting the recently promulgated NSPS of 30 ng/dscm corrected to 7% O₂. The annual emission rate and emission factors are calculated below for a single combustor unit.

Basis: 30.0 nanograms per dry standard cubic meter
corrected to 7 percent O₂ (ng/dscm @ 7% O₂)
(total tetra-octa PCDD and PCDF)

1. Adjust to actual O₂ as calculated by BURN

$$\frac{30.0 \text{ ng/dscm} (21\% - 10.0\% \text{ O}_2)}{\text{@ } 7\% \text{ O}_2 (21\% - 7.0\% \text{ O}_2)} = 23.6 \text{ ng/dscm actual}$$

2. Calculate the dry volumetric flow rate for the unit

$$\frac{187 \text{ moles of flue gas}}{\text{min}} \left(\frac{385.3 \text{ dry std cu ft}}{\text{mole}} \right) = \frac{72,051 \text{ dscf}}{\text{min}}$$

$$\frac{72,051 \text{ dscf}}{\text{min}} (0.0283 \text{ dscm}) = \frac{2,039 \text{ dscm}}{\text{min}}$$

3. Calculate the total tetra-octa PCDD and PCDF emission rate for each unit

$$23.6 \text{ ng/dscm} \left(\frac{2,039 \text{ dscm}}{\text{min}} \right) \left(\frac{1 \times 10^{-9}}{\text{ng}} \right) \left(\frac{60 \text{ min}}{\text{hr}} \right)$$

$$\left(\frac{0.002205 \text{ lb}}{\text{gm}} \right) = 6.37 \times 10^{-6} \frac{\text{lb}}{\text{hr}} = 2.7 \times 10^{-5} \frac{\text{tons}}{\text{yr}} \text{ total PCDD and PCDF}$$

4. Calculate total PCDD and PCDF emission factors

$$6.37 \times 10^{-6} \frac{\text{lb}}{\text{hr}} \left(\frac{\text{day}}{600 \text{ tons}} \right) \left(\frac{24 \text{ hr}}{\text{day}} \right) = 2.54 \times 10^{-7} \frac{\text{lb}}{\text{ton refuse}} \text{ total PCDD and PCDF}$$

$$2.55 \times 10^{-7} \frac{\text{lb}}{\text{ton refuse}} \left(\frac{\text{lb}}{5,000 \text{ Btu}} \right) \left(\frac{\text{ton}}{2,000 \text{ lb}} \right) = 2.54 \times 10^{-8} \frac{\text{lb}}{\text{MMBtu}} \text{ total PCDD and PCDF}$$

The Facility, which would have three combustor units, would have a total annual tetra-octa PCDD and PCDF emission rate of 8.3×10^{-5} tons/yr.

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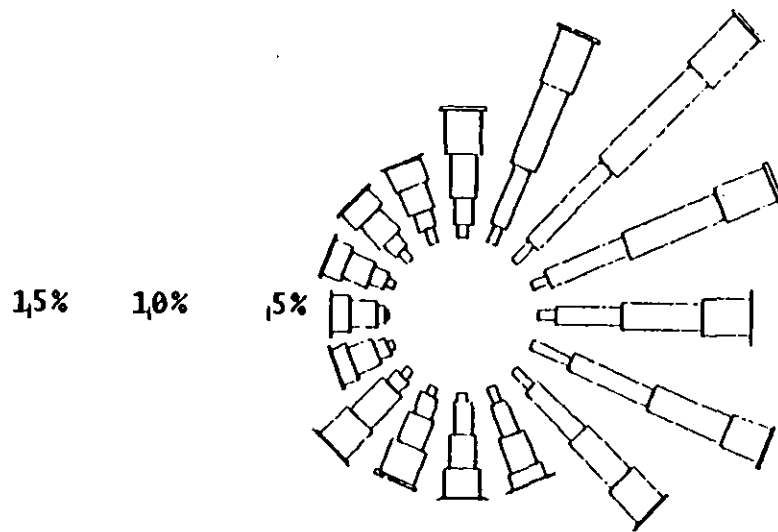
ATTACHMENT B
METEOROLOGICAL DATA

ATTACHMENT B
METEOROLOGICAL DATA

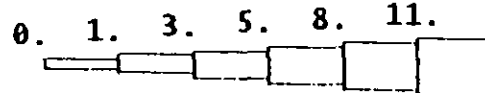
This attachment presents wind roses and wind speeds by stability class for each year (1982 to 1986) from National Weather Service Station Number 12835 at the Fort Myers Page Field Airport. These five years of surface wind data were used in the dispersion modeling analysis. The upper air data from National Weather Service Station Number 12842 at Tampa (Tampa International Airport) were used to estimate mixing heights during this period. The Fort Myers/Tampa data are the most representative data that are available of conditions at the Facility site. They were provided by Mr. Thomas rogers of DER for use in this permit application (Thomas Rogers, 1989).

SITE 01 FROM 01/02/82 TO 12/31/82

WIND SPEED AND DIRECTION ROSE



Wind Speed Class (mps)



NWS SURFACE METEOROLOGICAL DATA
STATION # 12835

STABILITY WIND ROSE

STABILITY INDEX A

FROM JAN. 1 1982 THROUGH DEC. 31 1982

DIRECTION	+-----WIND SPEED CLASSES (MPS)-----+						TOTAL	AVERAGE WIND SPEED
	0-2	2-3	3-5	5-8	8-11	>11		
N	0.01	0.08	0.00	0.00	0.00	0.00	0.09	2.31
NNE	0.00	0.02	0.00	0.00	0.00	0.00	0.02	2.31
NE	0.01	0.06	0.00	0.00	0.00	0.00	0.07	2.06
ENE	0.03	0.10	0.00	0.00	0.00	0.00	0.14	1.97
E	0.00	0.02	0.00	0.00	0.00	0.00	0.02	2.57
ESE	0.01	0.03	0.00	0.00	0.00	0.00	0.05	1.67
SE	0.00	0.02	0.00	0.00	0.00	0.00	0.02	2.31
SSE	0.00	0.01	0.00	0.00	0.00	0.00	0.01	2.06
S	0.00	0.05	0.00	0.00	0.00	0.00	0.05	2.31
SSW	0.00	0.03	0.00	0.00	0.00	0.00	0.03	2.40
SW	0.00	0.06	0.00	0.00	0.00	0.00	0.06	2.06
WSW	0.01	0.03	0.00	0.00	0.00	0.00	0.05	2.19
W	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WNW	0.00	0.01	0.00	0.00	0.00	0.00	0.01	2.57
NW	0.00	0.05	0.00	0.00	0.00	0.00	0.05	2.19
NNW	0.00	0.02	0.00	0.00	0.00	0.00	0.02	2.31
TOTAL	0.08	0.61	0.00	0.00	0.00	0.00	0.69	2.15
AVG SPD	0.88	2.32	0.00	0.00	0.00	0.00	2.15	2.15

NWS SURFACE METEOROLOGICAL DATA
 STATION # 12835

STABILITY WIND ROSE

STABILITY INDEX B

FROM JAN. 1 1982 THROUGH DEC. 31 1982

DIRECTION	+-----WIND SPEED CLASSES (MPS)-----+						TOTAL	AVERAGE WIND SPEED
	0-2	2-3	3-5	5-8	8-11	>11		
N	0.02	0.09	0.20	0.00	0.00	0.00	0.31	3.09
NNE	0.02	0.10	0.22	0.01	0.00	0.00	0.36	3.04
NE	0.06	0.11	0.25	0.00	0.00	0.00	0.42	2.95
ENE	0.03	0.07	0.40	0.00	0.00	0.00	0.51	3.18
E	0.02	0.07	0.26	0.00	0.00	0.00	0.36	3.19
ESE	0.01	0.13	0.42	0.00	0.00	0.00	0.56	3.25
SE	0.02	0.11	0.40	0.00	0.00	0.00	0.54	3.10
SSE	0.01	0.07	0.23	0.01	0.00	0.00	0.32	3.29
S	0.02	0.10	0.22	0.01	0.00	0.00	0.36	3.12
SSW	0.01	0.10	0.24	0.00	0.00	0.00	0.36	3.37
SW	0.00	0.03	0.36	0.02	0.00	0.00	0.41	3.54
WSW	0.00	0.05	0.17	0.01	0.00	0.00	0.23	3.47
W	0.00	0.05	0.29	0.06	0.00	0.00	0.39	3.81
WNW	0.01	0.09	0.17	0.01	0.00	0.00	0.29	3.15
NW	0.02	0.05	0.20	0.02	0.00	0.00	0.29	3.40
NNW	0.01	0.07	0.16	0.00	0.00	0.00	0.24	3.16
TOTAL	0.29	1.30	4.19	0.16	0.00	0.00	5.94	3.25
AVG SPD	1.09	2.35	3.59	5.44	0.00	0.00	3.25	3.25

NWS SURFACE METEOROLOGICAL DATA
STATION # 12835

STABILITY WIND ROSE

STABILITY INDEX C

FROM JAN. 1 1982 THROUGH DEC. 31 1982

DIRECTION	+-----WIND SPEED CLASSES (MPS)-----+						TOTAL	AVERAGE WIND SPEED
	0-2	2-3	3-5	5-8	8-11	>11		
N	0.02	0.08	0.24	0.16	0.01	0.00	0.52	4.07
NNE	0.03	0.09	0.42	0.42	0.00	0.00	0.98	4.45
NE	0.09	0.08	0.84	0.51	0.00	0.00	1.52	4.21
ENE	0.08	0.15	0.55	0.53	0.01	0.00	1.32	4.20
E	0.03	0.10	0.41	0.55	0.00	0.00	1.10	4.49
ESE	0.07	0.17	0.68	0.44	0.00	0.00	1.36	4.00
SE	0.03	0.21	0.55	0.40	0.00	0.00	1.19	4.00
SSE	0.02	0.09	0.41	0.10	0.00	0.00	0.63	3.82
S	0.03	0.15	0.41	0.30	0.01	0.00	0.91	4.05
SSW	0.03	0.09	0.31	0.37	0.08	0.00	0.88	4.91
SW	0.03	0.05	0.51	0.45	0.00	0.00	1.03	4.60
WSW	0.01	0.11	0.49	0.25	0.01	0.00	0.88	4.24
W	0.00	0.03	0.26	0.41	0.00	0.00	0.71	4.75
WNW	0.01	0.06	0.20	0.17	0.00	0.00	0.44	4.35
NW	0.00	0.03	0.26	0.17	0.00	0.00	0.47	4.39
NNW	0.01	0.10	0.18	0.10	0.00	0.00	0.40	3.69
TOTAL	0.53	1.61	6.74	5.34	0.13	0.00	14.34	4.27
AVG SPD	0.85	2.36	3.96	5.48	8.65	0.00	4.27	4.27

NWS SURFACE METEOROLOGICAL DATA
STATION # 12835

STABILITY WIND ROSE

STABILITY INDEX D

FROM JAN. 1 1982 THROUGH DEC. 31 1982

DIRECTION	+-----WIND SPEED CLASSES (MPS)-----+						TOTAL	AVERAGE WIND SPEED
	0-2	2-3	3-5	5-8	8-11	>11		
N	0.03	0.18	0.61	1.34	0.09	0.00	2.26	5.27
NNE	0.03	0.38	1.03	1.70	0.13	0.00	3.27	5.02
NE	0.09	0.40	1.52	2.06	0.15	0.00	4.21	4.92
ENE	0.06	0.40	1.14	1.60	0.16	0.00	3.35	4.86
E	0.06	0.30	0.91	1.26	0.02	0.01	2.56	4.77
ESE	0.07	0.46	0.94	1.16	0.08	0.00	2.71	4.62
SE	0.06	0.29	0.96	1.36	0.06	0.01	2.73	4.91
SSE	0.03	0.24	0.61	0.51	0.06	0.01	1.46	4.50
S	0.01	0.24	0.56	0.79	0.13	0.01	1.75	5.11
SSW	0.01	0.15	0.44	1.02	0.08	0.00	1.70	5.43
SW	0.00	0.15	0.61	1.06	0.09	0.01	1.92	5.24
WSW	0.00	0.13	0.31	0.44	0.03	0.00	0.91	4.70
W	0.00	0.11	0.24	0.32	0.01	0.00	0.69	4.42
WNW	0.00	0.08	0.22	0.59	0.07	0.00	0.95	5.51
NW	0.01	0.08	0.30	0.62	0.10	0.00	1.11	5.51
NNW	0.00	0.11	0.32	0.80	0.09	0.00	1.33	5.50
TOTAL	0.47	3.71	10.71	16.62	1.36	0.06	32.92	4.99
AVG SPD	0.54	2.34	3.80	6.14	8.81	11.94	4.99	4.99

NWS SURFACE METEOROLOGICAL DATA
STATION # 12835

STABILITY WIND ROSE

STABILITY INDEX E

FROM JAN. 1 1982 THROUGH DEC. 31 1982

DIRECTION	+-----WIND SPEED CLASSES (MPS)-----+						TOTAL	AVERAGE WIND SPEED
	0-2	2-3	3-5	5-8	8-11	>11		
N	0.03	0.21	0.57	0.33	0.00	0.00	1.15	3.88
NNE	0.06	0.49	1.19	0.24	0.00	0.00	1.99	3.45
NE	0.17	0.86	1.76	0.20	0.00	0.00	2.99	3.23
ENE	0.15	0.76	1.23	0.17	0.00	0.00	2.31	3.17
E	0.13	0.52	1.15	0.22	0.00	0.00	2.01	3.39
ESE	0.08	0.80	0.99	0.11	0.00	0.00	1.99	3.11
SE	0.13	0.67	0.41	0.02	0.00	0.00	1.23	2.61
SSE	0.03	0.25	0.18	0.01	0.00	0.00	0.48	2.73
S	0.03	0.29	0.22	0.02	0.00	0.00	0.56	2.72
SSW	0.01	0.13	0.30	0.07	0.00	0.00	0.51	3.55
SW	0.02	0.11	0.36	0.05	0.00	0.00	0.54	3.44
WSW	0.02	0.09	0.08	0.00	0.00	0.00	0.20	2.57
W	0.01	0.06	0.16	0.01	0.00	0.00	0.24	3.28
WNW	0.01	0.18	0.40	0.05	0.00	0.00	0.64	3.42
NW	0.01	0.15	0.30	0.09	0.00	0.00	0.55	3.56
NNW	0.01	0.08	0.37	0.11	0.00	0.00	0.57	4.02
TOTAL	0.92	5.65	9.67	1.71	0.00	0.00	17.95	3.27
AVG SPD	0.57	2.34	3.73	5.19	0.00	0.00	3.27	3.27

NWS SURFACE METEOROLOGICAL DATA
 STATION # 12835

STABILITY WIND ROSE

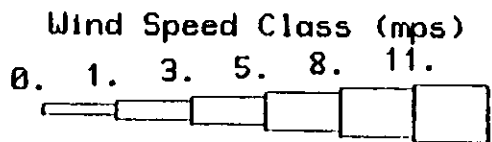
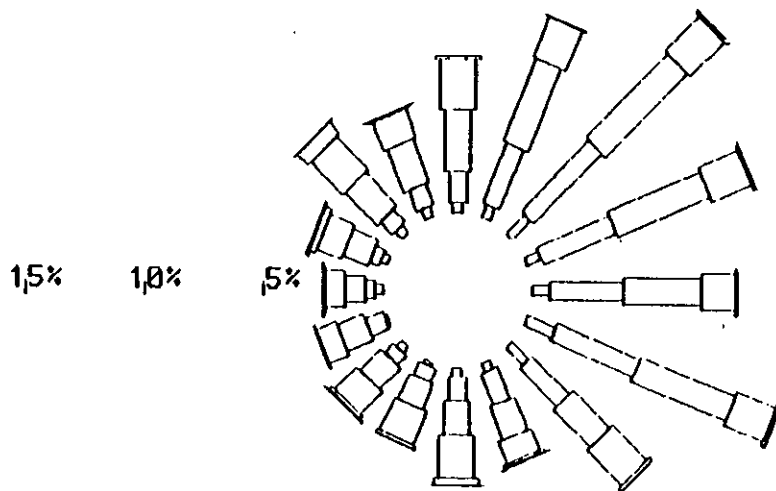
STABILITY INDEX F

FROM JAN. 1 1982 THROUGH DEC. 31 1982

DIRECTION	+-----WIND SPEED CLASSES (MPS)-----+						TOTAL	AVERAGE WIND SPEED
	0-2	2-3	3-5	5-8	8-11	>11		
N	0.32	0.32	0.22	0.00	0.00	0.00	0.86	1.70
NNE	0.95	1.34	0.72	0.00	0.00	0.00	3.02	1.86
NE	1.75	2.32	1.15	0.01	0.00	0.00	5.23	1.86
ENE	1.26	1.73	0.98	0.00	0.00	0.00	3.97	1.85
E	1.16	1.23	0.73	0.00	0.00	0.00	3.12	1.79
ESE	1.46	1.62	0.46	0.01	0.00	0.00	3.55	1.64
SE	1.22	1.00	0.25	0.00	0.00	0.00	2.47	1.46
SSE	0.63	0.55	0.09	0.00	0.00	0.00	1.27	1.49
S	0.52	0.36	0.06	0.00	0.00	0.00	0.93	1.24
SSW	0.34	0.34	0.08	0.00	0.00	0.00	0.77	1.46
SW	0.20	0.16	0.13	0.00	0.00	0.00	0.48	1.67
WSW	0.20	0.06	0.05	0.00	0.00	0.00	0.30	1.13
W	0.16	0.15	0.09	0.00	0.00	0.00	0.40	1.69
WNW	0.23	0.20	0.10	0.00	0.00	0.00	0.53	1.54
NW	0.28	0.22	0.14	0.00	0.00	0.00	0.63	1.70
NNW	0.23	0.30	0.09	0.00	0.00	0.00	0.62	1.65
TOTAL	10.90	11.90	5.34	0.02	0.00	0.00	28.16	1.71
AVG SPD	0.35	2.32	3.10	6.43	0.00	0.00	1.71	1.71

SITE 01 FROM 01/01/83 TO 12/31/83

WIND SPEED AND DIRECTION ROSE



NWS SURFACE METEOROLOGICAL DATA
STATION # 12835

STABILITY WIND ROSE

STABILITY INDEX A

FROM JAN. 1 1983 THROUGH DEC. 31 1983

DIRECTION	+-----WIND SPEED CLASSES (MPS)-----+						TOTAL	AVERAGE WIND SPEED
	0-2	2-3	3-5	5-8	8-11	>11		
N	0.01	0.06	0.00	0.00	0.00	0.00	0.07	1.01
NNE	0.02	0.04	0.00	0.00	0.00	0.00	0.05	1.62
NE	0.02	0.06	0.00	0.00	0.00	0.00	0.08	1.13
ENE	0.03	0.11	0.00	0.00	0.00	0.00	0.14	1.16
E	0.01	0.03	0.00	0.00	0.00	0.00	0.04	1.48
ESE	0.02	0.05	0.00	0.00	0.00	0.00	0.07	1.36
SE	0.01	0.04	0.00	0.00	0.00	0.00	0.05	1.57
SSE	0.01	0.02	0.00	0.00	0.00	0.00	0.03	1.63
S	0.00	0.05	0.00	0.00	0.00	0.00	0.05	1.57
SSW	0.00	0.03	0.00	0.00	0.00	0.00	0.03	1.41
SW	0.00	0.03	0.00	0.00	0.00	0.00	0.03	0.69
WSW	0.01	0.03	0.00	0.00	0.00	0.00	0.04	1.34
W	0.00	0.02	0.00	0.00	0.00	0.00	0.02	2.06
WNW	0.00	0.01	0.00	0.00	0.00	0.00	0.01	2.57
NW	0.00	0.03	0.00	0.00	0.00	0.00	0.03	1.14
NNW	0.00	0.04	0.00	0.00	0.00	0.00	0.04	2.09
TOTAL	0.13	0.64	0.00	0.00	0.00	0.00	0.77	1.36
AVG SPD	0.26	1.34	0.00	0.00	0.00	0.00	1.36	1.36

NWS SURFACE METEOROLOGICAL DATA
 STATION # 12835

STABILITY WIND ROSE

STABILITY INDEX B

FROM JAN. 1 1983 THROUGH DEC. 31 1983

DIRECTION	+-----WIND SPEED CLASSES (MPS)-----+						TOTAL	AVERAGE WIND SPEED
	0-2	2-3	3-5	5-8	8-11	>11		
N	0.03	0.09	0.20	0.00	0.00	0.00	0.32	1.70
NNE	0.03	0.09	0.22	0.01	0.00	0.00	0.35	1.60
NE	0.06	0.10	0.28	0.00	0.00	0.00	0.45	1.67
ENE	0.04	0.07	0.41	0.01	0.00	0.00	0.52	1.82
E	0.04	0.06	0.34	0.00	0.00	0.00	0.44	2.03
ESE	0.02	0.14	0.46	0.00	0.00	0.00	0.63	1.86
SE	0.04	0.11	0.33	0.00	0.01	0.00	0.48	1.59
SSE	0.01	0.06	0.16	0.01	0.00	0.00	0.24	1.28
S	0.02	0.07	0.16	0.01	0.00	0.00	0.25	1.06
SSW	0.01	0.06	0.14	0.02	0.00	0.00	0.23	1.19
SW	0.01	0.04	0.25	0.01	0.00	0.00	0.31	1.33
WSW	0.00	0.07	0.18	0.01	0.00	0.00	0.26	2.00
W	0.00	0.02	0.18	0.04	0.00	0.00	0.24	1.02
WNW	0.01	0.05	0.15	0.01	0.00	0.00	0.22	1.28
NW	0.01	0.05	0.19	0.02	0.00	0.00	0.26	1.83
NNW	0.01	0.07	0.15	0.01	0.00	0.00	0.23	1.67
TOTAL	0.32	1.16	3.81	0.13	0.01	0.00	5.43	1.62
AVG SPD	0.42	1.16	1.77	2.54	9.77	0.00	1.62	1.62

NWS SURFACE METEOROLOGICAL DATA
STATION # 12835

STABILITY WIND ROSE

STABILITY INDEX C

FROM JAN. 1 1983 THROUGH DEC. 31 1983

DIRECTION	+-----WIND SPEED CLASSES (MPS)-----+						TOTAL	AVERAGE WIND SPEED
	0-2	2-3	3-5	5-8	8-11	>11		
N	0.03	0.08	0.27	0.21	0.02	0.00	0.61	2.67
NNE	0.07	0.12	0.47	0.30	0.00	0.00	0.95	2.03
NE	0.12	0.13	0.83	0.41	0.01	0.00	1.49	2.06
ENE	0.10	0.13	0.57	0.41	0.01	0.00	1.22	1.95
E	0.05	0.13	0.48	0.48	0.00	0.00	1.14	2.28
ESE	0.11	0.23	0.71	0.53	0.02	0.00	1.60	2.52
SE	0.06	0.14	0.42	0.44	0.01	0.00	1.07	2.17
SSE	0.04	0.07	0.33	0.14	0.01	0.00	0.60	2.11
S	0.04	0.09	0.31	0.26	0.02	0.00	0.72	1.99
SSW	0.04	0.07	0.27	0.31	0.04	0.00	0.73	2.04
SW	0.02	0.04	0.42	0.37	0.01	0.00	0.86	2.10
WSW	0.01	0.11	0.44	0.26	0.01	0.00	0.83	2.18
W	0.02	0.04	0.25	0.29	0.00	0.00	0.60	2.02
WNW	0.02	0.03	0.16	0.17	0.01	0.00	0.39	2.43
NW	0.01	0.04	0.24	0.17	0.02	0.01	0.47	2.67
NNW	0.02	0.06	0.22	0.12	0.01	0.00	0.42	2.38
TOTAL	0.75	1.50	6.39	4.88	0.17	0.01	13.70	2.20
AVG SPD	0.27	1.22	2.05	2.81	6.22	11.83	2.20	2.20

NWS SURFACE METEOROLOGICAL DATA
STATION # 12835

STABILITY WIND ROSE

STABILITY INDEX D

FROM JAN. 1 1983 THROUGH DEC. 31 1983

DIRECTION	+-----WIND SPEED CLASSES (MPS)-----+						TOTAL	AVERAGE WIND SPEED
	0-2	2-3	3-5	5-8	8-11	>11		
N	0.05	0.14	0.62	1.29	0.10	0.00	2.19	2.79
NNE	0.10	0.31	1.01	1.45	0.07	0.00	2.94	2.26
NE	0.17	0.40	1.34	1.58	0.14	0.00	3.63	2.05
ENE	0.13	0.37	1.06	1.33	0.13	0.01	3.02	2.22
E	0.11	0.31	0.77	0.95	0.06	0.01	2.21	2.06
ESE	0.14	0.44	1.04	0.96	0.07	0.00	2.66	2.17
SE	0.11	0.26	0.78	1.24	0.08	0.01	2.48	2.40
SSE	0.06	0.19	0.54	0.56	0.09	0.01	1.45	2.64
S	0.04	0.17	0.54	1.02	0.17	0.01	1.95	3.31
SSW	0.04	0.10	0.47	1.01	0.11	0.00	1.72	3.02
SW	0.01	0.11	0.51	0.93	0.12	0.01	1.68	2.68
WSW	0.02	0.14	0.28	0.44	0.06	0.00	0.93	2.78
W	0.02	0.07	0.23	0.39	0.07	0.01	0.78	3.47
WNW	0.01	0.07	0.29	0.64	0.14	0.04	1.20	4.02
NW	0.02	0.11	0.35	0.96	0.31	0.01	1.76	4.45
NNW	0.02	0.13	0.40	0.77	0.07	0.01	1.40	2.79
TOTAL	1.05	3.30	10.23	15.51	1.78	0.12	32.00	2.66
AVG SPD	0.26	1.15	1.98	3.14	5.86	10.53	2.66	2.66

NWS SURFACE METEOROLOGICAL DATA
STATION # 12835

STABILITY WIND ROSE

STABILITY INDEX E

FROM JAN. 1 1983 THROUGH DEC. 31 1983

DIRECTION	+-----WIND SPEED CLASSES (MPS)-----+						TOTAL	AVERAGE WIND SPEED
	0-2	2-3	3-5	5-8	8-11	>11		
N	0.05	0.22	0.58	0.28	0.00	0.00	1.13	1.95
NNE	0.11	0.45	0.99	0.15	0.00	0.00	1.71	1.41
NE	0.24	0.77	1.49	0.19	0.00	0.00	2.70	1.49
ENE	0.21	0.67	1.04	0.14	0.00	0.00	2.06	1.37
E	0.17	0.44	0.92	0.15	0.00	0.00	1.68	1.36
ESE	0.19	0.65	0.95	0.11	0.00	0.00	1.89	1.46
SE	0.15	0.52	0.42	0.07	0.00	0.00	1.16	1.48
SSE	0.06	0.22	0.26	0.02	0.00	0.00	0.56	1.77
S	0.06	0.25	0.26	0.03	0.00	0.00	0.59	1.60
SSW	0.05	0.12	0.24	0.04	0.00	0.00	0.45	1.33
SW	0.03	0.09	0.25	0.02	0.00	0.00	0.39	1.06
WSW	0.03	0.09	0.11	0.01	0.00	0.00	0.24	1.74
W	0.02	0.05	0.14	0.01	0.00	0.00	0.22	1.56
WNW	0.03	0.12	0.32	0.06	0.00	0.00	0.52	1.55
NW	0.04	0.14	0.46	0.14	0.00	0.00	0.78	2.51
NNW	0.03	0.10	0.46	0.17	0.00	0.00	0.76	2.51
TOTAL	1.47	4.90	8.90	1.59	0.00	0.00	16.86	1.58
AVG SPD	0.22	1.11	1.85	2.64	0.00	0.00	1.58	1.58

NWS SURFACE METEOROLOGICAL DATA
STATION # 12835

STABILITY WIND ROSE

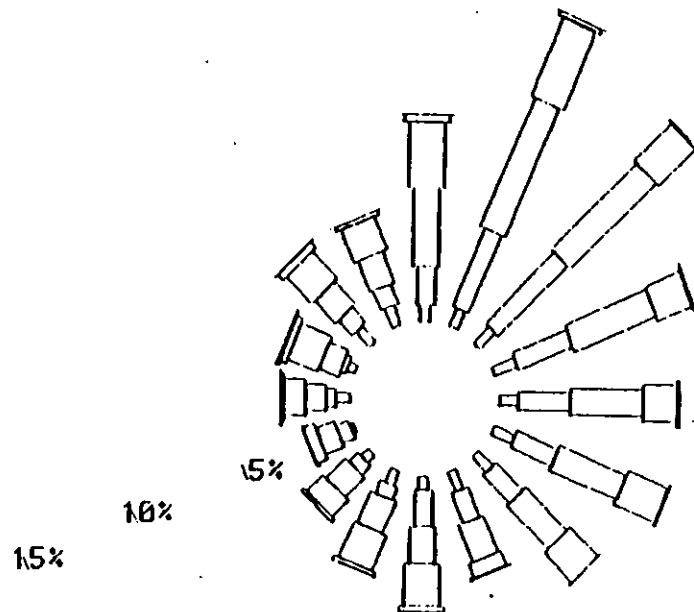
STABILITY INDEX F

FROM JAN. 1 1983 THROUGH DEC. 31 1983

DIRECTION	+-----WIND SPEED CLASSES (MPS)-----+						TOTAL	AVERAGE WIND SPEED
	0-2	2-3	3-5	5-8	8-11	>11		
N	0.61	0.35	0.32	0.01	0.00	0.00	1.27	1.00
NNE	1.46	1.13	0.65	0.00	0.00	0.00	3.25	0.74
NE	2.51	1.88	0.83	0.01	0.00	0.00	5.23	0.60
ENE	1.94	1.44	0.83	0.00	0.00	0.00	4.21	0.69
E	1.74	1.20	0.61	0.00	0.00	0.00	3.55	0.74
ESE	2.11	1.46	0.44	0.01	0.00	0.00	4.02	0.65
SE	1.62	0.82	0.27	0.00	0.00	0.00	2.71	0.56
SSE	0.91	0.52	0.09	0.00	0.00	0.00	1.52	0.63
S	0.72	0.35	0.09	0.00	0.00	0.00	1.16	0.62
SSW	0.48	0.23	0.07	0.00	0.00	0.00	0.77	0.39
SW	0.31	0.15	0.07	0.00	0.00	0.00	0.52	0.44
WSW	0.33	0.08	0.03	0.00	0.00	0.00	0.45	0.50
W	0.24	0.13	0.07	0.00	0.00	0.00	0.44	0.61
WNW	0.33	0.17	0.10	0.00	0.00	0.00	0.60	0.65
NW	0.38	0.20	0.14	0.00	0.00	0.00	0.73	0.73
NNW	0.41	0.27	0.14	0.00	0.00	0.00	0.82	0.87
TOTAL	16.10	10.38	4.76	0.02	0.00	0.00	31.25	0.67
AVG SPD	0.13	1.10	1.51	3.86	0.00	0.00	0.67	0.67

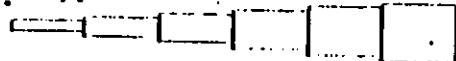
SITE 01 FROM 01/01/84 TO 12/31/84

WIND SPEED AND DIRECTION ROSE



Wind Speed Class (mps)

0. 1. 3. 5. 8. 11.



NWS SURFACE METEOROLOGICAL DATA
 STATION # 12835

STABILITY WIND ROSE

STABILITY INDEX A

FROM JAN. 1 1984 THROUGH DEC. 31 1984

DIRECTION	+-----WIND SPEED CLASSES (MPS)-----+						TOTAL	AVERAGE WIND SPEED
	0-2	2-3	3-5	5-8	8-11	>11		
N	0.01	0.06	0.00	0.00	0.00	0.00	0.07	0.91
NNE	0.02	0.04	0.00	0.00	0.00	0.00	0.06	0.83
NE	0.03	0.06	0.00	0.00	0.00	0.00	0.09	0.57
ENE	0.03	0.08	0.00	0.00	0.00	0.00	0.11	0.35
E	0.03	0.03	0.00	0.00	0.00	0.00	0.05	0.69
ESE	0.03	0.03	0.00	0.00	0.00	0.00	0.06	0.21
SE	0.02	0.03	0.00	0.00	0.00	0.00	0.04	0.44
SSE	0.01	0.02	0.00	0.00	0.00	0.00	0.04	0.76
S	0.00	0.04	0.00	0.00	0.00	0.00	0.04	0.71
SSW	0.00	0.02	0.00	0.00	0.00	0.00	0.02	0.57
SW	0.00	0.03	0.00	0.00	0.00	0.00	0.03	0.76
WSW	0.00	0.03	0.00	0.00	0.00	0.00	0.03	0.72
W	0.00	0.01	0.00	0.00	0.00	0.00	0.01	1.16
WNW	0.00	0.01	0.00	0.00	0.00	0.00	0.01	1.71
NW	0.00	0.04	0.00	0.00	0.00	0.00	0.04	1.16
NNW	0.00	0.04	0.00	0.00	0.00	0.00	0.04	1.07
TOTAL	0.20	0.56	0.00	0.00	0.00	0.00	0.76	0.68
AVG SPD	0.08	0.76	0.00	0.00	0.00	0.00	0.68	0.68

NWS SURFACE METEOROLOGICAL DATA
STATION # 12835

STABILITY WIND ROSE

STABILITY INDEX B

FROM JAN. 1 1984 THROUGH DEC. 31 1984

DIRECTION	+-----WIND SPEED CLASSES (MPS)-----+						TOTAL	AVERAGE WIND SPEED
	0-2	2-3	3-5	5-8	8-11	>11		
N	0.02	0.10	0.23	0.00	0.00	0.00	0.36	1.43
NNE	0.04	0.11	0.22	0.01	0.00	0.00	0.37	1.21
NE	0.06	0.08	0.26	0.00	0.00	0.00	0.41	0.96
ENE	0.04	0.07	0.30	0.00	0.00	0.00	0.41	0.62
E	0.04	0.06	0.30	0.00	0.00	0.00	0.40	1.02
ESE	0.04	0.11	0.39	0.00	0.00	0.00	0.54	0.87
SE	0.04	0.10	0.30	0.00	0.00	0.00	0.44	0.98
SSE	0.02	0.07	0.15	0.01	0.00	0.00	0.25	1.24
S	0.02	0.07	0.15	0.00	0.00	0.00	0.24	1.08
SSW	0.01	0.06	0.12	0.02	0.00	0.00	0.21	1.21
SW	0.01	0.04	0.18	0.01	0.00	0.00	0.24	0.62
WSW	0.00	0.06	0.13	0.01	0.00	0.00	0.20	0.68
W	0.00	0.03	0.13	0.03	0.00	0.00	0.18	0.73
WNW	0.01	0.04	0.11	0.01	0.00	0.00	0.17	0.74
NW	0.01	0.04	0.15	0.01	0.00	0.00	0.21	0.80
NNW	0.01	0.06	0.11	0.01	0.00	0.00	0.20	0.90
TOTAL	0.37	1.09	3.24	0.11	0.00	0.00	4.82	0.96
AVG SPD	0.12	0.85	1.04	1.94	9.77	0.00	0.96	0.96

NWS SURFACE METEOROLOGICAL DATA
STATION # 12835

STABILITY WIND ROSE

STABILITY INDEX C

FROM JAN. 1 1984 THROUGH DEC. 31 1984

DIRECTION	+-----WIND SPEED CLASSES (MPS)-----+						TOTAL	AVERAGE WIND SPEED
	0-2	2-3	3-5	5-8	8-11	>11		
N	0.04	0.08	0.35	0.22	0.01	0.00	0.70	1.89
NNE	0.09	0.11	0.56	0.38	0.01	0.00	1.16	2.08
NE	0.15	0.12	0.70	0.39	0.00	0.00	1.36	1.22
ENE	0.12	0.11	0.53	0.33	0.00	0.00	1.09	1.12
E	0.09	0.09	0.46	0.41	0.00	0.00	1.05	1.30
ESE	0.13	0.16	0.62	0.51	0.01	0.00	1.43	1.32
SE	0.09	0.12	0.45	0.39	0.01	0.00	1.05	1.48
SSE	0.06	0.05	0.31	0.14	0.01	0.00	0.56	1.40
S	0.06	0.08	0.25	0.26	0.03	0.00	0.69	1.57
SSW	0.04	0.05	0.25	0.30	0.04	0.00	0.68	1.71
SW	0.03	0.04	0.35	0.31	0.01	0.00	0.73	1.35
WSW	0.02	0.08	0.31	0.20	0.00	0.00	0.61	0.70
W	0.02	0.04	0.20	0.25	0.00	0.00	0.50	1.27
WNW	0.02	0.02	0.15	0.15	0.01	0.00	0.35	1.64
NW	0.02	0.04	0.21	0.15	0.03	0.00	0.45	1.62
NNW	0.02	0.06	0.19	0.12	0.00	0.00	0.40	1.47
TOTAL	0.97	1.24	5.90	4.52	0.17	0.00	12.80	1.44
AVG SPD	0.09	0.64	1.36	1.95	3.44	11.83	1.44	1.44

NWS SURFACE METEOROLOGICAL DATA
STATION # 12835

STABILITY WIND ROSE

STABILITY INDEX D

FROM JAN. 1 1984 THROUGH DEC. 31 1984

DIRECTION	+-----WIND SPEED CLASSES (MPS)-----+						TOTAL	AVERAGE WIND SPEED
	0-2	2-3	3-5	5-8	8-11	>11		
N	0.07	0.14	0.61	1.34	0.15	0.01	2.32	2.34
NNE	0.16	0.30	1.07	1.56	0.09	0.00	3.19	2.11
NE	0.25	0.37	1.19	1.39	0.10	0.00	3.29	1.37
ENE	0.19	0.34	0.92	1.13	0.09	0.01	2.69	1.30
E	0.17	0.28	0.76	0.85	0.06	0.00	2.11	1.48
ESE	0.21	0.31	0.86	0.90	0.06	0.00	2.34	1.31
SE	0.15	0.21	0.62	1.06	0.05	0.00	2.10	1.26
SSE	0.08	0.17	0.47	0.46	0.07	0.01	1.26	1.20
S	0.07	0.20	0.49	0.96	0.17	0.01	1.90	1.87
SSW	0.05	0.11	0.41	0.91	0.11	0.00	1.59	1.83
SW	0.02	0.09	0.42	0.75	0.11	0.01	1.40	1.46
WSW	0.04	0.11	0.26	0.35	0.04	0.00	0.80	1.26
W	0.02	0.07	0.22	0.41	0.08	0.01	0.82	2.29
WNW	0.02	0.05	0.22	0.69	0.16	0.05	1.20	2.62
NW	0.04	0.08	0.32	0.92	0.26	0.01	1.62	2.06
NNW	0.04	0.12	0.34	0.78	0.09	0.01	1.38	2.10
TOTAL	1.57	2.94	9.19	14.47	1.70	0.12	29.99	1.71
AVG SPD	0.05	0.76	1.24	2.16	3.29	5.38	1.71	1.71

NWS SURFACE METEOROLOGICAL DATA
STATION # 12835

STABILITY WIND ROSE

STABILITY INDEX E

FROM JAN. 1 1984 THROUGH DEC. 31 1984

DIRECTION	+-----WIND SPEED CLASSES (MPS)-----+						TOTAL	AVERAGE WIND SPEED
	0-2	2-3	3-5	5-8	8-11	>11		
N	0.08	0.22	0.63	0.27	0.00	0.00	1.20	1.51
NNE	0.18	0.48	1.10	0.17	0.00	0.00	1.93	1.48
NE	0.33	0.71	1.33	0.17	0.00	0.00	2.54	0.97
ENE	0.26	0.56	0.96	0.11	0.00	0.00	1.90	0.89
E	0.22	0.38	0.75	0.10	0.00	0.00	1.45	0.71
ESE	0.25	0.48	0.77	0.08	0.00	0.00	1.58	0.64
SE	0.20	0.40	0.43	0.06	0.00	0.00	1.09	0.84
SSE	0.10	0.19	0.24	0.02	0.00	0.00	0.54	0.88
S	0.09	0.24	0.23	0.04	0.00	0.00	0.60	1.00
SSW	0.06	0.11	0.25	0.03	0.00	0.00	0.46	1.18
SW	0.05	0.07	0.21	0.02	0.00	0.00	0.35	0.88
WSW	0.04	0.09	0.12	0.00	0.00	0.00	0.25	1.01
W	0.03	0.05	0.16	0.01	0.00	0.00	0.25	1.36
WNW	0.04	0.08	0.28	0.06	0.00	0.00	0.45	1.05
NW	0.05	0.12	0.41	0.11	0.00	0.00	0.69	1.06
NNW	0.05	0.08	0.40	0.13	0.00	0.00	0.67	1.03
TOTAL	2.04	4.25	8.28	1.37	0.00	0.00	15.94	1.01
AVG SPD	0.03	0.71	1.32	1.54	0.00	0.00	1.01	1.01

NWS SURFACE METEOROLOGICAL DATA
STATION # 12835

STABILITY WIND ROSE

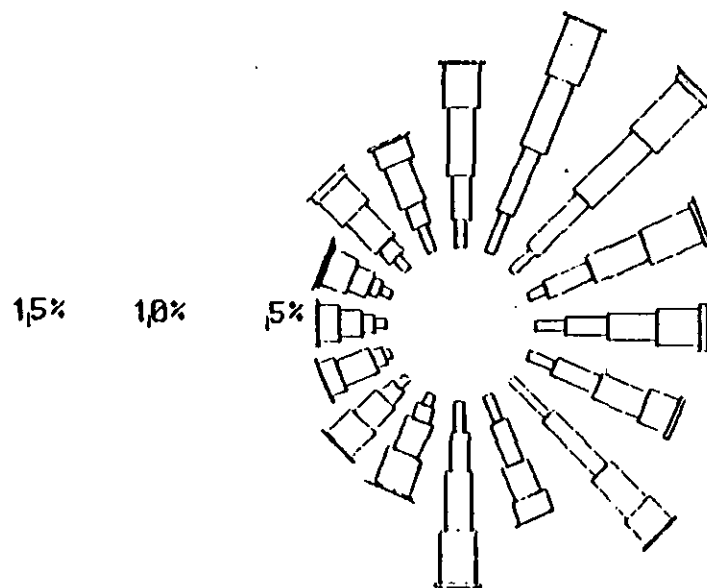
STABILITY INDEX F

FROM JAN. 1 1984 THROUGH DEC. 31 1984

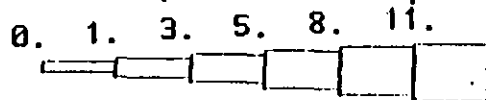
DIRECTION	+-----WIND SPEED CLASSES (MPS)-----+						TOTAL	AVERAGE WIND SPEED
	0-2	2-3	3-5	5-8	8-11	>11		
N	0.90	0.36	0.28	0.00	0.00	0.00	1.55	0.43
NNE	2.09	1.17	0.69	0.00	0.00	0.00	3.95	0.53
NE	3.42	1.74	0.81	0.00	0.00	0.00	5.97	0.41
ENE	2.65	1.19	0.70	0.00	0.00	0.00	4.54	0.31
E	2.28	1.04	0.49	0.00	0.00	0.00	3.80	0.30
ESE	2.81	1.18	0.40	0.00	0.00	0.00	4.39	0.27
SE	2.07	0.71	0.24	0.00	0.00	0.00	3.02	0.25
SSE	1.20	0.50	0.11	0.00	0.00	0.00	1.81	0.35
S	1.01	0.34	0.10	0.00	0.00	0.00	1.46	0.32
SSW	0.64	0.18	0.08	0.00	0.00	0.00	0.90	0.24
SW	0.45	0.14	0.06	0.00	0.00	0.00	0.64	0.30
WSW	0.47	0.09	0.05	0.00	0.00	0.00	0.61	0.36
W	0.33	0.11	0.06	0.00	0.00	0.00	0.50	0.27
WNW	0.43	0.14	0.09	0.00	0.00	0.00	0.66	0.28
NW	0.55	0.23	0.11	0.00	0.00	0.00	0.89	0.39
NNW	0.59	0.25	0.17	0.00	0.00	0.00	1.01	0.48
TOTAL	21.89	9.37	4.43	0.01	0.00	0.00	35.70	0.35
AVG SPD	0.02	0.78	1.09	2.25	0.00	0.00	0.35	0.35

SITE 01 FROM 01/01/85 TO 12/31/85

WIND SPEED AND DIRECTION ROSE



Wind Speed Class (mps)



NWS SURFACE METEOROLOGICAL DATA
 STATION # 12835

STABILITY WIND ROSE

STABILITY INDEX A

FROM JAN. 1 1985 THROUGH DEC. 31 1985

DIRECTION	+-----WIND SPEED CLASSES (MPS)-----+						TOTAL	AVERAGE WIND SPEED
	0-2	2-3	3-5	5-8	8-11	>11		
N	0.01	0.05	0.00	0.00	0.00	0.00	0.06	0.35
NNE	0.03	0.04	0.00	0.00	0.00	0.00	0.07	0.40
NE	0.05	0.04	0.00	0.00	0.00	0.00	0.09	0.13
ENE	0.04	0.06	0.00	0.00	0.00	0.00	0.10	0.01
E	0.04	0.02	0.00	0.00	0.00	0.00	0.06	0.18
ESE	0.04	0.03	0.00	0.00	0.00	0.00	0.07	0.29
SE	0.03	0.03	0.00	0.00	0.00	0.00	0.05	0.30
SSE	0.02	0.02	0.00	0.00	0.00	0.00	0.04	0.29
S	0.01	0.03	0.00	0.00	0.00	0.00	0.04	0.47
SSW	0.01	0.03	0.00	0.00	0.00	0.00	0.03	1.06
SW	0.00	0.03	0.00	0.00	0.00	0.00	0.03	0.87
WSW	0.00	0.02	0.00	0.00	0.00	0.00	0.03	0.57
W	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.83
WNW	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.86
NW	0.01	0.03	0.00	0.00	0.00	0.00	0.04	0.46
NNW	0.01	0.04	0.00	0.00	0.00	0.00	0.05	0.70
TOTAL	0.30	0.49	0.00	0.00	0.00	0.00	0.79	0.37
AVG SPD	0.01	0.54	0.00	0.00	0.00	0.00	0.37	0.37

NWS SURFACE METEOROLOGICAL DATA
STATION # 12835

STABILITY WIND ROSE

STABILITY INDEX B

FROM JAN. 1 1985 THROUGH DEC. 31 1985

DIRECTION	+-----WIND SPEED CLASSES (MPS)-----+						TOTAL	AVERAGE WIND SPEED
	0-2	2-3	3-5	5-8	8-11	>11		
N	0.03	0.10	0.19	0.00	0.00	0.00	0.32	0.64
NNE	0.05	0.09	0.20	0.01	0.00	0.00	0.35	0.71
NE	0.08	0.08	0.23	0.00	0.00	0.00	0.39	0.66
ENE	0.06	0.06	0.25	0.00	0.00	0.00	0.37	0.56
E	0.05	0.05	0.23	0.00	0.00	0.00	0.33	0.35
ESE	0.06	0.09	0.30	0.00	0.00	0.00	0.44	0.40
SE	0.05	0.09	0.25	0.00	0.00	0.00	0.39	0.61
SSE	0.03	0.07	0.14	0.01	0.00	0.00	0.24	0.80
S	0.03	0.08	0.17	0.00	0.00	0.00	0.29	1.24
SSW	0.01	0.04	0.14	0.01	0.00	0.00	0.21	1.08
SW	0.01	0.05	0.18	0.01	0.00	0.00	0.25	1.16
WSW	0.01	0.05	0.16	0.01	0.00	0.00	0.23	1.36
W	0.00	0.03	0.13	0.02	0.00	0.00	0.18	1.10
WNW	0.01	0.03	0.10	0.01	0.00	0.00	0.15	0.76
NW	0.01	0.04	0.15	0.01	0.00	0.00	0.21	1.03
NNW	0.02	0.06	0.11	0.00	0.00	0.00	0.20	0.88
TOTAL	0.50	1.01	2.92	0.10	0.00	0.00	4.53	0.78
AVG SPD	0.08	0.67	0.91	1.33	9.77	0.00	0.78	0.78

NWS SURFACE METEOROLOGICAL DATA
STATION # 12835

STABILITY WIND ROSE

STABILITY INDEX C

FROM JAN. 1 1985 THROUGH DEC. 31 1985

DIRECTION	+-----WIND SPEED CLASSES (MPS)-----+						TOTAL	AVERAGE WIND SPEED
	0-2	2-3	3-5	5-8	8-11	>11		
N	0.06	0.07	0.35	0.21	0.01	0.00	0.70	1.25
NNE	0.13	0.12	0.47	0.31	0.00	0.00	1.05	0.78
NE	0.20	0.11	0.57	0.34	0.01	0.00	1.22	0.75
ENE	0.16	0.09	0.41	0.29	0.00	0.00	0.95	0.69
E	0.12	0.09	0.37	0.33	0.00	0.00	0.91	0.68
ESE	0.17	0.14	0.50	0.39	0.01	0.00	1.20	0.54
SE	0.12	0.12	0.42	0.31	0.01	0.00	0.98	0.91
SSE	0.08	0.06	0.29	0.12	0.01	0.00	0.55	0.97
S	0.08	0.10	0.27	0.25	0.02	0.00	0.72	1.30
SSW	0.04	0.06	0.24	0.26	0.03	0.00	0.63	1.17
SW	0.03	0.04	0.31	0.30	0.01	0.00	0.68	1.22
WSW	0.03	0.06	0.29	0.18	0.00	0.00	0.56	1.09
W	0.02	0.03	0.18	0.22	0.00	0.00	0.45	1.17
WNW	0.02	0.02	0.13	0.15	0.01	0.00	0.33	1.27
NW	0.03	0.04	0.19	0.13	0.02	0.00	0.41	0.98
NNW	0.03	0.05	0.20	0.11	0.00	0.00	0.40	1.15
TOTAL	1.33	1.20	5.20	3.88	0.13	0.00	11.75	0.93
AVG SPD	0.03	0.73	0.94	1.25	1.52	11.83	0.93	0.93

NWS SURFACE METEOROLOGICAL DATA
STATION # 12835

STABILITY WIND ROSE

STABILITY INDEX D

FROM JAN. 1 1985 THROUGH DEC. 31 1985

DIRECTION	+-----WIND SPEED CLASSES (MPS)-----+						TOTAL	AVERAGE WIND SPEED
	0-2	2-3	3-5	5-8	8-11	>11		
N	0.10	0.16	0.59	1.12	0.12	0.00	2.09	1.14
NNE	0.22	0.28	0.87	1.37	0.08	0.00	2.82	1.05
NE	0.34	0.33	0.96	1.28	0.13	0.00	3.05	1.19
ENE	0.26	0.28	0.73	1.08	0.10	0.01	2.46	1.23
E	0.22	0.22	0.61	0.82	0.10	0.00	1.98	1.30
ESE	0.27	0.26	0.69	0.78	0.08	0.00	2.08	0.95
SE	0.20	0.21	0.51	0.89	0.04	0.00	1.87	0.92
SSE	0.12	0.16	0.40	0.43	0.05	0.00	1.17	1.08
S	0.10	0.19	0.47	0.95	0.15	0.00	1.86	1.59
SSW	0.06	0.09	0.35	0.83	0.10	0.00	1.42	1.35
SW	0.04	0.09	0.36	0.68	0.09	0.00	1.27	1.30
WSW	0.05	0.09	0.25	0.32	0.04	0.00	0.74	1.21
W	0.03	0.07	0.19	0.37	0.07	0.01	0.74	1.28
WNW	0.04	0.05	0.18	0.61	0.13	0.04	1.05	1.40
NW	0.05	0.08	0.28	0.84	0.24	0.01	1.50	1.58
NNW	0.06	0.12	0.31	0.64	0.08	0.00	1.21	1.12
TOTAL	2.17	2.68	7.75	13.02	1.61	0.10	27.33	1.21
AVG SPD	0.02	0.63	0.79	1.60	2.61	2.63	1.21	1.21

NWS SURFACE METEOROLOGICAL DATA
STATION # 12835

STABILITY WIND ROSE

STABILITY INDEX E

FROM JAN. 1 1985 THROUGH DEC. 31 1985

DIRECTION	+-----WIND SPEED CLASSES (MPS)-----+						TOTAL	AVERAGE WIND SPEED
	0-2	2-3	3-5	5-8	8-11	>11		
N	0.11	0.20	0.57	0.23	0.00	0.00	1.11	0.86
NNE	0.25	0.42	0.94	0.19	0.00	0.00	1.81	0.78
NE	0.44	0.58	1.14	0.20	0.00	0.00	2.36	0.70
ENE	0.33	0.44	0.82	0.13	0.00	0.00	1.72	0.66
E	0.28	0.33	0.63	0.10	0.00	0.00	1.34	0.63
ESE	0.34	0.39	0.61	0.07	0.00	0.00	1.41	0.45
SE	0.25	0.38	0.38	0.06	0.00	0.00	1.07	0.65
SSE	0.13	0.19	0.22	0.02	0.00	0.00	0.56	0.71
S	0.13	0.21	0.26	0.03	0.00	0.00	0.63	0.85
SSW	0.08	0.10	0.23	0.03	0.00	0.00	0.44	0.78
SW	0.06	0.07	0.17	0.01	0.00	0.00	0.31	0.47
WSW	0.06	0.08	0.11	0.01	0.00	0.00	0.25	0.69
W	0.04	0.05	0.14	0.01	0.00	0.00	0.24	0.85
WNW	0.05	0.06	0.25	0.06	0.00	0.00	0.42	
NW	0.07	0.10	0.37	0.09	0.			
NNW	0.07	0.08	0.37	0.11	0.			
TOTAL	2.69	3.71	7.20	1.36	0.			
AVG SPD	0.01	0.54	0.87	1.68	0.			

NWS SURFACE METEOROLOGICAL DATA
STATION # 12835

STABILITY WIND ROSE

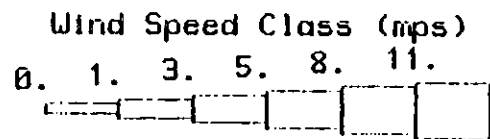
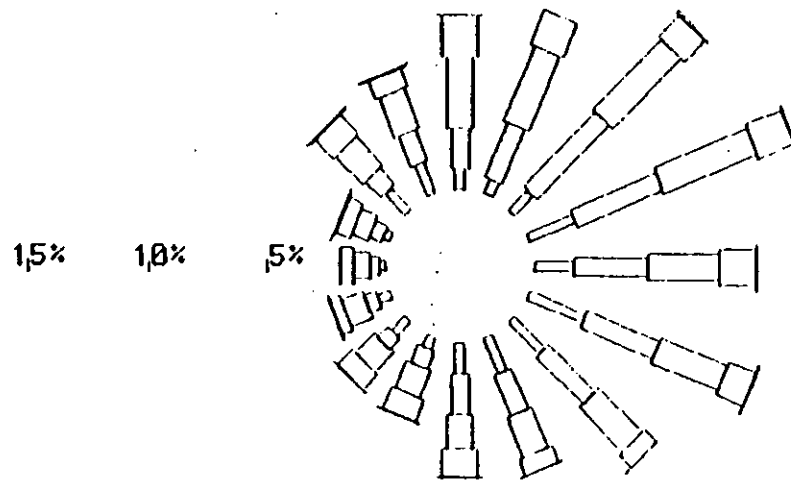
STABILITY INDEX F

FROM JAN. 1 1985 THROUGH DEC. 31 1985

DIRECTION	+-----WIND SPEED CLASSES (MPS)-----+						TOTAL	AVERAGE WIND SPEED
	0-2	2-3	3-5	5-8	8-11	>11		
N	1.25	0.37	0.25	0.00	0.00	0.00	1.89	0.30
NNE	2.82	1.04	0.55	0.00	0.00	0.00	4.42	0.21
NE	4.45	1.43	0.64	0.00	0.00	0.00	6.53	0.15
ENE	3.45	1.00	0.53	0.00	0.00	0.00	4.99	0.14
E	2.92	0.86	0.38	0.00	0.00	0.00	4.16	0.14
ESE	3.58	0.97	0.33	0.00	0.00	0.00	4.88	0.13
SE	2.69	0.77	0.21	0.00	0.00	0.00	3.67	0.24
SSE	1.58	0.49	0.09	0.00	0.00	0.00	2.16	0.21
S	1.36	0.32	0.10	0.00	0.00	0.00	1.77	0.17
SSW	0.82	0.16	0.07	0.00	0.00	0.00	1.06	0.15
SW	0.59	0.12	0.04	0.00	0.00	0.00	0.76	0.10
WSW	0.62	0.09	0.04	0.00	0.00	0.00	0.75	0.11
W	0.44	0.11	0.05	0.00	0.00	0.00	0.60	0.18
WNW	0.55	0.14	0.07	0.00	0.00	0.00	0.77	0.21
NW	0.73	0.21	0.13	0.00	0.00	0.00	1.06	0.29
NNW	0.80	0.23	0.16	0.00	0.00	0.00	1.20	0.25
TOTAL	28.66	8.32	3.65	0.02	0.00	0.00	40.65	0.18
AVG SPD	0.01	0.57	0.59	2.85	0.00	0.00	0.18	0.18

SITE 01 FROM 01/01/86 TO 12/31/86

WIND SPEED AND DIRECTION ROSE



NWS SURFACE METEOROLOGICAL DATA
 STATION # 12835

STABILITY WIND ROSE

STABILITY INDEX A

FROM JAN. 1 1986 THROUGH DEC. 31 1986

DIRECTION	+-----WIND SPEED CLASSES (MPS)-----+						TOTAL	AVERAGE WIND SPEED
	0-2	2-3	3-5	5-8	8-11	>11		
N	0.02	0.04	0.00	0.00	0.00	0.00	0.06	0.33
NNE	0.04	0.03	0.00	0.00	0.00	0.00	0.08	0.21
NE	0.07	0.03	0.00	0.00	0.00	0.00	0.10	0.12
ENE	0.05	0.05	0.00	0.00	0.00	0.00	0.10	0.21
E	0.05	0.03	0.00	0.00	0.00	0.00	0.07	0.46
ESE	0.05	0.03	0.00	0.00	0.00	0.00	0.08	0.22
SE	0.04	0.03	0.00	0.00	0.00	0.00	0.06	0.34
SSE	0.02	0.02	0.00	0.00	0.00	0.00	0.05	0.54
S	0.02	0.03	0.00	0.00	0.00	0.00	0.05	0.51
SSW	0.01	0.02	0.00	0.00	0.00	0.00	0.03	0.40
SW	0.01	0.02	0.00	0.00	0.00	0.00	0.03	0.19
WSW	0.01	0.02	0.00	0.00	0.00	0.00	0.03	0.28
W	0.00	0.01	0.00	0.00	0.00	0.00	0.02	0.34
WNW	0.00	0.01	0.00	0.00	0.00	0.00	0.02	1.10
NW	0.01	0.03	0.00	0.00	0.00	0.00	0.04	0.37
NNW	0.01	0.04	0.00	0.00	0.00	0.00	0.05	0.55
TOTAL	0.41	0.45	0.00	0.00	0.00	0.00	0.86	0.33
AVG SPD	0.03	0.58	0.00	0.00	0.00	0.00	0.33	0.33

NWS SURFACE METEOROLOGICAL DATA
STATION # 12835

STABILITY WIND ROSE

STABILITY INDEX B

FROM JAN. 1 1986 THROUGH DEC. 31 1986

DIRECTION	+-----WIND SPEED CLASSES (MPS)-----+						TOTAL	AVERAGE WIND SPEED
	0-2	2-3	3-5	5-8	8-11	>11		
N	0.03	0.08	0.19	0.00	0.00	0.00	0.30	0.68
NNE	0.06	0.08	0.17	0.01	0.00	0.00	0.32	0.45
NE	0.10	0.09	0.21	0.00	0.00	0.00	0.40	0.66
ENE	0.07	0.05	0.23	0.00	0.00	0.00	0.35	0.62
E	0.06	0.06	0.22	0.00	0.00	0.00	0.33	0.75
ESE	0.07	0.09	0.27	0.00	0.00	0.00	0.43	0.67
SE	0.06	0.08	0.23	0.00	0.00	0.00	0.37	0.62
SSE	0.04	0.07	0.13	0.01	0.00	0.00	0.24	0.77
S	0.04	0.08	0.15	0.00	0.00	0.00	0.27	0.62
SSW	0.02	0.05	0.12	0.01	0.00	0.00	0.19	0.69
SW	0.01	0.04	0.15	0.00	0.00	0.00	0.22	0.51
WSW	0.01	0.05	0.14	0.01	0.00	0.00	0.20	0.53
W	0.01	0.02	0.11	0.02	0.00	0.00	0.16	0.76
WNW	0.01	0.03	0.08	0.01	0.00	0.00	0.13	0.60
NW	0.01	0.04	0.13	0.01	0.00	0.00	0.19	0.62
NNW	0.02	0.06	0.10	0.00	0.00	0.00	0.19	0.67
TOTAL	0.62	0.97	2.62	0.08	0.00	0.00	4.30	0.64
AVG SPD	0.05	0.64	0.76	0.98	9.77	0.00	0.64	0.64

NWS SURFACE METEOROLOGICAL DATA
STATION # 12835

STABILITY WIND ROSE

STABILITY INDEX C

FROM JAN. 1 1986 THROUGH DEC. 31 1986

DIRECTION	+-----WIND SPEED CLASSES (MPS)-----+						TOTAL	AVERAGE WIND SPEED
	0-2	2-3	3-5	5-8	8-11	>11		
N	0.08	0.07	0.29	0.18	0.01	0.00	0.63	0.65
NNE	0.17	0.10	0.42	0.25	0.00	0.00	0.94	0.56
NE	0.26	0.11	0.50	0.27	0.01	0.00	1.14	0.59
ENE	0.20	0.10	0.42	0.25	0.00	0.00	0.97	0.89
E	0.16	0.08	0.35	0.31	0.00	0.00	0.89	0.90
ESE	0.21	0.12	0.46	0.34	0.01	0.00	1.12	0.73
SE	0.15	0.12	0.39	0.25	0.01	0.00	0.93	0.70
SSE	0.09	0.06	0.28	0.12	0.00	0.00	0.56	0.98
S	0.09	0.09	0.24	0.22	0.02	0.00	0.65	0.70
SSW	0.05	0.05	0.22	0.22	0.02	0.00	0.57	0.81
SW	0.04	0.04	0.27	0.26	0.01	0.00	0.61	0.84
WSW	0.03	0.06	0.25	0.14	0.00	0.00	0.50	0.69
W	0.02	0.03	0.16	0.18	0.00	0.00	0.39	0.73
WNW	0.03	0.03	0.13	0.12	0.01	0.00	0.31	0.94
NW	0.04	0.04	0.17	0.13	0.01	0.00	0.40	1.05
NNW	0.05	0.05	0.18	0.09	0.00	0.00	0.37	0.78
TOTAL	1.66	1.14	4.74	3.33	0.11	0.00	10.98	0.76
AVG SPD	0.03	0.62	0.88	0.97	1.18	13.72	0.76	0.76

NWS SURFACE METEOROLOGICAL DATA
STATION # 12835

STABILITY WIND ROSE

STABILITY INDEX D

FROM JAN. 1 1986 THROUGH DEC. 31 1986

DIRECTION	+-----WIND SPEED CLASSES (MPS)-----+						TOTAL	AVERAGE WIND SPEED
	0-2	2-3	3-5	5-8	8-11	>11		
N	0.13	0.16	0.52	0.95	0.09	0.00	1.85	0.82
NNE	0.28	0.24	0.75	1.11	0.06	0.00	2.45	0.61
NE	0.43	0.31	0.84	1.03	0.10	0.00	2.71	0.57
ENE	0.34	0.26	0.68	0.91	0.08	0.00	2.28	0.78
E	0.28	0.22	0.54	0.70	0.07	0.00	1.82	0.74
ESE	0.34	0.23	0.60	0.63	0.06	0.00	1.87	0.58
SE	0.26	0.21	0.46	0.69	0.03	0.00	1.66	0.54
SSE	0.15	0.14	0.35	0.36	0.04	0.00	1.05	0.64
S	0.14	0.17	0.41	0.77	0.12	0.00	1.61	0.68
SSW	0.08	0.09	0.31	0.67	0.07	0.00	1.22	0.71
SW	0.05	0.08	0.31	0.54	0.07	0.00	1.06	0.62
WSW	0.06	0.08	0.22	0.27	0.03	0.00	0.66	0.73
W	0.04	0.06	0.16	0.30	0.05	0.00	0.62	0.57
WNW	0.05	0.05	0.15	0.49	0.10	0.03	0.87	0.67
NW	0.07	0.07	0.26	0.68	0.18	0.01	1.27	0.73
NNW	0.08	0.11	0.28	0.53	0.06	0.00	1.07	0.81
TOTAL	2.78	2.48	6.87	10.64	1.21	0.08	24.06	0.67
AVG SPD	0.02	0.57	0.76	0.82	0.54	0.96	0.67	0.67

NWS SURFACE METEOROLOGICAL DATA
 STATION # 12835

STABILITY WIND ROSE

STABILITY INDEX E

FROM JAN. 1 1986 THROUGH DEC. 31 1986

DIRECTION	+-----WIND SPEED CLASSES (MPS)-----+						TOTAL	AVERAGE WIND SPEED
	0-2	2-3	3-5	5-8	8-11	>11		
N	0.15	0.18	0.54	0.18	0.00	0.00	1.05	0.69
NNE	0.33	0.36	0.80	0.16	0.00	0.00	1.64	0.48
NE	0.54	0.50	0.93	0.15	0.00	0.00	2.12	0.35
ENE	0.41	0.43	0.70	0.10	0.00	0.00	1.63	0.45
E	0.34	0.31	0.52	0.08	0.00	0.00	1.25	0.41
ESE	0.41	0.37	0.51	0.06	0.00	0.00	1.36	0.41
SE	0.31	0.35	0.33	0.04	0.00	0.00	1.04	0.42
SSE	0.18	0.18	0.18	0.02	0.00	0.00	0.55	0.38
S	0.16	0.20	0.19	0.02	0.00	0.00	0.58	0.31
SSW	0.10	0.09	0.18	0.02	0.00	0.00	0.39	0.29
SW	0.07	0.07	0.14	0.01	0.00	0.00	0.29	0.39
WSW	0.07	0.07	0.09	0.01	0.00	0.00	0.23	0.32
W	0.05	0.05	0.11	0.01	0.00	0.00	0.22	0.35
WNW	0.06	0.05	0.19	0.05	0.00	0.00	0.35	0.28
NW	0.09	0.09	0.32	0.07	0.00	0.00	0.57	0.56
NNW	0.09	0.08	0.34	0.10	0.00	0.00	0.61	0.72
TOTAL	3.36	3.36	6.07	1.08	0.00	0.00	13.87	0.44
AVG SPD	0.01	0.53	0.60	0.59	0.00	0.00	0.44	0.44

NWS SURFACE METEOROLOGICAL DATA
STATION # 12835

STABILITY WIND ROSE

STABILITY INDEX F

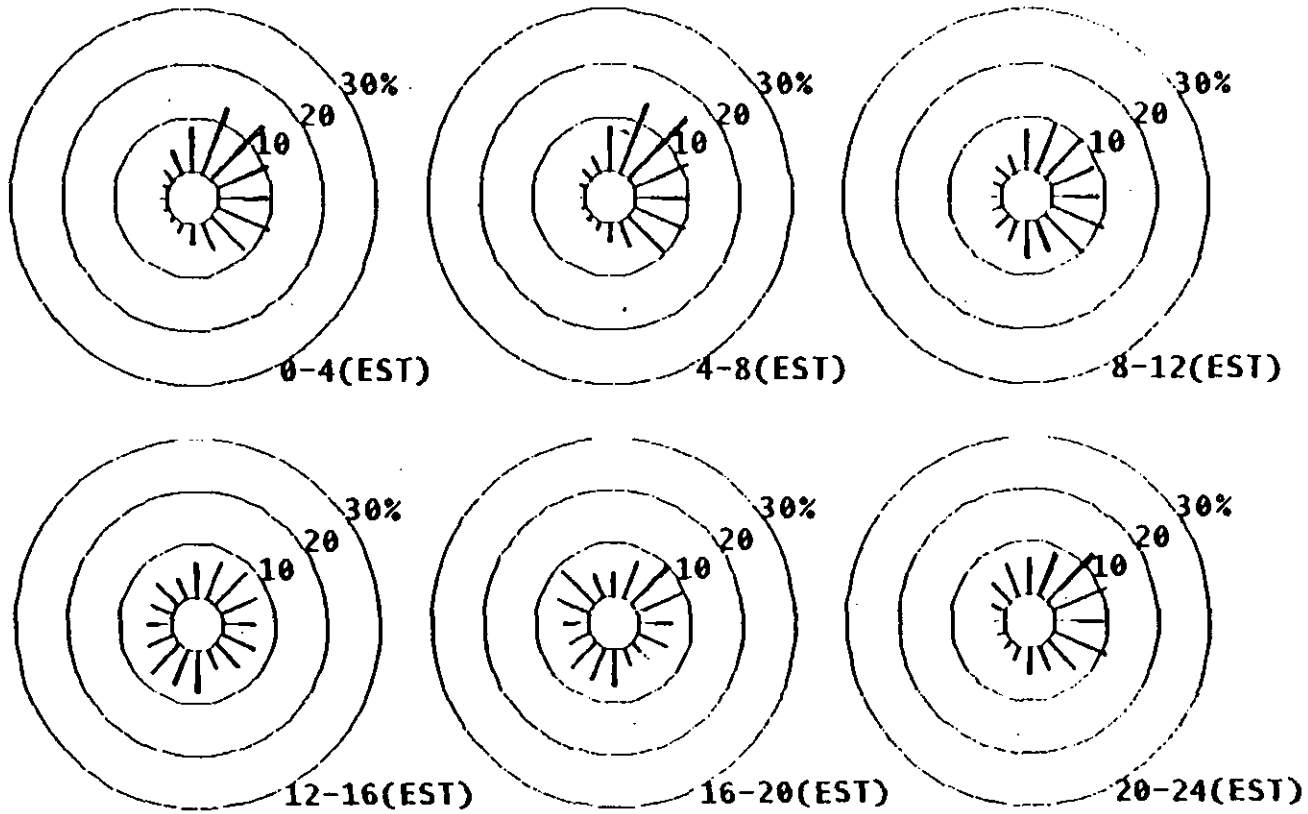
FROM JAN. 1 1986 THROUGH DEC. 31 1986

DIRECTION	+-----WIND SPEED CLASSES (MPS)-----+						TOTAL	AVERAGE WIND SPEED
	0-2	2-3	3-5	5-8	8-11	>11		
N	1.60	0.34	0.22	0.00	0.00	0.00	2.16	0.15
NNE	3.52	0.88	0.44	0.00	0.00	0.00	4.85	0.11
NE	5.48	1.27	0.55	0.00	0.00	0.00	7.30	0.13
ENE	4.25	0.94	0.47	0.00	0.00	0.00	5.66	0.16
E	3.56	0.79	0.34	0.00	0.00	0.00	4.69	0.15
ESE	4.37	0.88	0.27	0.00	0.00	0.00	5.51	0.11
SE	3.30	0.66	0.17	0.00	0.00	0.00	4.14	0.10
SSE	1.94	0.45	0.08	0.00	0.00	0.00	2.47	0.12
S	1.71	0.28	0.08	0.00	0.00	0.00	2.07	0.08
SSW	1.01	0.15	0.06	0.00	0.00	0.00	1.22	0.08
SW	0.74	0.11	0.03	0.00	0.00	0.00	0.88	0.08
WSW	0.76	0.07	0.03	0.00	0.00	0.00	0.86	0.02
W	0.54	0.09	0.04	0.00	0.00	0.00	0.67	0.05
WNW	0.67	0.12	0.07	0.00	0.00	0.00	0.85	0.10
NW	0.90	0.20	0.12	0.00	0.00	0.00	1.22	0.17
NNW	1.02	0.25	0.13	0.00	0.00	0.00	1.40	0.19
TOTAL	35.38	7.46	3.09	0.01	0.00	0.00	45.93	0.12
AVG SPD	0.01	0.50	0.51	0.89	0.00	0.00	0.12	0.12

**Diurnal Wind Roses for the Five-Year
Meteorological Database**

0100/ SITE 01 FROM 01/01/82 TO 12/31/86

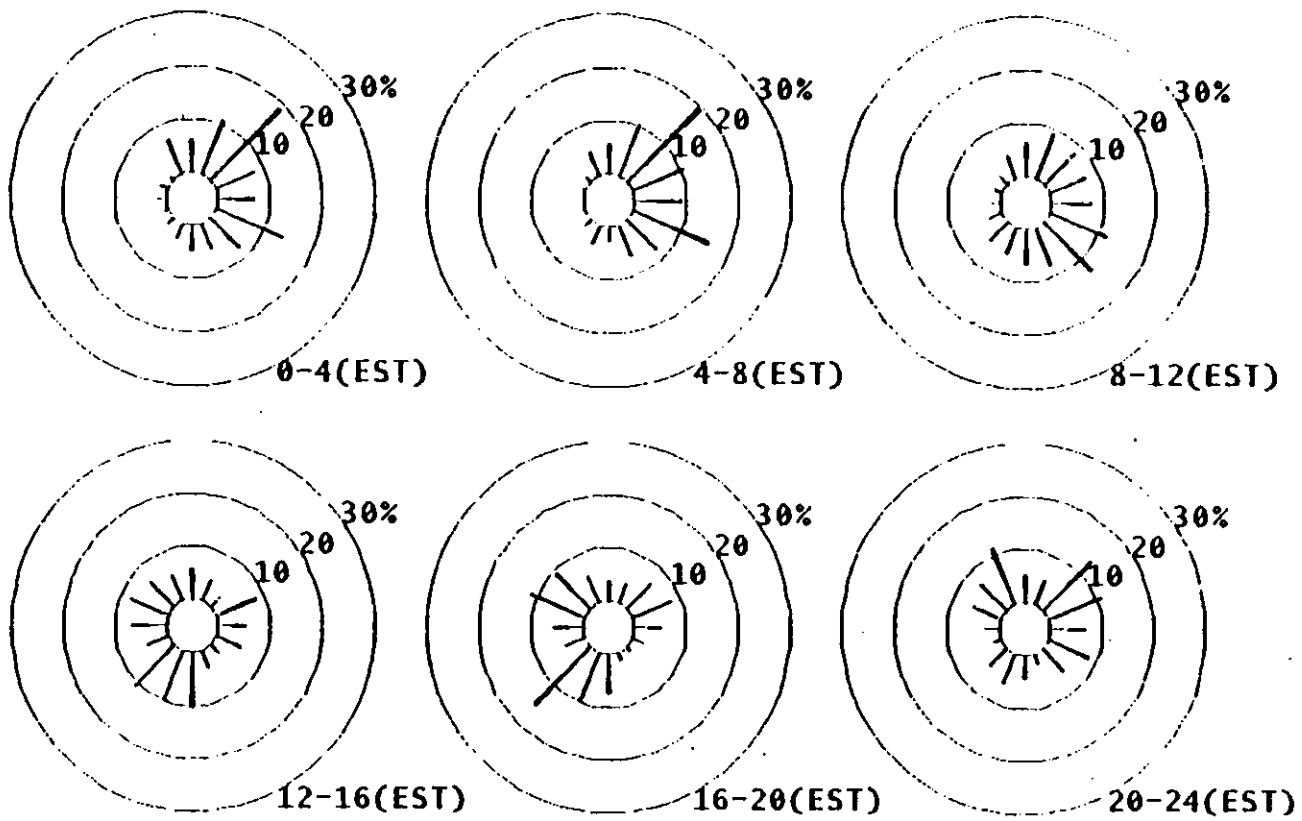
DIURNAL WIND DIRECTION ROSES



Seasonal Diurnal Wind Roses

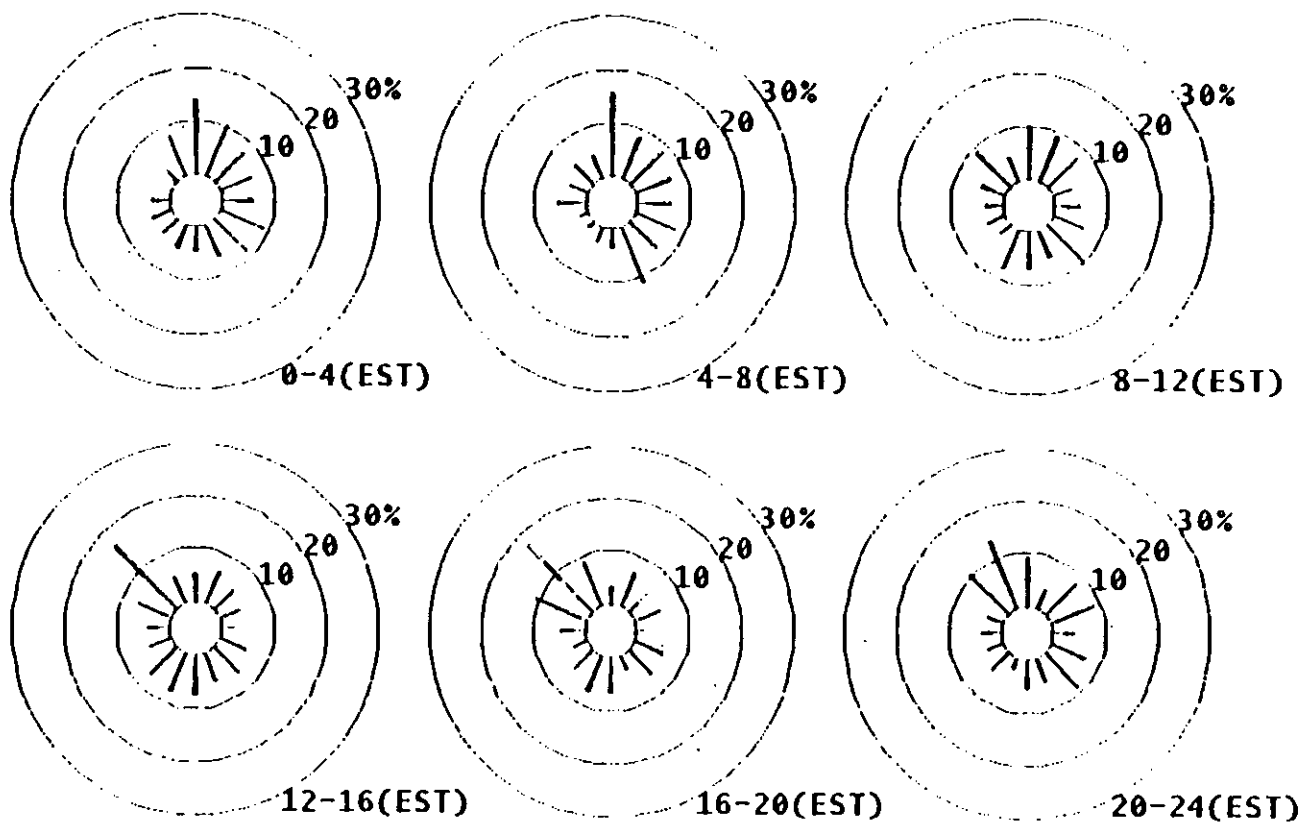
0100/ SITE 01 FROM 01/02/82 TO 03/31/82

DIURNAL WIND DIRECTION ROSES



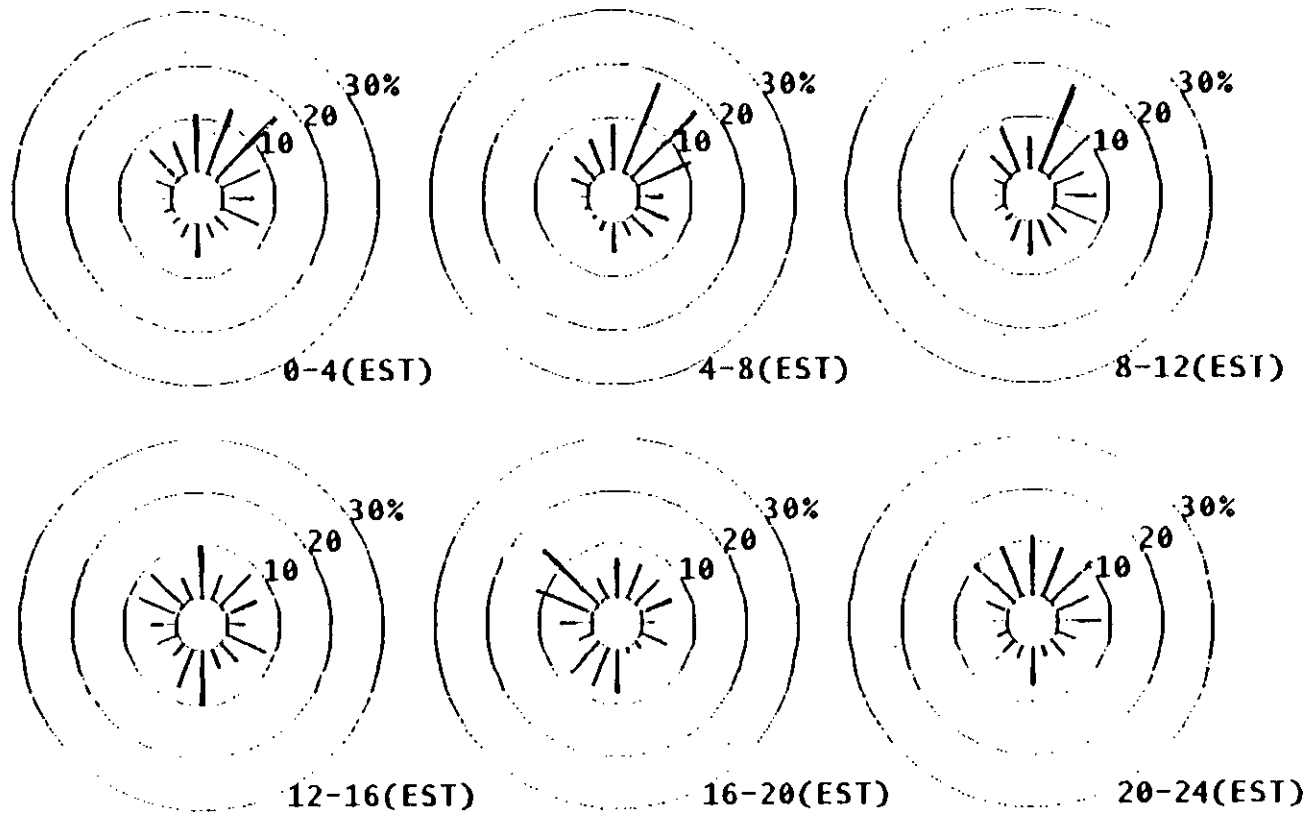
0100/ SITE 01 FROM 01/01/83 TO 03/31/83

DIURNAL WIND DIRECTION ROSES



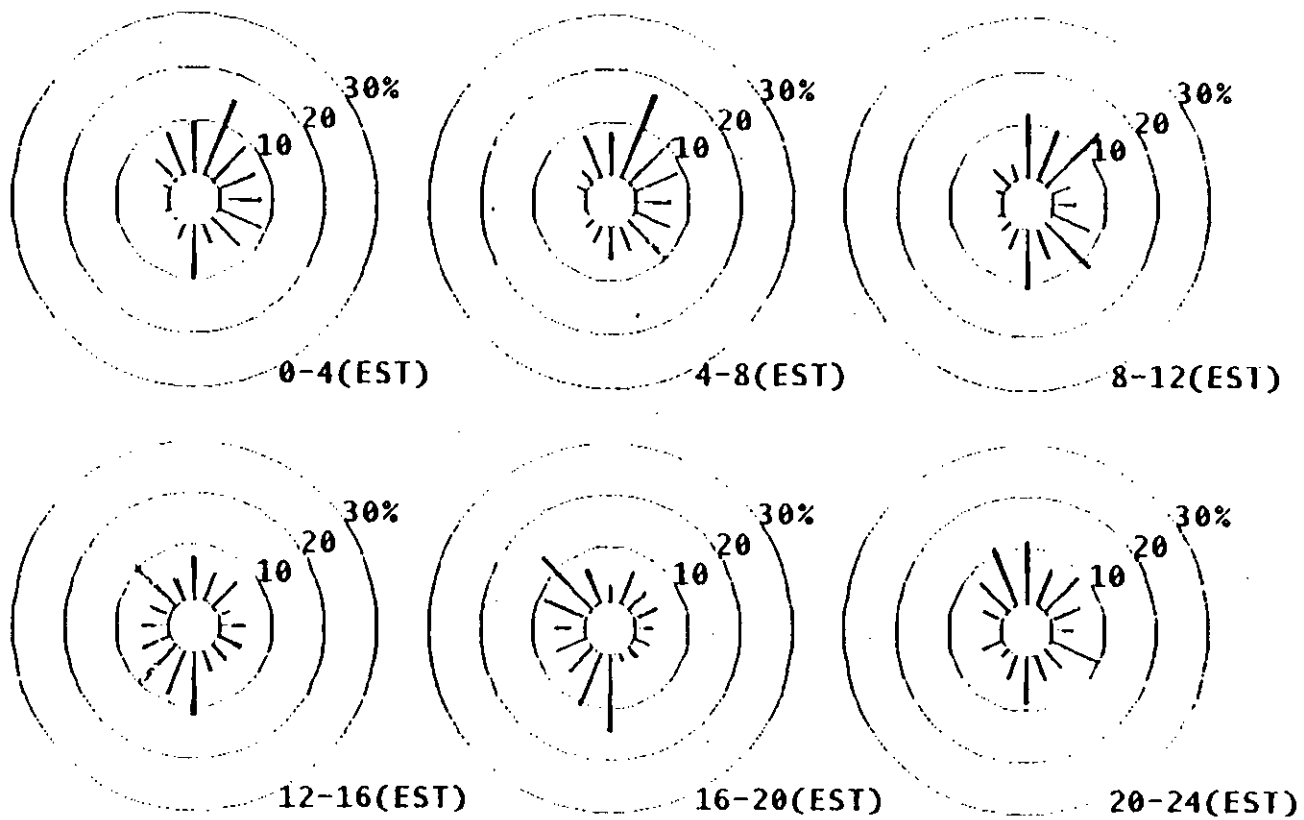
0100/ SITE 01 FROM 01/01/84 TO 03/31/84

DIURNAL WIND DIRECTION ROSES



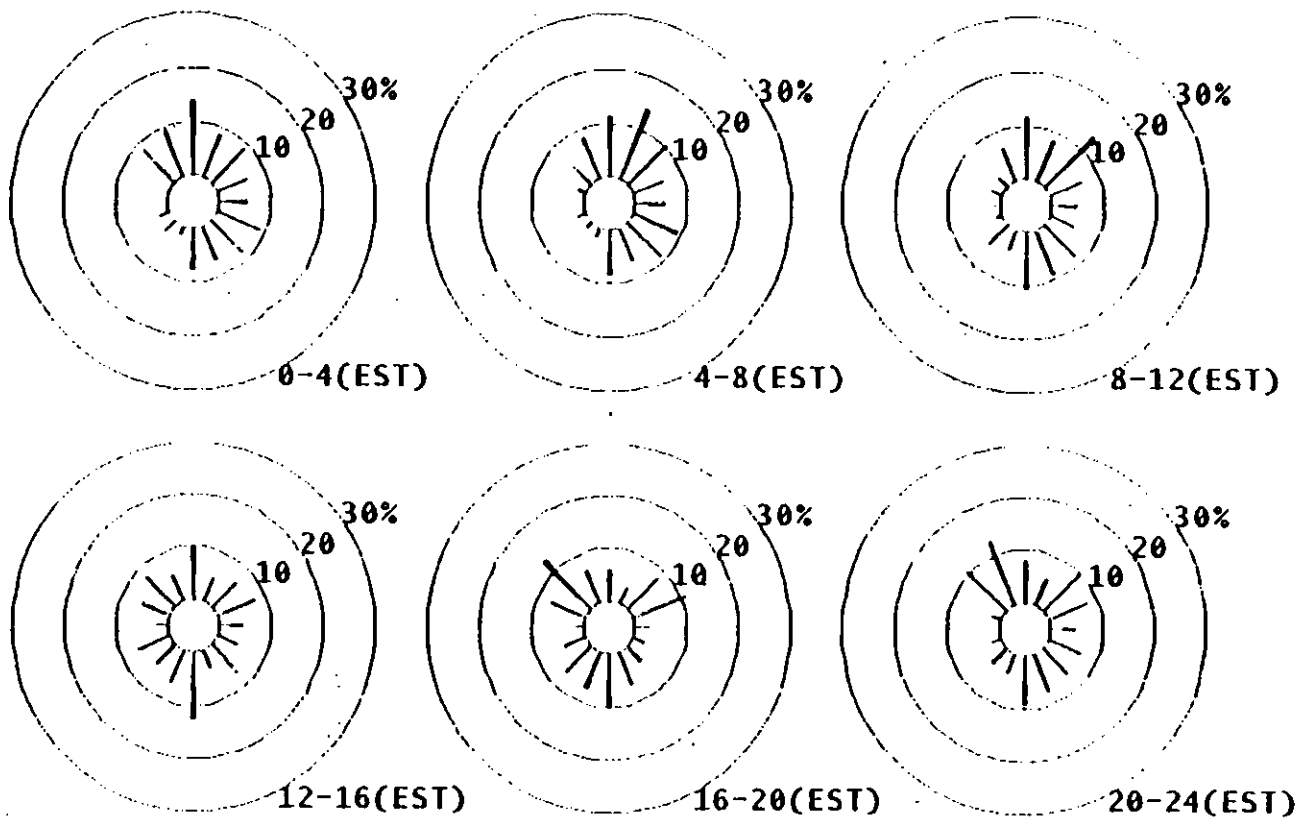
0100/ SITE 01 FROM 01/01/85 TO 03/31/85

DIURNAL WIND DIRECTION ROSES



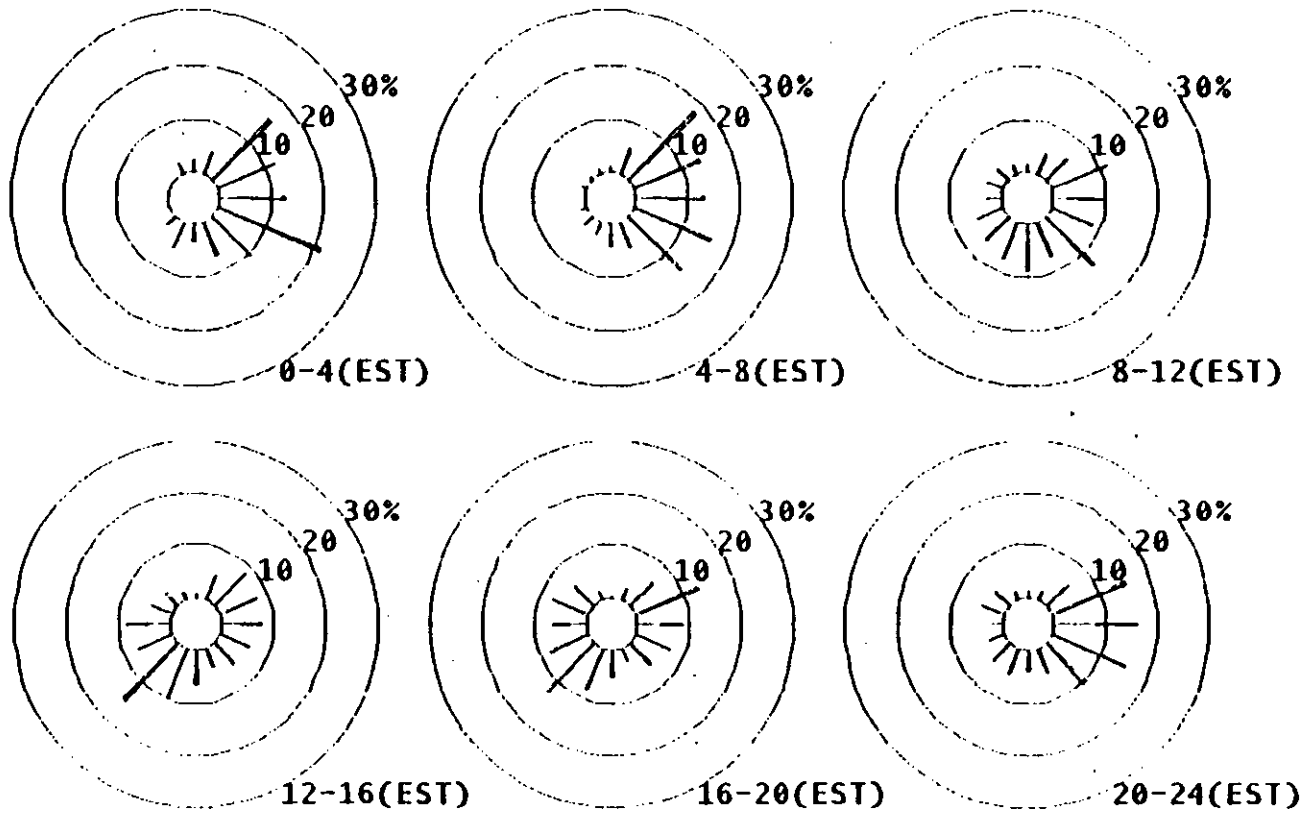
0100/ SITE 01 FROM 01/01/86 TO 03/31/86

DIURNAL WIND DIRECTION ROSES



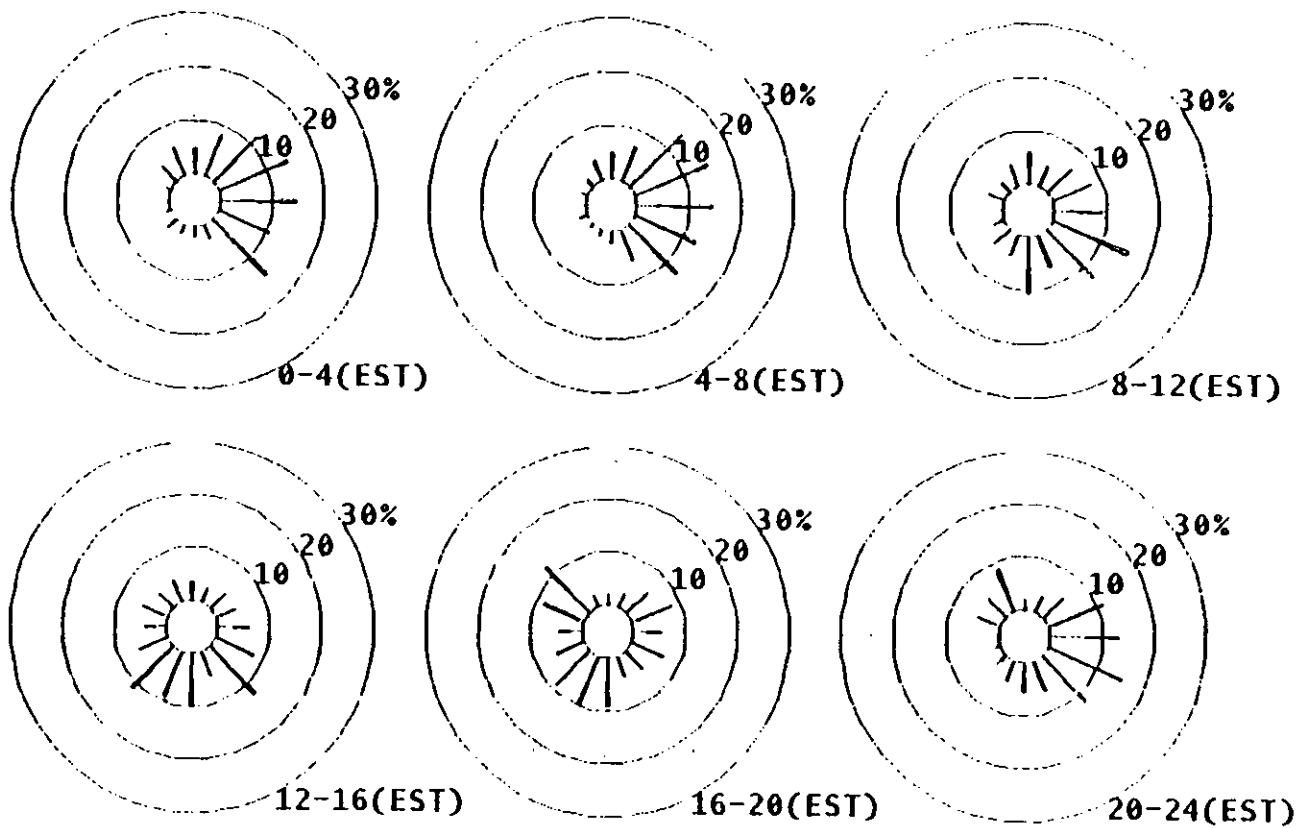
0100/ SITE 01 FROM 04/01/82 TO 06/30/82

DIURNAL WIND DIRECTION ROSES



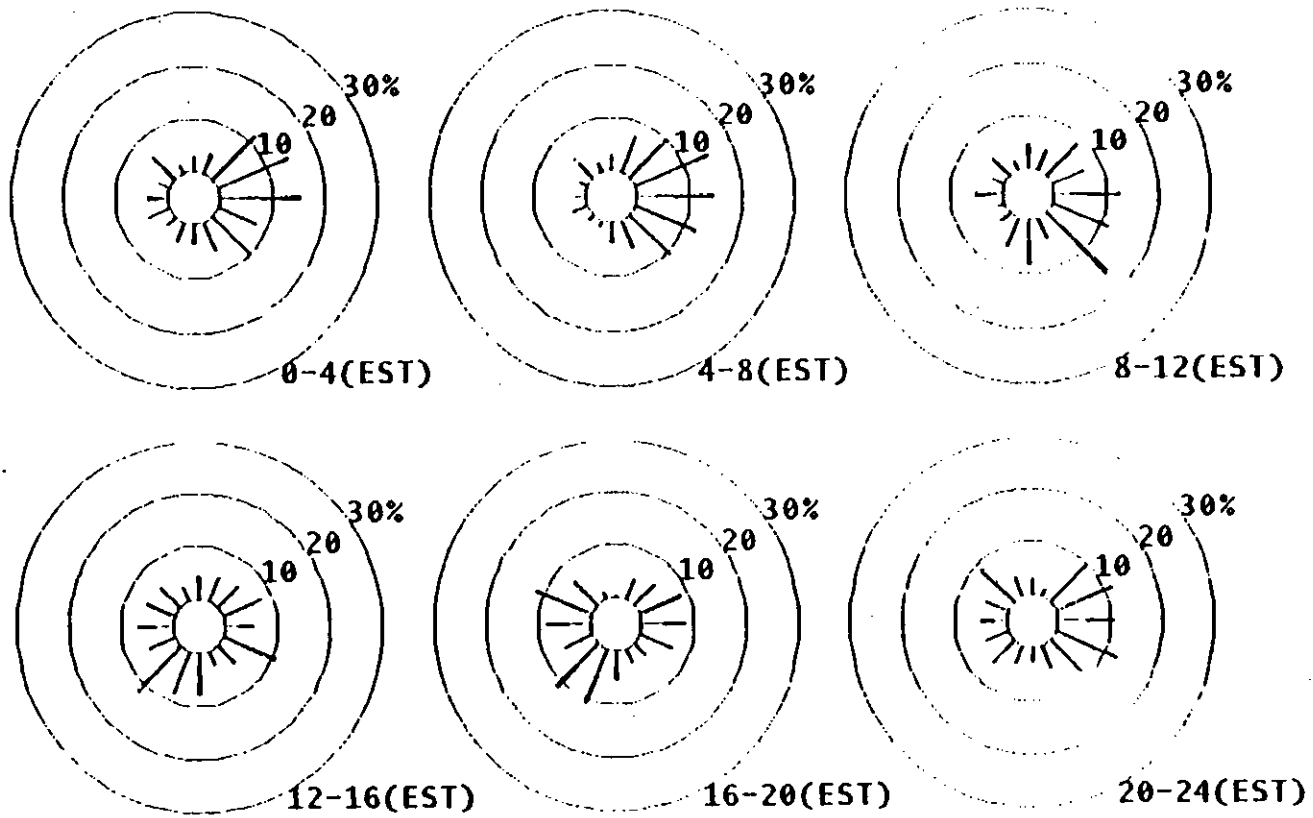
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DIURNAL WIND DIRECTION ROSES



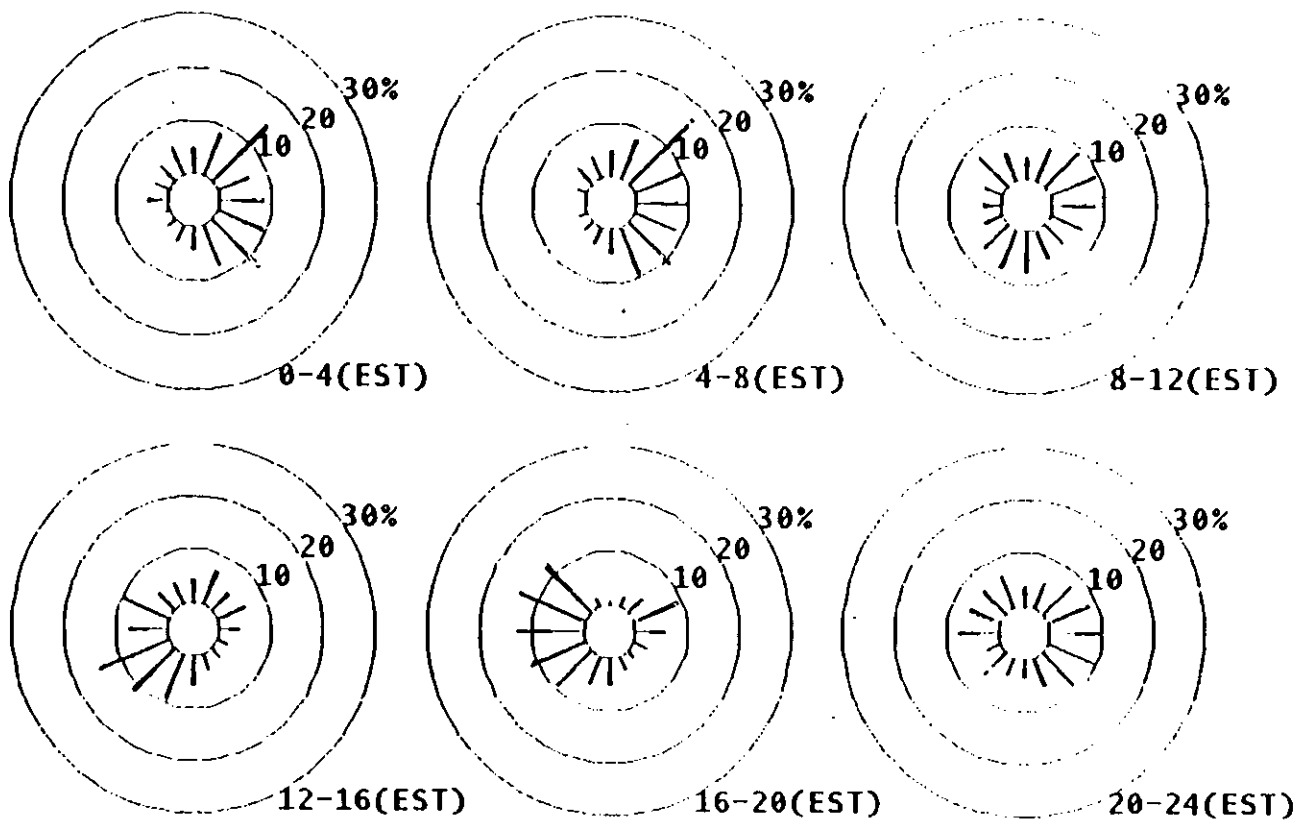
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DIURNAL WIND DIRECTION ROSES



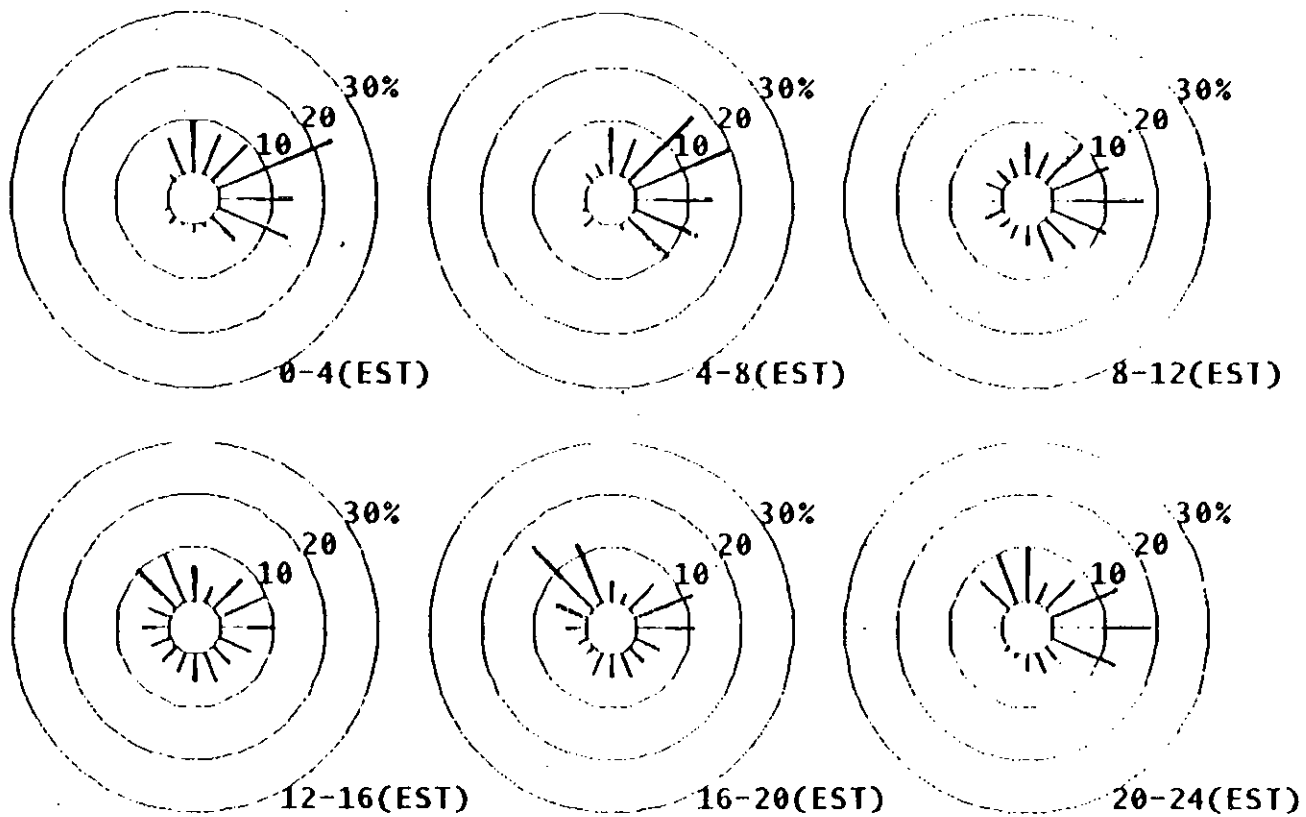
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DIURNAL WIND DIRECTION ROSES



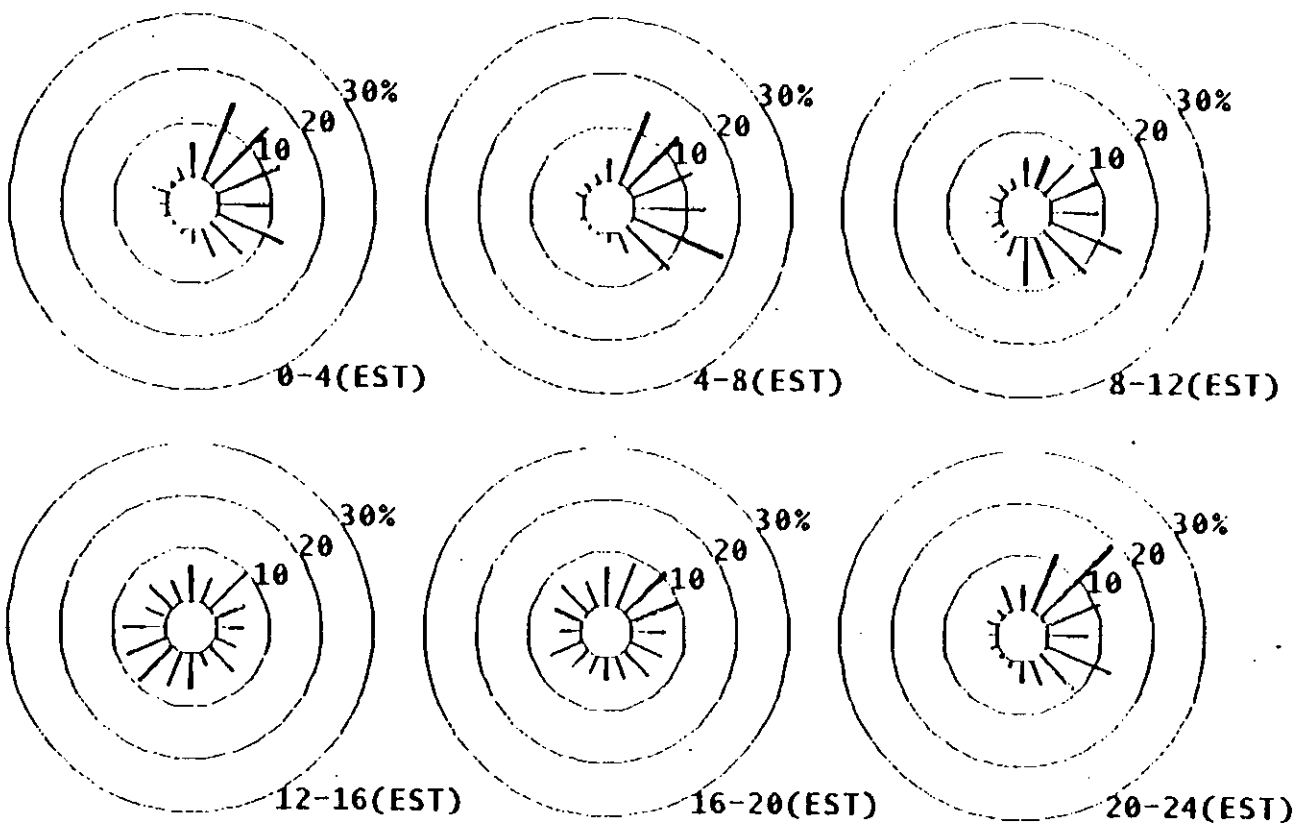
0100/ SITE 01 FROM 04/01/86 TO 06/30/86

DIURNAL WIND DIRECTION ROSES



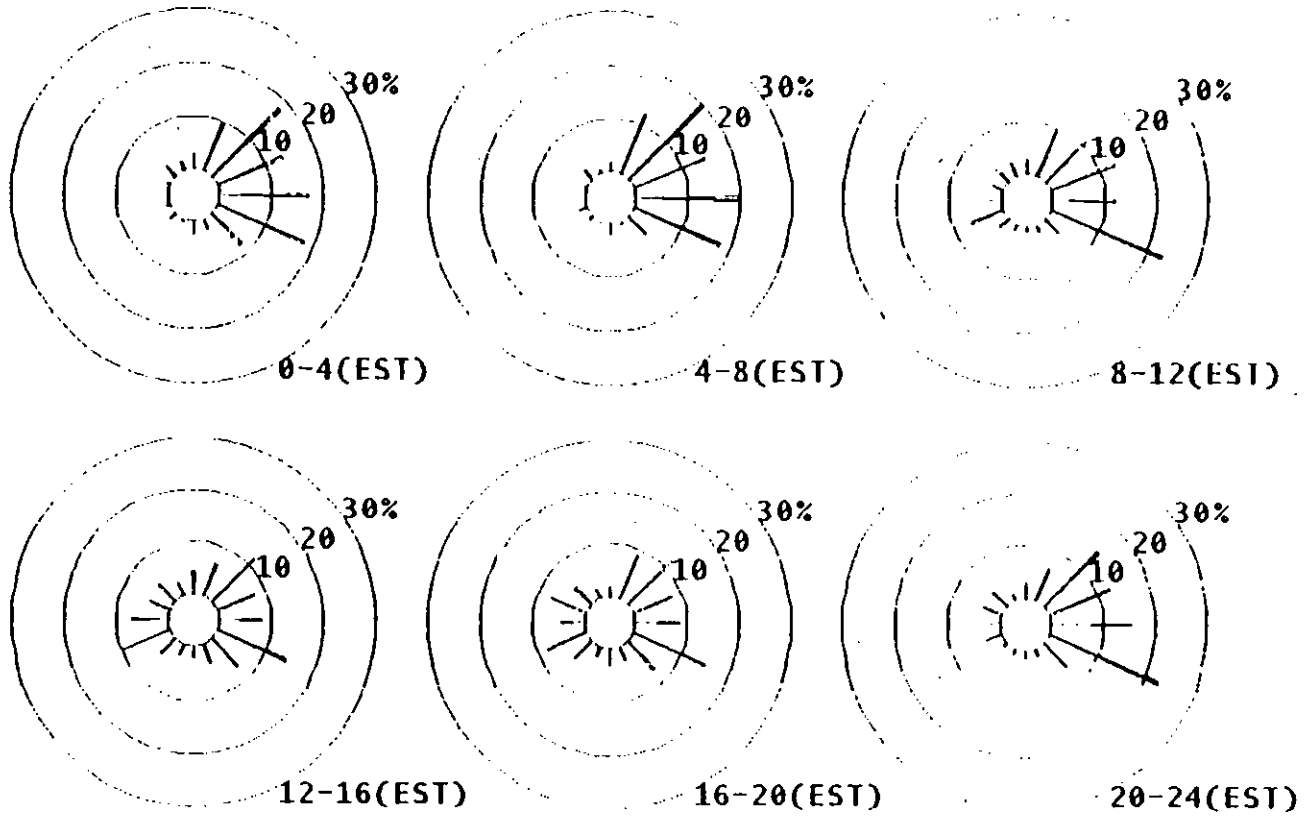
0100/ SITE 01 FROM 07/01/82 TO 09/30/82

DIURNAL WIND DIRECTION ROSES



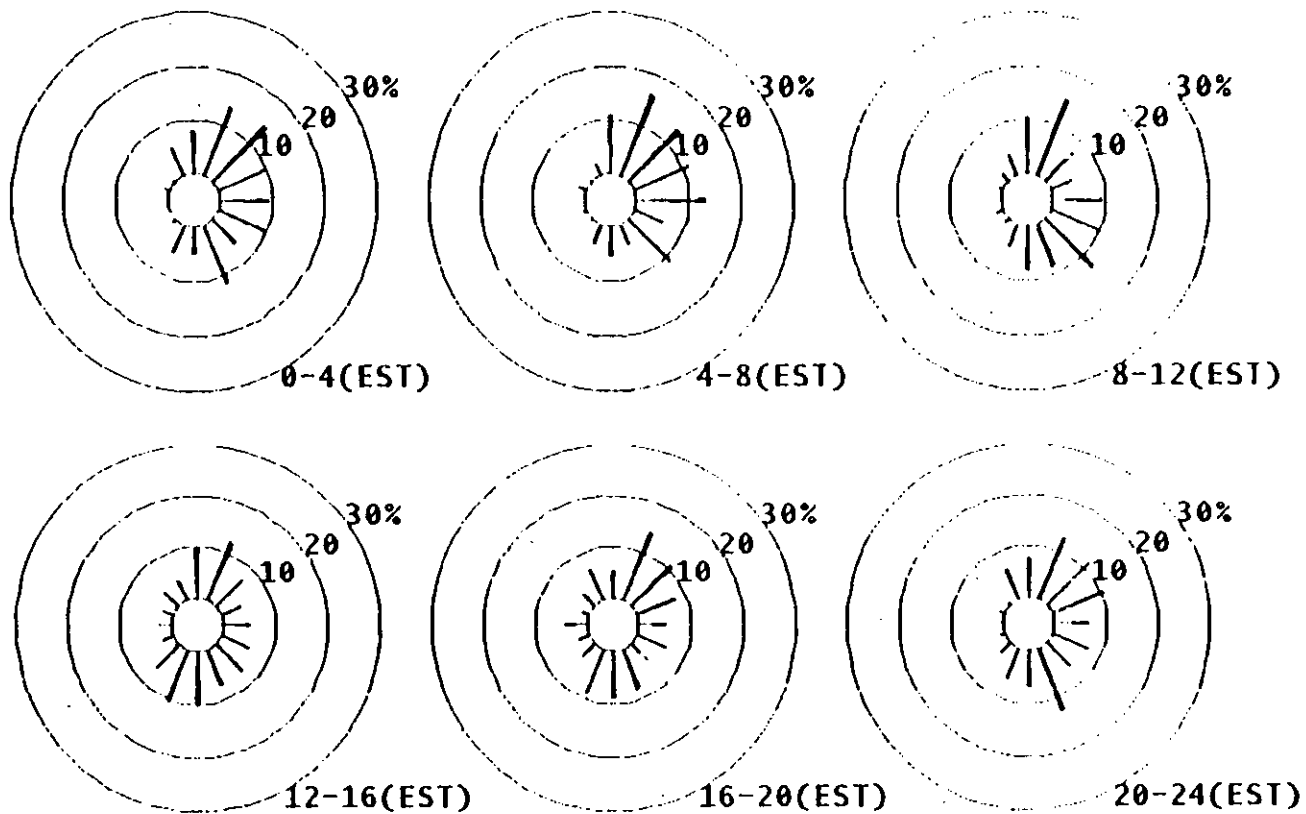
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DIURNAL WIND DIRECTION ROSES



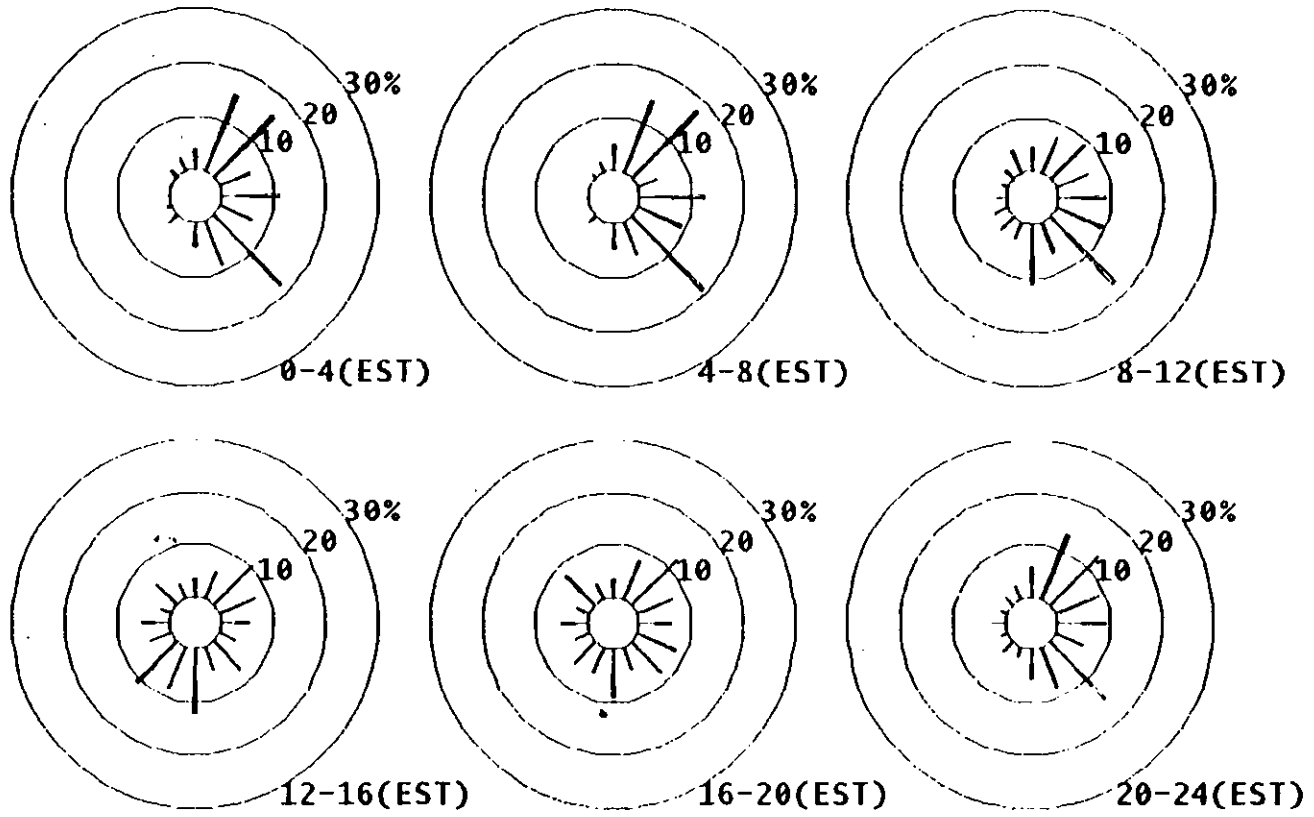
0100/ SITE 01 FROM 07/01/84 TO 09/30/84

DIURNAL WIND DIRECTION ROSES



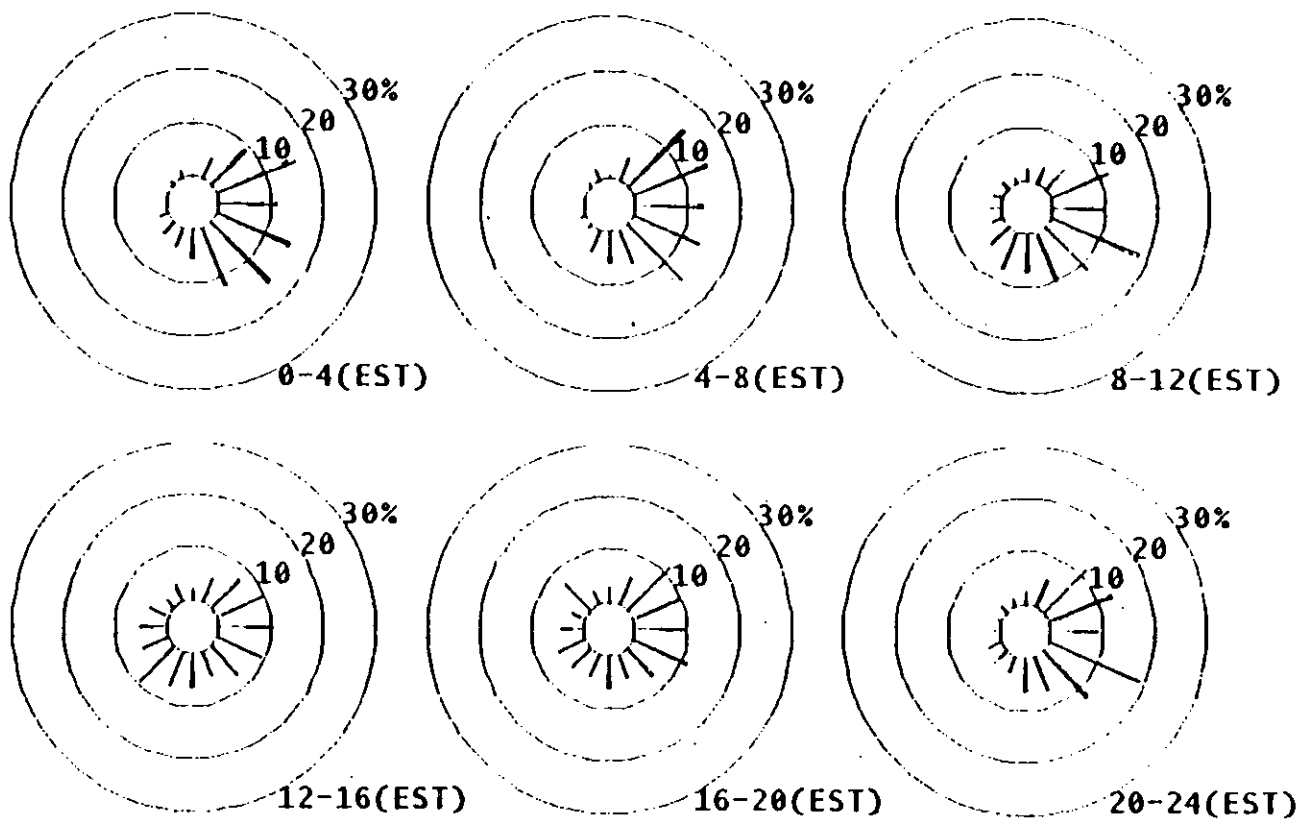
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DIURNAL WIND DIRECTION ROSES



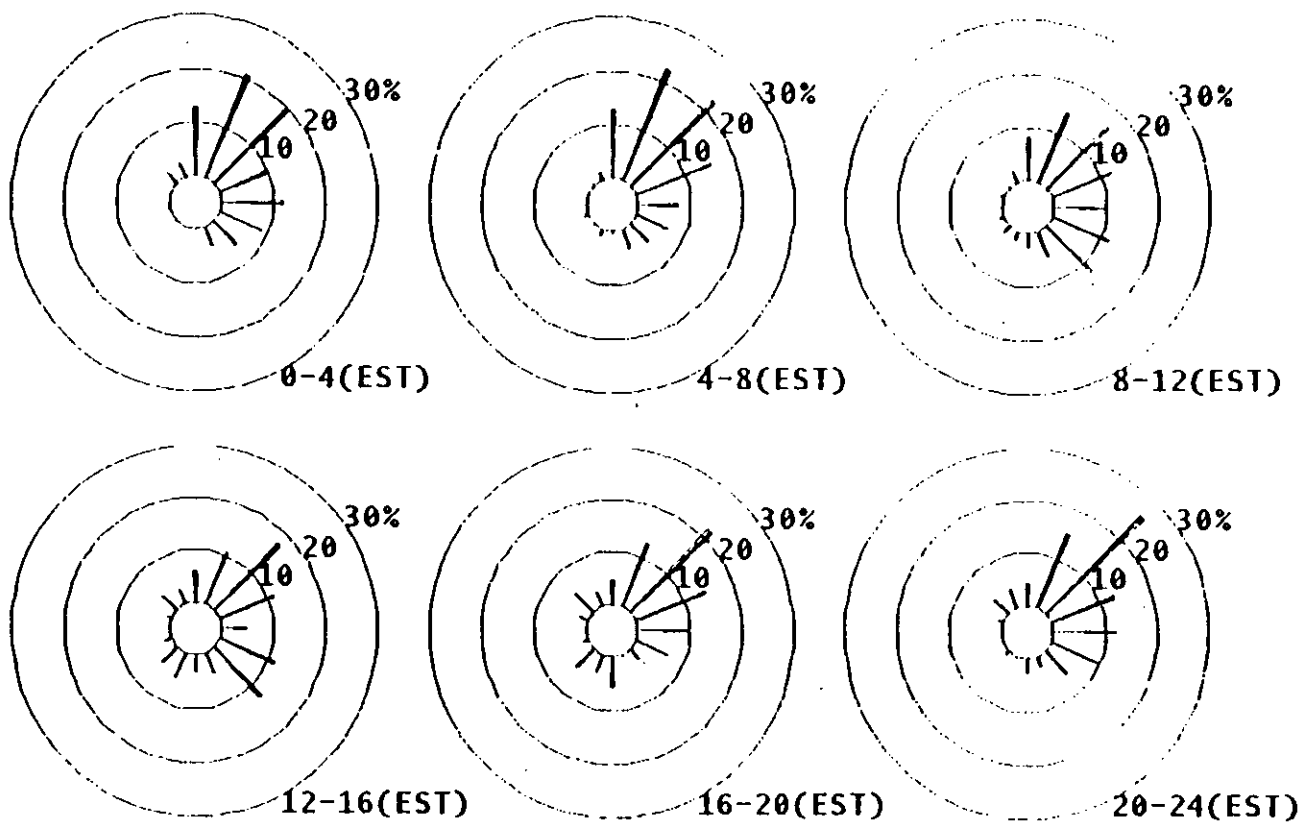
0100/ SITE 01 FROM 07/01/86 TO 09/30/86

DIURNAL WIND DIRECTION ROSES



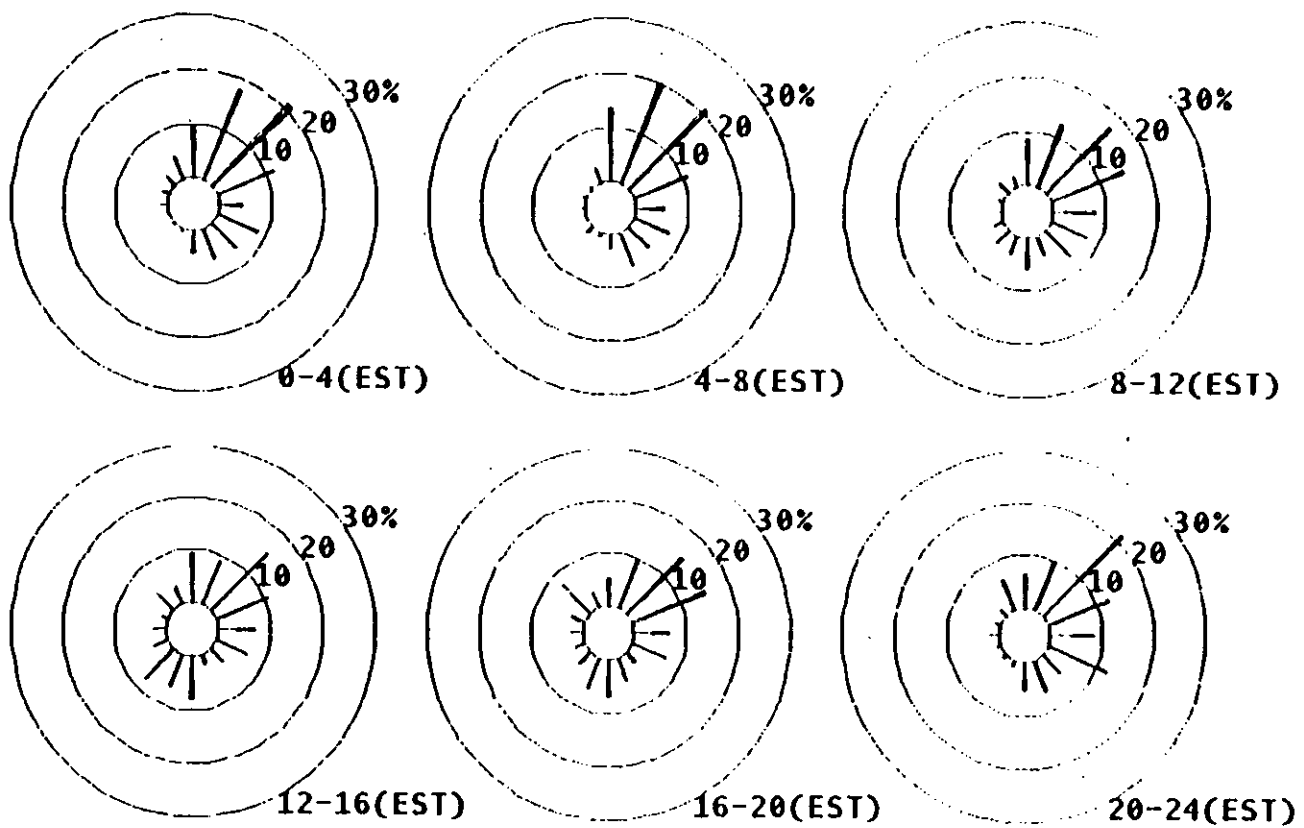
0100/ SITE 01 FROM 10/01/82 TO 12/31/82

DIURNAL WIND DIRECTION ROSES



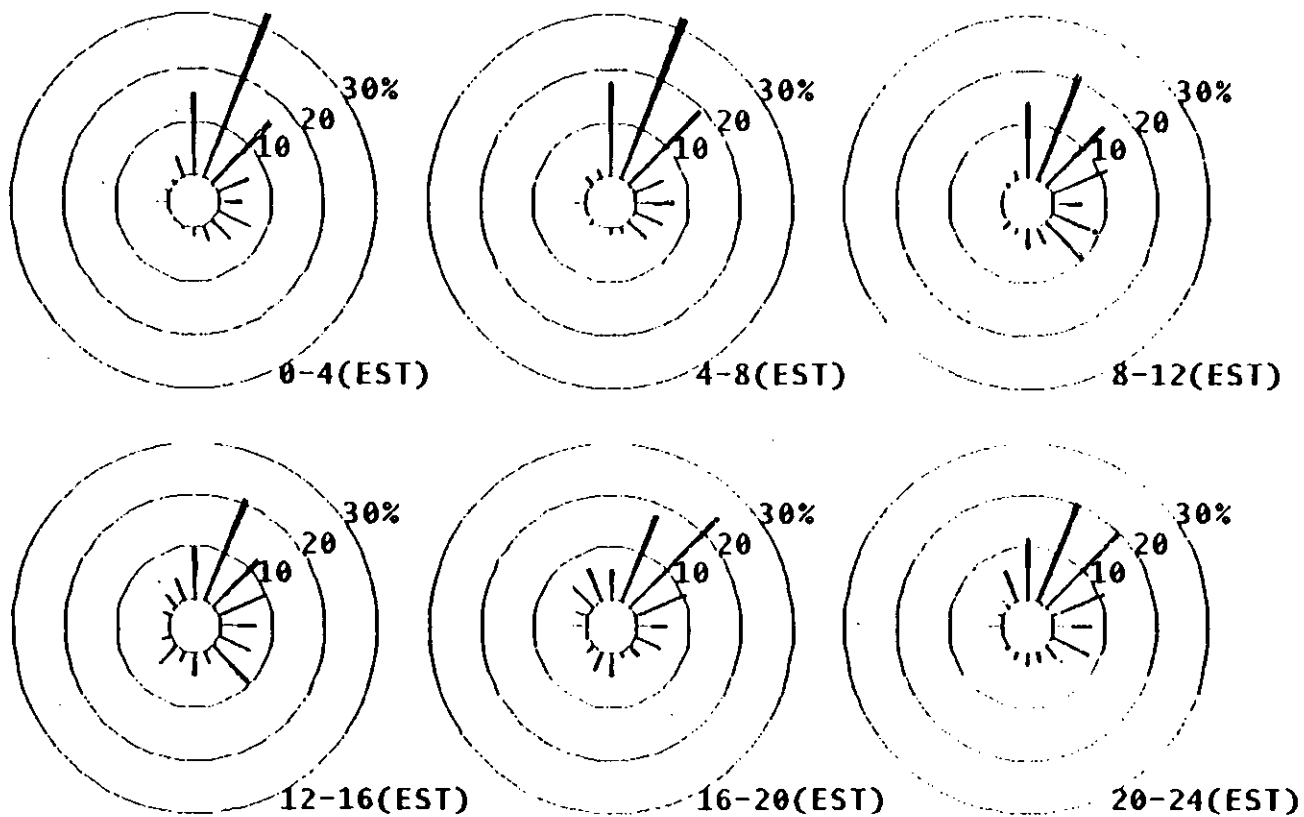
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DIURNAL WIND DIRECTION ROSES



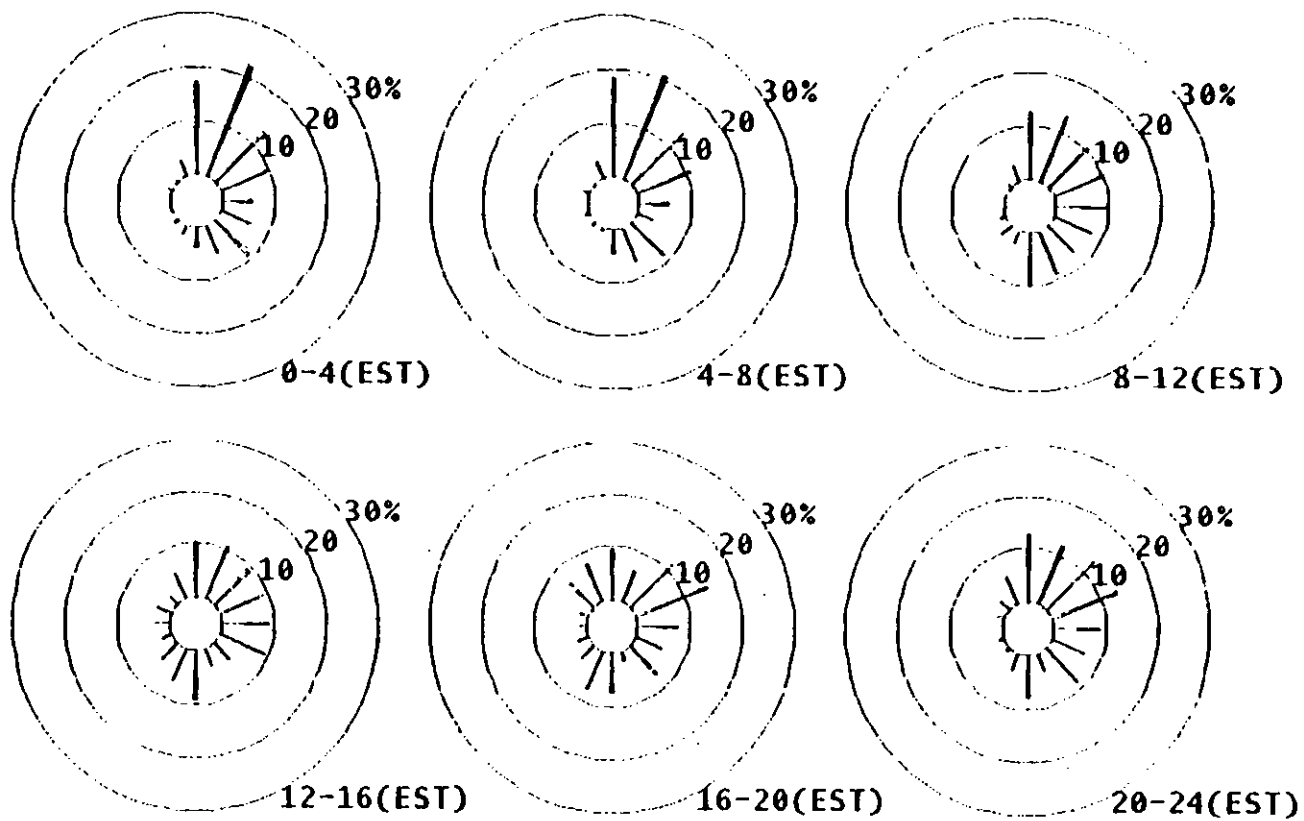
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DIURNAL WIND DIRECTION ROSES



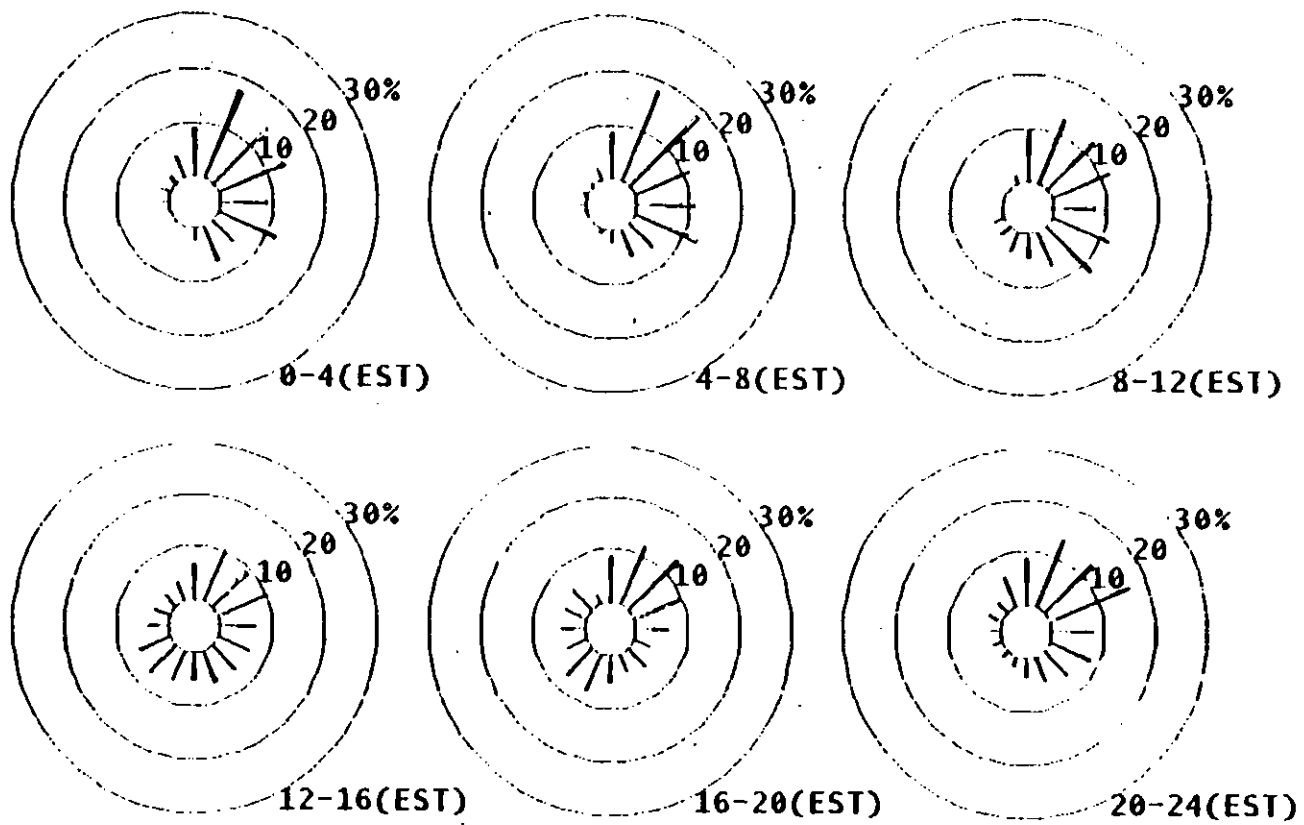
0100/ SITE 01 FROM 10/01/85 TO 12/31/85

DIURNAL WIND DIRECTION ROSES



0100/ SITE 01 FROM 10/01/86 TO 12/31/86

DIURNAL WIND DIRECTION ROSES



ATTACHMENT C

BACT DETERMINATIONS FOR FACILITIES BURNING REFUSE

ATTACHMENT C

LEE COUNTY ENERGY RECOVERY FACILITY
 RECENT BACT DETERMINATIONS FOR FACILITIES BURNING REFUSE (Page 1 of 21)

SOURCE TYPE/COMPANY NAME LOCATION/PERMIT NUMBER DATE OF ISSUE	SOURCE SIZE PROCESS DESCRIPTION	PROPOSED CONTROL TECHNOLOGY	BACT EMISSION LIMITATION DETERMINATION
Refuse Incineration/Energy Resources of Henrico, Inc. Henrico County, VA/50979 12/29/89	Two (2) RDF fired boilers with total capacity of 186.48 MMBtu/hr	Baghouse	PM: 0.0100 gr/dscf @ 12% CO ₂
		Dry Scrubber	SO ₂ : 17.2 lb/hr max 70% reduction HCl: 2.94 lb/hr 70% reduction HF: 0.09 lb/hr 70% reduction HBr: 0.4 lb/hr 70% reduction
		Combustion Controls/Low Excess Air	NOx: 0.4140 lb/MMBtu CO: 38.7 lb/hr
			Pb: 0.03 lb/hr As: 7.9 EE-4 lb/hr Be: 1.6 EE-5 lb/hr Cd: 1.4 EE-3 lb/hr Cr: 5.2 EE-3 lb/hr Ni: 5.0 EE-4 lb/hr Hg: 0.033 lb/hr TOD: 2.37 EE-5 lb/hr TODF: 5.25 EE-5 lb/hr FOD: 1.10 EE-5 lb/hr FODF: 3.50 EE-5 lb/hr BEN: 0.001 lb/hr

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LEE COUNTY ENERGY RECOVERY FACILITY
 RECENT BACT DETERMINATIONS FOR FACILITIES BURNING REFUSE (Page 2 of 21)

SOURCE TYPE/COMPANY NAME LOCATION/PERMIT NUMBER DATE OF ISSUE	SOURCE SIZE PROCESS DESCRIPTION	PROPOSED CONTROL TECHNOLOGY	BACT EMISSION LIMITATION DETERMINATION
Refuse Incineration/Lancaster County Solid Waste Management Conroy Township, PA/36-340-001 02/22/89	Three (3) mass burn boilers with total capacity of 1,200 tpd	Baghouse	PM: 0.012 gr/dscf @ 7% O ₂ PM ₁₀ : 0.01 gr/dscf @ 7% O ₂
		Dry Scrubber Furnace Inj.	SO ₂ : 29 ppmv 3hr avg 30 ppmv 1hr avg 90% reduction HCl: 30 ppmv 1hr avg 90% reduction
		Combustion Control	CO: 50 ppmv 8hr avg 200 ppmv 1hr avg NOx: 300 ppmv daily avg PCDD: 2 ng/cubic meter
Refuse Incineration/Signal Brooklyn, New York, NY	Four (4) mass burn boilers with total capacity of 3,000 tpd	Baghouse	PM ₁₀ : 0.013 gr/dscf @ 12% CO ₂ VE: 10% opacity
		Dry Scrubber	SO ₂ : 75% reduction HF: 90% reduction

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LEE COUNTY ENERGY RECOVERY FACILITY
 RECENT EACT DETERMINATIONS FOR FACILITIES BURNING REFUSE (Page 3 of 21)

SOURCE TYPE/COMPANY NAME LOCATION/PERMIT NUMBER DATE OF ISSUE	SOURCE SIZE PROCESS DESCRIPTION	PROPOSED CONTROL TECHNOLOGY	EACT EMISSION LIMITATION DETERMINATION
Refuse Incineration/Chester Solid Waste Associates Chester, PA/23-340-002 09/23/88	Six (6) mass burn furnace with total capacity of 2,688 tpd (rotary)	Baghouse	PM: 0.015 gr/dscf
		Dry Scrubber	HCL: 30 ppw 90% reduction SO ₂ : 30 ppw 70% reduction
		Combustion Control	CO: 100 ppw NOx: 235 ppw PCDD: 2 ng/cu meter
Refuse Incineration/Ogden- Martin Systems of Alexandria Alexandria, VA/71895 07/26/88	Three (3) MSW furnace with total capacity of 325 tpd	ESP	PM: 0.03 gr/dscf @ 12% CO ₂
		Dry Injection Scrubber	SO ₂ : 34 lb/hr HCL: 61 lb/hr HBr: 7.3 lb/hr HF: 1.7 lb/hr
		Combustion Control	VOC: 0.67 lb/hr NOx: 79.0 lb/hr CO: 68.5 lb/hr PB: 0.53 lb/hr PCDD: 2.0 ng/NM ₃ @ 12% CO ₂ Cd: 3.25 lb/hr Sb: 0.04 lb/hr As: 0.0093 lb/hr Hg: 0.22 lb/hr

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LEE COUNTY ENERGY RECOVERY FACILITY
 RECENT BACT DETERMINATIONS FOR FACILITIES BURNING REFUSE (Page 4 of 21)

SOURCE TYPE/COMPANY NAME LOCATION/PERMIT NUMBER DATE OF ISSUE	SOURCE SIZE PROCESS DESCRIPTION	PROPOSED CONTROL TECHNOLOGY	BACT EMISSION LIMITATION DETERMINATION
Refuse Incineration/Ogden Martin Systems of San Bernardino Ontario, CA/1A87-01 03/29/88	Three (3) mass burn boilers with a total capacity of 1600 tpd	Baghouse	PM: 0.01 gr/dscf @ 12% CO ₂
		Dry Scrubber	SO ₂ : 42 ppm @ 12% CO ₂ 80% reduction
		Dry Scrubber/ Baghouse	Hg: 0.0057 lb/hr each
Refuse Incineration/Signal Environmental Services Concord, NH/EPA-037-121NH03 12/09/87	Two (2) mass burn boilers with a total capacity of 500 tpd	Baghouse	PM: 0.02 gr/dscf @ 12% CO ₂
		Dry Lime Injection System	HCl: 50 ppmdv @ 7% O ₂ or 90% reduction SO ₂ : 21 lb/hr max
		Combustion Controls	NO _x : 0.61 lb/MMBtu CO: 0.11 lb/MMBtu 4 day average 0.25 lb/MMBtu 8 hour average Hb: 0.0034 lb/MMBtu

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LEE COUNTY ENERGY RECOVERY FACILITY
 RECENT BACT DETERMINATIONS FOR FACILITIES BURNING REFUSE (Page 5 of 21)

SOURCE TYPE/COMPANY NAME LOCATION/PERMIT NUMBER DATE OF ISSUE	SOURCE SIZE PROCESS DESCRIPTION	PROPOSED CONTROL TECHNOLOGY	BACT EMISSION LIMITATION DETERMINATION
Refuse Incineration/City & County of Honolulu/Oahu, HI/HI84-01 11/19/87	Two (2) RDF fired furnaces having a total capacity of 1700 tpd	ESP	PM: 0.015 gr/dscf @ 12% CO ₂
		Dry Scrubber	SO ₂ : 30 ppmdv @ 12% CO ₂ 84% reduction HF: 0.036 lb/ton
		Combustion Control	NO _x : 260 ppmdv @ 12% CO ₂ CO: 377 ppmdv @ 12% CO ₂ VOC: 21 ppmdv @ 12% CO ₂ Fb: 0.0028 lb/ton Hg: 0.0022 lb/ton Be: 1.3 x 10 ⁻⁵ lb/ton
Refuse Incineration/Huntsville Solid Waste Authority Huntsville, AL/7-09-1104-X001 thru X006 10/06/87	Two (2) RDF furnaces with total capacity of 258.8 MMBTU/hr	Baghouse	PM: 0.015 gr/dscf @ 12% CO ₂
		Dry Scrubber	SO ₂ : 50 ppm @ 7% O ₂ 70% reduction HCl: 90% reduction HF: 90% reduction H ₂ SO ₄ : 70% reduction
		Combustion Design	NO _x : 0.46 lb/MMBTU 59.2 lb/hr CO: 50 ppm @ 12% CO ₂ 7.6 lb/hr Hg: 320 GED

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LEE COUNTY ENERGY RECOVERY FACILITY
 RECENT BACT DETERMINATIONS FOR FACILITIES BURNING REFUSE (Page 6 of 21)

SOURCE TYPE/COMPANY NAME LOCATION/PERMIT NUMBER DATE OF ISSUE	SOURCE SIZE PROCESS DESCRIPTION	PROPOSED CONTROL TECHNOLOGY	BACT EMISSION LIMITATION DETERMINATION
Incineration/Kent Co. Department of Public Works Grand Rapids, MI/375-87 09/15/87	Two (2) solid waste furnaces with total capacity of 250 MMBTU/hr (625 tpd)	Baghouse	PM: 0.01 gr/dscf @ 12% CO ₂
		Dry Scrubber	SO ₂ : 50 ppm or 75% reduction HCl: 50 ppm or 90% reduction F1: 2.5 MG/DSCM SO ₃ : 39 MG/DSCM
		Combustion Controls	NOx: 400 ppw 1 hr avg 350 ppw 3 hr avg CO: 200 ppw 1 hr avg 50 ppw 4 hr avg VOC: 8.3 MG/DSCM Pb: 0.87 MG/DSCM Hg: 0.61 MG/DSCM Ar: 6.2 UG/DSCM Be: 0.16 UG/DSCM Cd: 37.0 UG/DSCM Cr: 4.2 UG/DSCM PCDD: 3.0 NG/DSCM VE: 10% opacity

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LEE COUNTY ENERGY RECOVERY FACILITY
 RECENT BACT DETERMINATIONS FOR FACILITIES BURNING REFUSE (Page 7 of 21)

SOURCE TYPE/COMPANY NAME LOCATION/PERMIT NUMBER DATE OF ISSUE	SOURCE SIZE PROCESS DESCRIPTION	PROPOSED CONTROL TECHNOLOGY	BACT EMISSION LIMITATION DETERMINATION
Refuse Incineration/Dravo Energy Resources Montgomery, BA 46-340-002 07/23/87	Mass burn waterwall refuse fired boilers with a total capacity of 1200 tpd	ESP	PM: 0.0150 gr/dscf 99% removal
		Spray Dryer	HCl: 30.0 ppm 90% reduction SO ₂ : 30.0 ppm 70% reduction NO _x : 300.0 ppmw CO: 100.0 ppmw PCDD: 2.0 ng/Nm ³
Refuse Incineration/Vicon Recovery Systems Manchester NH/EPA-036-121NH03 05/22/87	Four (4) mass burn furnaces with a total capacity of 560 tpd	Baghouse	PM: 0.035 gr/dscf @ 12% CO ₂
		Dry Lime Injection System	SO ₂ : 10.25 lb/hr (max) 65% removal HCl: 3.39 lb/hr
		Combustion Controls	NO _x : 17.5 lb/hr (max) CO: 5.73 lb/hr (max) Pb: 1.77 lb/hr (max) TCDD: 1.6 x 10 ⁻⁷ lb/hr TCDF: 5 x 10 ⁻⁶ lb/hr

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LEE COUNTY ENERGY RECOVERY FACILITY
 RECENT BACT DETERMINATIONS FOR FACILITIES BURNING REFUSE (Page 8 of 21)

SOURCE TYPE/COMPANY NAME LOCATION/PERMIT NUMBER DATE OF ISSUE	SOURCE SIZE PROCESS DESCRIPTION	PROPOSED CONTROL TECHNOLOGY	BACT EMISSION LIMITATION DETERMINATION
Refuse Incineration/South Broward County Resource Recovery/ Broward County/PSD-FL-105 05/15/87	Three (3) mass burn waterwall furnaces with a total capacity of 2590 tpd	ESP	PM: 0.015 gr/dscf @ 12% CO ₂
		Scrubber	SO ₂ : 0.31 lb/MBtu 65% reduction HF: 0.004 lb/MBtu 90% reduction
		Furnace Operation	NO _x : 0.56 lb/MBtu CO: 0.09 lb/MBtu Fb: 0.0015 lb/MBtu Be: 9.3 x 10 ⁻⁷ lb/MBtu Hg: 7.5 x 10 ⁻⁴ lb/MBtu VE: 15% opacity
Refuse Incineration/Dravo Energy Resources Montgomery, EA 46-340-002 07/23/87	Mass burn waterwall refuse fired boilers with a total capacity of 1200 tpd	ESP	PM: 0.0150 gr/dscf 99% removal
		Spray Dryer	HCl: 30.0 ppm 90% reduction SO ₂ : 30.0 ppm 70% reduction NO _x : 300.0 ppm CO: 100.0 ppm PCDD: 2.0 ng/Nm ³

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LEE COUNTY ENERGY RECOVERY FACILITY
 RECENT BACT DETERMINATIONS FOR FACILITIES BURNING REFUSE (Page 9 of 21)

SOURCE TYPE/COMPANY NAME LOCATION/PERMIT NUMBER DATE OF ISSUE	SOURCE SIZE PROCESS DESCRIPTION	PROPOSED CONTROL TECHNOLOGY	BACT EMISSION LIMITATION DETERMINATION
Refuse Incineration/Vicon Recovery Systems Manchester NH/EPA-036-121NH03 05/22/87	Four (4) mass burn furnaces with a total capacity of 560 tpd	Baghouse	PM: 0.035 gr/dscf @ 12% O ₂
		Dry Lime Injection System	SO ₂ : 10.25 lb/hr (max) 65% removal HCl: 3.39 lb/hr
		Combustion Controls	NO _x : 17.5 lb/hr (max) CO: 5.73 lb/hr (max) Hb: 1.77 lb/hr (max) TCDD: 1.6 x 10 ⁻⁷ lb/hr TCDF: 5 x 10 ⁻⁶ lb/hr
Refuse Incineration/York County Solid Waste and Refuse Authority York County, EA/67-340-001 05/13/87	Mass burn rotary combustor with a total capacity of 1344 tpd	Baghouse	PM: 0.015 gr/dscf @ 7% O ₂ VE: 10% opacity
		Spray Dryer	HCl: 30.0 ppw 90% reduction SO ₂ : 30.0 ppw 70% reduction CO: 100.0 ppw PCDD: 2.0 ng/Nm ³ @ 7% O ₂ Dry

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LEE COUNTY ENERGY RECOVERY FACILITY
 RECENT BACT DETERMINATIONS FOR FACILITIES BURNING REFUSE (Page 10 of 21)

SOURCE TYPE/COMPANY NAME LOCATION/PERMIT NUMBER DATE OF ISSUE	SOURCE SIZE PROCESS DESCRIPTION	PROPOSED CONTROL TECHNOLOGY	BACT EMISSION LIMITATION DETERMINATION
Refuse Incineration/ERIE Energy Resources, Inc. Erie, PA/ 25-340-001 02/05/87	RDF with a total capacity 710 tpd	Baghouse	PM: 0.015 gr/dscf @ 7% O ₂ Dry VE: 10% opacity
		Limestone Injection	HCl: 30.0 ppmv 90% reduction SO ₂ : 50.0 ppmv 70% reduction CO: 32.0 lb/hg PCDD: 2.0 ng/Nm ³ @ 7% O ₂ Dry
Refuse Incineration/Hennepin Energy Resource Co. Minneapolis, MN/2125 01/27/87	Two (2) mass burn water wall refuse fired boilers with a total capacity of 1212 tpd	Baghouse	PM: 0.02 gr/dscf @ 12% CO ₂
		Spray Dryer	SO ₂ : 0.55 lb/ton (100 ton/yr limit) HCl: 50 ppmv @ 12% CO ₂ or 90% reduction
		Combustion Control	NO _x : 250 ppmv @ 12% CO ₂ CO: 100 ppmv @ 12% CO ₂ Fb: 0.007 lb/ton Hg: 0.002 lb/ton VOC: 0.12 lb/ton (40 ton/yr limit) PCDD: 3.0 ng/dscm @ 12% CO ₂

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LEE COUNTY ENERGY RECOVERY FACILITY
 RECENT BACT DETERMINATIONS FOR FACILITIES BURNING REFUSE (Page 11 of 21)

SOURCE TYPE/COMPANY NAME LOCATION/PERMIT NUMBER DATE OF ISSUE	SOURCE SIZE PROCESS DESCRIPTION	PROPOSED CONTROL TECHNOLOGY	BACT EMISSION LIMITATION DETERMINATION
Refuse Incineration/1-95 Energy Resource Recovery Facility/ Fairfax, VA/71960 01/12/87	Four (4) mass burn units having a total capacity of 3000 tpd	ESP	PM: 0.010 gr/dscf @ 12% CO ₂ 7.500 lb/hr 99.0% removal
		Partial control by ESP	Hg: 0.33 lb/hr Pb: 1.7 lb/hr 99.0% removal Be: 2.0 EE-4 lb/hr Cd: 4.70 EE-2 lb/hr Sb: 0.1400 lb/hr As: 7.3 EE-3 lb/hr
		Acid Gas Control Device	HCl: 28.53 lb/hr 90% reduction SO ₂ : 44.4 lb/hr 70% reduction
		Combustion Controls	NO _x : 151.3 lb/hr CO: 158.1 lb/hr VOC: 1.70 lb/hr TCDD: 2.3 EE-6 lb/hr

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LEE COUNTY ENERGY RECOVERY FACILITY
 RECENT BACT DETERMINATIONS FOR FACILITIES BURNING REFUSE (Page 12 of 21)

SOURCE TYPE/COMPANY NAME LOCATION/PERMIT NUMBER DATE OF ISSUE	SOURCE SIZE PROCESS DESCRIPTION	PROPOSED CONTROL TECHNOLOGY	BACT EMISSION LIMITATION DETERMINATION
Refuse Incineration/American REF-Fuel of Hempstead, NY 11/06/86	Three (3) mass burn waterwall refuse fired boilers with a total capacity of 2250 tpd	Baghouse	PM: 0.015 gr/dscf @ 12% CO ₂
		Spray Dryer	SO ₂ : 70% reduction HCl: 50 ppmv @ 12% CO ₂ or 90% reduction
		Furnace Design	NO _x : 255 ppmv @ 12% CO ₂ CO: 100 ppmv @ 12% CO ₂ VOC: 36 ppmv @ 12% CO ₂
Refuse Incineration/Vicon Recovery Systems Rutland, VT 09/11/86	Two (2) MSW furnaces with total capacity of 240 tpd	ESP	PM: 0.01 gr/dscf @ 12% CO ₂
		Packed Tower Adsorber/ Scrubber	SO ₂ : 12 lb/hr HCl: 9.4 lb/hr HF: 0.3 lb/hr
		Combustion Controls	CO: 300 ppm @ 12% CO ₂ 1 hr avg 50 ppm @ 12% CO ₂ 24 hr avg NO _x : 36 lb/hr PCDD: 6.3 lb/hr PB: 0.4 lb/hr Hg: 0.0045 lb/hr

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LEE COUNTY ENERGY RECOVERY FACILITY
 RECENT BACT DETERMINATIONS FOR FACILITIES BURNING REFUSE (Page 13 of 21)

SOURCE TYPE/COMPANY NAME LOCATION/PERMIT NUMBER DATE OF ISSUE	SOURCE SIZE PROCESS DESCRIPTION	PROPOSED CONTROL TECHNOLOGY	BACT EMISSION LIMITATION DETERMINATION
Refuse Incineration/Stanislaus Waste Energy Co. Stanislaus County, CA/SJ 86-03 08/11/86	Two (2) mass burn waterwall with a total capacity of 800 tpd	Baghouse	PM: 0.01 gr/dscf @ 12% CO ₂ , 99% removal Hg: 0.083 lb/hr
		Dry Scrubber	SO ₂ : 42.0 ppm @ 12% CO ₂ , 80% removal
		Ammonia Injection	NO _x : 175.0 ppm @ 12% CO ₂ , 40% removal
		Combustion Control	CO: 400.0 ppm @ 12% CO ₂
Refuse Incineration/Ogden Martin Systems of Indianapolis Indianapolis, IN/11065 03/24/86	Three (3) mass burn waterwall furnaces with a capacity of 2178 tpd	Baghouse	PM: 0.010 gr/dscf @ 12% CO ₂ subject to LAER not BACT VE: 10% opacity Fb: 1.0 EE-3 gr/dscf @ 12% CO ₂
		Dry Scrubber/ Baghouse	SO ₂ : Subject to LAER not BACT 80% removal HCl: 80% removal
		Combustion Control	NO _x : 272.0 ppm @ 12% CO ₂ CO: 135.0 ppm @ 12% CO ₂ VOC: 3.3 lb/hr

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LEE COUNTY ENERGY RECOVERY FACILITY
 RECENT BACT DETERMINATIONS FOR FACILITIES BURNING REFUSE (Page 14 of 21)

SOURCE TYPE/COMPANY NAME LOCATION/PERMIT NUMBER DATE OF ISSUE	SOURCE SIZE PROCESS DESCRIPTION	PROPOSED CONTROL TECHNOLOGY	BACT EMISSION LIMITATION DETERMINATION
Refuse Incineration/Jackson County Board of Public Works Jackson, MI/451-85 03/18/86	Two (2) mass burn boilers with a total capacity of 400 tpd	Baghouse	PM: 0.015 gr/dscf @ 12% CO ₂
		Dry Scrubber	SO ₂ : 86 ppmv @ 12% CO ₂ or 70% reduction
			HCl: 90% reduction
			NO _x : 311 ppmv @ 12% CO ₂
			CO: 113 ppmv @ 12% CO ₂
			Cd: 63 ug/dscm @ 12% CO ₂
			Cr: 47 ug/dscm @ 12% CO ₂
			As: 12 ug/dscm @ 12% CO ₂
			PCDD: 0.52 ug/dscm @ 12% CO ₂
			PCDF: 0.5 ug/dscm @ 12% CO ₂
Refuse Incineration/Babylon Resource Recovery Facility 01/31/86	Two (2) mass burn furnaces having a total capacity of 750 tpd	Baghouse	PM: 0.02 gr/dscf @ 12% CO ₂
		Dry Scrubber	SO ₂ : 70% reduction
			HCl: 50 ppmv @ 12% CO ₂ or 90% reduction
Combustion Control	NO _x : 6.6 lb/ton		
	CO: 99.8% minimum combustion efficiency		

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LEE COUNTY ENERGY RECOVERY FACILITY
 RECENT BACT DETERMINATIONS FOR FACILITIES BURNING REFUSE (Page 15 of 21)

SOURCE TYPE/COMPANY NAME LOCATION/PERMIT NUMBER DATE OF ISSUE	SOURCE SIZE PROCESS DESCRIPTION	PROPOSED CONTROL TECHNOLOGY	BACT EMISSION LIMITATION DETERMINATION
Refuse Incineration/American Ref-Fuel of Essex County Newark, NJ 12/11/85	Three (3) mass burn waterwall furnaces with a total capacity of 2274 tpd	ESP	PM: 0.015 gr/dscf @ 7% O ₂ Subject to LAER not BACT VE: 20% opacity
		Dry Scrubber/ ESP	SO ₂ : 100.0 ppmv @ 7% O ₂ HCl: 50 ppmv @ 7% O ₂ 90% control HF: 0.820 lb/hr Hb: 0.50 lb/hr Hg: 0.053 lb/hr Be: 2.5 EE-4 lb/hr As: 5.10 EE-3 lb/hr Cd: 0.043 lb/hr Cr: 0.012 lb/hr Ni: 3.3 EE-3 lb/hr
		Aux Burners #2 Oil	CO: 126.0 lb/hr
		Automatic Air/ Fuel Control	NMC: 6.3 lb/hr BPH: 0.29 lb/hr NO _x : 95.0 lb/hr
Refuse Incineration/City of Long Beach Long Beach, CA/IA 83-01 10/23/85	Three (3) mass burn waterwall furnaces with a total capacity of 1360 tpd	Baghouse/ Dry Scrubber	SO ₂ : 26.0 ppm @ 12% CO ₂ , 80% removal Hb: 0.080 lb/hr Hg: 0.130 lb/hr
		Dry Scrubber	HF: 3.3 lb/hr 90% removal

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LEE COUNTY ENERGY RECOVERY FACILITY
 RECENT BACT DETERMINATIONS FOR FACILITIES BURNING REFUSE (Page 16 of 21)

SOURCE TYPE/COMPANY NAME LOCATION/PERMIT NUMBER DATE OF ISSUE	SOURCE SIZE PROCESS DESCRIPTION	PROPOSED CONTROL TECHNOLOGY	BACT EMISSION LIMITATION DETERMINATION
Refuse Incineration/Katy Seghers Clearfield, UT 02/24/84	500 tpd Incinerator & Waste Heat Boiler	ESP	PM: 0.025 gr/dscf @ 12% CO ₂ 98.0% removal VE: 20% Opacity F: 1.1 lb/hr Hg: 0.12 lb/hr Hb: 0.22 lb/hr
		Line Scrubber/ Injection	SO ₂ : 22.4 lb/hr 50% removal HCl: 31.8 lb/hr 50% removal
		Combustion Control	NO _x : 29.9 lb/hr CO: 35.5 lb/hr
Refuse Incineration/HMR Wallace, New Castle, DE AFC 84/633-636 01/01/84	Five (5) furnaces with total capacity of 600 tpd	ESP	PM: 0.05 gr/dscf VE: 20% opacity
		Combustion Control	CO: 50 ppm

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LEE COUNTY ENERGY RECOVERY FACILITY
 RECENT BACT DETERMINATIONS FOR FACILITIES BURNING REFUSE (Page 17 of 21)

SOURCE TYPE/COMPANY NAME LOCATION/PERMIT NUMBER DATE OF ISSUE	SOURCE SIZE PROCESS DESCRIPTION	PROPOSED CONTROL TECHNOLOGY	BACT EMISSION LIMITATION DETERMINATION
Refuse Incineration/Trans Energy Brooks, OR 24-5398 12/19/83 Scrubber	2 Incinerators, 312 tpd total	Baghouse or ESP	PM: 0.03 gr/dscf @ 12% CO ₂ VE: 10% Opacity HCl: 23.0 lb/hr 80% removal
		Equipment Design & Operation	NO _x : 94.0 lb/hr SO ₂ : 73.0 lb/hr CO: 55.0 lb/hr Hg: 0.17 lb/hr VOC: 3.1 lb/hr Pb: 0.52 lb/hr F: 1.6 lb/hr
Refuse Incineration/Dutchess Resource Recovery Poughkeepsie, NY/134601-0024 10/14/83	Waterwall combustion 200 tpd total	Baghouse	PM: 0.015 gr/dscf 99.5% removal
		Low S Fuel	SO ₂ : 25.0 lb/hr
		Lime Coating for Baghouse	HCl: 33.0 lb/hr, 80% removal
		Proper Boiler Design	NO _x : 25.0 lb/hr
		Good Combustion Control	CO: 13.0 lb/hr

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LEE COUNTY ENERGY RECOVERY FACILITY
 RECENT BACT DETERMINATIONS FOR FACILITIES BURNING REFUSE (Page 18 of 21)

SOURCE TYPE/COMPANY NAME LOCATION/PERMIT NUMBER DATE OF ISSUE	SOURCE SIZE PROCESS DESCRIPTION	PROPOSED CONTROL TECHNOLOGY	BACT EMISSION LIMITATION DETERMINATION
Refuse Incineration/NESAC North Andover, MA/029-121MA16 05/27/82	2 new mass burn waterwall refuse fired boilers with a total capacity of 1500 tpd	ESP Low S Fuel Incinerator Design	PM: 0.05 gr/dscf @ 12% CO ₂ SO ₂ : 0.34 lb/MMBTU NO _x : 0.32 lb/MMBTU CO: 0.07 lb/MMBTU 98% efficiency SO ₂ : 0.02 lb/MMBTU
Refuse Incineration/McKay Bay Tampa, FL PSD-FL-086 07/02/82	4 new refuse fired mass burn furnaces with a total capacity of 1000 tpd	ESP designed to comply with LAER Low S Fuel Combustion Technique	PM: Subject to LAER not BACT 99.0% efficiency VE: Continuous opacity monitor Be: 5.0 gr/day Hg: 0.6 lb/hr Fb: 3.1 lb/hr SO ₂ : 170 lb/hr NO _x : 300 lb/hr VOC: 9.0 lb/hr F: 6.0 lb/hr

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LEE COUNTY ENERGY RECOVERY FACILITY
 RECENT BACT DETERMINATIONS FOR FACILITIES BURNING REFUSE (Page 19 of 21)

SOURCE TYPE/COMPANY NAME LOCATION/PERMIT NUMBER DATE OF ISSUE	SOURCE SIZE PROCESS DESCRIPTION	PROPOSED CONTROL TECHNOLOGY	BACT EMISSION LIMITATION DETERMINATION
Refuse Incineration/Energy Answers Corp. SEMASS Project Rochester, MA/025-12MA14 03/15/82	3 new waterwall boilers rated at 600 tpd each firing refuse derived fuel	3 stage ESP with overall PM collection efficiency of 96%	PM: 0.05 gr/tscf @ 12% CO ₂
		Dry Scrubbers	SO ₂ : 0.34 lb/MMBTU
		Boiler Design	NO _x : 0.5 lb/MMBTU
Refuse Incinerator/Westchester County, NY 02/22/82	New mass burn waterwall refuse fired boilers with a total capacity of 2250 tpd	ESP	PM: 0.03 gr/tscf @ 12% CO ₂ 98.5% efficiency
			Pb: 0.03 gr/tscf @ 12% CO ₂ 98.5% removal
			Hg: 0.03 gr/tscf @ 12% CO ₂ 98.5% removal
			Be: 0.03 gr/tscf @ 12% CO ₂ 98.5% removal
		Design, high excess air, good combustion	CO: 0.62 lb/ton
	Design, proper operation	NO _x : 3.0 lb/ton	

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LEE COUNTY ENERGY RECOVERY FACILITY
 RECENT BACT DETERMINATIONS FOR FACILITIES BURNING REFUSE (Page 20 of 21)

SOURCE TYPE/COMPANY NAME LOCATION/PERMIT NUMBER DATE OF ISSUE	SOURCE SIZE PROCESS DESCRIPTION	PROPOSED CONTROL TECHNOLOGY	BACT EMISSION LIMITATION DETERMINATION
Refuse Incineration/N.E. Maryland Waste Disposal Authority Baltimore, MD/81MD01 09/01/81	3 waterwall incinerators 2010 tpd total	ESP	PM: 0.019 gr/dscf @ 12% O ₂ Being considered as LAER SO ₂ : 335.0 lb/hr CO: 109.0 lb/hr NO _x : 227.0 lb/hr F: 4.2 lb/hr
Refuse Incineration/Refuse Fuels, Inc. Lawrence, MA/023-121MA12 03/23/81	New RDF waterwall furnace with a total capacity of 960 tpd	5 field ESP Low S Fuel Boiler Design	PM: Subject to LAER 0.25 gr/dscf @ 12% O ₂ 98.0 efficiency SO ₂ : 1.2 lb/MMBtu NO _x : 0.7 lb/MMBtu
Refuse Incinerator/Resource Authority Gallatin, TN 08/01/80	2 new refuse mass burning waterwall boilers at 75 tpd each	Scrubber and fabric filters	PM: 0.04 gr/dscf NSPS 99.0% removal
		Note: Due to problems encountered with the existing scrubber/ fabric filter system, they have been replaced with ESPs.	

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LEE COUNTY ENERGY RECOVERY FACILITY
 RECENT BACT DETERMINATIONS FOR FACILITIES BURNING REFUSE (Page 21 of 21)

SOURCE TYPE/COMPANY NAME LOCATION/PERMIT NUMBER DATE OF ISSUE	SOURCE SIZE PROCESS DESCRIPTION	PROPOSED CONTROL TECHNOLOGY	BACT EMISSION LIMITATION DETERMINATION
Refuse Incineration/Municipal Incinerator Rulaski Highway Baltimore, MD/78MD-09 1/25/80	600 tpd municipal incinerator	ESP Proper combus- tion techniques	PM: per SIP 0.03 gr/dscf @ 12% CO ₂ 98.0% removal SO ₂ : 35.1 lb/hr CO: 30.0 lb/hr VOC: 1.3 lb/hr NO _x : 2.6 lb/hr

Source: EPA BACT/LAER Clearinghouse (USEPA 1984, 1987b, 1988)

- | | |
|-------------------------------------|--|
| PM - Particulate Matter | BACT - Best Available Control Technology |
| ESP - Electrostatic Precipitator | MBIU - Million Btu |
| VOC - Volatile Organic Compounds | LAER - Lowest Achievable Emission Rate |
| NO _x - Nitrogen Oxides | F - Hydrogen Fluorides |
| SO ₂ - Sulfur dioxide | CO - Carbon Monoxide |
| CO ₂ - Carbon Dioxide | Hg - Mercury |
| Be - Beryllium | Pb - Lead |
| Cd - Cadmium | Cr - CHROMIUM |
| HCl - Hydrogen Chloride | VE - Visible Emissions |
| Sb - Antimony | As - Arsenic |
| TCDD - Tetrachlorodibenzo-p-dioxins | PHH - Polynuclear Aromatic Hydrocarbons |
| SIP - State Implementation Plan | NSPS - New Source Performance Standards |
| | NMHC - Non-methane Hydrocarbons |

ATTACHMENT D

BURN MODEL OUTPUT

BURN - Version 3.0 COMBUSTION ANALYSIS: Lee County ERP
 One Unit (600tpd)
 at 5000 BTU/lb

6/28/91

WASTE FEED STREAMS

WEIGHT FIRED		PERCENT (DRY BASIS)					
NAME	in Wet LB/Hr	Carbon	Hydrogen	Sulfur	Fe(OH)3	Al(OH)3	Oxygen
STOKER_GRATE	50000.0	35.940	4.790	.130	00.000	00.000	31.650
COMPOSITE (LB)	50000.	14250.21	1899.23	51.54	.00	.00	12549.23
COMPOSITE MOLS	0.	1186.53	942.08	1.61	.00	.00	392.16
COMPOSITE (% DRY BASIS)		35.94	4.79	.13	.00	.00	31.65

PERCENT (DRY BASIS)

NAME	Nitrogen	Chlorine	CaCO3	Inert	Iron	Aluminum	Pct.H2O	BTU /LB
STOKER_GRATE	.630	.500	00.000	26.360	00.000	00.000	20.700	6305.2
COMPOSITE (LB)	249.79	198.25	.0010451.74	.00	.00	.00	10350.0	5000.0
COMPOSITE MOLS	8.92	5.59	.0010451.74	.00	.00	.00	575.0	
COMPOSITE (% DRY)	.63	.50	.00	26.36	.00	.00		

DRY BASIS

WET BASIS

THE MODIFIED DULONG HEATING VALUE IS: 6293.2 BTU/LB 4990.5 BTU/LB
 THE MODIFIED CHANG HEATING VALUE IS: 6392.5 BTU/LB 5069.2 BTU/LB
 THE BOIE HEATING VALUE IS: 6385.0 BTU/LB 5063.3 BTU/LB
 THE INPUT WASTE HEATING VALUE IS: 6305.2 BTU/LB 5000.0 BTU/LB

DAILY CHARGE RATE EQUALS: 600.0 TONS PER DAY.

RUN CONDITIONS AS INPUT

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AMBIENT AIR: 60.0 DEG. F ; PRESSURE 1.0 ATM; ABSOLUTE HUMIDITY .007500
 AVAILABLE PREHEATED AIR .0 ACFM AT .0 DEG. F
 OPERATING TEMPERATURES: MINIMUM OF 1800.0, MAXIMUM OF 2200.0 DEG. F
 FURNACE WATER COOLED, 100.00 % OF AREA; BOILER WATER COOLED, 100.00 % OF AREA
 TEMPERATURES MODERATED WITH AIR AND ELEVATED WITH GAS
 STEAM CONDITIONS: PRESSURE - 865. PSIA ; TEMPERATURE - 830. DEG. F
 ENTHALPY CHANGE FROM FEEDWATER TO STEAM: 1196.0 BTU/LB
 TEMPERATURE (DEG. F): PROCESS WATER 60. FEEDWATER 290.
 FLUE GASES LEAVE THE BOILER AT: 425.0 DEG. F , QUENCHER AT 241.0 DEG. F
 FLUE GASES LEAVE THE SUBCOOLER AT: .0 DEG. F
 MAXIMUM SUBCOOLER WATER DISCHARGE TEMPERATURE IS: 95.0 DEG. F
 STACK DIAM. IS 1.0 FT, HEIGHT 275.0 FT, VELOCITY = 65.0 FT/SEC
 .00 % OF FEED ENTHALPY IS ABSORBED IN PRIMARY
 RESIDUE IS WATER QUENCHED AND LEAVES SYSTEM AT 350.0 DEG. F
 UNBURNED PERCENTAGES OF FEED - CARBON 1.5, IRON 00.0, ALUMINUM 00.0
 AFTERBURNER TEMPERATURE: .0 DEG. F ; OPERATING FACTOR: 100.00 % OF DESIGN
 ATMOSPHERIC STABILITY CLASS IS: 0; DESIGN % EXCESS AIR IS: 90.0

***** NOTE *****

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

SUMMARY OF FURNACE OPERATIONS

Furnace Flue Gas Sensible Heat Content (SENH) as a Function of Tgas
 $SENH = A + B \cdot T + C \cdot T^2 + D \cdot T^3$

A = $-.5494215E+07$ C = $.8599385E+01$
 B = $.9105703E+05$ D = $-.7614848E-03$

At Tgas = 2097.44 DEG. F , SENH = $.2162975E+09$ BTU/HR

GAS ANALYSIS AFTER FURNACE

COMPONENT	VOLUME % DRY BASIS	VOLUME % WET BASIS	MOLS PER MINUTE	LB/HR	
CO2	10.41	9.076	19.48	51435.8	
SO2	.1435E-01	.1251E-01	.2685E-01	103.2	125. PPMV - WET
N2	79.52	69.33	148.8	250129.3	
O2	10.00	8.721	18.72	35937.2	
HCl	.4980E-01	.4342E-01	.9319E-01	203.9	434. PPMV - WET
H2O		12.81	27.50	29698.9	
TOTAL	100.0	100.0	214.6	367508.4	

	PERCENT SO2 TO SO3	DEWPOINT DEG. F
SULFURIC ACID	1	248.83
DEWPOINT FROM	3	266.88
OXIDATION OF	5	275.58
SO2 TO SO3	8	283.78
AFTER FURNACE	10	287.73
	15	295.03

PREHEATED AIR	.00 ACFM	
	.00 SCFM	.00 LB/HR
COMBUSTION AIR	72251.39 ACFM	
	72251.39 SCFM	328178.20 LB/HR
BURNER AIR	.00 ACFM	
	.00 SCFM	.00 LB/HR
COOLING AIR	.00 ACFM	
	.00 SCFM	.00 LB/HR
COOLING WATER	.00 GAL/MIN	.00 LB/HR

WITHOUT COOLING OR FUEL USE BUT USING 0. ACFM OF PREHEATED AIR, THE FURNACE TEMPERATURE IS: 2097. DEG. F ; A TEMPERATURE OF 1993. DEG. F WAS USED TO JUDGE POTENTIAL DISSOCIATION OF CaCO3, Fe(OH)3, AND Al(OH)3.

FLUE GAS 400488.60 ACFM AT 2097.4 DEG. F
81430.54 SCFM AT 60.0 DEG. F

BURNER FUEL USE .00 CFM (.00 FT3/HR) GAS

QUENCH TANK MAKEUP 7.10 GAL/MIN

RESIDUE ASSUMED TO LEAVE HOT ZONE AT 350.0 DEG. F
RESIDUE WEIGHT (75.00 % SOLIDS) 14220.66 LB/HR
(DRY) 10665.49 LB/HR

UNBURNED CARBON IN ASH: 2.002 PERCENT OF TOTAL ASH (INCLUDING CARBON)
HEATING VALUE OF RESIDUE (DRY BASIS): 282.5 BTU/LB

HEAT LOSSES	BTU/HR	PERCENT OF FEED HEAT CONTENT	PERCENT OF TOTAL HEAT RELEASE
RADIATION	1188667.	.48 PERCENT	.47 PERCENT
MOISTURE	31470790.	12.59 PERCENT	12.46 PERCENT
DRY GAS	216297500.	86.52 PERCENT	85.63 PERCENT
RESIDUE	3877637.	1.55 PERCENT	1.54 PERCENT

DESIGN EXCESS AIR (ON FEED) IS 90.00 PERCENT
ACTUAL EXCESS AIR (ON FEED) IS 90.01 PERCENT
ACTUAL EXCESS AIR (ON TOTAL COMBUSTIBLE) IS 90.01 PERCENT

EQUILIBRIUM THERMAL NOX CONCENTRATION IS 526.2 PPM (VOLUME)
PERCENT FUEL NITROGEN CONVERTED TO NOx= 69.666 PERCENT
FUEL NITROGEN NOx (Estimated by Soete) = 964.754 PPM (VOLUME)

SO2 UNCONTROLLED EMISSION RATE IS 13.01 GM/SEC EQUAL TO 103.07 LB/HR
HCl UNCONTROLLED EMISSION RATE IS 25.71 GM/SEC EQUAL TO 203.64 LB/HR

WITH ACID GAS CONTROL AT .0 PERCENT,
SO2 CONTROLLED EMISSION RATE IS 13.01 GM/SEC EQUAL TO 103.07 LB/HR
HCl CONTROLLED EMISSION RATE IS 25.71 GM/SEC EQUAL TO 203.64 LB/HR

SUMMARY OF BOILER OPERATION CALCULATIONS

BOILER STEAM PRODUCTION 150843.7 LB/HR
 PRESSURE 865.0 PSIA
 TEMPERATURE 830.0 DEG. F

FEEDWATER TEMPERATURE: 290.0 DEG. F
FEEDWATER ENTHALPY: .0 BTU/LB
PRODUCT STEAM ENTHALPY: .0 BTU/LB
ENTHALPY CHANGE: 1196.0 BTU/LB

SATURATION TEMPERATURE AT PRODUCT STEAM PRESSURE: .0 DEG. F
THE STEAM CARRIES: 830.0 DEG. F OF SUPERHEAT

FLUE GAS TEMPERATURE AT BOILER EXIT 425. DEG. F

RADIATION LOSS 1188667. BTU/HR OR .55 % OF SENSIBLE HEAT AT BOILER INLET

WITH REFERENCE TO NET ENTHALPY INPUT TO THE COMBUSTION SYSTEM,
THE BOILER EFFICIENCY IS: 73.04 PERCENT

WITH REFERENCE TO FEED ENTHALPY INPUT TO THE COMBUSTION SYSTEM,
THE BOILER EFFICIENCY IS: 72.16 PERCENT

MEAN MOLECULAR WEIGHT OF GASES
(DRY BASIS) 30.09
(WET BASIS) 28.54

TOTAL GAS FLOW RATE	LB/MIN	LB/HR	ACFM
(DRY BASIS)	5630.16	337809.50	--
(WET BASIS)	6125.58	367534.80	138591.3

EFFLUENT GAS HUMIDITY .0880 (MASS H2O/MASS BONE DRY GAS)

GAS DEW POINT IS 121.4 DEG. F

SUMMARY OF DRY SCRUBBER OPERATIONS

 DRY SCRUBBER EXIT TEMPERATURE 241.0 DEG. F

DRY SCRUBBER OPERATIONS SUMMARY
 =====

CONTROL EFFICIENCY: 95.00 PERCENT HCL REMOVAL
 80.00 PERCENT SO2 REMOVAL

LIME ASSAY: 90.00 PERCENT ACTIVE CaO
 SLURRY FEED STOICHIOMETRY: 170.00 PERCENT OF HCL + SO2
 SLURRY FEED AT: 8.00 PERCENT SOLIDS

LIME FEED RATE AT: 466.77 LB/HR
 SLURRY FEED RATE AT: 44794.49 GAL/HR

SUPPLEMENTAL WATER USE 20. GAL/MIN

GAS ANALYSIS AFTER DRY SCRUB

COMPONENT	VOLUME % DRY BASIS	VOLUME % WET BASIS	MOLS PER MINUTE	LB/HR	
CO2	10.42	8.507	19.48	51435.8	
SO2	.2871E-02	.2345E-02	.5369E-02	20.6	23. PPMV - WET
N2	79.57	64.98	148.8	250129.3	
O2	10.01	8.174	18.72	35937.2	
HCL	.2492E-02	.2035E-02	.4659E-02	10.2	20. PPMV - WET
H2O		18.33	41.97	45330.5	
TOTAL	100.0	100.0	229.0	382863.8	

	PERCENT SO2 TO SO3	DEWPOINT DEG. F
SULFURIC ACID	1	230.79
DEWPOINT FROM	3	247.23
OXIDATION OF	5	255.15
SO2 TO SO3	8	262.59
AFTER QUENCHER	10	266.18
	15	272.79