



**Enron North America Corp.**

P.O. Box 1188

Houston, TX 77251-1188

November 7, 2000

RECEIVED

NOV 09 2000

BUREAU OF AIR REGULATION

Mr. Al Linero, P.E.  
Administrator, New Source Review Section  
Florida Department of Environmental Protection  
2600 Blair Stone Road  
Tallahassee, Florida 32399-2400

RE: Midway Development Company, LLC  
Permit Application for Midway Energy Center

Dear Mr. Linero:

On behalf of Midway Development Company, LLC, enclosed are four (4) copies of an air permit application for the Midway Energy Center in St. Lucie County, Florida. This application is for a PSD permit for a simple cycle combustion turbine power plant consisting of 3 General Electric 7FA dual-fuel units. Also enclosed is a CD-ROM containing the modeling archive required for your review. A Separate copy of this application is being sent to the Southeast District of the Florida DEP. An application processing fee has not been enclosed. Due to previously-submitted and withdrawn applications, Enron North America believes that it has an existing positive fee balance with the Florida Department of Environmental Management.

If you have any questions, please don't hesitate to call me at (713) 853-3161.

Sincerely,  
Enron North America

A handwritten signature in cursive script that reads "David A. Kellermeyer". The signature is written in black ink and has a long, sweeping underline that extends to the right.

David A. Kellermeyer  
Director

Enclosures

cc: Mr. Lennon Anderson, Southeast District

**Midway Development  
Company, L.L.C.**

**Houston, TX**

**RECEIVED**

NOV 09 2000

BUREAU OF AIR REGULATION

**PSD Permit Application for the  
Midway Energy Center**

**ENSR International  
November 2000  
Document Number 6792-140-300**

**CONTENTS**

**1.0 INTRODUCTION ..... 1-1**

    1.1 Application Summary ..... 1-1

    1.2 General Applicant Information ..... 1-2

        1.2.1 Applicant's Address ..... 1-2

        1.2.2 Applicant's Contacts ..... 1-2

    1.3 Project Location ..... 1-3

    1.4 Document Organization ..... 1-3

**2.0 PROJECT DESCRIPTION ..... 2-1**

    2.1 Power Generation Facility ..... 2-1

    2.2 Major Facility Components ..... 2-1

        2.2.1 Gas Turbines ..... 2-3

        2.2.2 Simple-Cycle ..... 2-3

        2.2.3 Fuel Gas System ..... 2-4

        2.2.4 Distillate Oil Storage ..... 2-4

        2.2.5 Ancillary Facilities ..... 2-4

**3.0 PROJECT EMISSIONS ..... 3-1**

    3.1 Combustion Turbines ..... 3-1

        3.1.1 Criteria Pollutants ..... 3-1

        3.1.2 Non-Criteria Pollutants ..... 3-2

    3.2 Natural Gas Fuel Heater ..... 3-4

    3.3 Fugitive Emissions ..... 3-5

    3.4 Total Project Criteria Pollutant Emission Summary ..... 3-5

**4.0 APPLICABLE REGULATIONS AND STANDARDS ..... 4-1**

    4.1 Prevention of Significant Deterioration ..... 4-1

    4.2 NSPS ..... 4-3

    4.3 NESHAPS ..... 4-4

    4.4 Acid Rain ..... 4-4

    4.5 CAA Operating Permit Program ..... 4-4

**CONTENTS (Cont'd)**

4.6 State SIP Rules ..... 4-5

**5.0 CONTROL TECHNOLOGY EVALUATION ..... 5-1**

5.1 Introduction ..... 5-1

    5.1.1 Top-Down BACT Approach..... 5-1

    5.1.2 Cost Determination Methodology..... 5-2

    5.1.3 Capital Costs..... 5-2

5.2 Previous BACT/LAER Determinations for Simple-Cycle Combustion Turbines ..... 5-6

    5.2.1 Base Load Power (Combined-Cycle) ..... 5-6

    5.2.2 Peaking Power (Simple-Cycle) ..... 5-7

    5.2.3 BACT Determinations for Simple-Cycle Combustion Turbines ..... 5-8

    5.2.4 Combustion Turbine Fuel Use ..... 5-8

5.3 BACT for Nitrogen Oxides (NO<sub>x</sub>) ..... 5-9

    5.3.1 Formation ..... 5-9

    5.3.2 Front – End Control ..... 5-9

    5.3.3 Back – End Control..... 5-10

    5.3.4 Gas Turbines - Ranking of Available Control Techniques..... 5-13

    5.3.5 Natural Gas Fuel Heater..... 5-20

5.4 BACT for Carbon Monoxide..... 5-20

    5.4.1 Formation ..... 5-20

    5.4.2 Gas Turbines-Ranking of Available Control Techniques ..... 5-20

    5.4.3 Natural Gas Fuel Heater..... 5-23

5.5 BACT for Particulate Matter and Trace Metals ..... 5-26

    5.5.1 Formation ..... 5-26

    5.5.2 Gas Turbines..... 5-26

    5.5.3 Natural Gas Fuel Heater..... 5-27

5.6 BACT for Sulfur Dioxide and Sulfuric Acid Mist ..... 5-27

    5.6.1 Formation ..... 5-27

    5.6.2 Gas Turbines and Fuel Gas Heater ..... 5-27

5.7 Summary and Conclusions ..... 5-28

**6.0 AMBIENT AIR QUALITY IMPACT ANALYSIS ..... 6-1**

6.1 Overview of Analysis Methodology..... 6-1

6.2 Model Selection ..... 6-1

**CONTENTS (Cont'd)**

6.2.1 Physical Source Geometry ..... 6-1

6.2.2 Dispersion Environment ..... 6-4

6.2.3 Terrain Considerations ..... 6-4

6.3 Model Application ..... 6-5

6.3.1 Meteorological Data ..... 6-5

6.3.2 Model Receptor Grid ..... 6-5

6.3.3 Physical Source and Emissions Data ..... 6-8

6.4 Ambient Impact Criteria ..... 6-8

6.5 Results of Ambient Air Quality Impact Analysis ..... 6-13

**7.0 ADDITIONAL IMPACTS ..... 7-1**

7.1 Vegetation and Soils ..... 7-1

7.2 Associated Growth ..... 7-2

7.3 Class I Area Impact Analysis ..... 7-2

**APPENDICES**

- A FLORIDA DEP APPLICATION FORMS**
- B EMISSION CALCULATIONS**
- C BACT SUPPORTING INFORMATION**
- D BPIP MODEL OUTPUT FILE**
- E DETAILED ISCST3 MODELING RESULTS**
- F KEY TO ISCST3 MODELING FILES ON CD-ROM**

**LIST OF TABLES**

Table 3-1 Hourly Emission Rate Summary for the MEC Combustion Turbines..... 3-3

Table 3-2 Annual Emission Summary for the MEC Combustion Turbines..... 3-4

Table 3-3 Facility HAP Emission Summary..... 3-4

Table 3-4 Criteria Pollutant Emissions Summary for the Fuel Heater..... 3-4

Table 3-5 Project Hourly Emissions Summary, Criteria Pollutants, MEC..... 3-6

Table 3-6 Project Annual Emissions Summary, Criteria Pollutants, MEC..... 3-6

Table 4-1 Project PTE Criteria Pollutant Emissions Summary, Midway Energy Center..... 4-2

Table 4-2 Project PTE Non-Criteria Pollutant Emissions Summary..... 4-4

Table 5-1 Capital Cost Estimation Factors..... 5-3

Table 5-2 Annualized Cost Factors..... 5-5

Table 5-3 Ranking of NO<sub>x</sub> Control Technologies for a Dual Fuel Simple-Cycle Peaking Turbine.... 5-13

Table 5-4 US EPA National Simple Cycle PSD Turbine Projects..... 5-14

Table 5-5 High Temperature Oxidation Catalyst General Electric, Simple-Cycle, Model 7 FA..... 5-24

Table 5-6 Summary of Selected BACTs..... 5-28

Table 6-1 Summary of GEP Analysis..... 6-4

Table 6-2 Combustion Turbine Performance Data for Natural Gas and Distillate Fuel Oil Operation . 6-9

Table 6-3 Worst-Case Turbine Stack Data for Dispersion Modeling..... 6-11

Table 6-4 Ambient Impact Criteria..... 6-12

Table 6-5 ISCST3 Modeling Results for Natural Gas..... 6-14

Table 6-6 ISCST3 Modeling Results for Distillate Oil..... 6-15

Table 6-7 Comparison of Maximum ISCST3 Concentrations to Class II Significant Impact Levels... 6-16

Table 7-1 Comparison to U.S. EPA Criteria for Gaseous Pollutant Impacts on Natural Vegetation  
and Crops..... 7-2

---

**LIST OF FIGURES**

Figure 1-1 Site Plan.....	1-4
Figure 1-2 Plot Plan.....	1-5
Figure 2-1 Process Flow Diagram - Simple Cycle Combustion Turbines – Midway Energy Center ..	2-2
Figure 6-1 Location of Turbine Stacks Relative to Structures Included in the GEP Analysis .....	6-3
Figure 6-2 Near-Field Receptor Locations .....	6-6
Figure 6-3 Far-Field Receptors .....	6-7

## 1.0 INTRODUCTION

### 1.1 Application Summary

Midway Development Company, LLC is proposing to construct and operate a 510 MW (nominal) simple-cycle combustion turbine peaking electric generating facility in St. Lucie County. The facility, to be known as the Midway Energy Center (MEC), will be located on approximately 30 acres of property near Port St. Lucie, Florida. From an air emissions perspective, the key elements of the proposed action include:

- Three (3) combustion turbines;
- Natural gas fuel heater; and
- Two distillate oil storage tanks.

Midway Development Company, LLC desires to commence construction in April 2001 and begin commercial operation no later than May 1, 2002 (pending receipt of all necessary local and environmental approvals).

Since the proposed action will be a major stationary source under the Part C of the Clean Air Act, MEC is applying to the Florida Department of Environmental Protection (FDEP) for a Prevention of Significant Deterioration (PSD) permit and for a State Air Construction Permit. This application provides technical analyses and supporting data for a permit to construct the facility under the federal PSD program, as well as the state construction permit program. The federal PSD program in Florida is administered by the FDEP under a State Implementation Plan program approved by U.S. EPA under 40 CFR 51.166.

This application addresses the air construction permitting requirements specified under the provision of Florida Administrative Code (F.A.C.) Chapters 62-4, 62-210, and 62-212. The application is divided into seven additional sections. Section 2.0 presents an overview of the proposed action and processes covered by this permit application. Section 3.0 describes the methods used to calculate facility emissions and provides a summary of expected emissions. Section 4.0 reviews the regulatory requirements with which the facility must comply. Section 5.0 presents a control technology evaluation for those pollutants subject to PSD review. Section 6.0 presents the air dispersion modeling analysis required by PSD and FDEP regulations. Finally, Section 7.0 provides the additional impacts analysis required by PSD regulations.

FDEP application forms are located in Appendix A. Supporting emission calculations are presented in Appendix B. Information supporting the control technology review is presented in Appendix C. BPIP output data for establishing modeling downwash parameters is presented in Appendix D. Appendix E



provides a description of the dispersion modeling input data and output files, which have been submitted to FDEP on CD-ROM.

General information about the applicant and the location of the project site, are presented below. A more detailed discussion on the organization of this document is also presented. To facilitate FDEP's review of this document, individuals familiar with both the facility and the preparation of this application have been identified in the following section. FDEP should contact these individuals if additional information or clarification is required during the review process.

## 1.2 General Applicant Information

Listed below are the applicant's primary points of contact, and the address and phone number where they can be contacted. Since this permit application has been prepared by a third party under the direction of Midway Development Company, L.L.C., a contact has been included for the permitting consultant.

### 1.2.1 Applicant's Address

#### Corporate Office

Midway Development Company, LLC  
1400 Smith Street  
Houston, TX 77002-7631

#### Project Site

Midway Energy Center  
Northwest of the intersection of I-95 and  
W. Midway Rd.  
St. Lucie County (Port St. Lucie approximately  
1.5 km to the southeast)

### 1.2.2 Applicant's Contacts

#### Corporate Officer

Ben Jacoby  
Director  
1400 Smith Street  
Houston, TX 77002-7631

#### Environmental Contact

Dave Kellermeyer  
Director  
1400 Smith Street, EB-2957 B  
Houston, TX 77002-7631  
Telephone: (713) 853-3161  
Fax: (713) 646-3037

Permitting Consultant      Robert Iwanchuk  
 Project Manager  
 ENSR  
 35 Nagog Park  
 Acton, MA 01720  
 Telephone (978) 635-9500 X3265  
 Fax (978) 635-9180

**1.3 Project Location**

The Midway Energy Center will be located on an approximately 30-acre parcel of rural land located in St. Lucie County, Florida. The site is located northwest of the intersection of I-95 and W. Midway Road. The facility will be connected to electrical transmission lines and a natural gas pipeline located in close proximity to the site. The approximate project property boundary and local road network is shown on Figure 1-1. A detailed representation of the property boundary is shown on the plot plan drawing contained in Figure 1-2. The site exhibits low topographic relief and is currently occupied by an abandoned citrus grove. Stormwater will be handled by the facility's storage water management system, which includes one on-site stormwater detention pond.

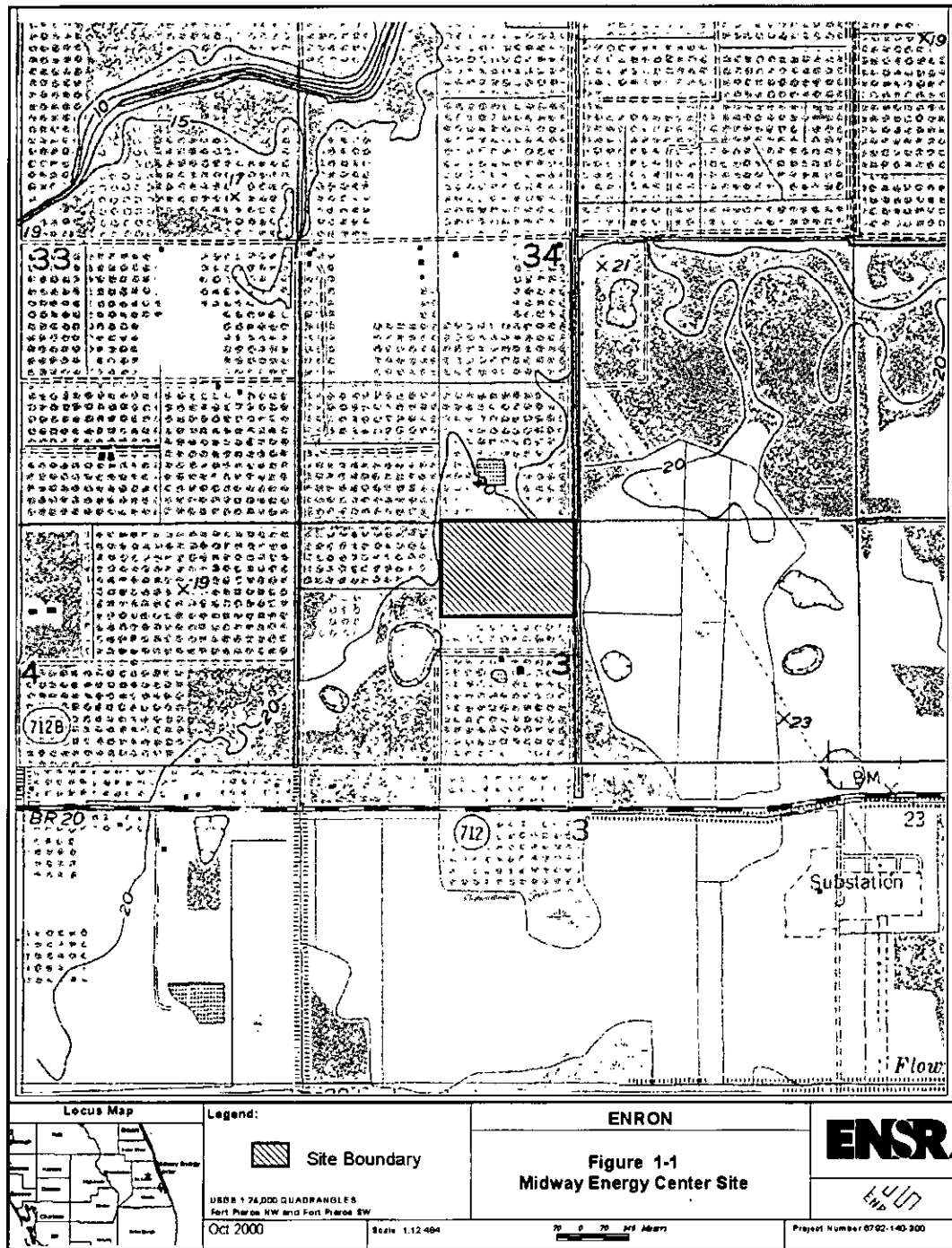
Benchmark Universal Transverse Mercator (UTM) coordinates for the plant, corresponding to the middle combustion turbine stack location shown in Figure 1-2 and the power island grade elevation are as follows:

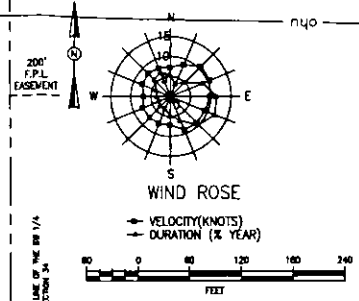
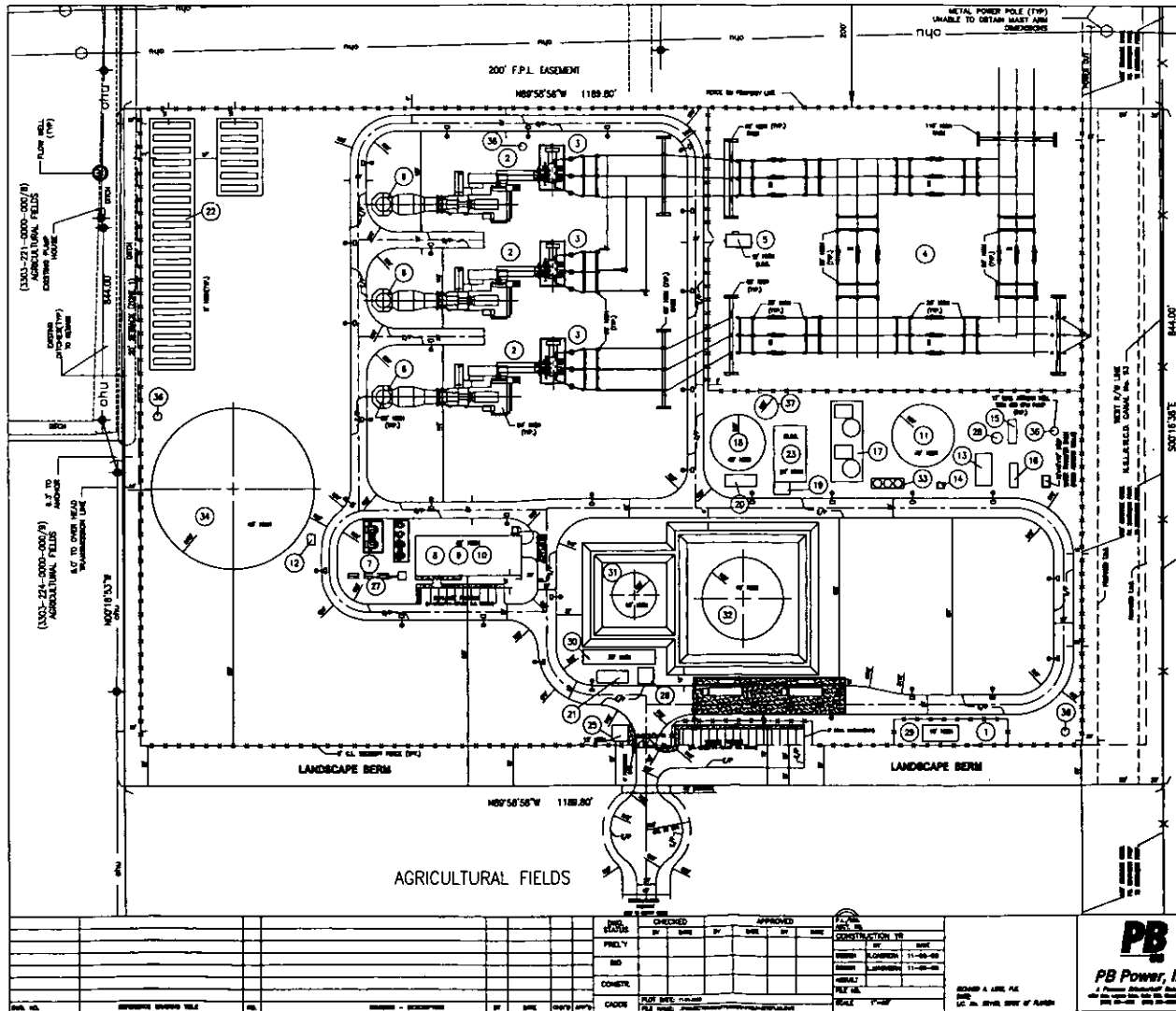
Zone Number	17
Northing (m)	3,028,548
Easting (m)	556,670
Site Elevation (ft msl)	20

**1.4 Document Organization**

The balance of this document is divided into sections which address the major issues of a preconstruction air quality permit review. The outline below provides an overview of the contents of each of the remaining sections.

- **Section 2.0 - Project Description** provides an overview of the facility including major facility components. A general description of the Simple-Cycle process by which power will be produced at this site is presented.
- **Section 3.0 - Emissions Summary** presents a detailed review of the emissions which will be generated at the project site subsequent to the completion of project development, under normal operating conditions. The basis and methods used to calculate emissions from the project are presented.





SCHEDULE OF COMPONENTS

NO.	DESCRIPTION	QTY	UNIT	DATE
1	...	...	...	...
2	...	...	...	...
3	...	...	...	...
4	...	...	...	...
5	...	...	...	...
6	...	...	...	...
7	...	...	...	...
8	...	...	...	...
9	...	...	...	...
10	...	...	...	...
11	...	...	...	...
12	...	...	...	...
13	...	...	...	...
14	...	...	...	...
15	...	...	...	...
16	...	...	...	...
17	...	...	...	...
18	...	...	...	...
19	...	...	...	...
20	...	...	...	...
21	...	...	...	...
22	...	...	...	...
23	...	...	...	...
24	...	...	...	...
25	...	...	...	...
26	...	...	...	...
27	...	...	...	...
28	...	...	...	...
29	...	...	...	...
30	...	...	...	...
31	...	...	...	...
32	...	...	...	...
33	...	...	...	...
34	...	...	...	...
35	...	...	...	...
36	...	...	...	...
37	...	...	...	...

NOTES:

- 1 - ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN FEET.
- 2 - ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN FEET.
- 3 - ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN FEET.
- 4 - ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN FEET.
- 5 - ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN FEET.
- 6 - ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN FEET.
- 7 - ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN FEET.
- 8 - ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN FEET.
- 9 - ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN FEET.
- 10 - ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN FEET.
- 11 - ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN FEET.
- 12 - ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN FEET.
- 13 - ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN FEET.
- 14 - ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN FEET.
- 15 - ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN FEET.
- 16 - ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN FEET.
- 17 - ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN FEET.
- 18 - ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN FEET.
- 19 - ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN FEET.
- 20 - ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN FEET.
- 21 - ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN FEET.
- 22 - ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN FEET.
- 23 - ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN FEET.
- 24 - ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN FEET.
- 25 - ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN FEET.
- 26 - ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN FEET.
- 27 - ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN FEET.
- 28 - ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN FEET.
- 29 - ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN FEET.
- 30 - ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN FEET.
- 31 - ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN FEET.
- 32 - ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN FEET.
- 33 - ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN FEET.
- 34 - ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN FEET.
- 35 - ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN FEET.
- 36 - ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN FEET.
- 37 - ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN FEET.

NO.	REVISION	DATE	BY	CHECKED	APPROVED	DESCRIPTION	DATE	SCALE	PROJECT	SHEET NO.	TOTAL SHEETS	DATE	DRAWN BY	CHECKED BY	APPROVED BY	DATE	PROJECT	SHEET NO.	TOTAL SHEETS	DATE		

**PB**  
**PB Power, Inc.**  
 10000 Midway Road  
 Houston, TX 77055-1000  
 (713) 251-1000

MIDWAY ENERGY CENTER  
**Figure 1-2**  
**SITE PLAN**

SHEET C-8

- **Section 4.0 - Applicable Regulations and Standards** presents a detailed review of both Federal and State regulations. The focus of this section will be on establishing which regulations are directly applicable to the proposed project and for which compliance must be demonstrated.
- **Section 5.0 - Control Technology Evaluation** is a substantial requirement for the PSD application. Since the proposed project will result in a significant increase in the emission of certain criteria pollutants, as defined under PSD regulations, a detailed review of control technologies is provided. Annual "Potential-to-Emit" (PTE) emissions, as defined by FDEP, are expected to be significant for Carbon Monoxide (CO), Particulate Matter (PM\PM<sub>10</sub>), Sulfur Dioxide (SO<sub>2</sub>), Nitrogen Oxides (NO<sub>x</sub>) and Sulfuric Acid Mist (H<sub>2</sub>SO<sub>4</sub>). Therefore, control technology analyses for these pollutants have been prepared. The review conforms to the EPA's Top-Down protocol.
- **Section 6.0 - Air Dispersion Modeling Analysis** provides the results of the air quality impact assessment required under the PSD regulations to demonstrate compliance with National Ambient Air Quality Standards (NAAQS), PSD Class II Increments, and the significant impact levels defined for them. The air quality impact analysis predicted no significant impacts; therefore no further modeling for compliance with the NAAQS and PSD increments was required. The air dispersion modeling was done in conformance with EPA modeling guidelines.
- **Section 7.0 - Additional Impacts** contains supplemental information regarding the potential impacts of the project. Specifically this section discusses the potential for impacts on local soils, vegetation, visibility, and growth related air quality impacts. PSD Class I area assessments of regional haze, increment and deposition impacts using the CALPUFF dispersion model will be submitted as a supplement to this permit application.
- **Section 8.0 - References** include a list of the documents relied upon during the preparation of this document.
- **Appendix** - Permit application forms, emission calculations, and supplemental materials supporting the information presented herein are contained in the appendices to this document. Modeling results, both input and output files, are provided on the enclosed CD-ROM.

---

## 2.0 PROJECT DESCRIPTION

The following section provides an overview of the facility addressed by this permit application. The facility will be owned and operated by Midway Development Company, LLC. The proposed project is a dual fuel Simple-Cycle merchant power plant to be located near Port St. Lucie, Florida. A merchant power plant is a non-utility generation facility designed to produce power within the emerging deregulated electricity market. The Midway Energy Center is designed to have a nominal generating capacity in the range of 510 MW. Commercial operation is scheduled to commence by May 1, 2002. As a merchant plant in a deregulated electricity market, the MEC is being designed to convert fuel to useful power quickly, cleanly, and reliably.

### 2.1 Power Generation Facility

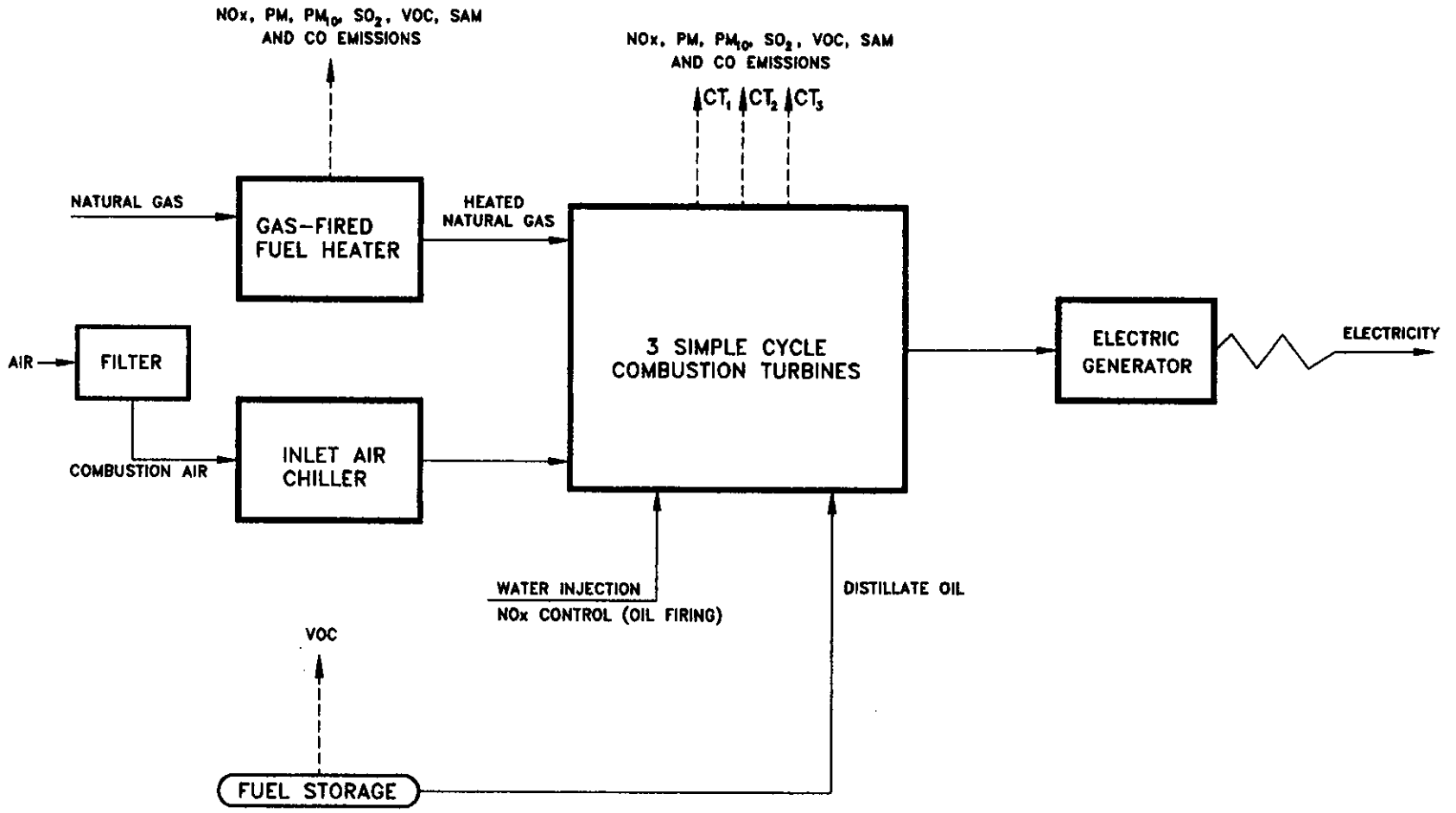
The MEC will include three (3) General Electric 7FA combustion turbine generators (CTGs) operating in Simple-Cycle mode. The CTGs will be designed to operate on both natural gas and low-sulfur diesel oil. Dry, low NO<sub>x</sub> combustors will be used to minimize NO<sub>x</sub> formation during combustion, and water injection will be employed during diesel oil-firing to reduce NO<sub>x</sub> emissions. Each turbine will be equipped with its own exhaust stack.

The proposed generation facility will utilize the Best Available Control Technology (BACT), as defined by U.S. EPA, for NO<sub>x</sub>, CO, SO<sub>2</sub>, Sulfuric Acid Mist, and PM/PM<sub>10</sub> to minimize air emissions. The project will not be a major source of hazardous air pollutants.

### 2.2 Major Facility Components

The primary source of criteria pollutants associated with the MEC are the three combustion turbine generators which exhaust through three separate stacks. A process flow diagram for a simple-cycle combustion turbine is shown in Figure 2-1. There will be a minor amount of emissions associated with the plant's ancillary facilities, including the two diesel fuel storage tanks and a fuel gas heater. A brief description of the major components of the facility is provided in the following sections.

Operating parameters for the combustion turbine at three loads (100%, 75%, 50%), and four ambient temperatures (30°F, 42°F, 50°F, 91°F), are presented in Appendix B. This covers the expected operating range of the facility.



679209A.DWG

**ENSR**<sup>TM</sup>  
 ENSR CONSULTING AND ENGINEERING

FIGURE 2-1  
**PROCESS FLOW DIAGRAM**  
 SIMPLE CYCLE COMBUSTION TURBINE  
 MIDWAY ENERGY CENTER

DRAWN:	JK	DATE:	10/00	PROJECT NUMBER:	6792-140	REV.	0
APPV'D:	DD	REVISED:	X				

### **2.2.1 Gas Turbines**

MEC proposes to install three (3) General Electric combustion turbine generators in Simple-Cycle mode with independent exhaust stacks. Each turbine will include an advanced firing combustion turbine air compressor, gas combustion system (dry, low NO<sub>x</sub> combustors), power turbine, and a 60-hertz (Hz), 13.8 kilovolt (kV) generator. The turbines will run predominantly on pipeline-quality natural gas, but will have the capability to operate on diesel oil. Each turbine is designed to produce a nominal 170 MW of electrical power.

The power output from a combustion turbine generator (CTG) is proportional to the mass flow rate of air and fuel through the expansion (power) turbine. Thus at high ambient temperatures the power available from a CTG is significantly reduced due to the lower density of the inlet air. As the CTG's proposed are intended to provide peak power generation, in an area where ambient temperatures frequently rise above 80°F, the CTG's have been equipped with inlet air chilling equipment. At high ambient temperatures, inlet air chillers will be operated to cool the inlet air to the turbines in order to compensate for the loss of power output due to lower compressor inlet density. At an ambient temperature of 91°F, chilling will reduce the compressor inlet temperature to 50°F resulting in an approximately 24 MW increase in gross power output per CTG unit. The inlet air chillers will operate using a closed loop cooling circuit, with waste heat exhausted to the atmosphere using dry, air-cooled cooling towers. These cooling towers will be of a non-contact design and thus do not represent a source of air emissions.

The gas turbine is the heart of a Simple-Cycle power system. First, air is filtered and compressed in a multiple-stage axial flow compressor. Compressed air and natural gas are mixed and combusted in the turbine combustion chamber. Dry, low NO<sub>x</sub> combustors and water injection are used to minimize NO<sub>x</sub> formation during combustion, depending on which fuel is fired. Exhaust gas from the combustion chamber is expanded through a multi-stage power turbine which drives both the air compressor and electric generator. The exhaust exits the power turbine at atmospheric pressure and approximately 1,100°F.

### **2.2.2 Simple-Cycle**

The MEC will use Simple-Cycle power generation technology to deliver electrical peaking power during periods when short-term demand exceeds base load requirements. Peaking power units are able to be brought on and off-line quickly, in response to nearly instantaneous fluctuations in electricity demand.

#### **2.2.2.1 The Brayton "Simple" Cycle**

The production of electricity using a combustion turbine engine coupled to a shaft driven generator is referred to as the Brayton Cycle. This power generation cycle has a thermodynamic efficiency which



generally approaches 40%. This is also referred to as "Simple-Cycle" and has been traditionally utilized for electricity peaking generation since the turbine(s) and subsequent electrical output can be brought on line very quickly. The largest energy loss from this cycle is from the turbine exhaust in which heat is discarded to the atmosphere at about 1,100°F.

### **2.2.3 Fuel Gas System**

Pipeline-quality natural gas is delivered to the plant boundary at a sufficient pressure so that no additional fuel compression will normally be required. If gas compression is required, it will be accomplished using an electrically-driven compression system. The gas is first sent through a knockout drum for removal of any large slugs of liquid which may have been carried through from the pipeline. Only one knockout drum is provided.

The natural gas then passes through a filter/separator to remove particulate matter and entrained liquids. The gas flows through the filter/separator's first chamber, the filtration section, where entrained liquid is coalesced on the filter cartridges, drops to the bottom of the chamber and either vaporizes and returns to the main gas stream or drains to the sump below. The gas then flows through the coalescing filters which remove any particulate matter. Next, the gas passes to the second chamber, the separation section, where any entrained liquid remaining in the stream is further separated by impingement on a net or labyrinth and drains to the bottom sump.

The gas is then heated by a natural gas-fired heater, prior to being split for distribution to the three GE turbines. The fuel gas heater is designed for use as a means to prevent condensation of moisture and hydrates in the natural gas used in the CTGs. Each stream is sent through one last knockout drum to protect against the presence of liquid in the fuel. Finally, the gas is delivered to the turbines and combusted as part of the power generation cycle.

### **2.2.4 Distillate Oil Storage**

Diesel fuel will be provided by tanker trucks and stored in two, above-ground storage tanks made of steel. These tanks will also supply fuel to the combustion turbines during diesel oil-firing. On site oil storage requirements have been estimated to be a maximum of 2.5 million gallons, with a maximum day storage tank requirement of 0.6 million gallons.

### **2.2.5 Ancillary Facilities**

Other systems supporting plant operations and safety include:

- Auxiliary Cooling Water System
- Fire Protection System

- Service Water System
- Process Waste Water System
- Potable Water and Sanitary Waste Water System
- Storm Water System
- Plant and Instrument Air System
- Continuous Emissions Monitoring System (CEMS)
- Maintenance Lifting System
- Unit Control System

### 3.0 PROJECT EMISSIONS

This section discusses the basis and methods used to calculate emissions for the MEC. The section is organized according to the primary emission source groups. Within each section the methods used to calculate emissions and any adjustments that are required appear first, followed by a summary of the emissions resulting from the specific operation or activity.

The calculation procedures used during the development of this application rely on process information developed by MEC for the operations to be conducted at the MEC, manufacturers' data, and methods presented by the U.S. EPA in the "Compilation of Air Pollution Emission Factor, AP-42". The summary presented below has been prepared for each major emission-generating component of the proposed project, which includes:

- Combustion Turbines (3 Units);
- Natural gas fuel heater; and
- Fugitive Emissions from distillate oil storage .

Detailed emission calculations for each emission source or source category are presented in Appendix B.

#### 3.1 Combustion Turbines

##### 3.1.1 Criteria Pollutants

Criteria pollutant emissions are those that contribute to the formation of ambient air concentrations of pollutants for which the EPA has established National Ambient Air Quality Standards (NAAQS) based on health effects criteria. The PSD-regulated criteria pollutant emissions associated with natural gas combustion are CO, NO<sub>x</sub>, VOC, SO<sub>2</sub>, and Particulates (PM/PM<sub>10</sub>). The only PSD-regulated non-criteria pollutant expected to be emitted in significant quantities is sulfuric acid mist (SAM).

The primary emission sources at the MEC will be the three(3) combustion turbines. Hourly emissions from these units were calculated from manufacturers' operating parameters and guaranteed in-stack concentrations for CO, NO<sub>x</sub>, and VOC. SO<sub>2</sub> emissions were calculated using the manufacturers' supplied fuel consumption data and fuel gas sulfur content. Particulate emissions include front-half and back-half particulate matter as measured by EPA Methods 5 and 202.

Maximum hourly emission rates for each compound are based on the type of fuel fired, the four ambient temperatures, and the three turbine load conditions (100%, 75%, and 50%) that represent the range of expected operating conditions. Annual emissions are based on the hourly emission rates for the worst-case loads during both natural gas and distillate oil-firing at an ambient temperature of 50°F

(the inlet temperature for the majority of expected operating hours during the summer with inlet chilling). Annual emission estimates for NO<sub>x</sub>, CO, VOC, SO<sub>2</sub>, and PM/PM<sub>10</sub> are calculated using a worst-case operating schedule of:

- 3,500 hours total operation per turbine, considering both natural gas and distillate oil;
- up to 3,500 hours of operation per year per turbine on natural gas; and
- 1,500 hours of operation per year per turbine on distillate oil.

The PSD permit will limit each turbine to 3,500 hours of operation per year.

The data used in this analysis is presented in Appendix B. Table 3-1 presents a summary of worst-case hourly emissions for the three combustion turbines. Table 3-2 presents a summary of estimates of annual potential emissions.

### 3.1.2 Non-Criteria Pollutants

Non-criteria pollutant emissions include PSD-regulated non-criteria pollutants and pollutants regulated by U.S. EPA under the National Emissions Standards for Hazardous Air Pollutants (NESHAPS). Estimates of Sulfuric Acid Mist and Lead emissions are included in tables 3-1 and 3-2, and have been prepared using the same calculation methodology as presented for PSD-regulated criteria pollutants.

An estimate of total Hazardous Air Pollutants emissions has also been performed. The calculation procedures used during the development of this application rely on process information developed for the proposed project, manufacturers' data and emission factors presented by U.S. EPA in the "Compilation of Air Pollution Emission Factor, AP-42". The summary presented below has been prepared for each source category identified previously. Detailed emission calculations for each emission source or source category are presented in Appendix B.

The primary emission sources at the MEC will be the three (3) combustion turbines. Hourly emissions from these units were calculated using the manufacturers' fuel feed rate (as MMBtu/hr). Emission factors were derived from one of two sources: 1) Section 3.1 of AP-42 or 2) information from the California Air Resources Board (CARB) CATEF database. The source of emission factors for each pollutant is identified in the Appendix B.

Maximum hourly emission rates for each compound were established using the highest hourly fuel feed rate (as MMBtu/hr, Higher Heating Value (HHV)) for the three load and the four ambient temperature conditions identified above. Annual emissions were based on the hourly fuel feed rate for 50°F, 100% load and 3,500 hours of operation with up to 1,500 hours of distillate oil operation. Table 3-3 presents a summary of emissions for the combustion turbines and the fuel heater.

**Table 3-1 Hourly Emission Rate Summary for the MEC Combustion Turbines**

Compound	Load (%)	Temperature (°F)			
		91	50	42	30
<b>Emissions for One GE 7FA Turbine – Natural Gas Operation</b>					
NO <sub>x</sub>	100	71.4	79.5	80.5	82.1
	75	58.0	63.4	64.1	65.3
	50	45.9	50.3	50.8	51.6
CO	100	26.5	29.6	30.1	30.9
	75	21.8	23.5	23.8	24.3
	50	18.4	19.5	19.7	20.0
VOC	100	2.6	2.9	2.9	3.0
	75	2.2	2.3	2.3	2.3
	50	1.8	1.9	1.9	1.9
SO <sub>2</sub>	100	9.5	10.6	10.7	10.9
	75	7.8	8.5	8.6	8.8
	50	6.2	6.8	6.9	7.0
H <sub>2</sub> SO <sub>4</sub>	100	1.5	1.6	1.6	1.7
	75	1.2	1.3	1.3	1.3
	50	0.9	1.0	1.1	1.1
PM	100	18.0	18.0	18.0	18.0
	75	18.0	18.0	18.0	18.0
	50	18.0	18.0	18.0	18.0
<b>Emissions for One GE 7FA Turbine – Distillate Oil Operation</b>					
NO <sub>x</sub>	100	289.6	321.0	325.5	332.1
	75	232.7	254.0	257.9	263.2
	50	181.9	199.2	201.5	204.6
CO	100	59.5	66.6	67.8	69.6
	75	50.7	56.8	57.5	58.5
	50	78.3	66.5	64.6	67.6
VOC	100	2.7	3.0	3.0	3.1
	75	2.2	2.3	2.3	2.4
	50	1.8	1.9	1.9	1.9
SO <sub>2</sub>	100	90.3	100.2	101.6	103.6
	75	73.3	80.0	81.3	82.9
	50	57.9	63.4	64.2	65.1
H <sub>2</sub> SO <sub>4</sub>	100	13.8	15.3	15.6	15.9
	75	11.2	12.2	12.4	12.7
	50	8.9	9.7	9.8	10.0
PM	100	34.0	34.0	34.0	34.0
	75	34.0	34.0	34.0	34.0
	50	34.0	34.0	34.0	34.0
Pb	100	0.025	0.027	0.028	0.028
	75	0.020	0.022	0.022	0.023
	50	0.016	0.017	0.018	0.018

**Table 3-2 Annual Emission Summary for the MEC Combustion Turbines**

Turbine	NO <sub>x</sub>	CO	VOC	SO <sub>2</sub>	H <sub>2</sub> SO <sub>4</sub>	PM	PM <sub>10</sub>	Pb
<b>Emissions for One Combustion Turbine (tons/year)<sup>1</sup></b>								
GE 7FA	320.3	79.6	5.2	85.8	13.1	43.5	43.5	0.02
<b>Emissions for All Combustion Turbines (tons/year)<sup>1</sup></b>								
3 x GE7FA	960.9	238.8	15.6	257.4	39.3	130.5	130.5	0.06
<b>Notes:</b>								
<sup>1</sup> Based on worst case hourly emission rate over the load range (50% - 100% base load), at the effective Annual Average Temperature of 50°F, and the following operation schedule: NG Annual Operation 2,000 hrs/year/turbine Oil Annual Operation 1,500 hrs/year/turbine Total Annual Operation 3,500 hrs/year/turbine								

**Table 3-3 Facility HAP Emission Summary**

		3500 hrs Natural Gas	2000 hrs NG	1500 hrs Oil	2000 hrs NG & 1500 hrs Oil	CTGs All Cases	Fuel Heater	Facility Total
Total HAPs	tpy	5.0	2.9	3.1	6.0	6.0	0.02	6.0
Max Single HAP	tpy	2.6	1.5	1.9	1.9	2.6	2.29E-02	2.6
Max HAP Compound		Formaldehyde	Formaldehyde	Manganese	Formaldehyde	Formaldehyde	Hexane	
							Major Total HAPs	No
							Major Single HAP	No

**3.2 Natural Gas Fuel Heater**

Emission calculations for this unit are presented in Appendix B and summarized in Table 3-4 for criteria pollutants.

**Table 3-4 Criteria Pollutant Emissions Summary for the Fuel Heater**

Criteria Pollutants	Emission Rate - per Unit	
	Hourly (Lbs/Hr)	Annual (Tons/Year)
Nitrogen Oxides	1.3	2.3
Carbon Monoxide	1.2	2.1
Volatile Organic Carbon	0.78	1.37
Sulfur Oxides	0.07	0.13
Particulate	0.13	0.13

### **3.3 Fugitive Emissions**

Breathing and working losses from the two, above-ground distillate oil storage tanks will constitute the main fugitive emissions from the MEC. The emission calculations were performed using Tanks 4.0, a U.S. EPA computer model, which considers tank characteristics, meteorological data, and annual material throughput to estimate emissions. A summary of the tanks' fugitive emissions is presented in Appendix B.

### **3.4 Total Project Criteria Pollutant Emission Summary**

Tables 3-5 and 3-6 combine the analyses summarized on the preceding pages to establish the maximum emissions for the MEC. The annual emissions summaries reflect the maximum number of hours the turbines and fuel heater will operate. This will become a federally enforceable limitation specified in the PSD permit upon issuance.

**Table 3-5 Project Hourly Emissions (lb/hr) Summary, Criteria Pollutants, MEC**

Source Name	Source	NO <sub>x</sub>	CO	VOC	SO <sub>2</sub>	H <sub>2</sub> SO <sub>4</sub>	PM/PM <sub>10</sub>	Pb
<b>Hourly Emission Rates (lb/hr)</b>								
Combustion Turbine No. 1	GE 7FA	332.1	78.3	3.1	103.6	15.9	34.0	0.03
Combustion Turbine No. 2	GE 7FA	332.1	78.3	3.1	103.6	15.9	34.0	0.03
Combustion Turbine No. 3	GE 7FA	332.1	78.3	3.1	103.6	15.9	34.0	0.03
Fuel Heater No. 1		1.3	1.2	0.78	0.07		0.13	
Fuel Tanks				2.58				
<b>Total</b>		<b>997.6</b>	<b>236.1</b>	<b>12.7</b>	<b>310.9</b>		<b>102.1</b>	<b>0.1</b>

**Note:** This table presents the maximum emission rate over the potential operating range (50% to 100% load and 30 to 91°F) for all operating conditions (Natural Gas or Oil).

**Table 3-6 Project Annual Emissions (tons/yr) Summary, Criteria Pollutants, MEC**

Source Name	Source	NO <sub>x</sub>	CO	VOC	SO <sub>2</sub>	H <sub>2</sub> SO <sub>4</sub>	PM/PM <sub>10</sub>	Pb
Combustion Turbine No. 1	GE 7FA	320.3	79.6	5.2	85.8	13.1	43.5	0.02
Combustion Turbine No. 2	GE 7FA	320.3	79.6	5.2	85.8	13.1	43.5	0.02
Combustion Turbine No. 3	GE 7FA	320.3	79.6	5.2	85.8	13.1	43.5	0.02
Fuel Heater No. 1		2.3	2.1	1.37	0.13		0.23	
Fuel Tanks				2.0				
<b>Total</b>		<b>963.2</b>	<b>240.9</b>	<b>18.9</b>	<b>257.5</b>	<b>39.3</b>	<b>130.7</b>	<b>0.1</b>

**Note:** This table presents the annual potential emissions based on maximum hourly emissions over 50% to 100% load range at the effective annual average temperature of 50 °F for all operating conditions (Natural Gas or Oil)



## 4.0 APPLICABLE REGULATIONS AND STANDARDS

The following air regulations have been reviewed as they may apply to the proposed facility:

- Prevention of Significant Deterioration (PSD) pre-construction review under 40 CFR Part 52;
- New Source Performance Standards (NSPS) under 40 CFR Part 60;
- National Emissions Standards for Hazardous Air Pollutants (NESHAPs) under 40 CFR Part 63;
- Acid Rain Deposition Control Program under 40 CFR Parts 72, 73, and 75;
- CAA Operating Permit Program under 40 CFR Part 70; and
- State of Florida Air Resource Management Rules under Chapter 62 of the Florida Administrative Code.

These regulations are implemented by the FDEP through the federally-approved CAA State Implementation Plan (SIP) or by U.S. EPA-delegated authority. A review of the applicability criteria for these rules and the conclusions drawn relative to the proposed facility is presented below.

### 4.1 Prevention of Significant Deterioration

The proposed facility is required to submit an application for a permit to construct under the Prevention of Significant Deterioration (PSD) rules codified at 40 CFR Part 52 and incorporated as a SIP-approved program into Rule 62-212.400, F.A.C. The facility would be subject to PSD review for PSD-regulated pollutants, if it is a "major" source. New sources of air emissions are considered major sources if they have the "Potential-to-Emit" (PTE) more than the 100 tons/year for "listed" source categories or 250 tons/year for all other source categories. One of the 28 source categories listed in the PSD regulations is "fossil-fuel fired steam electric plants of more than 250 million Btu per hour heat input." Gas turbines used without heat recovery, such as simple cycle peaking units, have been determined to fall outside of the 28-source category list, and thus are subject to PSD review if potential emissions of any regulated pollutant exceed 250 tons/year.

As shown in Table 3-6, air emissions from the MEC will exceed the 250 ton per year threshold for one or more criteria pollutants. As such, PSD review is required for each pollutant emitted in excess of the Significant Emission Rates listed in Table 62-212.400-2 F.A.C. and shown in Table 4-1.

**Table 4-1 Project PTE (TPY) Criteria Pollutant Emissions Summary, Midway Energy Center**

Source Name	NO <sub>x</sub>	CO	VOC	SO <sub>2</sub>	PM/PM <sub>10</sub>	H <sub>2</sub> SO <sub>4</sub>	Pb
Combustion Turbine No. 1	320.3	79.6	5.2	85.8	43.5	13.1	0.02
Combustion Turbine No. 2	320.3	79.6	5.2	85.8	43.5	13.1	0.02
Combustion Turbine No. 3	320.3	79.6	5.2	85.8	43.5	13.1	0.02
Natural Gas Heater	2.3	2.1	1.4	0.13	0.23		
Distillate Oil Storage			2.0				
<b>Total (Tons/year)</b>	<b>963.2</b>	<b>240.9</b>	<b>18.9</b>	<b>257.5</b>	<b>130.7</b>	<b>39.3</b>	<b>0.1</b>
<b>PSD Major Source Threshold</b>	<b>250</b>	<b>250</b>	<b>250</b>	<b>250</b>	<b>250</b>	<b>250</b>	<b>250</b>
<b>PSD Significant Threshold</b>	<b>40</b>	<b>100</b>	<b>40</b>	<b>40</b>	<b>25/15</b>	<b>7</b>	<b>0.6</b>

The following requirements are encompassed by PSD review.

- Compliance with any applicable emission limitation under the State Implementation Plan (SIP);
- Compliance with any applicable NSPS or NESHAPS;
- Application of Best Available Control Technology (BACT), as defined by the PSD rules, to emissions of NO<sub>x</sub>, CO, SO<sub>2</sub>, and PM/PM<sub>10</sub> from all significant sources at the facility;
- A demonstration that the facility's potential emissions, and any emissions of regulated pollutants resulting from directly related growth of a residential, commercial or industrial nature, will neither cause nor contribute to a violation of the NAAQS or allowable PSD increments;
- An analysis of the impacts on local soils, vegetation and visibility resulting from emissions from the facility and emissions from directly related growth of a residential, commercial, or industrial nature;
- An evaluation of impacts on Visibility and Air Quality Related Values (AQRVs) in PSD Class I areas (if applicable); and
- At the discretion of FDEP, pre-construction and/or post-construction air quality monitoring for NO<sub>x</sub>, CO, SO<sub>2</sub>, and PM/PM<sub>10</sub>.

Potentially applicable SIP limitations, NSPS and NESHAPs requirements are discussed below. A detailed BACT analysis is presented in Section 5. Contributions to the NAAQS and PSD increments are discussed in Section 6. Impacts on local soils, vegetation, and visibility are addressed in Section 7.

4.2 NSPS

The NSPS regulation that applies to combustion turbines is Subpart GG. This standard is applicable to stationary gas turbine units that have a heat input of greater than 10 MMBtu/hr. Under Subpart GG, units with a heat input at peak load greater than 100 MMBtu/hr and which supply more than one third of their electric generating capacity to a utility distribution system shall not emit NO<sub>x</sub> in excess of:

$$STD = 0.0075(14.4/Y) + F$$

Where:

STD is the allowable NO<sub>x</sub> emission, percent volume (corrected to 15 percent oxygen dry basis)

Y is rated heat rate at peak load, kilojoules/watt hour

F is NO<sub>x</sub> emission allowance for fuel bound nitrogen, percent volume (for nitrogen content greater than 0.25 percent weight, F is 0.005 percent volume)

Applying the heat rate to the proposed General Electric 7FA turbine results in an applicable NSPS for NO<sub>x</sub> emissions of approximately 110 ppmv on a dry basis, corrected to 15 percent oxygen, when firing natural gas. For distillate oil firing, the applicable NSPS limit is 102 ppm @ 15% oxygen. Both of these emission limits are well above the levels proposed as BACT (see Section 5).

Subpart GG also regulates the discharge of SO<sub>2</sub> by requiring compliance with one of the following two options:

- Limit SO<sub>2</sub> emissions to 0.015 percent or less by volume at 15 percent O<sub>2</sub> on a dry basis, or
- Limit the sulfur content of the fuel to 0.8 percent by weight or less.

The proposed project will readily meet the NSPS for SO<sub>2</sub> as both the proposed natural gas (2 grains/100 SCF) and distillate oil (<0.05 wt%) fuels will contain less than 0.8 percent sulfur content by weight.

Subpart Kb applies to each storage vessel, with some specified exceptions, with a capacity greater than or equal to 40 m<sup>3</sup> that is used to store volatile organic liquids for which construction commenced after July 23, 1984. Subpart Kb establishes storage vessel control equipment specifications, testing and associated procedures, and reporting and record keeping requirements. For this project, the distillate oil storage vessels will be subject to Subpart Kb based upon their maximum storage capacity. Due to the low vapor pressure of No. 2 distillate oil, these tanks will only be required to maintain records of the dimensions and maximum capacity of the tanks. No control requirements will apply.

**4.3 NESHAPS**

There is currently no NESHAPS for stationary gas turbines, although this is a source category scheduled for a determination of Maximum Achievable Control Technology (MACT) under 40 CFR Part 63. However, 40 CFR Part 63, Subpart B governs the construction or reconstruction of major sources of Hazardous Air Pollutants (HAPs) for which a NESHAP has not been promulgated. The rule requires new major sources of HAPs to install MACT for HAPs. MACT must be determined as a condition of pre-construction approval. A major source of HAPs is any stationary source that has the potential to emit 10 tons/year or more of a single HAP or 25 tons/year of combined HAPs.

Table 4-2 summarizes the project PTE for non-criteria pollutants. The project is not a major HAP source, and, therefore, 40 CFR Part 63 Subpart B does not apply.

**Table 4-2 Project PTE Non-Criteria Pollutant Emissions Summary**

Emission Source	HAP Emission Rate		Maximum HAP Emission Rate	
	Lbs/Hr	tons/year	Lbs/Hr	tons/year
Combustion Turbines <sup>(a)</sup>	4.7	6.0	1.5	2.6
Fuel Heater <sup>(b)</sup>	2.5x10 <sup>-2</sup>	0.04	2.3x10 <sup>-2</sup>	0.04
Total	4.7	6.0	1.5	2.6

(a) Formaldehyde is the single HAP, which has the greatest contribution to the Total HAP Potential to Emit from the combustion turbines.  
 (b) Hexane is the single HAP which has the greatest contribution to the Total HAP Potential to Emit from the fuel heater.

**4.4 Acid Rain**

The proposed facility meets the definition of "utility unit" and will be an affected Phase II unit under the Acid Rain Deposition Control Program pursuant to Title IV of the Clean Air Act. The proposed facility will have to obtain a Title IV permit before commencing operation. The Title IV permit will require that the facility hold calendar-year allowances for each ton of SO<sub>2</sub> that is emitted and conduct emissions monitoring for SO<sub>2</sub> and NO<sub>x</sub> pursuant to the requirements in 40 CFR Parts 72, 73, and 75.

**4.5 CAA Operating Permit Program**

FDEP administers the CAA Operating Permit Program under Rule 62-213 which has been approved by EPA under 40 CFR Part 70. A new major source must submit a Title V operating permit application to FDEP within 180 days after commencing operation. The Title V application will incorporate applicable emission limitations, monitoring, record keeping and reporting requirements from the PSD construction permit.

#### 4.6 State SIP Rules

In addition to the above regulations, the proposed facility is also subject to the Florida Air Pollution Control Regulations codified in Chapters 62-204 through 62-297 of the Florida Administrative Code (F.A.C.). The F.A.C. rules that are potentially applicable to the proposed project are as follows:

- General Pollutant Emission Limiting Standards

Rule 62-296.320 limits visible emissions from any activity not specifically addressed by another Florida Regulation in Chapter 62-296. The general visible emission standard for stacks limits opacity to 20%. Compliance with the visible emission standard must be done in accordance with U.S. EPA Method 9. A companion rule limits visible emissions from fugitive sources by requiring sources to take reasonable precautions to prevent such emissions. Fugitive emissions may occur during construction of the facility. Wet suppression or similar techniques will be used to control emissions as necessary during construction activities

- General Construction Permitting Requirements

Rule 62-210.310 requires that an air construction permit be obtained prior to commencing construction. The requirements for construction permits and approvals are contained in Rules 62-4.030, 62-4.050, 62-4.210, and 62-210.300(1). This document includes the general information required by the FDEP for a construction permit application.

- Stack Height Policy

Rule 62-210.550 specifies the stack height requirements and permissible dispersion techniques for permitting air emission sources. The facility will comply with the provisions of this regulation as presented in the air quality impact assessment (Section 6).

- Excess Emissions

Rule 62-210.700 provides allowances for excess emissions for emission units that may occur during periods of startup, shutdown, malfunction, and load changes (non steady-state operations). Excess emissions from the combustion turbines are expected to occur during startup and shutdowns. The facility will apply best operational practices to minimize the duration of excess emissions.

- Annual Emissions Reporting

Rule 62-210.370 requires Title V sources to submit an annual operating report that provides emissions information for the previous calendar year. Midway Development Company, LLC will submit to the FDEP annual emissions reports by March 1 of the following year.

---

## 5.0 CONTROL TECHNOLOGY EVALUATION

### 5.1 Introduction

In accordance with PSD requirements, FDEP requires the application of Best Available Control Technology (BACT) for the control of each regulated pollutant emitted in significant quantities from a new major stationary source located in an attainment area for that pollutant. The proposed Midway Energy Center's combustion turbines must demonstrate the application of BACT for oxides of nitrogen (NO<sub>x</sub>), carbon monoxide (CO), fine particulate (PM<sub>10</sub>), sulfur dioxide (SO<sub>2</sub>), and sulfuric acid mist (H<sub>2</sub>SO<sub>4</sub>).

#### 5.1.1 Top-Down BACT Approach

The BACT requirements are intended to ensure that a proposed facility or major modification will incorporate air pollution control systems that reflect the latest demonstrated practical techniques for each particular emission unit, and will not result in the exceedance of a National Ambient Air Quality Standard (NAAQS), PSD Increment, or other standards imposed at the state level. The BACT evaluation requires the documentation of performance levels achievable for each air pollution control technology applicable to the Midway Energy Center.

EPA and FDEP recommend a "top-down" approach when evaluating available air pollution control technologies. This approach to BACT involves determining the most stringent control technique available, known as the Lowest Achievable Emission Rate (LAER) for a similar or identical emission source. If it can be shown that the LAER is technically, environmentally, or economically impractical on a case-by-case basis for the proposed emission source, then the next most stringent level of control is similarly evaluated. This process continues until a control technology and associated emission level is determined that cannot be eliminated by any technical, environmental, or economic objections. The top-down BACT evaluation process is described in U.S. EPA's draft document "New Source Review Workshop Manual (U.S. EPA, October 1990). The five steps involved in a top-down BACT evaluation are:

- Identify options with practical potential for control of the regulated pollutant under evaluation;
- Eliminate technically infeasible or unavailable technology options;
- Rank the remaining control technologies by control effectiveness;
- Evaluate the most effective controls and document the results; if the top option is not selected as BACT, evaluate the next most effective control option; and

- Select BACT, which will be the most effective practical option not rejected based on prohibitive energy, environmental, or economic impacts.

ENSR employed the "top-down" approach in evaluating available pollution controls for the Midway Energy Center.

### **5.1.2 Cost Determination Methodology**

Economic analyses of certain BACT alternatives were performed to compare capital and annual control costs in terms of cost-effectiveness (i.e., dollars per ton of pollutant removed). Capital costs include the initial cost of components intrinsic to the complete control system. High-temperature SCR, for example, would include catalyst modules, transition piece, support frame, ammonia storage tanks, ammonia dilution air and injection system, piping, flue gas attemperation system, provisions for catalyst cleaning and removal, instrumentation, and installation costs. Annual operating costs consist of the financial efficiency losses, parasitic loads, and revenue loss from operation of the control system and include overhead, maintenance, labor, raw materials, and utilities.

### **5.1.3 Capital Costs**

The capital cost estimating technique used in this analysis is based on a factored method of determining direct and indirect installation costs. This technique is a modified version of the "Lang Method," whereby installation costs are expressed as a function of known equipment costs. This method is consistent with the latest U.S. EPA guidance manual (OAQPS Control Cost Manual) on estimating control technology costs (U.S. EPA, January 1996). The estimation factors used to calculate total capital costs are shown in Table 5-1.

Purchased equipment costs represent the delivered cost of the control equipment, auxiliary equipment, and instrumentation. Auxiliary equipment consists of all structural, mechanical, and electrical components required for continuous operation of the device. These may include such items as reagent storage tanks, supply piping, turbine outlet transition piece, catalyst removal crane, spare parts and catalyst, and air dilution system. Auxiliary equipment costs are taken as a straight percentage of the basic equipment cost, the percentage based on the average requirements of typical systems and their auxiliary equipment (U.S. EPA, January 1996). In this BACT evaluation, basic equipment costs were obtained from data provided by qualified vendors (see Appendix C). Instrumentation, which is usually not included in the basic equipment cost, is estimated at 10 percent of the basic equipment cost.

Direct installation costs consist of the direct expenditures for materials and labor including site preparation, foundations, structural steel, insulation erection, piping, electrical, painting, and enclosure.

**Table 5-1 Capital Cost Estimation Factors**

Item	Basis
<b>Direct Costs</b>	
<b>Purchased Equipment Cost</b>	
Equipment cost + auxiliaries <sup>1</sup>	A
Instrumentation	0.10 x A
Sales taxes	0.06 x A
Freight	0.05 x A
Total Purchased equipment cost, (PEC)	B = 1.21 x A
<b>Direct installation costs</b>	
Foundations and supports	0.08 x B
Handling and erection	0.14 x B
Electrical	0.04 x B
Piping	0.02 x B
Insulation for ductwork	0.01 x B
Painting	0.01 x B
Total direct installation cost	0.30 x B
Site Preparation, SP	As Required
Buildings, Bldg	As Required,
<b>Total Direct Cost, DC</b>	<b>1.30B + SP + Bldg.</b>
<b>Indirect Costs (installation)</b>	
Engineering	0.10 x B
Construction and field expenses	0.05 x B
Contractor fees	0.10 x B
Start-up	0.02 x B
Performance test	0.01 x B
Contingencies	Variable
Other <sup>2</sup>	As Required
Interest during construction <sup>3</sup>	DC x i x n
<b>Total Indirect Cost, IC</b>	<b>0.28B + Interest + Contingencies</b>
<sup>1</sup> Auxiliaries include ammonia tank, transition piece, crane, spare catalyst, dilution air system, etc. <sup>2</sup> Emergency Response Plan (ER), Spill Prevention Countermeasure and Control (SPCC), Risk Management Plan (RMP), etc. <sup>3</sup> Simple Interest During Construction, i = interest rate; n = interest period	
<b>Total Capital Investment (TCI) = DC + IC</b>	<b>1.58B+ SP + Bldg. + Interest + Contingencies</b>



Indirect installation costs include engineering and supervision of contractors, construction and field expenses, construction fees, contingencies, and additional permits and licensing costs.

Direct installation costs are expressed as a function of the purchased equipment cost, based on average installation requirements of typical systems. Indirect installation costs are designated as a percentage of the total direct cost (purchased equipment cost plus the direct installation cost) of the system. Other indirect costs include equipment startup and performance testing, contingencies, working capital, and interest during construction.

**5.1.3.1 Annualized Costs**

Annualized costs are comprised of direct and indirect operating costs. Direct costs include electricity losses, labor, maintenance, replacement parts, raw materials, and utilities. Indirect operating costs include overhead, taxes, insurance, general administration, contingencies, and capital charges. Annualized cost factors used to estimate total annualized cost are listed in Table 5-2, and are consistent with the EPA guidance on estimating control technology costs (U.S. EPA, January 1996).

Direct operating labor costs vary according to the system operating mode and operating time. Labor supervision is estimated as 15 percent of operating labor. Maintenance costs are calculated as 3 percent of total direct cost (TDC). Replacement part costs, such as the cost to replace aged or failed catalyst, have been included where appropriate. Reagent and utility costs are based upon estimated annual consumption and the unit costs are summarized in Table 5-2. The presence of a catalyst bed would increase turbine back pressure resulting in heat rate (efficiency) losses to the system. This is reflected in the economic analysis as the value of lost power output and is based on turbine vendor estimates. Based on the experience of other facilities contacted, the catalyst for a catalytic oxidation or reduction technology is assumed in this analysis to require replacement every 3 years due to failure or aging. The cost of replacement catalyst was provided by catalyst vendors which was then annualized over 3 years.

With the exception of overhead and contingency, indirect operating costs are calculated as a percentage of the total capital cost. The indirect capital costs are based on the capital recovery factor (CRF), defined as:

$$CRF = \frac{i(1+i)^n}{(1+i)^n - 1}$$

Where "i" is the annual interest rate and "n" is the equipment economic life (years). An emission control system's economic life is typically 10 to 20 years (U.S. EPA, January 1996). In this analysis, a 10-year equipment economic life (typical length of financing) was used. The average interest rate is assumed to be 7 percent (U.S. EPA, January 1996). CRF is therefore calculated to be 0.142.

**Table 5-2 Annualized Cost Factors**

Item	Cost Factor	Unit Cost
<b><u>DIRECT ANNUAL COSTS, DC</u></b>		
<b>Electricity</b>		
Heat rate loss due to pressure drop	0.1% output loss for every inch of delta P	\$0.10/kW-hr
Power lost due to extended startups	Extended startups due to catalyst bed	\$0.10/kW-hr
Dilution air fan electricity	Dilution air to prevent catalyst deterioration	\$0.10/kW-hr
<b>Operating labor</b>		
SCR Labor Req.	0.5 hr/shift	\$30.00/hr
Supervisor	15% Operating Labor	NA
Ammonia Delivery Requirement	24 hr/yr (3 deliveries per year)	
Ammonia Recordkeeping and Reporting	40 hr/yr (1 week of reporting)	
Catalyst Cleaning	80 hr/yr (2 workers x 40 hr/yr)	
<b>Maintenance</b>		
Catalyst Replacement Labor	8 workers, 40 hr, every 3 years	\$30.00/hr
Catalyst System Maintenance Labor Req.	0.5 hr/shift	\$30.00/hr
Ammonia System Maintenance Labor Req.	1 hr/day, 365 day/yr	\$30.00/hr
Material	100% Maintenance Labor	NA
<b>Ammonia</b>		
	Ammonia	\$315 per ton
<b>Process Air</b>		
	350 scf/lb NH <sub>3</sub>	\$0.20 per thousand scf
<b>Catalyst</b>		
	100% replaced/3 years plus disposal	
<b><u>INDIRECT ANNUAL COSTS, IC</u></b>		
<b>Overhead</b>		
Administrative Charges	60% labor + materials	
Property Taxes	2% TCI	
Insurance	1% TCI	
Capital Recovery	1% TCI	
	CRF x TCI	
<b>Contingency for new technology</b>		
	NA	0-20% DC
<b>Total Annual Cost (TAC) (\$)</b>		<b>Sum of Annual Costs</b>
<b>Total Pollutant Controlled (ton/yr)</b>		<b>As Calculated</b>
<b>COST EFFECTIVENESS (\$/ton)</b>		<b>TAC/tpy controlled</b>

### 5.1.3.2 Cost Effectiveness

The cost-effectiveness of an available control technology is based on the annualized cost of the technology and its annual pollutant emission reduction. Cost-effectiveness is calculated by dividing the annualized cost of the available control technology by the theoretical tons of pollutant that would be removed by that control technology each year. The basis for determining the percent reduction of a given technology was based on comparing the uncontrolled emission rate with the achievable emission rate based on information contained in issued permits, EPA literature and vendors of the control equipment.

## 5.2 Previous BACT/LAER Determinations for Simple-Cycle Combustion Turbines

The proposed Midway Energy Center is a "Simple-Cycle" electrical peaking facility. A Simple-Cycle peaking project is fundamentally different than the more common "Combined-Cycle" base load systems that represent the majority of listings in EPA's RACT/BACT/LAER Clearinghouse. The differences in these two types of power generation technology are reviewed in Sections 5.2.1 and 5.2.2.

In a deregulated market for electricity, new generation capacity will be built only when there is a sufficient customer demand for that capacity. The electric output of any new capacity must be sold (and must therefore be priced competitively with existing capacity) in order to earn a Return On Investment (ROI) commensurate with the financial risk of building the powerplant. A market need exists in Florida for peak load power and, therefore, the Midway Energy Center is being developed to serve that specific peak power market.

### 5.2.1 Base Load Power (Combined-Cycle)

Regional power demand is variable from night to day, from hot summer days (which reflect air-conditioning loads) to cold winter days, from workdays to weekends, etc. However, there is a certain constant level of electrical demand that is always present, referred to as "base load". The nature of generation capacity built to provide base load power is that it is designed to maximize annual operation at a constant or "base" load at the lowest operating cost possible. Since fuel cost is the single biggest component of the cost to produce power, competitive base load generators must be designed to operate at the highest possible fuel efficiency and to produce their rated output continuously at maximum availability. The Combined-Cycle plant meets these criteria.

A rotating combustion turbine, driving a generator via a connecting shaft represents a thermodynamic cycle known as the Brayton Cycle; this arrangement is also referred to as "Simple-Cycle". In a Simple-Cycle turbine, air and products of combustion exiting the turbine are exhausted to the atmosphere at temperatures of about 1,100°F, which represents a substantial energy loss.

A boiler that produces steam which is then used to generate electricity in a steam turbine/generator is referred to as the Rankine Cycle. In this thermodynamic cycle, energy lost as waste heat from a surface condenser is typically rejected to cooling towers or a large body of cooling water. Traditional central utility powerplants are of this design. Condensation of steam with cooling water also represents a substantial energy loss.

Each of these cycles is significantly limited in achievable "heat rate" (the amount of electricity that can be generated per Btu of fuel input) because in each case substantial amounts of heat energy are wasted. When a Brayton Cycle turbine is connected in series with a Rankine Cycle waste heat boiler, a much lower heat rate (higher thermal efficiency) can be achieved. This is referred to as "Combined-Cycle". While a Combined-Cycle powerplant exhibits much higher initial capital cost, these costs can be quickly recovered in greater fuel efficiency in a base load plant which operates around the clock at near full capacity. The Combined-Cycle powerplant therefore, by definition incorporates a waste heat boiler or Heat Recovery Steam Generator (HRSG) and steam turbine generator. The HRSG recovers waste heat exiting the turbine at about 1,100°F and exhausts at about 220°F. With an HRSG as a component of the above-mentioned combined cycle, a temperature "window" exists which has allowed catalytic pollution control technology to be widely applied to new Combined-Cycle powerplants. This post combustion control technology is responsible for the very low (i.e. 2.5 – 3.5 ppm) NO<sub>x</sub> emission rates reported for recent Combined-Cycle units in EPA's RACT/BACT/LAER Clearinghouse.

### 5.2.2 Peaking Power (Simple-Cycle)

Once base load demand is satisfied, a need still exists to supply additional power at certain times when base load requirements are exceeded by the short term peak power demand. Average peak power prices tend to be higher than for base load power. However, peaking units operate substantially fewer hours per year than base load units. The economics of providing peak power favor lower initial capital cost (there are fewer operating hours per year in which to earn back the capital investment) and are less sensitive to optimization of heat rate. Most importantly, peak power must be able to come on-and off-line very quickly and, in some cases is designed to "follow" electrical demand.

Simple-Cycle is the only combustion turbine configuration that meets this requirement. For example, a common application of combustion turbine engines that do not employ an HRSG is for aircraft applications. Helicopters and turbo-prop commuter aircraft utilize combustion turbine engines that drive a mechanical propeller shaft. These engines are routinely shut down during boarding, started up for taxiing and accelerated to full output during takeoff, all within a matter of minutes. Combined-Cycle units, on the other hand require a cold start-up schedule, measured in hours, to be brought from ambient temperature to full load. This is because the heat transfer surfaces and catalyst beds within the HRSG are sensitive to "thermal shock". Ceramics and steel that are heated too quickly are subjected to uneven thermal expansion and will warp, crack and/or fail if not allowed sufficient time to be brought to temperature more gradually. Start up schedules that are designed to protect back end equipment typically involve several steps of "ramping" and "soaking." This soaking time is required to

protect the back-end equipment from failure due to thermal stress limits the feasibility of HRSG's and catalysts for use in quick response peaking applications. On any given day, the demand for peak power may only last three to four hours. By the time a Combined-Cycle unit has been warmed up to full operating load, the market demand to produce the peak power may be over.

### **5.2.3 BACT Determinations for Simple-Cycle Combustion Turbines**

When reviewing emission levels that have been permitted as BACT or LAER in EPA's database, it is important to distinguish between Simple-Cycle and Combined-Cycle source categories, although the Clearinghouse listings are not always clearly categorized. It should also be noted that natural gas pipeline compressor engines are mechanical compressor drive applications; while they do not employ HRSG's, these sources are much smaller units (2-5 MW equivalent) and do not cycle on and off to meet demand as quickly or as frequently as power generation peaking turbines do. Compressor station turbines are not representative of a large scale peaking powerplant application.

A list of previous BACT/LAER determinations for all types of combustion turbines is presented in Appendix C. These tables are compiled from EPA's RACT/BACT/LAER Clearinghouse and from ENSR's database of combustion turbine projects. The RACT/BACT/LAER Clearinghouse keeps a listing of RACT/BACT/LAER determinations by governmental agencies for many types of air emission sources, and is available in hard copy or through a computerized database. While the RACT/BACT/LAER Clearinghouse covers information from the past 10 to 12 years, only the more recent decisions (1993-present) have been included here.

It should be noted that all listings in California represent LAER, even though they are often listed as BACT (BACT and LAER in California are identical). LAER is a much more stringent requirement than BACT, and involves application of control technology regardless of cost. This is not the case for the proposed Midway Energy Center peaking project. ENSR also reviewed the California Air Pollution Control Officers Association (CAPCOA) on-line BACT Clearinghouse and found the only LAER decisions listed after 1993 to be for the same facilities. ENSR also called regulators in Indiana, California and several other states to determine levels of control which are being proposed or required of the most recent projects. Finally, ENSR contacted the turbine and catalyst manufacturers. Our search identified several Simple Cycle projects not listed in EPA's BACT/RACT/LAER Clearinghouse which have been permitted recently in California with lower emission limits and which employ add-on control technology.

### **5.2.4 Combustion Turbine Fuel Use**

As part of its application, the Midway Energy Facility is requesting increased flexibility regarding the ability to burn 1,500 hours per year of oil. While the intention is to burn natural gas at every opportunity, near term constraints on the Florida Gas Transmission ("FGT") pipeline may impede the ability to burn natural gas during periods of peak demand often associated with the summer season. In general, the

FGT natural gas transmission line flows near its maximum pipeline capacity of 1.5 Bcf/day during the summer season. In order to accommodate the demand for incremental generation within the state of Florida, FGT plans to expand its pipeline capacity by approximately 600,000 MMbtu/day before the summer of 2002. Additionally, FGT is in active discussions with potential shippers to perform another expansion of its pipeline in 2003. The addition of this capacity should reduce periods of pipeline constraint and will result in an increased availability of natural gas to the proposed site. The request for greater oil burning flexibility is necessitated by near term FGT capacity constraints and is not due to deficient gas supplies received by FGT. Moreover, operational guidelines dictate that natural gas be the primary fuel source and oil will be used only to the extent transmission capacity constraints on FGT preclude the delivery of natural gas to the site.

As the proposed facility is intended to provide peak power which will typically occur during periods when natural gas demand will be high, the ability to operate using distillate oil as an alternative fuel is necessary to provide system reliability. As the facility is being proposed as a dual fuel facility the control technology analysis has been performed assuming the maximum amount of oil consumption, when determining potential emissions.

### **5.3 BACT for Nitrogen Oxides (NO<sub>x</sub>)**

#### **5.3.1 Formation**

NO<sub>x</sub> is primarily formed in combustion processes in two ways: 1) the combination of elemental nitrogen and oxygen in the combustion air within the high temperature environment of the combustor (thermal NO<sub>x</sub>); and 2) the oxidation of nitrogen contained in the fuel (fuel NO<sub>x</sub>). Although natural gas contains free nitrogen, it does not contain fuel bound nitrogen (EPA 1996); therefore, NO<sub>x</sub> emissions from combustion turbines when burning natural gas originate as thermal NO<sub>x</sub>. The rate of formation of thermal NO<sub>x</sub> is a function of residence time and free oxygen, and is exponential with peak flame temperature. Liquid fuels such as No. 2 distillate contain significant levels of fuel bound nitrogen. The combustion of liquid fuels results in inherently higher emissions of NO<sub>x</sub> due to the combination of both thermal NO<sub>x</sub> and fuel NO<sub>x</sub> which forms when fuel nitrogen is exposed to high flame temperatures in the presence of free oxygen.

#### **5.3.2 Front – End Control**

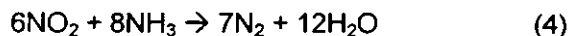
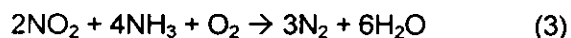
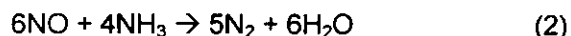
"Front-end" NO<sub>x</sub> control techniques are aimed at controlling one or more of these variables. The primary front-end combustion controls for gas turbines include water or steam injection and dry low NO<sub>x</sub> combustors. The addition of an inert diluent such as water or steam into the high temperature region of the flame controls NO<sub>x</sub> formation by quenching peak flame temperature, which reduces emissions of both thermal and fuel NO<sub>x</sub>. This technique can be operationally very hard on the turbine and combustors due to vibration and flame instability. Recent advances in the state-of-the-art have resulted in dry low NO<sub>x</sub> combustors for gas firing that limit peak flame temperature and excess oxygen

with lean, pre-mix flames, that can achieve equal or better NO<sub>x</sub> control without the addition of water or steam. Catalytic combustion is an emerging front-end technology for gas-only fired turbines using an oxidation catalyst within the combustor to produce a lower temperature flame and hence, low NO<sub>x</sub>. Catalytic combustion is potentially capable of reducing natural gas-fired turbine NO<sub>x</sub> emissions to 2-5 ppmv, but is not applicable to oil-fired or dual fuel applications. Catalytica, Inc. was the first company to commercially develop catalytic combustion controls for certain (mostly smaller) turbine engines and markets them under the name XONON™. Catalytic combustion technology is not yet commercially available for 170 MW F-Class turbines, and is not a technically feasible technology for dual fuel operation. Therefore, XONON™ does not represent an available control option for the Midway Energy Facility.

### 5.3.3 Back – End Control

Other control methods, known as "back-end" controls, remove NO<sub>x</sub> from the exhaust gas stream once NO<sub>x</sub> has been formed. Selective Catalytic Reduction (SCR) using ammonia as a reagent represents the state-of-the-art for back end gas turbine NO<sub>x</sub> removal from base load, combined cycle turbines. Conventional SCR is not applicable to simple cycle turbines due to materials temperature limitations which preclude its application in high temperature simple cycle turbine exhaust. A high temperature SCR technology has recently been introduced for potential application to simple-cycle turbines but with limited success to date. In particular, high temperature SCR has been applied at a few small peaking turbines in California.

Selective catalytic reduction (SCR) is a process which involves post-combustion removal of NO<sub>x</sub> from the flue gas with a catalytic reactor. In the SCR process, ammonia injected into the turbine exhaust gas reacts with nitrogen oxides and oxygen to form nitrogen and water. SCR converts nitrogen oxides to nitrogen and water by the following reactions (Cho, 1994):



The reactions take place on the surface of a catalyst. The function of the catalyst is to effectively lower the activation energy of the NO<sub>x</sub> decomposition reaction. Technical factors related to this technology include increased turbine backpressure, exhaust temperature materials limitations, thermal shock/stress during rapid starts, catalyst masking/blinding, reported catalyst failure due to "crumbling", design of the NH<sub>3</sub> injection system, and high NH<sub>3</sub> slip. There are only four U.S. installations of this technology on simple cycle peaking turbines (Booth, 1999), and none of these has a long-term history of success. Three of these applications are on relatively small natural gas-only peaking turbines that

have limited hours of operation to date. While these units have reported some initial problems, U.S. EPA has indicated that they consider high temperature SCR to be "demonstrated in practice" for natural gas fired peaking turbines.

One of the high temperature SCR installations is the Cambalache Electric Generating Facility, located in Puerto Rico. This project consists of three (3) ABB GT 11N1 combustion turbines operated in simple cycle mode, using distillate oil. The original permit issued for these turbines required the use of SCR to achieve NO<sub>x</sub> emissions of 10 ppm, with a limit of 10 ppm on ammonia emissions. This plant has been operating since 1997 with very poor results for the operation of the SCR system. This project has not been able to operate for any extended period of time while staying within the NO<sub>x</sub> and NH<sub>3</sub> limits and has been issued a Notice of Violation by EPA for exceedances of both NO<sub>x</sub> and NH<sub>3</sub>. Several attempts have been made to regenerate, or clean the catalyst, with no significant improvement in the performance of the system.

As a result of this experience, Englehard is no longer offering this technology for oil-fired turbine applications. The Midway Energy Center Facility is a dual fuel peaking project that must have the flexibility to burn liquid fuel as backup to natural gas. High temperature SCR is not technically feasible for oil firing, and has not been demonstrated in practice on dual fuel peaking turbines. In addition, this technology would not be cost effective, even if the turbines were natural gas only. As shown in Appendix C, high temperature SCR controlling NO<sub>x</sub> emissions to the LAER levels of 5 ppmvd @ 15% O<sub>2</sub> while firing natural gas and 10 ppmvd @ 15% O<sub>2</sub> while firing distillate oil would cost over \$20,000/ton of NO<sub>x</sub> removed.

On August 4, 2000 US EPA issued draft combustion turbine BACT guidance for public review (Appendix C). While this draft document is only being circulated for comment and does not represent official EPA policy, it does contain useful information relative to the application of SCR to GE's 9 ppm DLN generation turbines. Note that the discussion by EPA identifies several negative collateral environmental impacts associated with application of SCR to 9 ppm base load, combined cycle turbines. These negative impacts are exacerbated for simple cycle peaking applications, as discussed below:

Peaking turbines start and stop quickly, and may only operate a few hours at a time. Until the SCR catalyst reaches temperature, ammonia (NH<sub>3</sub>) may not be introduced (resulting in less relative NO<sub>x</sub> control), or if it is introduced will result in elevated NH<sub>3</sub> slip. Since a significant portion of a peaking turbines operation is spent warming up, following load (transient operation) and shutting down, high temperature SCR would control less NO<sub>x</sub> and emit more slip when dispatched than a base load turbine would.

To reduce NO<sub>x</sub> from 9-12 ppm to 5 ppm (the LAER for gas-only peaking turbines in California) on units that will operate less than 3,500 hours per year will result in much lower NO<sub>x</sub> reduction benefits than for EPA's analysis of combined cycle units. It should be noted that 3,500 hours represents an upper limit



on operation for permitting, but in actual operation peaking units may in fact be normally dispatched less than 1,500 hours per year.

Peaking turbines may be thought of as similar to emergency generators. When they are called upon to operate, it is to fill a temporary shortfall in generation capability. SCR systems rob electrical output (due to backpressure) precisely when that output is most needed (peak demand).

High temperature SCR is therefore, not technically feasible, would exhibit overriding negative collateral environmental impacts, and in any event would not be cost effective for application to the dual fuel Midway Energy Facility.

An emerging technology called  $\text{SCONO}_x^{\text{TM}}$ , which also uses a back-end catalyst but operates without ammonia, has shown promise during initial trials on a 23 MW turbine installation in California, and a 5 MW turbine in Massachusetts.  $\text{SCONO}_x^{\text{TM}}$  is an emerging technology that offers the promise of reducing  $\text{NO}_x$  concentrations to approximately 2-3.5 ppmv for smaller turbine applications. Despite this promise,  $\text{SCONO}_x^{\text{TM}}$  is still very new and only operates effectively over a narrow 300°F to 500°F temperature range. According to the ABB Alstom internet website, ( $\text{SCONO}_x^{\text{TM}}$  is marketed for applications greater than 100MW by Alstom).  $\text{SCONO}_x^{\text{TM}}$  is not available for application to simple cycle combustion turbines. The planned Midway Energy Facility turbines will have exhaust temperatures of 1100 to 1200°F therefore,  $\text{SCONO}_x^{\text{TM}}$  is not a technically feasible control option for the proposed Midway Energy Facility.

Two other back-end catalytic reduction technologies, Selective Non-Catalytic Reduction (SNCR) and Nonselective Catalytic Reduction (NSCR), have been used to control emissions from certain other combustion process applications. However, both of these technologies have limitations that make them inappropriate for application to combustion turbines. SNCR requires a flue gas exit temperature in the range of 1300 to 2100°F, with an optimum operating temperature zone between 1600 and 1900°F (Fuel Tech, 1991). Simple-cycle combustion turbines have exhaust temperatures of approximately 1100°F. Therefore, additional fuel combustion or a similar energy supply would be needed to create exhaust temperatures compatible with SNCR operation. This temperature restriction and related economic considerations make SNCR infeasible and inappropriate for the Midway Energy Facility turbines. NSCR is only effective in controlling fuel-rich reciprocating engine emissions and requires the combustion gas to be nearly depleted of oxygen (<4% by volume) to operate properly. Since combustion turbines operate with high levels of excess oxygen (typically 14 to 16%  $\text{O}_2$  in the exhaust), NSCR is infeasible and inappropriate for the Midway Energy Facility turbines.

The technologies that may represent effective controls for the proposed dual fuel peaking turbines are ranked and evaluated in the following sections. It should be stressed that levels of control being evaluated as BACT must be applicable to a dual fuel peaking power plant that will employ simple-cycle turbines for limited annual hours of operation.

**5.3.4 Gas Turbines - Ranking of Available Control Techniques**

Emission levels and control technologies for all types of combustion turbines have been identified and ranked for application to simple cycle dual fuel peaking turbines (see Table 5-3). Dry low NO<sub>x</sub> controls (as described in EPA's draft turbine policy) represent the most stringent control technology for the planned turbine installation. Environmental, technical, and economic analyses of various DLN emissions levels are reviewed in the remaining BACT evaluation sections.

**Table 5-3 Ranking of NO<sub>x</sub> Control Technologies for a Dual Fuel Simple-Cycle Peaking Turbine**

Control Technology	Typical Control Efficiency Range (% Removal)	Typical Emission Level <sup>(a)</sup> (ppmv)	Technically Feasible on Dual Fuel Simple-Cycle Gas Turbine
SCONO <sub>x</sub> <sup>TM</sup>	90-95	2-3.5	No
XONON <sup>TM</sup> flameless combustion	80-90	2-5	No
NSCR	30-70	9-25	No
SNCR	30-70	9-25	No
Conventional (low temperature) SCR plus water injection or SCR plus low-NO <sub>x</sub> combustor	50-95	2-6	No
High Temperature SCR plus water/steam injection or advanced low-NO <sub>x</sub> combustor	50-95	5-12	No
Dry low-NO <sub>x</sub> Combustor	30-70	9-25 (gas)	Yes
Water/steam injection Combustor	30-70	25-42 (oil)	Yes

<sup>(a)</sup> Values represent long-term emission rates.

A search of the U.S. EPA RACT/BACT/LAER Clearinghouse was completed to assist in the identification of potential control alternatives. The RACT/BACT/LAER Clearinghouse has become out of date due to the rapid pace of power projects being permitted due to deregulation of the power generation industry.

In order to determine the specific NO<sub>x</sub> emission levels being permitted for recent peaking turbine projects, ENSR also reviewed an informal list of recent projects obtained from US EPA. The simple cycle turbines subject to BACT in EPA's list are provided in Table 5-4. It can be seen from this list that many simple cycle turbines are being permitted with dry low NO<sub>x</sub> combustors in the range of 9–15 ppm. These emission levels are discussed in the following sections as candidates for BACT from the Midway Energy Center.

Table 5-4 US EPA National Simple Cycle PSD Turbine Projects

Region	State	Permit Date	Facility	# of CTs	# of DB	Turbine Model	Fuel	Mode	Hours	NO <sub>x</sub> Limit	Control Method	Avg. Time	Comments
REGION 4	AL	Applic. Under review	South Eastern Energy Corp.	6	6 if CC	GE 7FA or SW 501F	NG	SC or CC	8,760	9 or 25 or 3.5 ppm	DLN if SC/SC R if CC		For NO <sub>x</sub> and CO: SC w/GE or SC w/SW501F or CC (either)
REGION 4	AL	applic. under review	Tenaska Alabama II Generating Station	3	3	GE 7FA (170 MW)	NG; FO	SC & CC	8,760; 720 FO	15/42 ppm (SC); 4/42 ppm (CC)	DLN/WI ; SCR/WI		
REGION 4	FL	10-99	Polk Power (TECO)	2		GE 7 FA (165 MW)	NG; FO	SC	5,130; 750 FO	10.5 ppm NG; 42 ppm FO	DLN; WI		
REGION 4	FL	11-99	Oleander Power	5		GE 7FA (190 MW)	NG; FO	SC	3,390; 1,000 FO	9 ppm NG; 42 ppm FO	DLN; WI		
REGION 4	FL	10-99	Hardee Power Partners (TECO)	1		GE 7EA (75 MW)	NG; FO	SC	8,760; 876 FO	9 ppm NG; 42 ppm FO	DLN; WI		
REGION 4	FL	12-99	Reliant Energy Osceola	3		GE 7FA (170 MW)	NG; FO	SC	3,000; 2,000 FO	10.5 ppm NG; 42 ppm FO	DLN; WI		
REGION 4	FL	12-99	Florida Power Corp., Intercession City	3		GE 7EA (87 MW)	NG; FO	SC	3,390; 1,000 FO	9 ppm NG; 42 ppm FO	DLN; WI		
REGION 4	FL	10-99	Jacksonville Electric Authority - Brandy Branch	3		GE 7FA (170 MW)	NG; FO	SC	4,000; 800 FO	10.5 ppm NG; 42 ppm FO	DLN; WI		
REGION 4	FL	1-00	IPS Avon Park - Shady Hills	3		GE 7FA (170 MW)	NG; FO	SC	3,390; 1,000 FO	9 ppm NG; 42 ppm FO	DLN; WI		
REGION 4	FL	draft permit	Palmetto Power	3		SW 501F (180 MW)	NG	SC	3,750	15 ppm	DLN		
REGION 4	FL	applic. under review	Granite Power Partners	3		(180 MW)	NG; FO	SC	3,000; 500 FO	10.5/15/15/ 25 ppm NG; 42 ppm FO	DLN		4 vendor options: GE 7FA/SW 501F/SW 501D5A/ABB GT-24
REGION 4	FL	draft permit	IPS Avon Park Corp. - DeSoto Power Project	3		GE 7FA (170 MW)	NG; FO	SC	3,390; 1,000 FO	9 ppm NG; 42 ppm FO	DLN; WI		
REGION 4	FL	applic. under review	Florida Power & Light - Martin Power Plant	2		GE 7FA (170 MW)	NG; FO	SC	3,390; 500 FO	10.5 ppm NG (15 ppm HPM); 42 ppm FO	DLN; WI		HPM = High Power Mode (power augmentation)
REGION 4	GA	12-98	Tenaska Georgia Partners, L.P.	6		GE 7FA (160 MW)	NG; FO	SC	3,066; 720 FO	15 ppm NG; 42 ppm FO	DLN; WI		
REGION 4	GA	6-99	West Georgia Generating; Thomaston	4		GE 7FA (170 MW)	NG; FO	SC	4,760; 1,687 FO	12 ppm NG (15 ppm 30-day avg. for peak firing); 42 ppm FO	DLN; WI		
REGION 4	GA	10-99	Heard County Power	3		SW 501FD (170 MW)	NG	SC	4,000	15 ppm	DLN		
REGION 4	GA	8-99	Georgia Power, Jackson County	16		GE 7EA (76 MW)	NG; FO	SC	4,000; 1,000 FO	12 ppm NG (15 ppm 30-day avg. for peak firing); 42 ppm FO	DLN; WI		
REGION 4	KY	applic. under review	Duke Energy - Marshall Co.	8		GE 7EA (80 MW)	NG; FO	SC	2,500; 500 FO	12/9 ppm NG; 42 ppm FO	DLN; WI	1-hr	

Region	State	Permit Date	Facility	# of CTs	# of DB	Turbine Model	Fuel	Mode	Hours	NO <sub>x</sub> Limit	Control Method	Avg. Time	Comments
REGION 4	FL	7-10-98	City of Lakeland, McIntosh Power Plant	1		SW 501G (230 MW)	NG; FO	SC (later CC)	7,008; 250 FO	25 ppm until 5/2002, 9 ppm after, 7.5 ppm if CC. NG; 42 ppm or 15 ppm FO	DLN or SCR; WI or SCR		Power Augmentation
REGION 4	MS	applic. under review	Duke Energy Southaven	8		GE 7EA (80 MW)	NG; FO	SC	2,500; 500 FO	12 ppm NG (15 ppm 3-hr avg.); 42 ppm FO	DLN; WI		
REGION 4	MS	applic. under review	Warren Power LLC	4		GE 7EA (80 MW)	NG	SC	2,000	9 ppm	DLN		
REGION 4	NC	11-99	Carolina Power & Light, Richmond Co.	7		GE 7FA (170 MW)	NG; FO	SC	2,000; 1,000 FO	9 ppm NG at startup, 10.5 ppm long-term; 42 ppm FO	DLN; WI		
REGION 4	NC	11-99	Carolina Power & Light, Rowan Co.	5		GE 7FA (170 MW)	NG; FO	SC	2,000; 1,000 FO	9 ppm NG at startup, 10.5 ppm long-term; 42 ppm FO	DLN; WI		
REGION 4	NC	6-99	Rockingham Power (Dynergy)	5		SW 501F (156 MW)	NG; FO	SC	3,000; 1,000 FO	25 ppm NG until 4/01, 20 ppm until 4/02, 15 ppm after, 42 ppm FO	DLN; WI		
REGION 4	NC	applic. under review	Butter-Wamer Generation Plant	2		GE 7FA (170 MW)	NG; FO	SC & CC	8,760; 500 FO	9 ppm NG; 42 ppm FO	DLN; WI		
REGION 4	SC	draft permit	Santee Cooper, Rainey Generating Station	4		GE 7FA (170 MW)	NG; FO	2 CC, 2 SC	8,760; 1,000 FO	9 ppm NG; 42 ppm FO	DLN; WI		
REGION 4	SC	12-99	Broad River Energy (SkyGen)	3		GE 7FA (171 MW)	NG; FO	SC	3,000; 500 FO	9 ppm NG; 42 ppm FO	DLN; WI		
REGION 4	TN	7-99	TVA, Johnsonville Fossil Plant	4		GE 7EA (85 MW)	NG; FO	SC	see comment	15 ppm NG; 42 ppm FO	DLN; WI ?		10% NG base mode, 10% NG peaking, 10% FO base
REGION 4	TN	7-99	TVA, Gallatin Fossil Plant	4		GE 7EA (85 MW)	NG; FO	SC	see comment	15 ppm NG; 42 ppm FO	DLN; WI ?		10% NG base mode, 10% NG peaking, 10% FO base
REGION 4	TN	applic. under review	TVA, Lagoon Creek Plant	16		GE 7EA (110 MW)	NG; FO	SC	see comment	12 ppm/127 TPY NG; 42 ppm FO	DLN; WI ?	30; 15 day	10% NG base mode, 10% NG peaking, 10% FO base; 127 tpy of NO <sub>x</sub> is based on a 9 ppm
REGION 5	IL	Dec-98	Peoples Gas, McDonnell Energy	4		170 MW	NG, ethane	SC	1,500	15 ppm	DLN	1-hr	BACT; operational
REGION 5	IL	Sep-99	Enron, Des Plaines Green Land	8	0	83 MW	NG	SC	3,250	9/12/15 ppm	DLN	an/mol/hr	BACT; Ox Cat rejected at \$6800/ton
REGION 5	IL	Jan-00	Enron, Kendall New Century	8	0	83 MW	NG	SC	3,300	9/12/15 ppm	DLN	an/mol/hr	BACT; Ox Cat rejected at \$6700/ton
REGION 5	IL	Jan-00	LS Power, Nelson Project	4		220 MW	NG; FO	SC	2,549 total, 2,000 each	25/15	DLN	1-hr	Synth Minor, minor until test under 15 ppm
REGION 5	IL	draft permit	Duke Energy	8	0	83 MW	NG; FO	SC	2,000; 500 FO	15 ppm NG (12 ppm); 42 ppm FO	DLN	1 hr (ann.); 1 hr	

Region	State	Permit Date	Facility	# of CTs	# of DB	Turbine Model	Fuel	Mode	Hours	NO <sub>x</sub> Limit	Control Method	Avg. Time	Comments
REGION 5	IN	Jul-99	Vermillion Generating Station	8	0	GE 7EA (80 MW)	NG; FO	SC	2,500	12/15 ppm NG; 42 ppm FO	DLN and WI	an	BACT; Usage limit of 20,336 MMCF NG-12 consec. months. Also 2 Emergency Generators; 1 Emergency Diesel Fire Pump; 4 Diesel Storage Tanks; SCR @ \$19,309/ton (avg.); Ox Cat @ 90% Control, rejected at \$8,977/ton
REGION 5	IN	applic. under review	DeSoto Generating Station	8		GE 7EA (80 MW)	NG	SC	2,500	15 ppm NG (12 ppm); 42 ppm FO	DLN	1 hr (ann.); 1 hr	BACT
REGION 5	MN	draft permit	Lakefield Junction	6		GE model PG7121EA (92 MW)	NG; FO	SC	7,300	9 base, 25 peak, 42 FO	DLN, WI	3-hr	PSD; SCR rejected @ \$11,500/ton; Ox Cat rejected at \$3000/ton
REGION 5	OH	Jul-99	Duke Energy Madison LLC	8		GE 7EA (80 MW)	NG; FO	SC	2,500 NG; 500 FO	15 ppm (12 ppm) NG; 42 ppm FO	DLN	1 hr (ann.)	BACT; SCR rejected at \$19,000/ton; Ox Cat rejected at \$9000/ton
REGION 5	WI	Jan-99	RockGen Energy	3		GE 7FA (175 MW)	NG; FO	SC	3,800 Total, 800 FO	12/15 ppm NG; 42 ppm FO	DLN	24 hr/inst; 1 hr	BACT; SCR not chosen; cost \$23,018/ton; Ox Cat rejected at \$15 K/ton
REGION 5	WI	Feb-99	Manitowoc Public Utility	1		GE Frame 5 (24.5 MW)	NG; FO	SC	2,328 Total	77 ppm NG; 77 ppm FO	WI	1-hr	BACT
REGION 5	WI	Feb-99	Southern Energy	2		GE 7FA (180 MW)	NG; FO	SC	8,760 Total, 699 FO	12/15 ppm NG; 42 ppm FO	DLN	24 hr/inst; 1 hr	BACT; Ox Cat rejected at \$14 K/ton
REGION 5	WI	Jul-99	Wisconsin Public Service	1		GE 7EA (102 MW)	NG; FO	SC	4,000 Total, 2,000 FO	9 ppm NG; 42 ppm FO	DLN	hr, nat gas, FO	BACT; SCR rejected at \$13,866/ton; Ox Cat rejected at \$6053/ton incremental cost
REGION 5	WI	draft permit	Wisconsin Electric	1		GE 7EA (85 MW)	NG; FO	SC	178,000 MWhrs, 2,000 hrs, 100 hr power aug.	9 ppm NG (20 ppm w/power aug.); 42 ppm FO	DLN	24-hr, 1-hr FO	BACT; SCR rejected at \$10,257/ton; Ox Cat rejected at \$5984/ton incremental cost
REGION 7	KS	draft permit	Western Resources	3		2 - 100 MW, 1 - 180 MW (200 MW)	NG; FO	SC		15 ppm NG; 42 ppm FO	DLN; WI		NOx limits are for > 70% load. NSPS limits will apply at < 70 % Load
REGION 7	MO	1-96	Kansas City Power & Light - Jackson	1			NG	SC					
REGION 7	MO	draft permit	AECI - Nodaway	2		(100 MW)	NG	SC		25 ppm	DLN		
REGION 7	MO	applic. under review	Kansas City Power & Light - Jackson	2		(75 MW)	NG	SC		9 ppm	DLN		
REGION 7	MO	applic. under review	Duke Energy - Audrain	8		GE 7EA (80 MW)	NG; FO	SC	2,500; 500 FO	12 ppm NG (15 ppm 1-hr avg.); 42 ppm FO	DLN; WI		
REGION 7	MO	applic. under review	Duke Energy - Bollinger	8		GE 7EA (80 MW)	NG	SC	2,500	12 ppm (15 ppm 1-hr avg.)	DLN		
REGION 7	NE	7-99	Omaha Public Power	4		(25 MW)	NG; FO	SC		25 ppm NG; 42 ppm FO	WI		
REGION 7	NE	6-99	Lincoln Electric System	1		(90 MW)	NG; FO	SC		25 ppm NG; 42 ppm FO	DLN; WI		
REGION 8	CO	final 4/99	Colorado Springs Utilities/Nixon (66 MW)	2		GE PG6541(B)	NG	SC	8,660 (both CTs)	15 ppm	DLN	1-hr	did not trigger BACT for CO

Region	State	Permit Date	Facility	# of CTs	# of DB	Turbine Model	Fuel	Mode	Hours	NO <sub>x</sub> Limit	Control Method	Avg. Time	Comments
REGION 8	CO	final 8/99	Fulton Cogeneration /Manchief (284 MW)	2		SW V84.3A1	NG	SC	8,760	15 ppm	DLN	1-hr	
REGION 8	CO	applic. 11/99	KN Energy/Front Range Energy Associates - Ft. Lupton (160 MW)	4		GE LM6000	NG	SC	**	25 ppm (proposed)	WI		project originally PSD application; State drafted syn minor permit w/ operating hours restrictions in 7/99; EPA commented to State concerning single source issue w/ adjacent PSCo facility; PSCo appealed to US 10th circuit court - currently
REGION 8	CO	applic. 3/00	Platte River Power Authority/Ra whide (82 MW)	1		GE Frame 7EA	NG	SC	8,760	9 ppm	DLN		plan startup 5/2002; CO PTE below significance level so didn't do BACT; characterized as peaking plant, but not restricted in operating hours
REGION 8	CO	draft permit 5/00	Public Service Co. of Colo./Ft. St. Vrain Unit 4 (242 MW)	1	1	GE PG7241 (FA)	NG	SC/CC	8,760	4 ppm (CC); 9 ppm (SC)	DLN+S CR (CC); DLN (SC)	24-hr	plan startup 6/2001;
REGION 8	CO	applic. 11/99	Front Range Power Project/Ray Nixon Sta., Fountain, CO (480 MW)	2	2	GE Frame 7	NG	SC/CC	8,760	9 ppm/16 ppm w/ DB	DLN		plan to begin construction 1/01, operation 7/02; PSD mod to existing Colo Springs Utils/Nixon coal-fired power plant; revising application to net out of PSD for NO <sub>x</sub> using reductions at coal-fired unit; applicant calculated PTE using 95% ca
REGION 8	SD	applic. 11/99	Black Hills Power & Light/Lange CT Facility (80 MW)	2		GE LM6000PD	NG	SC	8,760	25ppm (proposed)	DLN	24-hr	Characterized as peaking plant, but not restricted in operating hours
REGION 8	WY	final 3/00	Black Hills Power & Light/Niel Simpson II (80 MW)	2		GE LM6000PD	NG	SC	8,760	25 ppm	DLN	24-hr	Region provided written comment disagreeing w/ NO <sub>x</sub> BACT determination; characterized as peaking plant, but not restricted in operating hours
REGION 8	WY	final 2/98	Two Elk Generation Partners (33 MW turbine)	1		GE LM5000	NG	SC	8,760	25 ppm	DLN	1-hr	Facility is 250 MW coal-fired steam electric plus 33 MW NG CT; characterized as peaking plant, but not restricted in operating hours

#### 5.3.4.1 Low NO<sub>x</sub> Combustors

Dry low-NO<sub>x</sub> combustion control techniques reduce NO<sub>x</sub> emissions without injecting water or steam (hence "dry").

Lean premixed combustors are currently available for certain turbine models in the range of 9–25 ppm NO<sub>x</sub>. The lowest dry low- NO<sub>x</sub> emission rate turbines on the market are the GE 7FA, which are proposed for the Midway Energy Facility. Lean premix designs reduce peak combustion temperatures, thereby reducing thermal NO<sub>x</sub>; however fuel NO<sub>x</sub> formation (oil contains significant fuel-bound nitrogen) is not reduced with this technique. In a conventional turbine combustor, the air and fuel are introduced at an approximately stoichiometric ratio and air/fuel mixing occurs simultaneously with combustion. A lean premixed combustor premixes natural gas and air prior to combustion. Premixing results in a homogenous fuel lean air/fuel mixture, which minimizes localized fuel-rich pockets that produce elevated combustion temperatures and higher NO<sub>x</sub> emissions. An air-to-fuel ratio approaching the lean flammability limit is maintained, and the excess air serves as a heat sink to lower combustion temperatures, which lowers thermal NO<sub>x</sub> formation. A pilot flame is often used to maintain combustion stability in this fuel-lean environment.

#### 5.3.4.2 Continuously Achievable NO<sub>x</sub> Emissions for Peakers

The GE 7FA turbines proposed for the Midway Energy Facility employ General Electric's state-of-the-art 9 ppm NO<sub>x</sub> Dry low-NO<sub>x</sub> (DLN) Combustion technology. EPA acknowledges that 9 ppm is the lowest Dry low- NO<sub>x</sub> emission level that has been demonstrated for any combined cycle, base load turbine. Since add-on controls have previously been shown to be not technically feasible for application to the proposed dual fuel fired simple cycle peakers (and would not be cost effective in any case), the lowest emission rate continuously achievable using Dry low- NO<sub>x</sub> combustors represents the next candidate for BACT. The Midway Energy Facility will utilize the lowest emitting DLN turbine technology on the market today, which therefore represents Best Available Control Technology (BACT).

When evaluating achievable NO<sub>x</sub> emission rates for peaking applications, it is important to first qualify General Electric's 9 ppm guarantee for the 7FA. GE guarantees that the turbine will achieve 9 ppm of NO<sub>x</sub>, corrected to 15% O<sub>2</sub>, in new and clean condition, under steady-state operation, and corrected to international standards organization (ISO) ambient conditions. This guarantee, coupled with a 40 CFR Part 60 one-time compliance test, or with a 24-hour averaging time Continuous Emissions Monitoring System (CEMS) may be achievable during base load operation, but is not continuously achievable during peaking operation. A base load turbine normally operates 24 hours per day, as near as possible to its full load output. Flame stability is crucial in a dry low NO<sub>x</sub> combustor. To maintain flame stability during transient conditions, GE uses a combination of richer pre-mix and a conventional pilot flame. These factors may increase NO<sub>x</sub> emissions to 12-15 ppm during transient conditions. Even through emission rates may climb to 12 or 15 ppm during transient load changes, the duration of such

load changes is short compared in a base loaded unit with the 24-hour averaging time of the permit compliance limit.

Peaking turbines, on the other hand, spend very little of their operation at steady state conditions. In a daily peaking cycle, a peaking turbine may be called upon to start up at 2:30 p.m., be at full load by 3:00 p.m. and commence shut down sequence at 5:00 p.m. It is even possible that the unit could be dispatched at several different loads during this event. It can be seen that the peaking turbine exhibits a much greater ratio of transient operation to steady state operation than would a base load turbine.

The "9 ppm" DLN 7FA turbine cannot meet a continuous compliance limit of 9 ppm, in that a substantial portion of its operating hours will be at non-steady state conditions, with DLN emission levels rising to 12-15 ppm. GE does not guarantee that the 7FA turbine will continuously meet 9 ppm during such peaking operation, and no turbine in the US has demonstrated the ability to continuously meet 9 ppm in peaking service. Transient load changes are part of normal operation for a peaker – they cannot be exempted from compliance limits as start-up" or "malfunction".

Since the Midway Energy Center Facility will continuously monitor NO<sub>x</sub> emissions to demonstrate continuous compliance with enforceable permit limits, the permitted NO<sub>x</sub> emission limit must be set at a value that can be complied with on a continuous basis in actual peaking operation. This level is 12 ppm. In addition to the 12 ppm limit Midway Energy Center Facility proposes to demonstrate compliance with the 9 ppmvd @ 15% O<sub>2</sub> emission concentration guaranteed by GE during an initial and annual performance stack tests.

While most of the discussion has been dealing with achievable NO<sub>x</sub> emissions limits for natural gas fired operation, Midway Development Company, L.L.C. proposes a NO<sub>x</sub> emission limit of 42 pmvd @ 15% O<sub>2</sub> achieved using water injection. Similar to other permits issued in Florida Midway Development Company L.L.C. proposes that within 18 months after the initial compliance test, an engineering report will be prepared regarding the lowest NO<sub>x</sub> emission rate that can be consistently achieved while firing distillate oil. This lowest NO<sub>x</sub> emission rate would account for long-term performance expectations and reasonable operating margins. Based on the results of this report, the NO<sub>x</sub> emission limit for distillate oil fired operation could be lowered.

#### 5.3.4.3 Summary of Gas Turbine NO<sub>x</sub> BACT

Midway Development Company L.L.C. proposes to implement NO<sub>x</sub> BACT through the application of state-of-the-art GE 7FA turbines with "9 ppm" steady-state capable combustor technology as demonstrated during the initial and annual stack tests. Using these machines in peaking service will result in emissions that vary between 9-15 ppm during actual operation, resulting in a long-term compliance limit of 12 ppm with natural gas and 42 ppm (water injected) on distillate oil. This level represents the lowest dry low NO<sub>x</sub> emission rate that is continuously achievable in peaking operation (both transient and steady state) for the Midway Energy Facility. This is equivalent to or more stringent



than other recent BACT decisions for dual fuel simple cycle peaking projects using DLN for NO<sub>x</sub> control. There is no operational facility for the GE 7FA turbine demonstrating the ability to continuously achieve short term or annual NO<sub>x</sub> limits lower than 12 ppm under the rigors of peaking service. Midway Development Company, L.L.C. concludes that BACT for gas/oil fired peaking turbines is the current generation of General Electric 7FA "9 ppm" dry low NO<sub>x</sub> combustors with a compliance limit of 12 ppmvd corrected to 15 percent oxygen while firing natural gas, and 42 ppmvd corrected to 15 percent oxygen while firing No. 2 distillate oil.

### 5.3.5 Natural Gas Fuel Heater

Based on a review of the RACT/BACT/LAER Clearinghouse the top NO<sub>x</sub> control technology for heaters which fire less than 20 MMBtu/hr is the use of Low-NO<sub>x</sub> burners. For a heater of this size, with limited hours of operation add-on control technology would not be cost effective. Midway Energy Facility will install a natural gas fired fuel heater equipped with Low-NO<sub>x</sub> burner technology which will achieve a NO<sub>x</sub> emission rate of less than 0.10 lb/MMBtu which will result in annual NO<sub>x</sub> emissions of less than 2.3 tons/year. It should also be noted that the natural gas fuel heater is incorporated into this project to ensure that the natural gas fuel being used in the three combustion turbines is at the appropriate temperature for effective operation of GE's advanced DLN system.

## 5.4 BACT for Carbon Monoxide

### 5.4.1 Formation

Carbon monoxide (CO) is formed as a result of incomplete combustion of fuel. Control of CO is accomplished by providing adequate fuel residence time and high temperature in the combustion zone to ensure complete combustion. These control factors, however, also tend to result in increased emissions of NO<sub>x</sub>. Conversely, a low NO<sub>x</sub> emission rate achieved through flame temperature control (by water injection or aggressive dry lean pre-mix) tends to result in higher levels of CO emissions. Thus, a compromise must be established whereby the flame temperature reduction is set to achieve the lowest NO<sub>x</sub> emission rate possible while keeping CO emission rates at acceptable levels.

### 5.4.2 Gas Turbines-Ranking of Available Control Techniques

CO emissions from gas turbines are a function of oxygen availability (excess air), flame temperature, residence time at flame temperature, combustion zone design, and turbulence. Alternative Simple-Cycle turbine CO control methods include exhaust gas cleanup methods such as high temperature catalytic oxidation, and front-end methods such as combustion control wherein CO formation is suppressed within the combustors.

A review of EPA's RACT/BACT/LAER Clearinghouse (Appendix C) indicates several levels of CO control which may be achieved for Simple-Cycle natural gas fired gas turbines. High temperature

oxidation catalyst (analogous to high temperature SCR) is a relatively new add-on control technology that could be applied to Simple-Cycle peaking turbines. The Carson Energy project in California, a 64 MW peaker, uses this technology. As shown in Appendix C, the majority of projects in the Clearinghouse reference combustion controls (burner design) as BACT for CO. Emission levels and control technologies have been identified and ranked as follows:

- 2 to 6 ppm: High-temperature CO oxidation catalyst
- 10 to 50 ppm: Good combustion practices

These levels of CO control are evaluated in terms of Best Available Control Technology in the following sections.

#### 5.4.2.1 LAER: 2 to 6 ppm CO with High-Temperature Catalytic Oxidation

The most stringent CO control level available for Simple-Cycle gas turbines would be achieved with the use of a high temperature (zeolite based) oxidation catalyst system, which can remove up to 90 percent of CO in the flue gas (Booth, 1998). According to the list of Simple-Cycle turbines in the RACT/BACT/LAER Clearinghouse with limits for CO, none are listed with high-temperature oxidation catalyst systems. Our search identified one Simple-Cycle peaking project in California, and Englehard offers the technology commercially. A high temperature CO oxidation catalyst is, therefore, concluded to represent a technically feasible add-on control technology to control CO from natural gas fired, Simple-Cycle turbines. This zeolite catalyst technology, however, exhibits many of the same start-up responsiveness limitations and negative environmental impacts expressed previously for high temperature SCR. The use of an oxidation catalyst would extend the startup period for the combustion turbines, and increase back pressure on the turbine, which in both cases would contribute to increased emissions of pollutants. Also the installation of an oxidation catalyst would contribute to increased formation of SO<sub>3</sub>, which is a precursor for PM<sub>10</sub> and H<sub>2</sub>SO<sub>4</sub> formation.

#### Technical Analysis

As with SCR catalyst technology for NO<sub>x</sub> control, oxidation catalyst systems seek to remove pollutants from the turbine exhaust gas rather than limiting pollutant formation at the source. Unlike an SCR catalyst system, which requires the use of ammonia as a reducing agent, oxidation catalyst technology does not require the introduction of additional chemicals for the reaction to occur. Rather, the oxidation of CO to CO<sub>2</sub> utilizes the excess air present in the turbine exhaust and the activation energy required for the reaction to proceed is lowered in the presence of the catalyst. Technical factors relating to this technology include turbine back pressure losses, unknown catalyst life due to masking or poisoning, greater emissions and reduced market responsiveness due to extended start-ups, and potential collateral increases in emissions of SO<sub>3</sub>, sulfuric acid mist and condensable PM<sub>10</sub>.

As with SCR, traditional CO catalytic oxidation reactors operate in a relatively narrow temperature range. Optimum operating temperatures for these systems generally fall into the range of 700°F to 900°F. According to Englehard, high-temperature oxidation catalyst is rated up to 1,200°F, so a dilution air system would not be required for the proposed General Electric 7 FA turbines.

Typical pressure losses across an oxidation catalyst reactor are in the range of 1.5 to 3.0 inches of water (Englehard, 1997). Pressure drops in this range correspond roughly to a 0.15 to 0.30 percent loss in power output and fuel efficiency (General Electric, 1997), or approximately 0.1 percent loss in power output for each 1.0 inch of water pressure loss.

All catalyst systems are subject to loss of activity over time. Since the catalyst itself is the most costly part of the installation, the cost of catalyst replacement has been considered on an annualized basis. Catalyst life may vary from the manufacturer's typical 3-year guarantee to a 5- to 6-year predicted life, but no operating units were identified with more than about 3,500 hours. Periodic testing of catalyst material is necessary to predict actual catalyst life for a given installation. The following economic analysis assumes that catalyst will be replaced every 3 years per vendor guarantee. This system would also be expected to control as much as 40 percent of hydrocarbon (VOC) emissions.

Like high-temperature SCR, this technology has yet to be demonstrated-in-practice on Simple-Cycle turbines in this size range. It is, however, a passive control technology (does not require NH<sub>3</sub> injection) and can withstand higher turbine exhaust temperatures. It would however, limit the project's ability to come on line quickly enough to meet peak power market demand.

### Environmental Analysis

A CO catalyst will also oxidize other species within the turbine exhaust. For example, sulfur in natural gas (fuel sulfur and mercaptans added as an odorant) is oxidized to gaseous SO<sub>2</sub> within the combustor, but will be further oxidized to SO<sub>3</sub> across a high temperature catalyst (70% conversion is assumed). SO<sub>3</sub> will be emitted and/or combined to form H<sub>2</sub>SO<sub>4</sub> (sulfuric acid mist) in the exhaust stack or downstream in the ambient air. These sulfates condense as additional PM<sub>10</sub> (and PM<sub>2.5</sub>). Thus, an oxidation catalyst would reduce emissions of CO and VOC, but would increase emissions of PM<sub>10</sub> and PM<sub>2.5</sub>.

The negative environmental impacts associated with this technology are less than for high-temperature SCR since no ammonia slip or ammonium salts are emitted. Collateral emissions due to efficiency losses or forced outages would still result in negative regional environmental impacts.

### Economic Analysis

A high-temperature CO oxidation catalyst cost effectiveness evaluation was performed for the proposed Simple-Cycle General Electric 7FA turbines. Capital and annual costs associated with

installation of a high temperature CO oxidation catalyst system were obtained from Engelhard, the vendor of high-temperature oxidation catalyst systems. Based on the quote from Engelhard (see Appendix C), the purchased equipment cost for each turbine is estimated at \$1,807,450. Capital costs include the catalytic reactor, support structure, turbine transition piece, spare parts and catalyst charge, freight, engineering and design, and installation. As shown in Table 5-5, when adding direct installation costs and indirect costs, the total capital cost (per turbine) is estimated at \$2,992,100. Catalyst replacement is treated separately in this analysis as an operating cost. Annual operating costs, also summarized in Table 5-5, include operating labor (0.5 hour/shift), routine inspection and maintenance, spent catalyst replacement, and lost cycle efficiency due to increased back pressure. Annualized catalyst replacement cost was calculated based on a 3-year life.

Table 3-2 presents a worst-case CO emission estimate for the proposed project of 240 tons per year (79.6 tons per year per turbine). This estimate is based on 2,000 hours per year per turbine on natural gas at 50°F and 100 percent load and 1,500 hours per year per turbine on distillate oil at 50°F and 100 percent load, which serves as a conservative estimate of the maximum annual emissions for the proposed turbines. The amount of CO removed annually by the oxidation catalyst would be 71.6 tons per turbine, based on estimated removal efficiency of 90 percent. The total annualized cost of oxidation catalyst for this case is estimated at \$2,277,300, resulting in an overall cost-effectiveness of about \$31,800 per ton of CO removed which is a prohibitive figure for non-LAER control of CO.

#### 5.4.2.2 Next Best Level of Control – 10 to 50 ppm with Combustion Control

The next best level of control is the General Electric 7FA combustors optimized CO emission rate of 9 ppmvd while firing natural gas and 20 ppmvd while firing distillate oil. This level of control is available, will not cause negative operational or environmental impacts, is cost effective, and represents BACT.

#### Summary

The use of a high temperature oxidation catalyst to control emissions of CO would result in collateral increases in PM<sub>10</sub> (and PM<sub>2.5</sub>) NO<sub>x</sub>, SO<sub>2</sub>, and CO<sub>2</sub> emissions, is not cost effective, and does not represent BACT for the Midway Energy Center. Further, it would also lengthen peaking start-up times and limit the responsiveness of the project in its ability to address the peak power market. The next best level of control, 9 ppmvd while firing natural gas and 20 ppmvd while firing distillate oil using combustion control, is concluded to represent BACT for this facility.

#### 5.4.3 Natural Gas Fuel Heater

The natural gas fuel heater will employ good combustion control for CO which has been determined to represent BACT for this source type. No add on control would be considered cost effective for control of CO emissions from this source.

**Table 5-5 High Temperature Oxidation Catalyst (Carbon Monoxide) General Electric, Simple-Cycle, Model 7 FA**

Control Efficiency (%)	90%
------------------------	-----

**Facility Input Data**

Item	Value
<b>Operating Schedule</b>	
Shifts per day	3
Hours per day	24
Days per week	7
Total Hours per year	3,500
Natural Gas Firing (Normal Operation)	2,000
Distillate Oil Firing (Normal Operation)	1,500
Source(s) Controlled <sup>1</sup>	One Power Block, 175 MW
CO From Normal Natural Gas Operation (lb/hr)	29.6
CO From Distillate Oil Operation (lb/hr)	66.6
CO From Source(s) (tpy)	79.6
Site Specific Enclosure (Building) Cost	NA
Site Specific Electricity Value (\$/kWh)	0.10
Site Specific Natural Gas Cost (\$/MMBtu)	NA
Site Specific Operating Labor Cost (\$/hr)	30
Site Specific Maint. Labor Cost (\$/hr)	30

<sup>1</sup>CO emissions are based on data at 100% load and intake air chilled to maximum of 50°F.

**Capital Costs<sup>1</sup>**

Item	Value	Basis
<b>Direct Costs</b>		
1.) Purchased Equipment Cost		
a ) Equipment cost + auxiliaries	\$1,493,750	Scaled Engelhard quote + auxiliaries. A
b ) Instrumentation	\$149,400	0.10 x A
c ) Sales taxes	\$74,700	0.05 x A
d ) Freight	\$89,600	0.06 x A
Total Purchased equipment cost, (PEC)	\$1,807,450	B = 1.21 x A
2.) Direct installation costs		
a ) Foundations and supports	\$144,600	0.08 x B
b ) Handling and erection	\$253,000	0.14 x B
c ) Electrical	\$72,300	0.04 x B
d ) Piping	\$36,100	0.02 x B
e ) Insulation for ductwork	\$18,100	0.01 x B
f ) Painting	\$18,100	0.01 x B
Total direct installation cost	\$542,200	0.30 x B
3.) Site preparation, SP	NA	NA
4.) Buildings, Bldg	NA	NA
Total Direct Cost, DC	\$2,349,700	1.30B + SP + Bldg
<b>Indirect Costs (installation)</b>		
5.) Engineering	\$180,700	0.10 x B
6.) Construction and field expenses	\$90,400	0.05 x B
7.) Contractor fees	\$180,700	0.10 x B
8.) Start-up	\$36,100	0.02 x B
9.) Performance test	\$18,100	0.01 x B
10.) Contingencies	\$54,200	0.03 x B
11.) Simple Interest During Construction	\$82,200	DC x 7% x 0.5 years
Total Indirect Cost, IC	\$642,400	0.28B
<b>Total Capital Investment (TCI) = DC + IC</b>	<b>\$2,992,100</b>	<b>1.58B + SP + Bldg</b>

<sup>1</sup> See Appendix C, Tables C-1 and C-1A

Table 5-5 High Temperature Oxidation Catalyst (Carbon Monoxide) General Electric, Simple-Cycle, Model 7 FA (Continued)

Annual Costs

Item	Value	Basis	Source
<b>1) Electricity</b>			
Press. Drop (in. W.C.)	3.0	Pressure drop - catalyst bed	Vendor
Power Output of Turbine (kW)	175,000		
Power Loss Due to Pressure Drop (%)	0.32%	0.105% for every 1" pressure drop	Vendor
Power Loss Due to Pressure Drop (kW)	551		
Unit Cost (\$/kWh)	\$0.10	Estimated Market Value	Estimate
Cost of Heat Rate Loss (\$/yr)	\$192,940		
Power Loss Due to Extended Startups (kW-hr)	13,125,000	Extended startup time due to catalyst bed	Estimate
Cost of Extra Startups (\$/yr)	\$1,312,500	\$0.10/kWh	
Total Cost (\$/yr)	\$1,505,440		
<b>2) Operating Labor</b>			
Requirement (hr/yr)	218.75	1/2 hr/shift, 3,500 hours per year	OAQPS
Unit Cost (\$/hr)	\$30.00	Facility Data	Estimate
Cost (\$/yr)	\$6,560		
<b>3) Supervisory Labor</b>			
Cost (\$/yr)	\$980	15% Operating Labor	OAQPS
<b>4) Maintenance</b>			
Labor Req. (hr/shift)	218.75	1/2 hour per shift	OAQPS
Unit Cost (\$/hr)	\$30.00	Facility Data	Estimate
Labor Cost (\$/yr)	\$6,563		
Material Cost (\$/yr)	\$6,560	100% of Maintenance Labor	OAQPS
Total Cost (\$/yr)	\$13,120		
<b>7) Catalyst Replacement</b>			
Catalyst Cost (\$)	\$670,000	Catalyst modules	Vendor
Catalyst Disposal Cost (\$)	\$50,000	Disposal of catalyst modules	Estimate
Sales Tax (\$)	\$33,500	5% sales tax in Indiana	Estimate
Catalyst Life (yrs)	3	n	OAQPS
Interest Rate (%)	7	i	
CRF	0.38	Amortization of Catalyst	OAQPS
Annual Cost (\$/yr)	\$287,120	(Volume)(Unit Cost)(CRF)	
<b>9) Indirect Annual Costs</b>			
Overhead	\$12,400	60% of O&M Costs	OAQPS
Administration	\$59,800	2% of Total Capital Investment	OAQPS
Property Tax	\$29,900	1% of Total Capital Investment	OAQPS
Insurance	\$29,900	1% of Total Capital Investment	OAQPS
Capital Recovery	\$332,100	10 yr life; 7% interest (-cat. cost)	OAQPS
Total Indirect (\$/yr)	\$464,100		
Total Annualized Cost (\$/yr)	\$2,277,300		
Total CO Controlled (tpy)	71.6		
Cost Effectiveness (\$/ton)	\$31,800		

## 5.5 BACT for Particulate Matter and Trace Metals

### 5.5.1 Formation

Particulate (PM) emissions from natural gas and distillate oil combustion sources consist of inert contaminants in the fuel, sulfates from fuel sulfur or mercaptans used as odorants, dust drawn in from the ambient air, particulates of carbon and hydrocarbons resulting from incomplete combustion, and condensibles, including sulfates and nitrates. Units firing fuels with low ash content and high combustion efficiency exhibit correspondingly low particulate emissions. Trace metals that may be emitted from natural gas combustion are discussed in this section because they form a portion of particulate emissions. Lead and mercury, which are regulated in Florida's SIP regulations, may be a metal constituent of distillate fuel oils. However, neither lead nor mercury are estimated to emit more than the significant emission rates established in 40 CFR 52.21.

### 5.5.2 Gas Turbines

When the New Source Performance Standard for Stationary Gas Turbines (40 CFR 60 Subpart GG) was promulgated in 1979, the EPA recognized that "particulate emissions from stationary gas turbines are minimal," and noted that particulate control devices are not typically installed on gas turbines and that the cost of installing a particulate control device is prohibitive (U.S. EPA, September 1977). Performance standards for particulate control of stationary gas turbines were, therefore, not proposed or promulgated.

The most stringent particulate control method demonstrated for gas turbines or diesel engines is the use of low ash fuel (such as natural gas or low sulfur transportation diesel) and the avoidance of catalytic technologies such as SCR when not required for LAER. No particulate matter or mercury-specific add-on control technologies are listed in the RACT/BACT/LAER Clearinghouse listings for Simple Cycle combustion turbines as shown in Appendix C. Proper combustion control and the firing of fuels with negligible or zero ash content (natural gas and 0.05% sulfur transportation diesel) is the predominant control method listed.

Add on controls, such as electrostatic precipitators (ESPs) or baghouses, have never been applied to commercial gas fired turbines. The use of ESPs or baghouse filters is technically infeasible, and does not represent an available control technology.

The use of negligible or zero ash fuels such as natural gas and low sulfur diesel, and good combustion control is concluded to represent BACT for PM control for the proposed Simple-Cycle peaking turbines and diesel engine. BACT for PM<sub>10</sub> precludes the selection of high-temperature SCR for NO<sub>x</sub> control as NH<sub>3</sub> slip at 10 ppm could result in additional PM<sub>10</sub> (and PM<sub>10</sub> precursor) emissions.

### 5.5.3 Natural Gas Fuel Heater

The most stringent particulate control method demonstrated for, natural gas fired heaters is the use of low ash fuel (such as natural gas). Proper combustion control and the firing of fuels with negligible or zero ash content is the predominant control method listed in the RACT/BACT/LAER Clearinghouse for similar sources. Add-on controls, such as ESPs or baghouses, have never been applied to small natural gas fired heaters. The use of ESPs and baghouse filters is considered technically infeasible, and does not represent an available control technology.

## 5.6 BACT for Sulfur Dioxide and Sulfuric Acid Mist

### 5.6.1 Formation

Sulfur dioxide ( $\text{SO}_2$ ) is exclusively formed through the oxidation of sulfur present in the fuel. The emission rate is a function of the sulfur content of the fuel, since virtually all fuel sulfur is converted to  $\text{SO}_2$ . Another by-product of sulfur oxidation is when sulfur trioxide ( $\text{SO}_3$ ) combines with water to form sulfuric acid ( $\text{H}_2\text{SO}_4$ ). As a condensable gas, the sulfuric acid will appear in mist form in the stack if the temperatures are sufficiently low for condensation to occur. Since the stack exhaust will be in the  $1050^\circ\text{F} - 1250^\circ\text{F}$  range, and the boiling point of sulfuric acid is less than  $650^\circ\text{F}$ , sulfuric acid mist will not form in the stack.

### 5.6.2 Gas Turbines and Fuel Gas Heater

The proposed simple cycle gas turbines will fire pipeline-quality natural gas and low sulfur transportation grade distillate fuel, the natural gas fuel heater will fire pipeline-quality natural gas only. Pipeline grade natural gas typically averages between 1-10 grains of sulfur per hundred standard cubic feet gas. A review of EPA RACT/BACT/LAER Clearinghouse information shows low sulfur fuel as the only available  $\text{SO}_2$  control method selected as BACT in previous determinations for gas turbines. This indicates that the firing of pipeline quality natural gas and low sulfur transportation grade distillate fuel is the most stringent  $\text{SO}_2$  control methodology that has been demonstrated in practice for any combustion turbine. Therefore, this evaluation concludes that that firing of pipeline quality natural gas and low sulfur transportation grade distillate fuel in the proposed Simple-Cycle peaking turbines and pipeline quality natural gas in the proposed fuel gas heater is BACT for  $\text{SO}_2$ .

If BACT were to be applied to  $\text{H}_2\text{SO}_4$ , which would preclude the use of an oxidation catalyst or SCR as the catalysts would further oxidize  $\text{SO}_2$  to  $\text{SO}_3$  which is a precursor of  $\text{H}_2\text{SO}_4$ . We should also state that  $\text{H}_2\text{SO}_4$  would not be directly emitted from the turbine stack as the stack temperatures are too high. We should state that even though  $\text{H}_2\text{SO}_4$  would not be emitted directly the test method used for sampling  $\text{SO}_2$  if used could cause the formation of  $\text{H}_2\text{SO}_4$  when the sample is cooled.



**5.7 Summary and Conclusions**

A summary of technologies determined to represent BACT for the MEC project is are presented in Table 5-6. Expected total emissions are summarized in Section 3 which are estimated based on 100% load for 3,500 hours per year including up to 1,500 hours per year of distillate oil operation and application of BACT as determined in this analysis.

**Table 5-6 Summary of Selected BACTs**

Pollutant	Gas Turbines
NO <sub>x</sub>	Dry Low NO <sub>x</sub> Combustors with Natural Gas (12 ppmvd, 15% O <sub>2</sub> , 24 hour average, 9 ppmvd @ 15% O <sub>2</sub> during initial and annual performance tests), Water injection with Distillate Oil (42 ppmvd, 15% O <sub>2</sub> )
CO	Good combustion control (9 ppmvd with Natural Gas, 20 ppmvd with Distillate Oil)
PM	Good combustion control; low ash, low sulfur fuel
SO <sub>2</sub>	Low sulfur fuel; natural gas (2 grains S / 100 scf gas) distillate oil (0.05 wt% S)

---

## 6.0 AMBIENT AIR QUALITY IMPACT ANALYSIS

### 6.1 Overview of Analysis Methodology

The PSD rules require an analysis of the impact of the proposed facility on ambient concentrations of pollutants emitted in significant quantities, for which there is a National Ambient Air Quality Standard or PSD Increment. For the proposed facility, this includes NO<sub>x</sub>, CO, SO<sub>2</sub>, and PM<sub>10</sub>. Although the project is not subject to PSD review for lead, the air quality standards analysis included a compliance assessment of this pollutant.

The ambient concentrations of PSD pollutants resulting from allowable emissions from the proposed facility are predicted using an approved U.S. EPA atmospheric dispersion model in accordance with U.S. EPA's "Guideline on Air Quality Models" (U.S. EPA, 1999). The atmospheric dispersion of emissions is simulated for a record of representative sequential hourly meteorological conditions over a historical five-year period. Ground-level concentrations at various averaging periods depending on the pollutant are predicted for a grid of ground-level model "receptors" surrounding the proposed facility. The following sections detail the specific aspects of the ambient air quality impact analysis.

### 6.2 Model Selection

The selection of an appropriate dispersion model must take into consideration the physical geometry of the sources, the local dispersion environment, and terrain characteristics. These factors, which formulate the basis for choosing one or more of the models recommended in the U.S. EPA modeling guidelines for both screening and refined modeling, are discussed below.

#### 6.2.1 Physical Source Geometry

The sources of PSD pollutants from the proposed facility consist of high velocity, high temperature exhausts from stacks connected to the combustion turbines. This requires the use of a model capable of simulating the dispersion of buoyant releases from elevated point sources. The U.S. EPA modeling guidelines require the evaluation of the potential for physical structures to affect the dispersion of emissions from elevated point sources. The exhaust from stacks that are located within specified distances of buildings, and whose physical heights are below specified levels, may be subject to "aerodynamic building downwash" under certain meteorological conditions. If this is the case, a model capable of simulating this effect must be employed.

The analysis used to evaluate the potential for building downwash is referred to as a physical "Good Engineering Practice" (GEP) stack height analysis. Stacks with heights below physical GEP are considered to be subject to building downwash. In the absence of structural effects, U.S. EPA has established a "default" GEP height of 213 feet. Any portion of a stack above the maximum of the

physical or default GEP height cannot be used in the dispersion modeling analysis for purposes of comparison to U.S EPA's ambient impact criteria.

Each of the three combustion turbines at the proposed facility will have its own stack. A GEP stack height analysis was performed for the proposed project configuration in accordance with U.S. EPA's guidelines (U.S. EPA, 1985). Per the guidelines, the physical GEP height,  $H_{GEP}$ , is determined from the dimensions of all buildings which are within the region of influence using the following equation:

$$H_g = H + 1.5L$$

where:

H = height of the structure within 5L of the stack which maximizes  $H_g$ , and

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

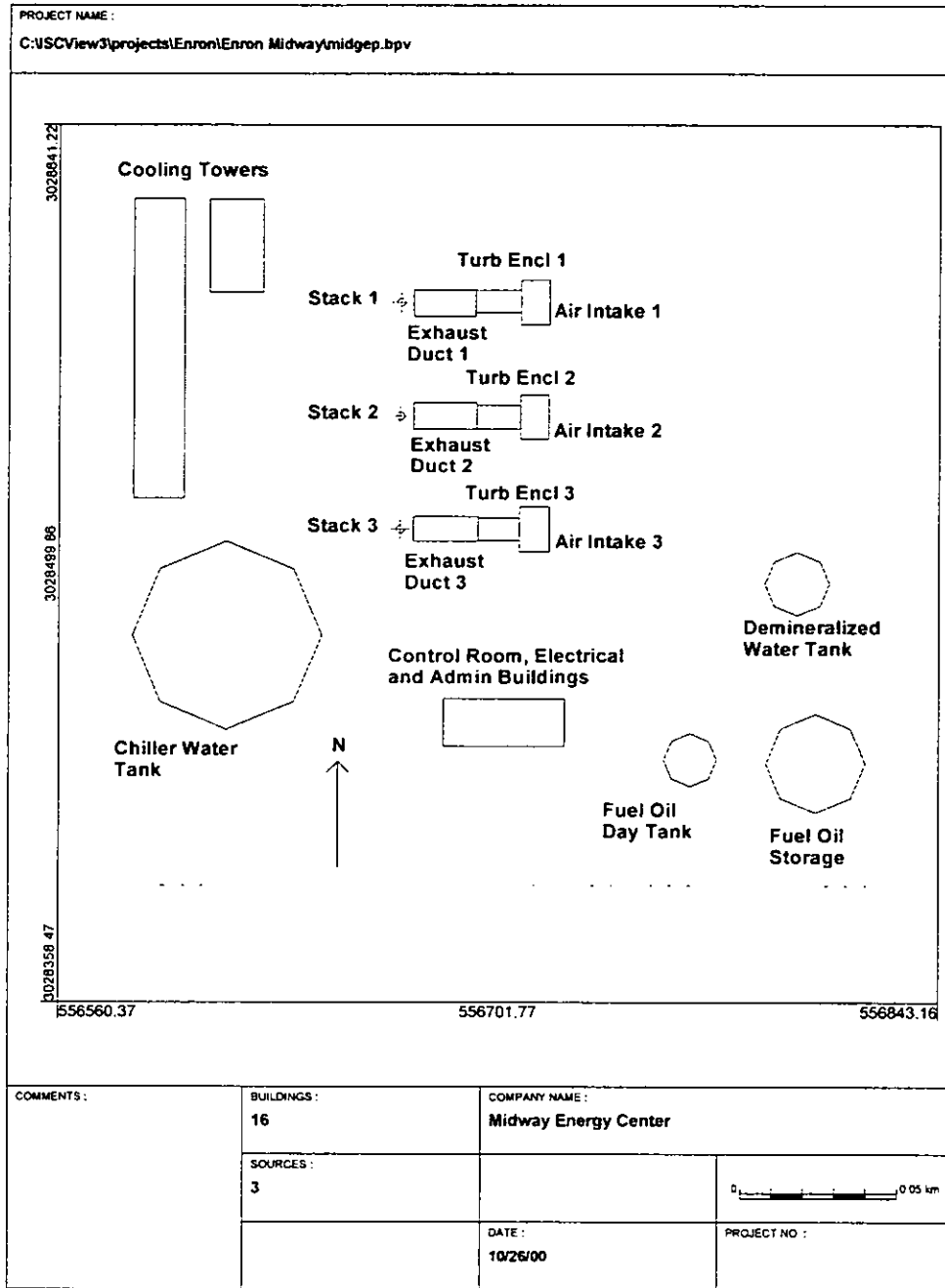
For a squat structure, i.e., height less than projected width, the formula reduces to:

$$H_g = 2.5H$$

In the absence of influencing structures, a "default" GEP stack height is credited up to 65 meters (213 feet). The locations and dimensions of the various structures at the proposed facility relative to the exhaust stacks are depicted in Figure 6-1. An analysis of the potential for building downwash is presented below.

The significant structures of the proposed facility will include the turbine enclosures, turbine air intake structures, control room/electrical room/administration building, water storage tanks, and fuel storage tanks. U.S. EPA's Building Profile Input Processor (BPIP), as implemented in Lakes-Environmental *BPIP View* software, was used to determine the GEP stack height and to develop building input data for the modeling analysis. The output of the BPIP analysis is provided in Appendix D. A summary of the GEP analysis and the controlling building is provided in Table 6-1. The table lists the physical GEP stack height calculated for each influencing structure. Based on the BPIP analysis, the GEP stack height for the turbine stacks is 135 feet. Since the proposed height of the combustion turbine stacks is 80 feet, building downwash affects must be simulated in the dispersion modeling analysis. Also, since the stacks are less than the default GEP height of 213 feet, their full height can be considered in the modeling.

**Figure 6-1 Location of Turbine Stacks Relative to Structures Included in the GEP Analysis**



**Table 6-1 Summary of GEP Analysis (Units in Feet)**

Structure	Height	Length	Width	MPW <sup>(2)</sup>	GEP Formula Height	5L <sup>(3)</sup>	Distance to Turbine Stack <sup>(4)</sup>	Turbine Stack(s) Potentially Affected By Downwash Yes/No
Turbine Air Intake <sup>(1)</sup>	54	45	36	57	135	270	112	Yes
Turbine Enclosure <sup>(1)</sup>	45	49	23	54	113	225	62	Yes
Exhaust Duct <sup>(1)</sup>	27	62	26	67	67.5	135	0	Yes
Control/Admin Building	45	110	45	119	112.5	225	180	Yes
Chiller Water Tank	48	210	210	210	120	240	105	Yes
Deminerlized Water Tank	48	59	59	59	120	240	380	No
Fuel Oil Day Tank	40	55	55	55	100	200	355	No
Fuel Oil Storage Tank	48	100	100	100	120	240	440	No
Chiller	8	310	50	315	20	40	135	No

(1) One associated with each turbine (see Figure 6-1).  
 (2) Maximum projected width.  
 (3) 5 times the lessor of the MPW or height is the maximum influence region.  
 (4) Closest distance relative to all turbine stacks.

**6.2.2 Dispersion Environment**

The selection and application of the model requires characterization of the local (within 3 km) dispersion environment as either urban or rural, based on a U.S. EPA-recommended procedure that characterizes an area by prevalent land use. This land use approach classifies an area according to 12 land use types. In this scheme, areas of industrial, commercial, and compact residential land use are designated urban. According to U.S. EPA modeling guidelines, if more than 50 percent of an area within a three-kilometer radius of the proposed facility is classified as rural, then rural dispersion coefficients are to be used in the dispersion modeling analysis.

For this analysis, the 1:24,000 scale United States Geological Survey (USGS) topographic maps for West Dixie Bend was obtained. Visual observation of the land use depicted on these maps clearly indicates that the region within 3 km is predominately rural.

**6.2.3 Terrain Considerations**

The U.S. EPA modeling guidelines require that the differences in terrain elevations, between the stack base and each location (receptor) at which air quality impacts are predicted, be considered in the modeling analyses. There are three types of terrain:

- simple terrain – locations where the terrain elevation is at or below the exhaust height of the stacks to be modeled;

- intermediate terrain – locations where the terrain is between the height of the stack and the modeled exhaust “plume” centerline (this varies as a function of plume rise, which in turn, varies as a function of meteorological condition);
- complex terrain – locations where the terrain is above the plume centerline.

Based on a review of USGS topographical maps, the area throughout the modeling domain is generally flat. The dispersion model must therefore be capable of simulating impacts on simple terrain only.

Based on a review of the factors discussed above, the ISCST3-Version 00101 dispersion model was selected for use in the modeling analysis.

### 6.3 Model Application

The ISCST3 model was used to calculate concentrations at simple receptor locations. The model was applied using the ISCST3 regulatory default option, in accordance with the U.S. EPA Guidelines.

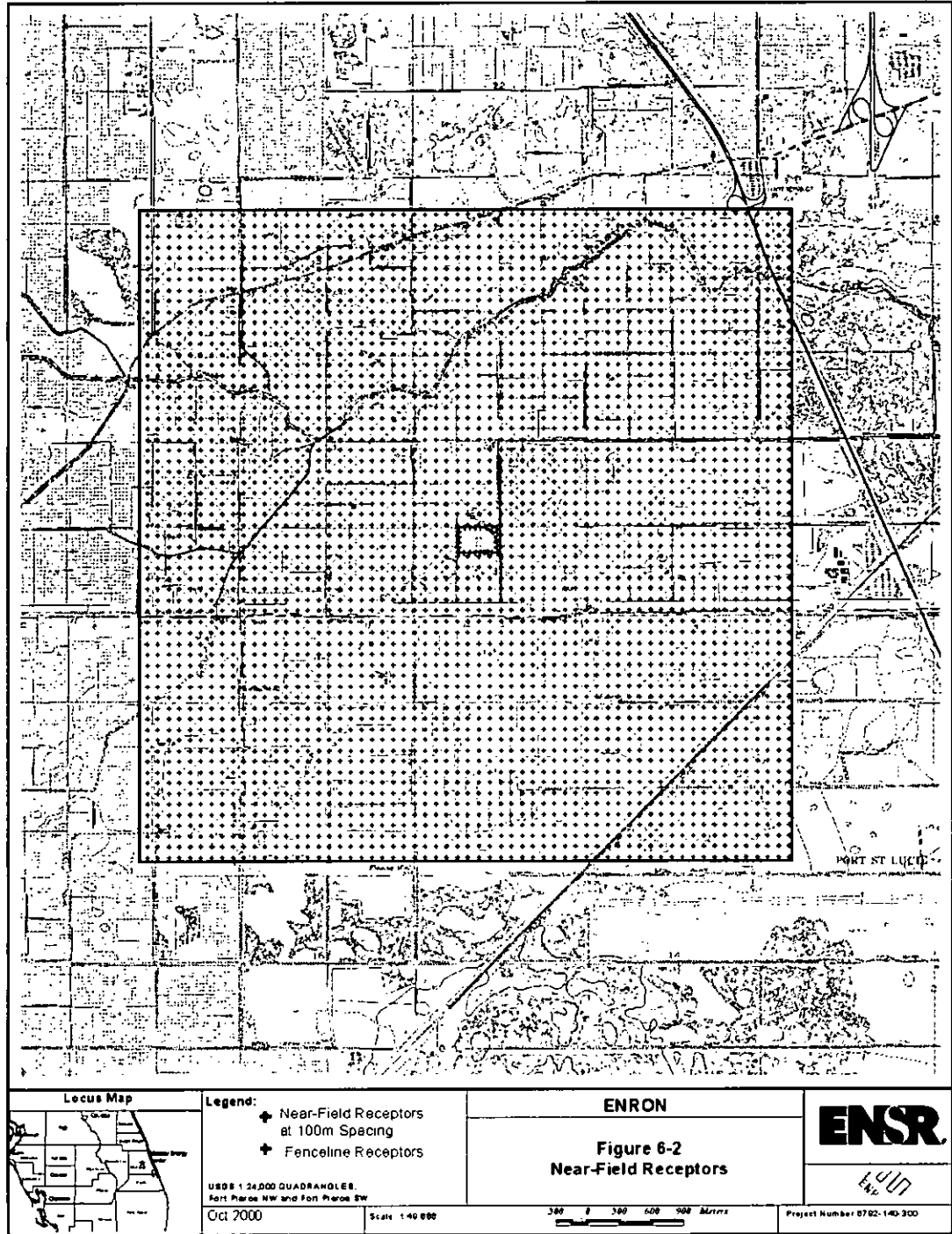
#### 6.3.1 Meteorological Data

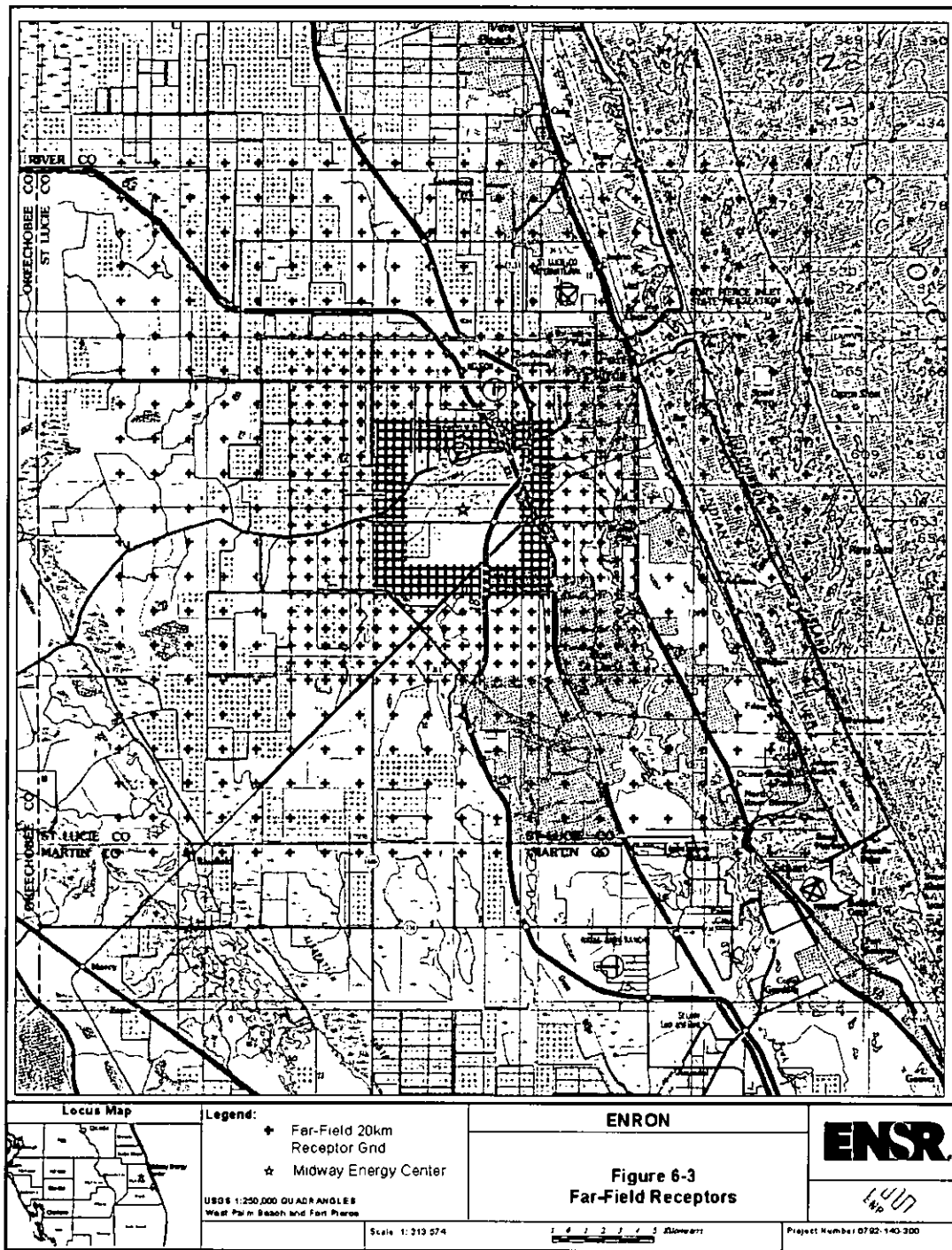
The ISCST3 model requires a sequential hourly record of dispersion meteorology representative of the region within which the proposed source is located. In the absence of site-specific measurements, the EPA Guidelines recommend the use of data from nearby National Weather Service (NWS) stations, provided they are representative. For this analysis a five-year sequential meteorological data set was used consisting of surface observations and concurrent mixing height data from the NWS station at West Palm Beach International airport from 1987 through 1991. The West Palm Beach data are the closest representative data available and were recommended by the DEP for use in this application. The DEP provided the data in the processed format required for input to ISCST3.

#### 6.3.2 Model Receptor Grid

A cartesian receptor grid was generated for use in the ISCST3 modeling. The grid consisted of densely spaced receptors at 100 meters apart starting at and extending to 3000 meters from the fence-line. Beyond 3000 meters, a spacing of 500 meters was used out to five kilometers from the facility. From six to ten kilometers, a spacing of 1000 meters was used. Between ten and twenty kilometers, a spacing of 2000 meters was used. Additional receptors were placed approximately every 50 meters along the property fence-line for increased resolution of impacts. As recommended by DEP, terrain elevations were not used for the receptors given that the terrain in the study area is generally flat. The extent of this grid was sufficient to capture maximum impacts.

Figure 6-2 shows the near-field receptors (out to three kilometers) including the near-field portion of the cartesian grid and fence-line receptors. The full cartesian receptor grid out to twenty kilometers is shown in Figure 6-3.







### 6.3.3 Physical Source and Emissions Data

The air dispersion modeling analysis was conducted with emission rates and flue gas exhaust characteristics (flow rate and temperature) that are expected to represent the worst-case parameters among the range of possible values for the GE turbine model under consideration. Because turbine emission rates and flue gas characteristics for a given turbine load vary as a function of ambient temperature and fuel use, data were derived for four ambient temperatures for each proposed fuel at each of the three operating load scenarios (100%, 75% and 50%). The temperatures selected were:

- 30°F, an extreme lower boundary
- 42°F,
- 50°F, the effective inlet air temperature when the chillers are operating
- 91°F, a representative upper boundary

A summary of the exhaust data and emission rates for the PSD regulated pollutants for each fuel at each temperature and the three operating loads is provided in Table 6-2 for the GE 7FA turbines. Detailed calculations of the emissions parameters are presented in Appendix B.

In order to conservatively calculate ground-level concentrations, a composite "worst-case" set of emissions parameters was developed for each proposed fuel for input to the modeling. For each operating load, the highest pollutant-specific emission rate, the lowest exhaust temperature and the lowest exhaust flow rate were selected. Table 6-3 summarizes the worst-case emissions parameters for the two fuels at three operating loads.

Wind-direction-specific dimensions of the structures potentially causing building downwash of the turbine stacks were derived using the U.S. EPA BPIP processor. The BPIP inputs to the ISCST3 model are provided in Appendix D.

## 6.4 Ambient Impact Criteria

The U.S. EPA has established specific ambient impact criteria against which to evaluate the impact of a proposed new source. These are listed in Table 6-4 for the pollutants considered in this analysis. A description of each of the criteria and the relevance to the PSD application is described below.

**Table 6-2 Combustion Turbine Performance Data for Natural Gas and Distillate Fuel Oil Operation**

**100 % Load – Natural Gas**

Parameter		Values			
Ambient Temperature (°F)		91	50	42	30
Stack Height (Ft.)		80	80	80	80
Stack Diameter (Ft.)		18.0	18.0	18.0	18.0
Exit Temperature (°F)		1149	1109	1100	1087
Exit Velocity (Ft./sec)		150.4	160.6	162.0	164.0
Pollutant Emissions Per Combustion Turbine (lb/hr)	NO <sub>x</sub>	71.4	79.5	80.5	82.1
	CO	26.5	29.6	30.1	30.9
	SO <sub>2</sub>	9.5	10.6	10.7	10.9
	PM <sub>10</sub>	18.0	18.0	18.0	18.0

**75 % Load – Natural Gas**

Parameter		Values			
Ambient Temperature (°F)		91	50	42	30
Stack Height (Ft.)		80	80	80	80
Stack Diameter (Ft.)		18.0	18.0	18.0	18.0
Exit Temperature (°F)		1180	1147	1142	1134
Exit Velocity (Ft./sec)		125.8	130.8	131.5	132.7
Pollutant Emissions Per Combustion Turbine (lb/hr)	NO <sub>x</sub>	58.0	63.4	64.1	65.3
	CO	21.8	23.5	23.8	24.3
	SO <sub>2</sub>	7.8	8.5	8.6	8.8
	PM <sub>10</sub>	18.0	18.0	18.0	18.0

**50 % Load – Natural Gas**

Parameter		Values			
Ambient Temperature (°F)		91	50	42	30
Stack Height (Ft.)		80	80	80	80
Stack Diameter (Ft.)		18.0	18.0	18.0	18.0
Exit Temperature (°F)		1200	1194	1189	1182
Exit Velocity (Ft./sec)		106.9	111.3	111.8	112.4
Pollutant Emissions Per Combustion Turbine (lb/hr)	NO <sub>x</sub>	45.9	50.3	50.8	51.6
	CO	18.4	19.5	19.7	20.0
	SO <sub>2</sub>	0.9	1.0	1.1	1.1
	PM <sub>10</sub>	18.0	18.0	18.0	18.0

**Table 6-2 Combustion Turbine Performance Data for Natural Gas and Distillate Fuel Oil Operation (continued)**

**100 % Load –Distillate Fuel Oil**

Parameter		Values			
Ambient Temperature (°F)		91	50	42	30
Stack Height (Ft.)		80	80	80	80
Stack Diameter (Ft.)		18.0	18.0	18.0	18.0
Exit Temperature (°F)		1138	1088	1079	1065
Exit Velocity (Ft./sec)		154.4	165.0	166.5	168.6
Pollutant Emissions Per Combustion Turbine (lb/hr)	NO <sub>x</sub>	289.6	321.0	325.5	332.1
	CO	59.5	66.6	67.8	69.6
	SO <sub>2</sub>	90.3	100.2	101.6	103.6
	PM <sub>10</sub>	34.0	34.0	34.0	34.0
	Lead	0.03	0.03	0.03	0.03

**75 % Load –Distillate Fuel Oil**

Parameter		Values			
Ambient Temperature (°F)		91	50	42	30
Stack Height (Ft.)		80	80	80	80
Stack Diameter (Ft.)		18.0	18.0	18.0	18.0
Exit Temperature (°F)		1186	1153	1148	1142
Exit Velocity (Ft./sec)		128.3	133.0	134.0	135.5
Pollutant Emissions Per Combustion Turbine (lb/hr)	NO <sub>x</sub>	232.7	254.0	257.9	263.2
	CO	50.7	56.8	57.5	58.5
	SO <sub>2</sub>	73.3	80.0	81.3	82.9
	PM <sub>10</sub>	34.0	34.0	34.0	34.0
	Lead	0.02	0.02	0.02	0.02

**50 % Load –Distillate Fuel Oil**

Parameter		Values			
Ambient Temperature (°F)		91	50	42	30
Stack Height (Ft.)		80	80	80	80
Stack Diameter (Ft.)		18.0	18.0	18.0	18.0
Exit Temperature (°F)		1200	1200	1200	1193
Exit Velocity (Ft./sec)		109.0	112.5	112.9	113.4
Pollutant Emissions Per Combustion Turbine (lb/hr)	NO <sub>x</sub>	181.9	199.2	201.5	204.6
	CO	78.3	66.5	64.6	67.6
	SO <sub>2</sub>	57.9	63.4	64.2	65.1
	PM <sub>10</sub>	34.0	34.0	34.0	34.0
	Lead	0.02	0.02	0.02	0.02

**Table 6-3 Worst-Case Turbine Stack Data for Dispersion Modeling**

**Natural Gas Operation**

Parameter		Value		
Load (%)		100	75	50
Stack Height (Ft.)		80	80	80
Stack Diameter (Ft.)		18	18	18
Exit Temperature (°F)		1087	1134	1182
Exit Velocity (Ft./sec)		150.4	125.8	106.9
Pollutant Emissions Per Combustion Turbine (lb/hr)	NO <sub>x</sub>	82.1	65.3	51.6
	CO	30.9	24.3	20.0
	SO <sub>2</sub>	10.9	8.8	7.0
	PM <sub>10</sub>	18.0	18.0	18.0

**No. 2 Fuel Operation**

Parameter		Value		
Load (%)		100	75	50
Stack Height (Ft.)		80	80	80
Stack Diameter (Ft.)		18	18	18
Exit Temperature (°F)		1065	1142	1193
Exit Velocity (Ft./sec)		154.4	128.3	109.0
Pollutant Emissions Per Combustion Turbine (lb/hr)	NO <sub>x</sub>	332.1	263.2	204.6
	CO	69.6	58.5	78.3
	SO <sub>2</sub>	103.6	82.9	65.1
	PM <sub>10</sub>	34.0	34.0	34.0
	Lead	0.028	0.023	0.018

**Table 6-3 Worst-Case Turbine Stack Data for Dispersion Modeling**

**Natural Gas Operation**

Parameter		Value		
Load (%)		100	75	50
Stack Height (Ft.)		80	80	80
Stack Diameter (Ft.)		18	18	18
Exit Temperature (°F)		1087	1134	1182
Exit Velocity (Ft./sec)		150.4	125.8	106.9
Pollutant Emissions Per Combustion Turbine (lb/hr)	NO <sub>x</sub>	82.1	65.3	51.6
	CO	30.9	24.3	20.0
	SO <sub>2</sub>	10.9	8.8	7.0
	PM <sub>10</sub>	18.0	18.0	18.0

**No. 2 Fuel Operation**

Parameter		Value		
Load (%)		100	75	50
Stack Height (Ft.)		80	80	80
Stack Diameter (Ft.)		18	18	18
Exit Temperature (°F)		1065	1142	1193
Exit Velocity (Ft./sec)		154.4	128.3	109.0
Pollutant Emissions Per Combustion Turbine (lb/hr)	NO <sub>x</sub>	332.1	263.2	204.6
	CO	69.6	58.5	78.3
	SO <sub>2</sub>	103.6	82.9	65.1
	PM <sub>10</sub>	34.0	34.0	34.0
	Lead	0.028	0.023	0.018

Table 6-4 Ambient Impact Criteria<sup>1</sup>

Pollutant	Averaging Period	NAAQS		Maximum Allowable PSD Class II Increments	PSD Significant Monitoring Concentration	PSD Class II Significant Impact Levels	PSD Class I Significant Impact Levels
		Primary	Secondary				
NO <sub>2</sub>	Annual	100	100	25	14	1	0.1
CO	1-hour	40,000	NA	NA	NA	2,000	NA
	8-hour	10,000	NA	NA	575	500	NA
PM <sub>10</sub>	24-hour	150	150	30	10	5	0.3
	Annual	50	50	17	NA	1	0.2
SO <sub>2</sub>	3-hour	NA	1300	512	NA	25	1.0
	24-hour	365	NA	91	13	5	0.2
	Annual	80	NA	20	NA	1	0.1
Lead	Quarter	1.5	1.5	NA	NA	NA	NA
<sup>1</sup> All values in µg/m <sup>3</sup> . Annual averages are the maximum over all receptors. Short-term averages are the highest of the second-highest concentration over all receptors. NA = Not Applicable							

National Ambient Air Quality Standards (NAAQS)

National Ambient Air Quality Standards (NAAQS) are set by U.S. EPA, based on specific health and welfare effects criteria. Hence the term "criteria" pollutants. Ambient air refers to the air to which the general public is exposed, not the air inside buildings or in workplaces. The combined impacts of all existing sources cannot exceed the NAAQS. The primary NAAQS are established to protect the health of sensitive individuals. The secondary NAAQS are established to protect the general welfare of the public-at-large from adverse impacts on air quality related values such as visibility.

Allowable PSD Increments

The PSD increments are maximum allowable incremental increases in the ambient concentrations of the criteria pollutants in NAAQS attainment areas. The net combined impacts of all emissions increases and decreases from all sources occurring after a specified baseline date cannot exceed the PSD Increments. The PSD Class II increments apply to most areas of the country, including most of Florida with the exception of the designated PSD Class I areas. PSD Class I areas are National Parks and Wilderness Areas designated by U.S. EPA for special protection, including tighter PSD increments. The nearest PSD Class I area to the proposed facility is the Everglades National Park located about 180 kilometers to the southwest. New sources are presumed to have an insignificant impact on a PSD Class I area if maximum modeled impacts are less than the levels shown in Table 6-4. Since long range transport modeling involving the use of the CALPUFF dispersion model is

required for the Class I impact assessment, a separate analysis is being completed for this assessment in coordination with the National Park Service Air Quality Division. The results of the PSD Class I area assessment will be submitted as a supplement to this permit application.

#### PSD Significant Monitoring Concentrations

PSD applicants can be granted a discretionary waiver from PSD pre-construction air quality monitoring requirements if the modeled impacts of the new source are below these concentrations.

#### PSD Significant Impact Levels

As can be seen from the concentrations representing these levels, the Significant Impact Levels (SILs) are small fractions of the NAAQS and PSD increments. The U.S. EPA guidelines require these levels to be used to determine the extent of the area surrounding a proposed source within which the source could significantly add to ambient air quality concentrations. For proposed sources whose impacts are above these levels, an analysis of the combined impacts of the proposed source with other existing sources is required. If a proposed source's impacts are below these levels it is considered to be unable to either cause or contribute to violations of the NAAQS, PSD Class II, or Class I increments. Therefore, a cumulative impact assessment is not required.

### **6.5 Results of Ambient Air Quality Impact Analysis**

The emissions from the turbine stacks (3) were modeled with ISCST3 to estimate the maximum concentrations for the criteria pollutants including NO<sub>x</sub>, PM/PM<sub>10</sub>, SO<sub>2</sub>, CO, and lead for each year of meteorological data. Note that the modeling of annual impacts reflects limited operation of the combustion turbines (3500 hours/year/turbine including up to 1500 hours/year/turbine of distillate fuel oil usage).

#### Class II Area Receptors

Tables 6-5 and 6-6 provide summaries of the ISCST3 modeling results for NO<sub>x</sub>, PM/PM<sub>10</sub>, SO<sub>2</sub>, CO, and lead for the Class II cartesian grid and fence-line receptors for natural gas and oil firing, respectively. The maximum air concentrations over the five years modeled and corresponding receptor locations are listed for each turbine load case (100%, 75% and 50%). The modeling results

**Table 6-5 ISCAST3 Modeling Results for Natural Gas**

**100% Load**

Pollutant	Averaging Period	Maximum Concentration ( $\mu\text{g}/\text{m}^3$ )*	Receptor Location	
			UTM East (m)	UTM North (m)
NO <sub>x</sub>	Annual	0.020	547670	3033548
PM-10	24-hour	0.149	540670	3038548
	Annual	0.004	547670	3033548
SO <sub>2</sub>	3-hour	0.369	562670	3012548
	24-hour	0.090	540670	3038548
	Annual	0.003	547670	3033548
CO	1-hour	2.469	555670	3029848
	8-hour	0.619	538670	3024548

\* Annual concentrations based on a maximum of 3500 hours/year of natural gas use.

**75% Load**

Pollutant	Averaging Period	Maximum Concentration ( $\mu\text{g}/\text{m}^3$ )*	Receptor Location	
			UTM East (m)	UTM North (m)
NO <sub>x</sub>	Annual	0.019	547670	3033548
PM-10	24-hour	0.224	556730.6	3028621
	Annual	0.005	547670	3033548
SO <sub>2</sub>	3-hour	0.601	556770	3028648
	24-hour	0.110	556730.6	3028621
	Annual	0.003	547670	3033548
CO	1-hour	4.977	556770	3028648
	8-hour	0.908	556730.6	3028621

\* Annual concentrations based on a maximum of 3500 hours/year of natural gas use.

**50% Load**

Pollutant	Averaging Period	Maximum Concentration ( $\mu\text{g}/\text{m}^3$ )*	Receptor Location	
			UTM East (m)	UTM North (m)
NO <sub>x</sub>	Annual	0.017	547670	3033548
PM-10	24-hour	0.323	556580.9	3028573
	Annual	0.006	547670	3033548
SO <sub>2</sub>	3-hour	0.622	556470	3028548
	24-hour	0.126	556580.9	3028573
	Annual	0.002	547670	3033548
CO	1-hour	4.744	556770	3028648
	8-hour	0.881	556730.6	3028621

\* Annual concentrations based on a maximum of 3500 hours/year of natural gas use.



**Table 6-6 ISCST3 Modeling Results for Distillate Oil**

**100% Load**

Pollutant	Averaging Period	Maximum Concentration ( $\mu\text{g}/\text{m}^3$ )*	Receptor Location	
			UTM East (m)	UTM North (m)
NO <sub>x</sub>	Annual	0.034	547670	3033548
PM-10	24-hour	0.277	540670	3038548
	Annual	0.004	547670	3033548
SO <sub>2</sub>	3-hour	3.441	562670	3012548
	24-hour	0.844	540670	3038548
	Annual	0.011	547670	3033548
CO	1-hour	5.546	555670	3029848
	8-hour	1.371	538670	3024548
Lead	24-hour	2.28E-04	540670	3038548

\* Annual concentrations based on a maximum of 1500 hours/year of oil use.

**75% Load**

Pollutant	Averaging Period	Maximum Concentration ( $\mu\text{g}/\text{m}^3$ )*	Receptor Location	
			UTM East (m)	UTM North (m)
NO <sub>x</sub>	Annual	0.032	547670	3033548
PM-10	24-hour	0.414	556730.6	3028621
	Annual	0.004	547670	3033548
SO <sub>2</sub>	3-hour	5.536	556770	3028648
	24-hour	1.009	556730.6	3028621
	Annual	0.010	547670	3033548
CO	1-hour	11.721	556770	3028648
	8-hour	2.135	556730.6	3028621
Lead	24-hour	3.41E-04	556730.6	3028621

\* Annual concentrations based on a maximum of 1500 hours/year of oil use.

**50% Load**

Pollutant	Averaging Period	Maximum Concentration ( $\mu\text{g}/\text{m}^3$ )*	Receptor Location	
			UTM East (m)	UTM North (m)
NO <sub>x</sub>	Annual	0.029	547670	3033548
PM-10	24-hour	0.593	556580.9	3028573
	Annual	0.005	547670	3033548
SO <sub>2</sub>	3-hour	5.638	556470	3028548
	24-hour	1.136	556580.9	3028573
	Annual	0.009	547670	3033548
CO	1-hour	18.168	556770	3028648
	8-hour	3.371	556730.6	3028621
Lead	24-hour	4.88E-04	556580.9	3028573

\* Annual concentrations based on a maximum of 1500 hours/year of oil use.

for all years of modeling are provided in Appendix E. Note that in Table 6-5 (results for natural gas), the maximum annual concentrations are based on a maximum of 3500 hours/year of natural gas firing (i.e., the results have been scaled by a factor of 3500/8760). Similarly, in Table 6-6 (results for oil), the maximum annual concentrations are based on a maximum of 1500 hours/year of oil firing (i.e., the results have been scaled by a factor of 1500/8760).

A comparison of the overall maximum pollutant impacts with the Class II Significant Impact Levels is presented in Table 6-7. For each pollutant and averaging period, the table lists the maximum predicted concentration for all fuels, years of meteorology, and worst-case turbine operating load. All of the modeled concentrations are below the SILs. Based on these results it can be concluded that the proposed facility will neither cause nor contribute to a violation of the NAAQS or PSD Class II increments. It is also pointed out that these impacts are below the relevant PSD significant monitoring concentrations as well. Thus, the facility is eligible for a waiver from pre-construction monitoring.

**Table 6-7 Comparison of Maximum ISCST3 Concentrations to Class II Significant Impact Levels**

Pollutant	Averaging Period	Maximum Concentration ( $\mu\text{g}/\text{m}^3$ )*	SIL ( $\mu\text{g}/\text{m}^3$ )
NO <sub>x</sub>	Annual	0.046	1
PM-10	24-hour	0.593	5
	Annual	0.008	1
SO <sub>2</sub>	3-hour	5.638	25
	24-hour	1.136	5
	Annual	0.012	1
CO	1-hour	18.168	2,000
	8-hour	3.371	500
Lead**	Quarterly	4.88E-04	1.5
<p>* Annual concentrations based on a worst-case composite of maximum natural gas concentration scaled by 2000 hours/year plus maximum oil concentration scaled by 1500 hours/year.</p> <p>** Lead concentration is conservatively represented by the maximum 24-hour value. There is no SIL for Lead. The lead concentration is compared to the NAAQS.</p>			

---

## 7.0 ADDITIONAL IMPACTS

The preceding sections of this permit application have focused on demonstrating the proposed action will incorporate Best Available Control Technology and will not have a significant impact on air quality. Beyond consideration of these basic air quality concerns, PSD regulations require a review of some of the more subtle effects a project may induce. The following section discusses the potential impacts which may result from the proposed project with respect to the following:

- Vegetation and Soils
- Associated Growth
- PSD Class I Area Impacts – Air Quality Increments, Regional Haze, and Deposition

### 7.1 Vegetation and Soils

The project lies in an area of primarily agricultural use. No significant off-site impacts are expected from the proposed action. Therefore, the potential for adverse impacts to either soils or vegetation is minimal. The following discussion reviews the project's potential to impact its surroundings, based on the facility's PTE and the model-predictions of maximum ground level concentrations of SO<sub>2</sub>, NO<sub>x</sub> and CO, the PSD-applicable pollutants of concern for potential impact to soils and vegetation.

The criteria for evaluating impacts on soils and vegetation is taken from U.S. EPA's A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils and Animals (U.S. EPA 1980). Table 7-1 lists the U.S. EPA suggested criteria for the gaseous pollutants emitted directly from the proposed facility and the predicted facility impacts. These criteria are established for sensitive vegetation and crops exposed to the effects of the gaseous pollutants through direct exposure. Adverse impacts on soil systems result more readily from the secondary effects of these pollutants' impacts on the stability of the soil system. These impacts could include increased soil temperature and moisture stress and/or increased runoff and erosion resulting from damage to vegetative cover. Thus, the Table 7-1 criteria have been applied to the proposed facility to evaluate impacts on both soils and vegetation. As shown in Table 7-1, the results clearly indicate that no adverse impacts will occur to sensitive vegetation, crops, or soil systems as a result of operation of the proposed facility.

**Table 7-1 Comparison to U.S. EPA Criteria for Gaseous Pollutant Impacts on Natural Vegetation and Crops**

Pollutant	Averaging Time*	Minimum Impact Level for Affects On Sensitive Plants ( $\mu\text{g}/\text{m}^3$ )	Maximum Impact of Proposed Facility ( $\mu\text{g}/\text{m}^3$ )
SO <sub>2</sub>	1 hour	917	16.61
	3 hours	786	5.64
	Annual	18	0.012
NO <sub>x</sub>	4 hours	3760	17.72
	8 hours	3760	9.61
	1 month	564	3.57
	Annual	94	0.046
CO	1 week	1,800,000	1.37

\* 24-hour average used to conservatively represent 1-week and 1-month average impacts and 3-hour average used to conservatively represent 4-hour average impact.

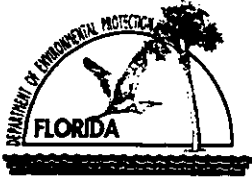
## 7.2 Associated Growth

The proposed project will employ approximately 200 personnel during the construction phase. The project will employ approximately 10 personnel on a permanent basis. It is a goal of the project to hire from the local community when possible. There should be no substantial increase in community growth, or need for additional infrastructure. It is not anticipated that the proposed action will result in an increase in secondary emissions associated with non-project related activities. Therefore, in accordance with PSD guidelines, the analysis of ambient air quality impacts need consider only emissions from the facility itself.

## 7.3 Class I Area Impact Analysis

The nearest PSD Class I area to the proposed facility is the Everglades National Park located about 180 kilometers to the southwest. Given that the Class I area is greater than 50 kilometers from the proposed facility, long range transport modeling involving the use of the CALPUFF dispersion model is required for the Class I impact assessment. The analysis will evaluate the potential impact of the proposed facility emissions in terms of air quality, regional haze, and deposition (sulfur and nitrogen). A separate analysis is being completed for this assessment in coordination with the National Park Service Air Quality Division. The results of the PSD Class I area assessment will be submitted as a supplement to this permit application.

**APPENDIX A**  
**FLORIDA DEP APPLICATION FORMS**



# Department of Environmental Protection

## Division of Air Resources Management

### APPLICATION FOR AIR PERMIT - TITLE V SOURCE

See Instructions for Form No. 62-210.900(1)

#### I. APPLICATION INFORMATION

##### Identification of Facility

1. Facility Owner/Company Name: <b>Midway Development Company, L.L.C.</b>	
2. Site Name: <b>Midway Energy Center</b>	
3. Facility Identification Number: <span style="float: right;"><input checked="" type="checkbox"/> Unknown</span>	
4. Facility Location: Street Address or Other Locator: <b>Northwest of the intersection of I-95 and W. Midway Rd</b> City: <b>Near Port St. Lucie</b> County: <b>St. Lucie</b> Zip Code: <b>34945</b>	
5. Relocatable Facility? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	6. Existing Permitted Facility? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No

##### Application Contact

1. Name and Title of Application Contact: <b>Dave Kellermeyer, Director</b>	
2. Application Contact Mailing Address: Organization/Firm: <b>Midway Development Company, L.L.C.</b> Street Address: <b>1400 Smith Street</b> City: <b>Houston</b> State: <b>TX</b> Zip Code: <b>77002-7631</b>	
3. Application Contact Telephone Numbers: Telephone: <b>(713) 853-3161</b> Fax: <b>(713) 646-3037</b>	

##### Application Processing Information (DEP Use)

1. Date of Receipt of Application:	<b>11-9-00</b>
2. Permit Number:	<b>1110099-002-AC</b>
3. PSD Number (if applicable):	<b>PSD-FL-305</b>
4. Siting Number (if applicable):	

**Purpose of Application**

**Air Operation Permit Application**

This Application for Air Permit is submitted to obtain: (Check one)


- Initial Title V air operation permit for an existing facility which is classified as a Title V source.
- Initial Title V air operation permit for a facility which, upon start up of one or more newly constructed or modified emissions units addressed in this application, would become classified as a Title V source.  
Current construction permit number: \_\_\_\_\_
- Title V air operation permit revision to address one or more newly constructed or modified emissions units addressed in this application.  
Current construction permit number: \_\_\_\_\_  
Operation permit number to be revised: \_\_\_\_\_
- Title V air operation permit revision or administrative correction to address one or more proposed new or modified emissions units and to be processed concurrently with the air construction permit application. (Also check Air Construction Permit Application below.)  
Operation permit number to be revised/corrected: \_\_\_\_\_
- Title V air operation permit revision for reasons other than construction or modification of an emissions unit. Give reason for the revision; e.g., to comply with a new applicable requirement or to request approval of an "Early Reductions" proposal.  
Operation permit number to be revised: \_\_\_\_\_  
Reason for revision: \_\_\_\_\_

**Air Construction Permit Application**

This Application for Air Permit is submitted to obtain: (Check one)

- Air construction permit to construct or modify one or more emissions units.
- Air construction permit to make federally enforceable an assumed restriction on the potential emissions of one or more existing, permitted emissions units.
- Air construction permit for one or more existing, but unpermitted, emissions units.

**Owner/Authorized Representative or Responsible Official**

1. Name and Title of Owner/Authorized Representative or Responsible Official: <b>Ben Jacoby – Director</b>
2. Owner/Authorized Representative or Responsible Official Mailing Address: Organization/Firm: <b>Midway Development Company, L.L.C.</b> Street Address: <b>1400 Smith Street</b> City: <b>Houston</b> State: <b>TX</b> Zip Code: <b>77002-7631</b>
3. Owner/Authorized Representative or Responsible Official Telephone Numbers: Telephone: <b>(713) 853-6173</b> Fax: <b>(713) 646-3037</b>
4. Owner/Authorized Representative or Responsible Official Statement: <i>I, the undersigned, am the owner or authorized representative*(check here [ ], if so) or the responsible official (check here [✓], if so) of the Title V source addressed in this application, whichever is applicable. I hereby certify, based on information and belief formed after reasonable inquiry, that the statements made in this application are true, accurate and complete and that, to the best of my knowledge, any estimates of emissions reported in this application are based upon reasonable techniques for calculating emissions. The air pollutant emissions units and air pollution control equipment described in this application will be operated and maintained so as to comply with all applicable standards for control of air pollutant emissions found in the statutes of the State of Florida and rules of the Department of Environmental Protection and revisions thereof. I understand that a permit, if granted by the Department, cannot be transferred without authorization from the Department, and I will promptly notify the Department upon sale or legal transfer of any permitted emissions unit.</i>   _____ Signature  11-7-00 _____ Date

\* Attach letter of authorization if not currently on file.

**Professional Engineer Certification**

1. Professional Engineer Name: <b>Blair Burgess</b> Registration Number: <b>45460</b>
2. Professional Engineer Mailing Address: Organization/Firm: <b>ENSR</b> Street Address: <b>2809 West Mall Drive</b> City: <b>Florence</b> State: <b>AL</b> Zip Code: <b>35630</b>
3. Professional Engineer Telephone Numbers: Telephone: <b>(256) 767-1210</b> Fax: <b>(256) 767-1211</b>



4. Professional Engineer Statement:

*I, the undersigned, hereby certify, except as particularly noted herein\*, that:*

*(1) To the best of my knowledge, there is reasonable assurance that the air pollutant emissions unit(s) and the air pollution control equipment described in this Application for Air Permit, when properly operated and maintained, will comply with all applicable standards for control of air pollutant emissions found in the Florida Statutes and rules of the Department of Environmental Protection; and*

*(2) To the best of my knowledge, any emission estimates reported or relied on in this application are true, accurate, and complete and are either based upon reasonable techniques available for calculating emissions or, for emission estimates of hazardous air pollutants not regulated for an emissions unit addressed in this application, based solely upon the materials, information and calculations submitted with this application.*

*If the purpose of this application is to obtain a Title V source air operation permit (check here [  ], if so), I further certify that each emissions unit described in this Application for Air Permit, when properly operated and maintained, will comply with the applicable requirements identified in this application to which the unit is subject, except those emissions units for which a compliance schedule is submitted with this application.*

*If the purpose of this application is to obtain an air construction permit for one or more proposed new or modified emissions units (check here [], if so), I further certify that the engineering features of each such emissions unit described in this application have been designed or examined by me or individuals under my direct supervision and found to be in conformity with sound engineering principles applicable to the control of emissions of the air pollutants characterized in this application.*

*If the purpose of this application is to obtain an initial air operation permit or operation permit revision for one or more newly constructed or modified emissions units (check here [  ], if so), I further certify that, with the exception of any changes detailed as part of this application, each such emissions unit has been constructed or modified in substantial accordance with the information given in the corresponding application for air construction permit and with all provisions contained in such permit.*

11/2/00

Signature

(seal)

Date

11/2/00

\* Attach any exception to certification statement.

**Scope of Application**

Emissions Unit ID	Description of Emissions Unit	Permit Type	Processing Fee
CT001 – CT003	PG7241S(FA) Simple Cycle Combustion Turbines (Three identical combustion turbines)	AC1A	<b>\$7,500</b> Similar emissions unit fee per Rule 62-4.050(4)(a)(4)
T001 – T002	Distillate Fuel Oil Storage Tanks (Main Tank and Day Tank)	AC1F	
NGH	Natural Gas Fuel Heater	AC1F	

**Application Processing Fee**

Check one:  Attached - Amount:  Not Applicable

**Note: Due to previously-submitted and withdrawn permit applications, the parent company of Midway Energy Center has an existing positive application fee balance with the Florida Department of Environmental Protection.**

**Construction/Modification Information**

1. Description of Proposed Project or Alterations

**Midway Development Company, L.L.C. proposes to construct and operate a peaking electrical power generating facility at a greenfield site in St. Lucie County, Florida. The facility will consist of three (3) GE PG7241S(FA) (GE 7FA) combustion turbines operating in simple cycle mode; each turbine has a nominal generating capacity of 170 MW at ISO base rating. The combustion turbines will be fired up to 1,500 hours on low sulfur distillate oil, the remaining operation on natural gas, for a total of up to 3,500 hours. Ancillary equipment includes one 2.5 million gallon distillate oil main storage tank, one 617,400 gallon distillate oil day storage tank and one 13 MMBtu/hr natural gas fuel heater.**

2. Projected or Actual Date of Commencement of Construction:

**April 1, 2001**

3. Projected Date of Completion of Construction:

**May 1, 2002**

**Application Comment**

--



**Facility Regulatory Classifications**

Check all that apply:

1. [ ] Small Business Stationary Source?	[ ] Unknown
2. [✓] Major Source of Pollutants Other than Hazardous Air Pollutants (HAPs)?	
3. [ ] Synthetic Minor Source of Pollutants Other than HAPs?	
4. [ ] Major Source of Hazardous Air Pollutants (HAPs)?	
5. [ ] Synthetic Minor Source of HAPs?	
6. [✓] One or More Emissions Units Subject to NSPS?	
7. [ ] One or More Emission Units Subject to NESHAP?	
8. [✓] Title V Source by EPA Designation?	
9. Facility Regulatory Classifications Comment (limit to 200 characters):	

**List of Applicable Regulations (Facility-wide)**

<b>Chapter 62-4</b>	<b>Permits</b>
<b>Rule 62-204.220</b>	<b>Ambient Air Quality Protection</b>
<b>Rule 62-204.240</b>	<b>Ambient Air Quality Standards</b>
<b>Rule 62-204.260</b>	<b>Prevention of Significant Deterioration Increments</b>
<b>Rule 62-204.800</b>	<b>Federal Regulations Adopted by Reference</b>
<b>Rule 62-210.300</b>	<b>Permits Required</b>
<b>Rule 62-210.350</b>	<b>Public Notice and Comments</b>
<b>Rule 62-210.370</b>	<b>Reports</b>
<b>Rule 62-210.550</b>	<b>Stack Height Policy</b>
<b>Rule 62-210.650</b>	<b>Circumvention</b>
<b>Rule 62-210.700</b>	<b>Excess Emissions</b>
<b>Rule 62-210.900</b>	<b>Forms and Instructions</b>
<b>Rule 62-212.300</b>	<b>General Preconstruction Review Requirements</b>
<b>Rule 62-212.400</b>	<b>Prevention of Significant Deterioration</b>
<b>Rule 62-213</b>	<b>Operation Permits for Major Sources of Air Pollution</b>
<b>Rule 62-214</b>	<b>Requirements for Sources Subject to the Federal Acid Rain Program</b>
<b>Rule 62-296.</b>	<b>General Pollutant Emission Limiting Standards</b>
<b>Rule 62-297.310</b>	<b>General Test Requirements</b>
<b>Rule 62-297.401</b>	<b>Compliance Test Methods</b>
<b>Rule 62-297.520</b>	<b>EPA Continuous Monitor Performance Specifications</b>
<b>40 CFR 60</b>	<b>Applicable sections of Subpart A, General Requirements, NSPS Subparts GG and Kb</b>
<b>40 CFR 72</b>	<b>Acid Rain Permits</b>
<b>40 CFR 75</b>	<b>Monitoring</b>
<b>40 CFR 77</b>	<b>Acid Rain Program - Excess Emissions</b>

## B. FACILITY POLLUTANTS

### List of Pollutants Emitted

1. Pollutant Emitted	2. Pollutant Classif.	3. Requested Emissions Cap		4. Basis for Emissions Cap	5. Pollutant Comment
		lb/hour	tons/year		
NOX	A				
CO	A				
SO2	A				
VOC	B				Units T001 and T002 subject to record keeping requirements of 40 CFR 60, Subpart Kb
PM	A				
PM10	A				
PB	B				
H114	B				
SAM	B				

**C. FACILITY SUPPLEMENTAL INFORMATION**

**Supplemental Requirements**

1. Area Map Showing Facility Location: [ <input checked="" type="checkbox"/> ] Attached, Document ID: <b>Fig. 1-1</b> [ <input type="checkbox"/> ] Not Applicable [ <input type="checkbox"/> ] Waiver Requested
2. Facility Plot Plan: [ <input checked="" type="checkbox"/> ] Attached, Document ID: <b>Fig. 1-2</b> [ <input type="checkbox"/> ] Not Applicable [ <input type="checkbox"/> ] Waiver Requested
3. Process Flow Diagram(s): [ <input checked="" type="checkbox"/> ] Attached, Document ID: <b>Fig. 2-1</b> [ <input type="checkbox"/> ] Not Applicable [ <input type="checkbox"/> ] Waiver Requested
4. Precautions to Prevent Emissions of Unconfined Particulate Matter: [ <input type="checkbox"/> ] Attached, Document ID: _____ [ <input checked="" type="checkbox"/> ] Not Applicable [ <input type="checkbox"/> ] Waiver Requested
5. Fugitive Emissions Identification: [ <input type="checkbox"/> ] Attached, Document ID: _____ [ <input checked="" type="checkbox"/> ] Not Applicable [ <input type="checkbox"/> ] Waiver Requested
6. Supplemental Information for Construction Permit Application: [ <input checked="" type="checkbox"/> ] Attached, Document ID: <b>ENSR Document No. 6792-140-300</b> [ <input type="checkbox"/> ] Not Applicable
7. Supplemental Requirements Comment: <b>See PSD BACT analysis in Section 5, air quality modeling results in Section 6, and additional impacts analysis in Section 7. Class I area analysis will be submitted as a supplement to the application at a later date.</b>

**Additional Supplemental Requirements for Title V Air Operation Permit Applications**

8. List of Proposed Insignificant Activities: <input checked="" type="checkbox"/> Attached, Document ID: <b>Section 2</b> <input type="checkbox"/> Not Applicable <b>A qualifying insignificant emission units based on PTE is the fuel gas heater. See Appendix B for supporting emission calculations.</b>
9. List of Equipment/Activities Regulated under Title VI: <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Equipment/Activities On site but Not Required to be Individually Listed <input checked="" type="checkbox"/> Not Applicable
10. Alternative Methods of Operation: <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable
11. Alternative Modes of Operation (Emissions Trading): <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable
12. Identification of Additional Applicable Requirements: <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable
13. Risk Management Plan Verification: <input type="checkbox"/> Plan previously submitted to Chemical Emergency Preparedness and Prevention Office (CEPPO). Verification of submittal attached (Document ID: _____) or previously submitted to DEP (Date and DEP Office: _____) <input type="checkbox"/> Plan to be submitted to CEPPO (Date required: _____) <input checked="" type="checkbox"/> Not Applicable
14. Compliance Report and Plan: <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable
15. Compliance Certification (Hard-copy Required): <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable



**Emissions Unit Information Section 1 of 2**

**III. EMISSIONS UNIT INFORMATION**

A separate Emissions Unit Information Section (including subsections A through J as required) must be completed for each emissions unit addressed in this Application for Air Permit. If submitting the application form in hard copy, indicate, in the space provided at the top of each page, the number of this Emissions Unit Information Section and the total number of Emissions Unit Information Sections submitted as part of this application.

**A. GENERAL EMISSIONS UNIT INFORMATION  
(All Emissions Units)**

**Emissions Unit Description and Status**

1. Type of Emissions Unit Addressed in This Section: (Check one)			
<input checked="" type="checkbox"/> This Emissions Unit Information Section addresses, as a single emissions unit, a single process or production unit, or activity, which produces one or more air pollutants and which has at least one definable emission point (stack or vent).			
<input type="checkbox"/> This Emissions Unit Information Section addresses, as a single emissions unit, a group of process or production units and activities which has at least one definable emission point (stack or vent) but may also produce fugitive emissions.			
<input type="checkbox"/> This Emissions Unit Information Section addresses, as a single emissions unit, one or more process or production units and activities which produce fugitive emissions only.			
2. Regulated or Unregulated Emissions Unit? (Check one)			
<input checked="" type="checkbox"/> The emissions unit addressed in this Emissions Unit Information Section is a regulated emissions unit.			
<input type="checkbox"/> The emissions unit addressed in this Emissions Unit Information Section is an unregulated emissions unit.			
3. Description of Emissions Unit Addressed in This Section (limit to 60 characters): <b>CT001 through CT003 are identical GE PG7241S(FA) (GE 7FA) simple cycle combustion turbines (CT) each having a nominal rating 170 megawatts (MW) at base load ISO conditions. Each CT will be fired with natural gas or low sulfur distillate oil.</b>			
4. Emissions Unit Identification Number: ID: <b>CT001; CT002; CT003</b>		<input checked="" type="checkbox"/> No ID <input type="checkbox"/> ID Unknown	
5. Emissions Unit Status Code: <b>C</b>	6. Initial Startup Date: <b>May 2002</b>	7. Emissions Unit Major Group SIC Code: <b>49</b>	8. Acid Rain Unit? <input checked="" type="checkbox"/>
9. Emissions Unit Comment: (Limit to 500 Characters) <b>Each combustion turbine (CT001, CT002, CT003) should be considered separate emissions units. The grouping of all turbines into one Emissions Unit Information Section has been done for administrative convenience since the information required in Subsections A through J is identical for each combustion turbine.</b>			

**Emissions Unit Information Section 1 of 2**

**Emissions Unit Control Equipment**

1. Control Equipment/Method Description (Limit to 200 characters per device or method):

**NOx is limited through use of dry low NOx combustors for natural gas firing and water injection for distillate oil firing. See BACT analysis in Section 5.**

2. Control Device or Method Code(s): **024**

**Emissions Unit Details**

1. Package Unit:	
Manufacturer: <b>General Electric</b>	Model Number: <b>PG7241S(FA)</b>
2. Generator Nameplate Rating:	<b>170 MW (nominal @ base load ISO)</b>
3. Incinerator Information: <b>N/A</b>	
Dwell Temperature:	°F
Dwell Time:	seconds
Incinerator Afterburner Temperature:	°F

**B. EMISSIONS UNIT CAPACITY INFORMATION  
(Regulated Emissions Units Only)**

**Emissions Unit Operating Capacity and Schedule**

1. Maximum Heat Input Rate:	2027 MMBtu hr HHV (base load on fuel oil @ 30°F)	
2. Maximum Incineration Rate:	N/A lb/hr	N/A tons/day
3. Maximum Process or Throughput Rate:	N/A	
4. Maximum Production Rate:	N/A	
5. Requested Maximum Operating Schedule:	24 hours/day	7 days/week
	52 weeks/year	3500 <sup>1</sup> hours/year
6. Operating Capacity/Schedule Comment (limit to 200 characters):	<p><b>1 – Annual operations are based on a total of 3,500 hours per year per unit of which 1,500 hours per year per unit may be distillate fuel oil.</b></p>	

**C. EMISSIONS UNIT REGULATIONS  
(Regulated Emissions Units Only)**

List of Applicable Regulations

<b>40 CFR 60, Subpart A (General Provisions for New Source Performance Standards)</b>	
<b>40 CFR 60.332(a)(1) – NO<sub>x</sub> standards for Stationary Gas Turbines</b>	
<b>40 CFR 60.333 – SO<sub>2</sub> standards for Stationary Gas Turbines</b>	
<b>40 CFR 60.334 – Monitoring Provisions for Stationary Gas Turbines</b>	
<b>40 CFR Part 72 – Acid Rain Program Requirements Regulations</b>	
<b>40 CFR Part 73 – Acid Rain Program SO<sub>2</sub> Allowances System</b>	
<b>40 CFR Part 75 – Acid Rain Program Continuous Emissions Monitoring</b>	
<b>Rule 62-296.320(4)(b)1 – Visible emissions</b>	
<b>40 CFR 52.21 – Prevention of Significant Deterioration</b>	
<b>Rule 62-212.400 – Prevention of Significant Deterioration</b>	

**D. EMISSION POINT (STACK/VENT) INFORMATION  
(Regulated Emissions Units Only)**

**Emission Point Description and Type**

1. Identification of Point on Plot Plan or Flow Diagram? <b>CT001, CT002, CT003</b>		2. Emission Point Type Code: <b>1</b>	
3. Descriptions of Emission Points Comprising this Emissions Unit for VE Tracking (limit to 100 characters per point): <b>Exhaust stacks for combustion turbines; one stack per turbine unit.</b>			
4. ID Numbers or Descriptions of Emission Units with this Emission Point in Common: <b>N/A</b>			
5. Discharge Type Code: <b>V</b>	6. Stack Height: <b>80 feet</b>	7. Exit Diameter: <b>18 feet</b>	
8. Exit Temperature: <b>1109°F (NG)</b> <b>1088°F (Oil)</b>	9. Actual Volumetric Flow Rate: <b>2,451,600 acfm (NG)</b> <b>2,519,400 acfm (Oil)</b>	10. Water Vapor: <b>8.54 % (NG)</b> <b>11.05 % (Oil)</b>	
11. Maximum Dry Standard Flow Rate: <b>754,000 dscfm (NG)</b> <b>764,000 dscfm (Oil)</b>		12. Nonstack Emission Point Height: <b>N/A</b> feet	
13. Emission Point UTM Coordinates:  <b>Zone: 17 CT001: East (km): 556.670 North (km): 3,028.584</b> <b>CT002: East (km): 556.670 North (km): 3,028.548</b> <b>CT003: East (km): 556.670 North (km): 3,028.511</b>			
14. Emission Point Comment (limit to 200 characters):  <b>Exhaust temperatures and flow rates (items 8, 9, 10, 11) are at <u>100% load and 50° F</u> operating conditions. It is expected that the proposed turbines will operate using inlet air chilling during summer peaking operations and as such the inlet air temperature will effectively be at 50° F during the majority of operating hours. Stack temperatures and flow rates will vary with load and ambient temperature.</b>			

**E. SEGMENT (PROCESS/FUEL) INFORMATION  
(All Emissions Units)**

**Segment Description and Rate:** Segment  1  of  2

1. Segment Description (Process/Fuel Type ) (limit to 500 characters): <b>Natural gas</b>		
1. Source Classification Code (SCC): <b>2-01-002-01</b>	3. SCC Units: <b>Million Cubic Feet Burned</b>	
6. Maximum Hourly Rate: <b>1.912 (per turbine)</b>	7. Maximum Annual Rate: <b>6,691 (per turbine)</b>	6. Estimated Annual Activity Factor: <b>N/A</b>
7. Maximum % Sulfur: <b>2 grains/100 SCF</b>	8. Maximum % Ash: <b>N/A</b>	9. Million Btu per SCC Unit: <b>978 (HHV)</b>
10. Segment Comment (limit to 200 characters): <b>Maximum Annual Rate is based on the hourly fuel consumption rate at base load, 50°F for 3500 hours per year.</b>		

**Segment Description and Rate:** Segment  2  of  2

2. Segment Description (Process/Fuel Type) (limit to 500 characters): <b>No. 2 Distillate Fuel Oil</b>		
3. Source Classification Code (SCC): <b>2-01-001-0</b>	3. SCC Units: <b>Thousand Gallons Burned</b>	
4. Maximum Hourly Rate: <b>14.6 (per turbine)</b>	5. Maximum Annual Rate: <b>21,876 (per turbine)</b>	6. Estimated Annual Activity Factor: <b>N/A</b>
7. Maximum % Sulfur: <b>0.05</b>	8. Maximum % Ash: <b>Trace</b>	9. Million Btu per SCC Unit: <b>139 (HHV)</b>
10. Segment Comment (limit to 200 characters): <b>Maximum Annual Rate is based on the hourly fuel consumption rate at base load and 50° F for 1500 hours per year.</b>		

**F. EMISSIONS UNIT POLLUTANTS  
(All Emissions Units)**

1. Pollutant Emitted	2. Primary Control Device Code	3. Secondary Control Device Code	4. Pollutant Regulatory Code
NOX	024 (GE DLN on gas)/028 (oil firing)		EL
CO	0		EL
PM	0		EL
PM10	0		EL
SO2	0		EL
VOC	0		EL
PB	0		EL
SAM	0		EL
H114	0		EL
<b>EL-Annual emissions potential to emit is based on operating 3,500 hours per year at full load, with 1,500 hours on oil.</b>			

**G. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION  
 (Regulated Emissions Units -  
 Emissions-Limited and Preconstruction Review Pollutants Only)**

**Potential/Fugitive Emissions**

1. Pollutant Emitted: <b>NO<sub>x</sub></b>	2. Total Percent Efficiency of Control:
3. Potential Emissions: <b>332.1 lb/hour (per turbine) 320 tons/year (per turbine)</b>	4. Synthetically Limited? <input checked="" type="checkbox"/>
5. Range of Estimated Fugitive Emissions: [ ] 1 [ ] 2 [ ] 3 _____ to _____ tons/year	
6. Emission Factor: <b>12 ppmvd @15% O<sub>2</sub> on gas</b>  Reference: See Appendix B for emissions calculations	7. Emissions Method Code: <b>2</b>
8. Calculation of Emissions (limit to 600 characters):  <b>Hourly emission rate is based on worst case vendor emission rate for both natural gas and distillate oil for the expected ranges of operating loads and ambient temperature. Annual NO<sub>x</sub> emissions based on 2000 hours on gas and 1500 hours on distillate oil at base load, 50° F.</b>	
9. Pollutant Potential/Fugitive Emissions Comment (limit to 200 characters):	

**Allowable Emissions** Allowable Emissions   1   of   2  

1. Basis for Allowable Emissions Code: <b>OTHER</b>	2. Future Effective Date of Allowable Emissions: <b>N/A</b>
3. Requested Allowable Emissions and Units: <b>9 to 12 ppmvd@15% O<sub>2</sub> on gas (CT001, CT002, CT003)</b>	4. Equivalent Allowable Emissions: <b>82.1 lb/hour 320 tons/year</b>
5. Method of Compliance (limit to 60 characters): <b>Compliance with 9 ppm limit during initial and annual performance stack tests using EPA Method 20. Compliance with 12 ppm limit shall be with CEM on a 24-hour block average.</b>	
6. Allowable Emissions Comment (Desc. of Operating Method) (limit to 200 characters): <b>Applicant requests limit in accordance with BACT analysis presented in Section 5.0 per FDEP Rule 62-212.400.</b>	



**G. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION**  
**(Regulated Emissions Units -**  
**Emissions-Limited and Preconstruction Review Pollutants Only)**

**Allowable Emissions** Allowable Emissions   2   of   2  

1. Basis for Allowable Emissions Code: <b>OTHER</b>	2. Future Effective Date of Allowable Emissions: <b>N/A</b>
2. Requested Allowable Emissions and Units: <b>42 ppmvd@15% O<sub>2</sub> on oil for 1500 of 3500 hours (CT001, CT002, CT003)</b>	4. Equivalent Allowable Emissions: <b>332.1 lb/hour      320 tons/year</b>
5. Method of Compliance (limit to 60 characters): <b>Initial and annual performance stack tests with EPA Method 20. Continuous compliance based on CEM 3-hour average.</b>	
6. Allowable Emissions Comment (Desc. of Operating Method) (limit to 200 characters):  <b>Applicant requests limit in accordance with BACT analysis presented in Section 5.0 per FDEP Rule 62-212.400.</b>	

**G. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION**  
**(Regulated Emissions Units -**  
**Emissions-Limited and Preconstruction Review Pollutants Only)**

**Potential/Fugitive Emissions**

1. Pollutant Emitted: <b>CO</b>	2. Total Percent Efficiency of Control:
3. Potential Emissions: <b>78.3 lb/hour (per turbine) 238.8 tons/year (per turbine)</b>	4. Synthetically Limited? [ <input checked="" type="checkbox"/> ]
5. Range of Estimated Fugitive Emissions: [ ] 1 [ ] 2 [ ] 3 _____ to _____ tons/year	
6. Emission Factor: <b>9 ppmvd @15% O<sub>2</sub> on gas</b> <b>30 ppmvd @15% O<sub>2</sub> on oil</b> Reference: <b>See Appendix B for emission calculations</b>	7. Emissions Method Code: <b>2</b>
8. Calculation of Emissions (limit to 600 characters): <b>Hourly emission rate is based on worst case vendor emission rate for both natural gas and distillate oil for the expected ranges of operating loads and ambient temperatures. Annual CO emissions based on 2000 hours on gas and 1500 hours on distillate oil at base load, 50° F.</b>	
9. Pollutant Potential/Fugitive Emissions Comment (limit to 200 characters):	

**Allowable Emissions** Allowable Emissions   1   of   2  

1. Basis for Allowable Emissions Code: <b>OTHER</b>	2. Future Effective Date of Allowable Emissions: <b>N/A</b>
3. Requested Allowable Emissions and Units: <b>9 ppmvd @ 15% O<sub>2</sub> on gas (CT001, CT002, CT003)</b>	4. Equivalent Allowable Emissions: <b>30.9 lb/hour 79.6 tons/year</b>
5. Method of Compliance (limit to 60 characters): <b>Initial and annual performance stack tests using EPA Method 10.</b>	
6. Allowable Emissions Comment (Desc. of Operating Method) (limit to 200 characters): <b>Applicant requests limit in accordance with BACT analysis presented in Section 5.0 per FDEP Rule 62-212.400.</b>	

**G. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION**  
 (Regulated Emissions Units -  
 Emissions-Limited and Preconstruction Review Pollutants Only)

**Allowable Emissions** Allowable Emissions 2 of 2

1. Basis for Allowable Emissions Code: <b>OTHER</b>	2. Future Effective Date of Allowable Emissions: <b>N/A</b>
2. Requested Allowable Emissions and Units: <b>30 ppm<sub>v</sub> @15% O<sub>2</sub> on oil (CT001, CT002, CT003)</b>	4. Equivalent Allowable Emissions: <b>78.3 lb/hour      79.6 tons/year</b>
5. Method of Compliance (limit to 60 characters): <b>Initial and annual performance stack tests using EPA Method 10.</b>	
6. Allowable Emissions Comment (Desc. of Operating Method) (limit to 200 characters):  <b>Applicant requests limit in accordance with BACT analysis presented in Section 5.0 per FDEP Rule 62-212.400.</b>	

**G. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION**  
**(Regulated Emissions Units -**  
**Emissions-Limited and Preconstruction Review Pollutants Only)**

**Potential/Fugitive Emissions**

1. Pollutant Emitted: <b>PM/PM<sub>10</sub></b>	2. Total Percent Efficiency of Control:
3. Potential Emissions: <b>34.0 lb/hour(per turbine) 43.5 tons/year (per turbine)</b>	4. Synthetically Limited? <input checked="" type="checkbox"/>
5. Range of Estimated Fugitive Emissions: [ ] 1 [ ] 2 [ ] 3 _____ to _____ tons/year	
6. Emission Factor: <b>0.003 lb/MMBtu on oil</b> <b>0.017 lb/MMBtu on gas</b>  Reference: <b>See Appendix B for emissions calculations</b>	7. Emissions Method Code: <b>2</b>
8. Calculation of Emissions (limit to 600 characters): <b>Hourly emission rate is based on worst case vendor emission rate for both natural gas and distillate oil for the expected ranges of operating loads and ambient temperature. Annual PM/PM10 emissions based on 2000 hours on gas and 1500 hours on distillate oil at base load, 50° F.</b>	
9. Pollutant Potential/Fugitive Emissions Comment (limit to 200 characters):	

**Allowable Emissions** Allowable Emissions   1   of   2  

1. Basis for Allowable Emissions Code: <b>OTHER</b>	2. Future Effective Date of Allowable Emissions: <b>N/A</b>
3. Requested Allowable Emissions and Units: <b>18 lb/hr on gas (CT001, CT002, CT003)</b>	4. Equivalent Allowable Emissions: <b>18 lb/hour 43.5 tons/year</b>
5. Method of Compliance (limit to 60 characters): <b>Visible emissions testing as a surrogate for PM compliance testing.</b>	
6. Allowable Emissions Comment (Desc. of Operating Method) (limit to 200 characters): <b>Applicant requests limit in accordance with BACT analysis presented in Section 5.0 per FDEP Rule 62-212.400.</b>	

**G. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION**  
**(Regulated Emissions Units -**  
**Emissions-Limited and Preconstruction Review Pollutants Only)**

Allowable Emissions Allowable Emissions 2 of 2

1. Basis for Allowable Emissions Code: <b>OTHER</b>	2. Future Effective Date of Allowable Emissions: <b>N/A</b>
2. Requested Allowable Emissions and Units: <b>34 lb/hr on oil (CT001, CT002, CT003)</b>	4. Equivalent Allowable Emissions: <b>34 lb/hour 43.5 tons/year</b>
5. Method of Compliance (limit to 60 characters): <b>Visible emissions testing as a surrogate for PM compliance testing.</b>	
6. Allowable Emissions Comment (Desc. of Operating Method) (limit to 200 characters): <b>Applicant requests limit in accordance with BACT analysis presented in Section 5.0 per FDEP Rule 62-212.400.</b>	

**G. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION**  
**(Regulated Emissions Units -**  
**Emissions-Limited and Preconstruction Review Pollutants Only)**

**Potential/Fugitive Emissions**

1. Pollutant Emitted: <b>SO<sub>2</sub></b>	2. Total Percent Efficiency of Control:
3. Potential Emissions: <b>103.6 lb/hour (per turbine) 85.8 tons/year (per turbines)</b>	4. Synthetically Limited? <input checked="" type="checkbox"/>
5. Range of Estimated Fugitive Emissions: [ ] 1 [ ] 2 [ ] 3 _____ to _____ tons/year	
7. Emission Factor: <b>0.02 gr S / SCF nat. gas.</b> <b>0.05% S in oil.</b>  Reference: <b>See Appendix B for emissions calculations</b>	7. Emissions Method Code: <b>2</b>
8. Calculation of Emissions (limit to 600 characters): <b>Hourly emission rate is based on worst case vendor emission rate for both natural gas and distillate oil for the expected ranges of operating loads and ambient temperature. Annual SO<sub>2</sub> emissions based on 2000 hours on gas and 1500 hours on distillate oil at base load, 50° F.</b>	
9. Pollutant Potential/Fugitive Emissions Comment (limit to 200 characters):	

**Allowable Emissions** Allowable Emissions   1   of   2  

1. Basis for Allowable Emissions Code: <b>OTHER</b>	2. Future Effective Date of Allowable Emissions: <b>N/A</b>
3. Requested Allowable Emissions and Units: <b>10.9 lb/hr on gas (CT001, CT002, CT003) Sulfur content 2 gr/100 dscf</b>	4. Equivalent Allowable Emissions: <b>10.9 lb/hour 85.8 tons/year</b>
5. Method of Compliance (limit to 60 characters): <b>Use of pipeline natural gas and custom fuel monitoring schedule.</b>	
6. Allowable Emissions Comment (Desc. of Operating Method) (limit to 200 characters): <b>Applicant requests limit in accordance with BACT analysis presented in Section 5.0 per FDEP Rule 62-212.400.</b>	

**G. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION**  
 (Regulated Emissions Units -  
 Emissions-Limited and Preconstruction Review Pollutants Only)

Allowable Emissions Allowable Emissions 2 of 2

1. Basis for Allowable Emissions Code: <b>OTHER</b>	2. Future Effective Date of Allowable Emissions: N/A
2. Requested Allowable Emissions and Units: <b>103.6 lb/hr on oil; 0.05% S content fuel</b>	4. Equivalent Allowable Emissions: <b>103.6 lb/hour 85.8 tons/year</b>
5. Method of Compliance (limit to 60 characters): <b>Use of low sulfur distillate fuel oil.</b>	
6. Allowable Emissions Comment (Desc. of Operating Method) (limit to 200 characters):  <b>Applicant requests limit in accordance with BACT analysis presented in Section 5.0 per FDEP Rule 62-212.400.</b>	

**G. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION**  
**(Regulated Emissions Units -**  
**Emissions-Limited and Preconstruction Review Pollutants Only)**

**Potential/Fugitive Emissions**

1. Pollutant Emitted: <b>VOC</b>	2. Total Percent Efficiency of Control:
3. Potential Emissions: <b>3.1 lb/hour (per turbine) 5.2 tons/year (per turbine)</b>	4. Synthetically Limited? <input checked="" type="checkbox"/>
5. Range of Estimated Fugitive Emissions: [ ] 1 [ ] 2 [ ] 3 _____ to _____ tons/year	
6. Emission Factor: <b>1.4 ppmvw</b>  Reference: <b>See Appendix B for emissions calculations</b>	7. Emissions Method Code: <b>2</b>
8. Calculation of Emissions (limit to 600 characters): <b>Hourly emission rate is based on worst case vendor emission rate for both natural gas and distillate oil for the expected ranges of operating loads and ambient temperature. Annual VOC emissions based on 2000 hours on gas and 1500 hours on distillate oil at base load, 50° F.</b>	
9. Pollutant Potential/Fugitive Emissions Comment (limit to 200 characters):	

**Allowable Emissions** Allowable Emissions 1 of 2 N/A

1. Basis for Allowable Emissions Code: <b>OTHER</b>	2. Future Effective Date of Allowable Emissions: <b>N/A</b>
3. Requested Allowable Emissions and Units: <b>3.0 lb/hr on natural gas</b>	4. Equivalent Allowable Emissions: <b>3.0 lb/hour 5.2 tons/year</b>
5. Method of Compliance (limit to 60 characters): <b>Initial Stack Test using Method 18, 25 or 25A.</b>	
6. Allowable Emissions Comment (Desc. of Operating Method) (limit to 200 characters): <b>Applicant requests limit in accordance with BACT analysis presented in Section 5.0 per FDEP Rule 62-212.400.</b>	



**G. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION**  
**(Regulated Emissions Units -**  
**Emissions-Limited and Preconstruction Review Pollutants Only)**

**Allowable Emissions** Allowable Emissions   2   of   2  

2. Basis for Allowable Emissions Code: <b>OTHER</b>	2. Future Effective Date of Allowable Emissions: <b>N/A</b>
4. Requested Allowable Emissions and Units: <b>3.1 lb/hr on fuel oil</b>	4. Equivalent Allowable Emissions: <b>3.1 lb/hour      5.2 tons/year</b>
5. Method of Compliance (limit to 60 characters): <b>Initial stack test using Method 18, 25 or 25A.</b>	
6. Allowable Emissions Comment (Desc. of Operating Method) (limit to 200 characters): <b>Applicant requests limit in accordance with BACT analysis presented in Section 5.0 per FDEP Rule 62-212.400.</b>	

**G. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION**  
 (Regulated Emissions Units -  
 Emissions-Limited and Preconstruction Review Pollutants Only)

**Potential/Fugitive Emissions**

1. Pollutant Emitted: <b>Pb</b>		2. Total Percent Efficiency of Control:	
3. Potential Emissions: <b>0.028 lb/hour (per turbine)</b> <b>0.02 tons/year (per turbine)</b>		4. Synthetically Limited? [ ]	
5. Range of Estimated Fugitive Emissions: [ ] 1      [ ] 2      [ ] 3      _____ to _____ tons/year			
6. Emission Factor: <b>0.000014 lb/MMBtu</b> Reference: <b>See Appendix B for emissions calculations</b>		7. Emissions Method Code: <b>2</b>	
8. Calculation of Emissions (limit to 600 characters):  <b>Emission factor is for worst case, firing on distillate oil. No Pb is expected from natural gas combustion.</b>			

**Allowable Emissions** Allowable Emissions \_\_\_\_\_ of \_\_\_\_\_ **N/A**

1. Basis for Allowable Emissions Code:		2. Future Effective Date of Allowable Emissions:	
3. Requested Allowable Emissions and Units:		4. Equivalent Allowable Emissions: lb/hour      tons/year	
5. Method of Compliance (limit to 60 characters):			
6. Allowable Emissions Comment (Desc. of Operating Method) (limit to 200 characters):			

**G. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION**  
 (Regulated Emissions Units -  
 Emissions-Limited and Preconstruction Review Pollutants Only)

Potential/Fugitive Emissions

1. Pollutant Emitted: <b>SAM</b>	2. Total Percent Efficiency of Control:
3. Potential Emissions: <b>15.9 lb/hour (per turbine)</b> <b>13.1 tons/year (per turbine)</b>	4. Synthetically Limited? [ ]
5. Range of Estimated Fugitive Emissions: [ ] 1      [ ] 2      [ ] 3      _____ to _____ tons/year	
6. Emission Factor: <b>0.009 lb/MMBtu on oil</b> Reference: <b>See Appendix B for emissions calculations.</b>	8. Emissions Method Code: <b>2</b>
8. Calculation of Emissions (limit to 600 characters):	
9. Pollutant Potential/Fugitive Emissions Comment (limit to 200 characters): <b>SAM is not expected to be generated prior to leaving the stack, due to the high temperatures. However, precursor to SAM (SO3) is generated.</b>	

Allowable Emissions Allowable Emissions \_\_\_\_\_ of \_\_\_\_\_ N/A

1. Basis for Allowable Emissions Code:	2. Future Effective Date of Allowable Emissions:
3. Requested Allowable Emissions and Units:	4. Equivalent Allowable Emissions: lb/hour      tons/year
5. Method of Compliance (limit to 60 characters):	
6. Allowable Emissions Comment (Desc. of Operating Method) (limit to 200 characters):	

**G. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION**  
 (Regulated Emissions Units -  
 Emissions-Limited and Preconstruction Review Pollutants Only)

**Potential/Fugitive Emissions**

1. Pollutant Emitted: <b>H114</b>	2. Total Percent Efficiency of Control:
3. Potential Emissions: <b>1.47 E-3</b> lb/hour <b>9.60 E-4</b> tons/year	4. Synthetically Limited? <input type="checkbox"/>
5. Range of Estimated Fugitive Emissions: <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3      _____ to _____ tons/year	
6. Emission Factor: 1.2 E-6 lb/MMBtu Reference: <b>See Appendix B for emissions calculations.</b>	7. Emissions Method Code: <b>2</b>
8. Calculation of Emissions (limit to 600 characters):	
9. Pollutant Potential/Fugitive Emissions Comment (limit to 200 characters):  <b>Emission factor for mercury (Hg) is for worst case, firing on distillate oil. No Hg is expected from natural gas combustion.</b>	

**Allowable Emissions** Allowable Emissions \_\_\_\_\_ of \_\_\_\_\_ **N/A**

1. Basis for Allowable Emissions Code:	2. Future Effective Date of Allowable Emissions:
3. Requested Allowable Emissions and Units:	4. Equivalent Allowable Emissions:  lb/hour                      tons/year
5. Method of Compliance (limit to 60 characters):	
6. Allowable Emissions Comment (Desc. of Operating Method) (limit to 200 characters):	

Emissions Unit Information Section 1 of 2

**H. VISIBLE EMISSIONS INFORMATION**  
 (Only Regulated Emissions Units Subject to a VE Limitation)

**Visible Emissions Limitation:** Visible Emissions Limitation   1   of   1  

1. Visible Emissions Subtype: <b>VE20</b>	2. Basis for Allowable Opacity: <input checked="" type="checkbox"/> Rule <input type="checkbox"/> Other
3. Requested Allowable Opacity: Normal Conditions: <b>20</b> %      Exceptional Conditions:      % Maximum Period of Excess Opacity Allowed:      min/hour	
4. Method of Compliance: <b>EPA Reference Method 9.</b>	
5. Visible Emissions Comment (limit to 200 characters): <b>The general visible emission standard requirements of Rule 62-296.320(4)(b)1, F.A.C. apply to each turbine stack.</b>	

**I. CONTINUOUS MONITOR INFORMATION**  
 (Only Regulated Emissions Units Subject to Continuous Monitoring)

**Continuous Monitoring System:** Continuous Monitor   1   of   1  

1. Parameter Code: <b>EM</b>	2. Pollutant(s): <b>NOX</b>
3. CMS Requirement:	<input checked="" type="checkbox"/> Rule (NOX) <input type="checkbox"/> Other
4. Monitor Information: <b>TBD</b> Manufacturer: <b>TBD</b> Model Number: <b>TBD</b> Serial Number: <b>TBD</b>	
5. Installation Date: <b>Prior to start up</b>	6. Performance Specification Test Date: <b>90 days after unit commences commercial operation in accordance with 40 CFR 75.4(b)(2).</b>
7. Continuous Monitor Comment (limit to 200 characters):	

**J. EMISSIONS UNIT SUPPLEMENTAL INFORMATION  
(Regulated Emissions Units Only)**

**Supplemental Requirements**

1. Process Flow Diagram <input checked="" type="checkbox"/> Attached, Document ID: <b>Fig. 2-2</b> <input type="checkbox"/> Not Applicable <input type="checkbox"/> Waiver Requested
2. Fuel Analysis or Specification <input checked="" type="checkbox"/> Attached, Document ID: <b>App. B</b> <input type="checkbox"/> Not Applicable <input type="checkbox"/> Waiver Requested
3. Detailed Description of Control Equipment <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable <input type="checkbox"/> Waiver Requested
4. Description of Stack Sampling Facilities <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable <input type="checkbox"/> Waiver Requested
5. Compliance Test Report <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously submitted, Date: _____ <input checked="" type="checkbox"/> Not Applicable
6. Procedures for Startup and Shutdown <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable <input type="checkbox"/> Waiver Requested
7. Operation and Maintenance Plan <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable <input type="checkbox"/> Waiver Requested
8. Supplemental Information for Construction Permit Application <input checked="" type="checkbox"/> Attached, Document ID: <b>ENSR Doc. No. 6792-140-300</b>
9. Other Information Required by Rule or Statute <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable
10. Supplemental Requirements Comment:

Emissions Unit Information Section 1 of 2

**Additional Supplemental Requirements for Title V Air Operation Permit Applications**

11. Alternative Methods of Operation [ ] Attached, Document ID: _____ [✓] Not Applicable
12. Alternative Modes of Operation (Emissions Trading) [ ] Attached, Document ID: _____ [✓] Not Applicable
13. Identification of Additional Applicable Requirements [ ] Attached, Document ID: _____ [✓] Not Applicable
14. Compliance Assurance Monitoring Plan [ ] Attached, Document ID: _____ [✓] Not Applicable
15. Acid Rain Part Application (Hard-copy Required) [✓] Acid Rain Part - Phase II (Form No. 62-210.900(1)(a)) Attached, Document ID: <b>To be supplied at a later date</b> [ ] Repowering Extension Plan (Form No. 62-210.900(1)(a)1.) Attached, Document ID: _____ [ ] New Unit Exemption (Form No. 62-210.900(1)(a)2.) Attached, Document ID: _____ [ ] Retired Unit Exemption (Form No. 62-210.900(1)(a)3.) Attached, Document ID: _____ [ ] Phase II NOx Compliance Plan (Form No. 62-210.900(1)(a)4.) Attached, Document ID: _____ [ ] Phase NOx Averaging Plan (Form No. 62-210.900(1)(a)5.) Attached, Document ID: _____ [ ] Not Applicable

**III. TANK EMISSIONS UNIT INFORMATION**

A separate Emissions Unit Information Section (including subsections A through J as required) must be completed for each emissions unit addressed in this Application for Air Permit. If submitting the application form in hard copy, indicate, in the space provided at the top of each page, the number of this Emissions Unit Information Section and the total number of Emissions Unit Information Sections submitted as part of this application.

**A. GENERAL EMISSIONS UNIT INFORMATION  
(All Emissions Units)**

**Emissions Unit Description and Status**

<p>1. Type of Emissions Unit Addressed in This Section: (Check one)</p> <p><input type="checkbox"/> This Emissions Unit Information Section addresses, as a single emissions unit, a single process or production unit, or activity, which produces one or more air pollutants and which has at least one definable emission point (stack or vent).</p> <p><input checked="" type="checkbox"/> This Emissions Unit Information Section addresses, as a single emissions unit, a group of process or production units and activities which has at least one definable emission point (stack or vent) but may also produce fugitive emissions.</p> <p><input type="checkbox"/> This Emissions Unit Information Section addresses, as a single emissions unit, one or more process or production units and activities which produce fugitive emissions only.</p>			
<p>2. Regulated or Unregulated Emissions Unit? (Check one)</p> <p><input type="checkbox"/> The emissions unit addressed in this Emissions Unit Information Section is a regulated emissions unit.</p> <p><input checked="" type="checkbox"/> The emissions unit addressed in this Emissions Unit Information Section is an unregulated emissions unit.</p>			
<p>3. Description of Emissions Unit Addressed in This Section (limit to 60 characters): <b>Distillate fuel oil storage tanks</b></p>			
<p>4. Emissions Unit Identification Number: ID: <b>T001, T002</b></p>		<p><input checked="" type="checkbox"/> No ID <input type="checkbox"/> ID Unknown</p>	
<p>5. Emissions Unit Status Code: <b>C</b></p>	<p>6. Initial Startup Date: <b>May 2002</b></p>	<p>7. Emissions Unit Major Group SIC Code: <b>49</b></p>	<p>8. Acid Rain Unit? <input type="checkbox"/></p>
<p>9. Emissions Unit Comment: (Limit to 500 Characters)</p> <p><b>T001 - main storage tank T002 - day storage tank.</b></p>			



**Emissions Unit Information Section 2 of 2**

**Emissions Unit Control Equipment**

1. Control Equipment/Method Description (Limit to 200 characters per device or method):

None

2. Control Device or Method Code(s):

**Emissions Unit Details**

1. Package Unit:

Manufacturer:

Model Number:

2. Generator Nameplate Rating:

MW

3. Incinerator Information:

Dwell Temperature:

°F

Dwell Time:

seconds

Incinerator Afterburner Temperature:

°F





**D. EMISSION POINT (STACK/VENT) INFORMATION**  
**(Regulated Emissions Units Only)**

**Emission Point Description and Type**

1. Identification of Point on Plot Plan or Flow Diagram? <b>T001, T002</b>		2. Emission Point Type Code: <b>4</b>	
3. Descriptions of Emission Points Comprising this Emissions Unit for VE Tracking (limit to 100 characters per point): <b>N/A</b>			
4. ID Numbers or Descriptions of Emission Units with this Emission Point in Common: <b>N/A</b>			
5. Discharge Type Code: <b>V</b>	6. Stack Height: <b>N/A feet</b>	7. Exit Diameter: <b>N/A feet</b>	
8. Exit Temperature: <b>N/A</b>	9. Actual Volumetric Flow Rate: <b>N/A</b>	10. Water Vapor: <b>N/A</b>	
11. Maximum Dry Standard Flow Rate: <b>N/A dscfm</b>		12. Nonstack Emission Point Height: <b>N/A feet</b>	
13. Emission Point UTM Coordinates: <b>Main tank: Zone 17; 556.763 East (km) 3,028.437 North (km)</b> <b>Day tank: Zone 17; 556.803 East (km) 3,028.435 North (km)</b>			
14. Emission Point Comment (limit to 200 characters):			

Emissions Unit Information Section 2 of 2

**E. SEGMENT (PROCESS/FUEL) INFORMATION**  
**(All Emissions Units)**

**Segment Description and Rate:** Segment 1 of 1

1. Segment Description (Process/Fuel Type) (limit to 500 characters):  <b>Distillate fuel oil storage tanks</b>		
2. Source Classification Code (SCC): <b>40301021</b>		3. SCC Units: <b>Thousand Gallons Throughput</b>
4. Maximum Hourly Rate: <b>N/A</b>	5. Maximum Annual Rate: <b>65,700</b>	6. Estimated Annual Activity Factor: <b>N/A</b>
7. Maximum % Sulfur: <b>N/A</b>	8. Maximum % Ash: <b>N/A</b>	9. Million Btu per SCC Unit: <b>N/A</b>
10. Segment Comment (limit to 200 characters):		

**Segment Description and Rate:** Segment \_\_\_ of \_\_\_

1. Segment Description (Process/Fuel Type ) (limit to 500 characters):		
2. Source Classification Code (SCC):		3. SCC Units:
4. Maximum Hourly Rate:	5. Maximum Annual Rate:	6. Estimated Annual Activity Factor:
7. Maximum % Sulfur:	8. Maximum % Ash:	9. Million Btu per SCC Unit:
10. Segment Comment (limit to 200 characters):		



**G. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION  
(Regulated Emissions Units -  
Emissions-Limited and Preconstruction Review Pollutants Only)**

**Potential/Fugitive Emissions**

1. Pollutant Emitted: <b>VOC</b>		2. Total Percent Efficiency of Control:	
3. Potential Emissions: lb/hour                  tons/year		4. Synthetically Limited? [ ]	
5. Range of Estimated Fugitive Emissions: [ ] 1                  [ ] 2                  [ ] 3                  _____ to _____ tons/year			
6. Emission Factor:  Reference:		7. Emissions Method Code:	
8. Calculation of Emissions (limit to 600 characters):			
9. Pollutant Potential/Fugitive Emissions Comment (limit to 200 characters):  <b>Potential VOC emissions from distillate fuel oil storage tanks are less than 5 tons per year (less than the threshold amount for reporting in this subsection). See Appendix B for emission calculations.</b>			

**Allowable Emissions** Allowable Emissions 1 of 1 N/A

1. Basis for Allowable Emissions Code:		2. Future Effective Date of Allowable Emissions:	
3. Requested Allowable Emissions and Units:		4. Equivalent Allowable Emissions: lb/hour                  tons/year	
5. Method of Compliance (limit to 60 characters):			
6. Allowable Emissions Comment (Desc. of Operating Method) (limit to 200 characters):			







**J. EMISSIONS UNIT SUPPLEMENTAL INFORMATION  
(Regulated Emissions Units Only)**

**Supplemental Requirements**

1. Process Flow Diagram <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable <input type="checkbox"/> Waiver Requested
2. Fuel Analysis or Specification <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable <input type="checkbox"/> Waiver Requested
3. Detailed Description of Control Equipment <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable <input type="checkbox"/> Waiver Requested
4. Description of Stack Sampling Facilities <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable <input type="checkbox"/> Waiver Requested
5. Compliance Test Report <input type="checkbox"/> Attached, Document ID: _____ <input type="checkbox"/> Previously submitted, Date: _____ <input checked="" type="checkbox"/> Not Applicable
6. Procedures for Startup and Shutdown <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable <input type="checkbox"/> Waiver Requested
7. Operation and Maintenance Plan <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable <input type="checkbox"/> Waiver Requested
8. Supplemental Information for Construction Permit Application <input checked="" type="checkbox"/> Attached, Document ID: <b>See calculations in Appendix B for tank information.</b>
9. Other Information Required by Rule or Statute <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable
10. Supplemental Requirements Comment:          

Emissions Unit Information Section 2 of 2

**Additional Supplemental Requirements for Title V Air Operation Permit Applications**

11. Alternative Methods of Operation <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable
12. Alternative Modes of Operation (Emissions Trading) <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable
13. Identification of Additional Applicable Requirements <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable
14. Compliance Assurance Monitoring Plan <input type="checkbox"/> Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable
15. Acid Rain Part Application (Hard-copy Required) <input type="checkbox"/> Acid Rain Part – Phase II (Form No. 62-210.900(1)(a)) Attached, Document ID: _____ <input type="checkbox"/> Repowering Extension Plan (Form No. 62-210.900(1)(a)1.) Attached, Document ID: _____ <input type="checkbox"/> New Unit Exemption (Form No. 62-210.900(1)(a)2.) Attached, Document ID: _____ <input type="checkbox"/> Retired Unit Exemption (Form No. 62-210.900(1)(a)3.) Attached, Document ID: _____ <input type="checkbox"/> Phase II NOx Compliance Plan (Form No. 62-210.900(1)(a)4.) Attached, Document ID: _____ <input type="checkbox"/> Phase NOx Averaging Plan (Form No. 62-210.900(1)(a)5.) Attached, Document ID: _____ <input checked="" type="checkbox"/> Not Applicable

**APPENDIX B**  
**EMISSION CALCULATIONS**

**CALCULATIONS AND COMPUTATIONS**

Project: Florida GE 7FA Turbine  
 Project Number: 8792-140  
 Subject: Gas Turbine Emission Calculations - GE 7FA - 100 % Load Conditions

Computed by: M. Lafond Date: 9/24/00  
 Checked by: M. Griffin Date: 9/26/00

Design Parameters	Units	Design Data				Proposed Permit Limit	Comments
Turbine Load	(%)	100					Manufacturer Supplied Data
Stack Diameter	(Feet)	18					Proposed Design Specification
Fuel Type		Natural Gas Only					Proposed Design Specification
Fuel Heating Value	(Btu/SCF, LHV)	881.1					Manufacturer Supplied Data
Fuel Sulfur Content	(Grains/SCF)	0.02					Manufacturer Supplied Data
Ambient Temperature	(F)	91	50	42	30		Manufacturer Supplied Data
Relative Humidity	(%)						Manufacturer Supplied Data
CTG - Gross Power Output	(kW)	151000	174800	178000	182200		
Heat Input Rate	(MMBtu/Hr, LHV)	1,464.7	1,629.1	1,652.7	1,684.4		Manufacturer Supplied Data
Fuel Feed Rate	(SCF/Hr)	1,862,354	1,848,939	1,875,724	1,911,701		Calculated
Exhaust Temperature	(F)	1,149	1,109	1,100	1,087		Manufacturer Supplied Data
Exhaust Velocity	(F/S)	150.4	160.6	162.0	164.0		Calculated
Exhaust Analysis							
Argon		0.87	0.90	0.90	0.90		39.948 lb/lb mol Ar
Nitrogen		72.83	74.32	74.55	74.94		28.0134 lb/lb mol N <sub>2</sub>
Oxygen		12.22	12.50	12.57	12.68		31.998 lb/lb mol O <sub>2</sub>
Carbon Dioxide		3.69	3.75	3.74	3.74		44.009 lb/lb mol CO <sub>2</sub>
Water		10.40	8.54	8.25	7.75		18.0148 lb/lb mol H <sub>2</sub> O
Exhaust Molecular Weight	(Lbs/Lb-Mol)	28.16	28.37	28.40	28.45		Calculated
Exhaust Flow Rate	(Lbs/Hr, Wet)	3,301,000	3,642,000	3,700,000	3,783,000		Manufacturer Supplied Data
	(ACFW)	137,744,689	147,096,451	148,423,690	150,200,713		Calculated
	(ACFMW)	2,295,745	2,451,608	2,473,728	2,503,345		Calculated
	(ACFHD)	123,419,241	134,534,414	136,178,735	138,560,158		Calculated
	(ACFMD)	2,056,987	2,242,240	2,269,646	2,309,336		Calculated
	(SCFW)	45,182,505	49,480,378	50,214,935	51,243,258		Calculated
	(SCFMW)	753,042	824,673	836,916	854,054		Calculated
	(SCFHD)	40,483,524	45,254,754	46,072,203	47,271,908		Calculated
	(SCFMD)	674,725	754,246	767,870	787,865		Calculated
Exhaust Moisture	(%)	10.40	8.54	8.25	7.75		Manufacturer Supplied Data
Exhaust O <sub>2</sub> Dry	(%)	13.64	13.67	13.70	13.75		Calculated
Concentration of NO <sub>x</sub> in Exhaust	(ppmvd @ 15% O <sub>2</sub> )	12	12	12	12		Manufacturer Supplied Data
	(ppmvd)	14.8	14.7	14.8	14.6		Calculated
Concentration of CO in Exhaust	(ppmvd)	9	9	9	9		Manufacturer Supplied Data
	(ppmvd @ 15% O <sub>2</sub> )	7.3	7.3	7.4	7.4		Calculated
Concentration of VOC in Exhaust	(ppmvw)	1.4	1.4	1.4	1.4		Manufacturer Supplied Data
	(ppmvd)	1.6	1.5	1.5	1.5		Calculated
	(ppmvd @ 15% O <sub>2</sub> )	1.3	1.2	1.3	1.3		Calculated
<b>Note:</b>							

**CALCULATIONS AND COMPUTATIONS**

Project: Florida GE 7FA Turbine  
 Project Number: 8792-140  
 Subject: Gas Turbine Emission Calculations - GE 7FA - 100 % Load Conditions

Computed by: M. Lafond Date: 9/24/00  
 Checked by: M. Griffin Date: 9/26/00

**OXIDES OF NITROGEN**

Lbs/Hr = 
$$\frac{(\text{NOx Concentration, ppmvd}) * (\text{Exhaust Flow Rate, SCFMD}) * (\text{Mol Wt. NOx, Lbs/Lb-Mol}) * 60 \text{ Min/Hr}}{(385 \text{ SCF/Lb-Mol}) * (1,000,000)}$$

**Oxides of Nitrogen Emissions Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
	Emission Per Combustion Turbine Unit				
Lbs/Hr =	71.4	79.5	80.5	82.1	

**CARBON MONOXIDE**

Lbs/Hr = 
$$\frac{(\text{CO Concentration, ppmvd}) * (\text{Exhaust Flow Rate, SCFMD}) * (\text{Mol Wt. CO, Lbs/Lb-Mol}) * 60 \text{ Min/Hr}}{(385 \text{ SCF/Lb-Mol}) * (1,000,000)}$$

**Carbon Monoxide Emission Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
	Emission Per Combustion Turbine Unit				
Lbs/Hr =	26.5	29.6	30.1	30.9	

**VOLATILE ORGANIC COMPOUNDS**

Lbs/Hr = 
$$\frac{(\text{VOC Concentration as Methane, ppmvw}) * (\text{Exhaust Flow Rate, SCFMW}) * (\text{Mol Wt. VOC, Lbs/Lb-Mol}) * 60 \text{ Min/Hr}}{(385 \text{ SCF/Lb-Mol}) * (1,000,000)}$$

**Volatile Organic Compounds Emission Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
	Emission Per Combustion Turbine Unit				
Lbs/Hr =	2.6	2.9	2.9	3.0	

**CALCULATIONS AND COMPUTATIONS**

Project: Florida GE 7FA Turbine  
 Project Number: 6792-140  
 Subject: Gas Turbine Emission Calculations - GE 7FA - 100 % Load Conditions

Computed by: M. Lafond Date: 9/24/00  
 Checked by: M. Griffin Date: 9/26/00

**SULFUR DIOXIDE**

Lbs/Hr = 
$$\frac{(\text{Expected Fuel Gas Sulfur Content, Grains/SCF}) * (\text{Fuel Feed Rate, SCF/Hr}) * (64 \text{ Lbs SO}_2/32 \text{ Lbs S})}{(7,000 \text{ Grains/Lbs})}$$

**Sulfur Dioxide Emissions Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
	Emission Per Combustion Turbine Unit				
Lbs/Hr =	9.5	10.6	10.7	10.9	

Note:  
 Sulfur emissions calculated based on Natural Gas sulfur content of 0.02 grains of sulfur/SCF Natural Gas

**SULFURIC ACID MIST**

Lbs/Hr = 
$$(\text{SO}_2 \text{ Emission Rate, lb/hr}) * (\text{SO}_2 \text{ to SO}_3 \text{ Conversion Rate, lb/Hr}) * (98.07 \text{ Lbs SO}_2/64.062 \text{ Lbs S})$$

**Sulfuric Acid Mist Emissions Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
	Emission Per Combustion Turbine Unit				
Lbs/Hr =	1.5	1.6	1.6	1.7	

Note:  
 Assume 10% conversion of SO2 to SO3. Assume all SO3 is converted to H2SO4.

**PARTICULATE MATTER**

**Particulate Matter Emissions Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
	Emission Per Combustion Turbine Unit				
Lbs/Hr =	18	18	18	18	

**CALCULATIONS AND COMPUTATIONS**

Project: Florida GE 7FA Turbine  
 Project Number: 8792-140  
 Subject: Gas Turbine Emission Calculations - GE 7FA - 75 % Load Conditions

Computed by: M. Lafond Date: 9/25/00  
 Checked by: M. Griffin Date: 9/26/00

Design Parameters	Units	Design Data				Proposed Permit Limit	Comments
Turbine Load	(%)	100					Manufacturer Supplied Data
Stack Diameter	(Feet)	18					Proposed Design Specification
Fuel Type		Natural Gas Only					Proposed Design Specification
Fuel Heating Value	(Btu/SCF, LHV)	881.1					Manufacturer Supplied Data
Fuel Sulfur Content	(Grains/SCF)	0.02					Manufacturer Supplied Data
Ambient Temperature	(F)	91	50	42	30		Manufacturer Supplied Data
Relative Humidity	(%)						Manufacturer Supplied Data
CTG - Gross Power Output	(kW)	113300	131100	133500	136700		
Heat Input Rate	(MMBtu/Hr, LHV)	1,202.1	1,312.3	1,328.3	1,353.3		Manufacturer Supplied Data
Fuel Feed Rate	(SCF/Hr)	1,384,317	1,489,388	1,507,547	1,535,921		Calculated
Exhaust Temperature	(F)	1,180	1,147	1,142	1,134		Manufacturer Supplied Data
Exhaust Velocity	(F/S)	125.8	130.8	131.5	132.7		Calculated
Exhaust Analysis	Argon	0.87	0.89	0.89	0.89		39,948 lb/lb mol Ar
	Nitrogen	72.86	74.31	74.53	74.90		28.0134 lb/lb mol N <sub>2</sub>
	Oxygen	12.30	12.48	12.51	12.58		31.998 lb/lb mol O <sub>2</sub>
	Carbon Dioxide	3.65	3.76	3.77	3.79		44,009 lb/lb mol CO <sub>2</sub>
	Water	10.32	8.56	8.30	7.84		18,0148 lb/lb mol H <sub>2</sub> O
Exhaust Molecular Weight	(Lbs/Lb-Mol)	28.16	28.36	28.39	28.44		Calculated
Exhaust Flow Rate	(Lbs/Hr, Wet)	2,710,000	2,897,000	2,923,000	2,970,000		Manufacturer Supplied Data
	(ACFW)	115,254,389	119,863,053	120,440,174	121,542,995		Calculated
	(ACFMW)	1,920,906	1,997,718	2,007,338	2,025,717		Calculated
	(ACFHD)	103,360,136	109,602,775	110,443,839	112,014,025		Calculated
	(ACFMD)	1,722,669	1,826,713	1,840,727	1,866,900		Calculated
	(SCFW)	37,090,563	39,365,979	39,679,002	40,243,333		Calculated
	(SCFMW)	618,176	656,100	661,317	670,722		Calculated
	(SCFHD)	33,262,817	35,996,251	36,385,644	37,088,256		Calculated
	(SCFMD)	554,380	599,938	606,427	618,138		Calculated
Exhaust Moisture	(%)	10.32	8.56	8.30	7.84		Manufacturer Supplied Data
Exhaust O <sub>2</sub> Dry	(%)	13.72	13.65	13.64	13.65		Calculated
Concentration of NO <sub>x</sub> in Exhaust	(ppmvd @ 15% O <sub>2</sub> )	12	12	12	12		Manufacturer Supplied Data
	(ppmvd)	14.6	14.7	14.8	14.7		Calculated
Concentration of CO in Exhaust	(ppmvd)	9	9	9	9		Manufacturer Supplied Data
	(ppmvd @ 15% O <sub>2</sub> )	7.4	7.3	7.3	7.3		Calculated
Concentration of VOC in Exhaust	(ppmvw)	1.4	1.4	1.4	1.4		Manufacturer Supplied Data
	(ppmvd)	1.8	1.5	1.5	1.5		Calculated
	(ppmvd @ 15% O <sub>2</sub> )	1.3	1.2	1.2	1.2		Calculated

Note:



**CALCULATIONS AND COMPUTATIONS**

Project: Florida GE 7FA Turbine Date: 9/25/00  
 Project Number: 8792-140 Date: 9/26/00  
 Subject: Gas Turbine Emission Calculations - GE 7FA - 75 % Load Conditions

**OXIDES OF NITROGEN**

$$\text{Lbs/Hr} = \frac{(\text{NOx Concentration, ppmvd}) * (\text{Exhaust Flow Rate, SCFMD}) * (\text{Mol Wt. NOx, Lbs/Lb-Mol}) * 60 \text{ Min/Hr}}{(385 \text{ SCF/Lb-Mol}) * (1,000,000)}$$

**Oxides of Nitrogen Emission Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
	Emission Per Combustion Turbine Unit				
Lbs/Hr =	58.0	63.4	64.1	65.3	

**CARBON MONOXIDE**

$$\text{Lbs/Hr} = \frac{(\text{CO Concentration, ppmvd}) * (\text{Exhaust Flow Rate, SCFMD}) * (\text{Mol Wt. CO, Lbs/Lb-Mol}) * 60 \text{ Min/Hr}}{(385 \text{ SCF/Lb-Mol}) * (1,000,000)}$$

**Carbon Monoxide Emission Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
	Emission Per Combustion Turbine Unit				
Lbs/Hr =	21.8	23.5	23.8	24.3	

**VOLATILE ORGANIC COMPOUNDS**

$$\text{Lbs/Hr} = \frac{(\text{VOC Concentration as Methane, ppmvw}) * (\text{Exhaust Flow Rate, SCFMW}) * (\text{Mol Wt. VOC, Lbs/Lb-Mol}) * 60 \text{ Min/Hr}}{(385 \text{ SCF/Lb-Mol}) * (1,000,000)}$$

**Volatile Organic Compounds Emission Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
	Emission Per Combustion Turbine Unit				
Lbs/Hr =	2.2	2.3	2.3	2.3	

**CALCULATIONS AND COMPUTATIONS**

Project: Florida GE 7FA Turbine  
 Project Number: 6792-140  
 Subject: Gas Turbine Emission Calculations - GE 7FA - 75 % Load Conditions

Date: 9/25/00  
 Date: 9/26/00

**SULFUR DIOXIDE**

Lbs/Hr = \_\_\_\_\_ (Expected Fuel Gas Sulfur Content, Grains/SCF) \* (Fuel Feed Rate, SCF/Hr) \* (64 Lbs SO<sub>2</sub>/32 Lbs S)  
 (7,000 Grains/Lbs)

**Sulfur Dioxide Emissions Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
	Emission Per Combustion Turbine Unit				
Lbs/Hr =	7.8	8.5	8.6	8.8	

**SULFURIC ACID MIST**

Lbs/Hr = \_\_\_\_\_ (SO<sub>2</sub> Emission Rate, lb/hr) \* (SO<sub>2</sub> to SO<sub>3</sub> Conversion Rate, lb/hr) \* (98.07 Lbs SO<sub>2</sub>/64.062 Lbs S)

**Sulfuric Acid Mist Emissions Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
	Emission Per Combustion Turbine Unit				
Lbs/Hr =	1.2	1.3	1.3	1.3	

Note:  
 Assume 10% conversion of SO<sub>2</sub> to SO<sub>3</sub>. Assume all SO<sub>3</sub> is converted to H<sub>2</sub>SO<sub>4</sub>.

**PARTICULATE MATTER**

**Particulate Matter Emissions Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
	Emission Per Combustion Turbine Unit				
Lbs/Hr =	18	18	18	18	

Notes:

**CALCULATIONS AND COMPUTATIONS**

Project: Florida GE 7FA Turbine  
 Project Number: 6792-140  
 Subject: Gas Turbine Emission Calculations - GE 7FA - 50 % Load Conditions

Computed by: M. Lafond Date: 9/25/00  
 Checked by: M. Griffin Date: 9/26/00

Design Parameters	Units	Design Data				Proposed Permit Limit	Comments
Turbine Load	(%)	100					Manufacturer Supplied Data
Stack Diameter	(Feet)	18					Proposed Design Specification
Fuel Type		Natural Gas Only					Proposed Design Specification
Fuel Heating Value	(Btu/SCF, LHV)	881.1					Manufacturer Supplied Data
Fuel Sulfur Content	(Grains/SCF)	0.02					Manufacturer Supplied Data
Ambient Temperature	(F)	81	50	42	30		Manufacturer Supplied Data
Relative Humidity	(%)						Manufacturer Supplied Data
CTG - Gross Power Output	(kW)	75500	87400	89000	91100		
Heat Input Rate	(MMBtu/Hr, LHV)	961.1	1,052.3	1,063.6	1,079.5		Manufacturer Supplied Data
Fuel Feed Rate	(SCF/Hr)	1,090,796	1,194,303	1,207,127	1,225,173		Calculated
Exhaust Temperature	(F)	1,200	1,194	1,189	1,182		Manufacturer Supplied Data
Exhaust Velocity	(F/S)	106.9	111.3	111.8	112.4		Calculated
Exhaust Analysis							
Argon		0.88	0.88	0.89	0.90		39.948 lb/lb mol Ar
Nitrogen		73.02	74.43	74.64	75.02		28.0134 lb/lb mol N <sub>2</sub>
Oxygen		12.76	12.81	12.84	12.90		31.998 lb/lb mol O <sub>2</sub>
Carbon Dioxide		3.44	3.61	3.62	3.64		44.009 lb/lb mol CO <sub>2</sub>
Water		9.91	8.27	8.01	7.55		18.0148 lb/lb mol H <sub>2</sub> O
Exhaust Molecular Weight	(Lbs/Lb-Mol)	28.19	28.38	28.41	28.46		Calculated
Exhaust Flow Rate	(Lbs/Hr, Wet)	2,278,000	2,396,000	2,416,000	2,444,000		Manufacturer Supplied Data
	(ACFHW)	97,960,041	101,973,241	102,405,341	102,950,915		Calculated
	(ACFMW)	1,632,667	1,699,554	1,706,756	1,715,849		Calculated
	(ACFHD)	88,252,201	93,540,054	94,202,673	95,178,121		Calculated
	(ACFMD)	1,470,870	1,559,001	1,570,045	1,586,302		Calculated
	(SCFHW)	31,145,092	32,538,669	32,775,647	33,090,761		Calculated
	(SCFMW)	519,085	542,311	546,261	551,513		Calculated
	(SCFHD)	28,058,613	29,847,721	30,150,318	30,592,408		Calculated
	(SCFMD)	467,644	497,462	502,505	509,873		Calculated
Exhaust Moisture	(%)	9.91	8.27	8.01	7.55		Manufacturer Supplied Data
Exhaust O2 Dry	(%)	14.16	13.96	13.96	13.95		Calculated
Concentration of NOx in Exhaust	(ppmv @ 15% O2)	12	12	12	12		Manufacturer Supplied Data
	(ppmv)	13.7	14.1	14.1	14.1		Calculated
Concentration of CO in Exhaust	(ppmv)	9	9	9	9		Manufacturer Supplied Data
	(ppmv @ 15% O2)	7.9	7.7	7.6	7.6		Calculated
Concentration of VOC in Exhaust	(ppmv)	1.4	1.4	1.4	1.4		Manufacturer Supplied Data
	(ppmv @ 15% O2)	1.6	1.5	1.5	1.5		Calculated
	(ppmv @ 15% O2)	1.4	1.3	1.3	1.3		Calculated

Note:

**CALCULATIONS AND COMPUTATIONS**

Project: Florida GE 7FA Turbine Date: 9/25/00  
 Project Number: 6792-140 Date: 9/26/00  
 Subject: Gas Turbine Emission Calculations - GE 7FA - 50 % Load Conditions

**OXIDES OF NITROGEN**

Lbs/Hr = 
$$\frac{(\text{NOx Concentration, ppmvd}) \cdot (\text{Exhaust Flow Rate, SCFMD}) \cdot (\text{Mol Wt. NOx, Lbs/Lb-Mol}) \cdot 60 \text{ Min/Hr}}{(385 \text{ SCF/Lb-Mol}) \cdot (1,000,000)}$$

**Oxides of Nitrogen Emissions Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
	Emission Per Combustion Turbine Unit				
Lbs/Hr =	45.9	50.3	50.8	51.8	

**CARBON MONOXIDE**

Lbs/Hr = 
$$\frac{(\text{CO Concentration, ppmvd}) \cdot (\text{Exhaust Flow Rate, SCFMD}) \cdot (\text{Mol Wt. CO, Lbs/Lb-Mol}) \cdot 60 \text{ Min/Hr}}{(385 \text{ SCF/Lb-Mol}) \cdot (1,000,000)}$$

**Carbon Monoxide Emission Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
	Emission Per Combustion Turbine Unit				
Lbs/Hr =	18.4	19.5	19.7	20.0	

**VOLATILE ORGANIC COMPOUNDS**

Lbs/Hr = 
$$\frac{(\text{VOC Concentration as Methane, ppmvw}) \cdot (\text{Exhaust Flow Rate, SCFMW}) \cdot (\text{Mol Wt. VOC, Lbs/Lb-Mol}) \cdot 60 \text{ Min/Hr}}{(385 \text{ SCF/Lb-Mol}) \cdot (1,000,000)}$$

**Volatile Organic Compounds Emission Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
	Emission Per Combustion Turbine Unit				
Lbs/Hr =	1.8	1.9	1.9	1.9	

**CALCULATIONS AND COMPUTATIONS**

Project: Florida GE 7FA Turbine \_\_\_\_\_ Date: 9/25/00  
 Project Number: 6792-140 \_\_\_\_\_ Date: 9/28/00  
 Subject: Gas Turbine Emission Calculations - GE 7FA - 50 % Load Conditions \_\_\_\_\_

**SULFUR DIOXIDE**

Lbs/Hr = \_\_\_\_\_ (Expected Fuel Gas Sulfur Content, Grains/SCF) \* (Fuel Feed Rate, SCF/Hr) \* (64 Lbs SO<sub>2</sub>/32 Lbs S)  
 (7,000 Grains/Lbs)

**Sulfur Dioxide Emissions Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
	Emission Per Combustion Turbine Unit				
Lbs/Hr =	6.2	6.8	6.9	7.0	

Note:  
 Sulfur emissions calculated based on Natural Gas sulfur content of 0.02 grains of sulfur/SCF Natural Gas

**SULFURIC ACID MIST**

Lbs/Hr = \_\_\_\_\_ (SO<sub>2</sub> Emission Rate, lb/hr) \* (SO<sub>2</sub> to SO<sub>3</sub> Conversion Rate, lb/Hr) \* (98.07 Lbs SO<sub>2</sub>/64.062 Lbs S)

**Sulfuric Acid Mist Emissions Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
	Emission Per Combustion Turbine Unit				
Lbs/Hr =	0.9	1.0	1.1	1.1	

Note:  
 Assume 10% conversion of SO<sub>2</sub> to SO<sub>3</sub>. Assume all SO<sub>3</sub> is converted to H<sub>2</sub>SO<sub>4</sub>.

**PARTICULATE MATTER**

Base Equallons

**Particulate Matter Emissions Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
	Emission Per Combustion Turbine Unit				
Lbs/Hr =	18	18	18	18	

Notes:

**CALCULATIONS AND COMPUTATIONS**

Project: Florida GE 7FA Turbine  
 Project Number: 6792-140  
 Subject: Gas Turbine Emission Calculations - GE 7FA - 100 % Load Conditions

Computed by: M. Lafond Date: 9/24/00  
 Checked by: M. Griffin Date: 9/28/00

Design Parameters	Units	Design Data				Proposed Permit Limit	Comments
Turbine Load	(%)	100					Manufacturer Supplied Data
Stack Diameter	(Feet)	18					Proposed Design Specification
Fuel Type		Distillate Oil					Proposed Design Specification
Fuel Heating Value	(Btu/lb, LHV)	18200					Manufacturer Supplied Data
Fuel Sulfur Content	(wt % sulfur)	0.05%					Manufacturer Supplied Data
Ambient Temperature	(F)	91	50	42	30		Manufacturer Supplied Data
Relative Humidity	(%)						Manufacturer Supplied Data
CTG - Gross Power Output	(kW)	160,800.00	182500	185,400.00	189300		
Heat Input Rate	(MMBtu/Hr, LHV)	1,645.0	1,825.0	1,851.2	1,887.3		Manufacturer Supplied Data
Fuel Feed Rate	(lb/Hr)	90,385	100,275	101,714	103,698		Calculated
Exhaust Temperature	(F)	1,138	1,088	1,079	1,065		Manufacturer Supplied Data
Exhaust Velocity	(F/S)	154.4	165.0	166.5	168.6		Calculated
Exhaust Analysis	Argon	0.85	0.85	0.85	0.87		39.948 lb/lb mol Ar
	Nitrogen	70.33	71.37	71.56	71.86		28.0134 lb/lb mol N <sub>2</sub>
	Oxygen	11.02	11.26	11.32	11.41		31.998 lb/lb mol O <sub>2</sub>
	Carbon Dioxide	5.44	5.47	5.46	5.45		44.009 lb/lb mol CO <sub>2</sub>
	Water	12.37	11.05	10.81	10.42		18.0148 lb/lb mol H <sub>2</sub> O
Exhaust Molecular Weight	(Lbs/Lb-Mol)	28.19	28.33	28.36	28.40		Calculated
Exhaust Flow Rate	(Lbs/Hr, Wet)	3,417,000	3,789,000	3,850,000	3,939,000		Manufacturer Supplied Data
	(ACFHW)	141,445,658	151,166,218	152,573,185	154,428,463		Calculated
	(ACFMW)	2,357,428	2,519,437	2,542,886	2,573,808		Calculated
	(ACFHD)	123,948,830	134,462,350	136,080,024	138,337,017		Calculated
	(ACFMD)	2,065,814	2,241,039	2,268,000	2,305,617		Calculated
	(SCFMW)	46,715,924	51,539,332	52,323,300	53,445,839		Calculated
	(SCFMW)	778,599	858,989	872,055	890,764		Calculated
	(SCFHD)	40,937,164	45,844,236	46,667,152	47,876,782		Calculated
	(SCFMD)	682,286	764,071	777,786	797,948		Calculated
Exhaust Moisture	(%)	12.37	11.05	10.81	10.42		Manufacturer Supplied Data
Exhaust O <sub>2</sub> Dry	(%)	12.58	12.66	12.69	12.74		Calculated
Concentration of NO <sub>x</sub> in Exhaust	(ppmvd @ 15% O <sub>2</sub> )	42	42	42	42		Manufacturer Supplied Data
	(ppmvd)	59.3	58.7	58.4	58.1		Calculated
Concentration of CO in Exhaust	(ppmvd)	20	20	20	20		Manufacturer Supplied Data
	(ppmvd @ 15% O <sub>2</sub> )	14.2	14.3	14.4	14.5		Calculated
Concentration of VOC in Exhaust	(ppmvw)	1.4	1.4	1.4	1.4		Manufacturer Supplied Data
	(ppmvd)	1.6	1.6	1.6	1.6		Calculated
	(ppmvd @ 15% O <sub>2</sub> )	1.1	1.1	1.1	1.1		Calculated

Note:

**CALCULATIONS AND COMPUTATIONS**

Project: Florida GE 7FA Turbine  
 Project Number: 6792-140  
 Subject: Gas Turbine Emission Calculations - GE 7FA - 100 % Load Conditions

Computed by: M. Lafond Date: 9/24/00  
 Checked by: M. Griffin Date: 9/28/00

**OXIDES OF NITROGEN**

Lbs/Hr = 
$$\frac{(\text{NOx Concentration, ppmvd}) * (\text{Exhaust Flow Rate, SCFMD}) * (\text{Mol Wt. NOx, Lbs/Lb-Mol}) * 60 \text{ Min/Hr}}{(385 \text{ SCF/Lb-Mol}) * (1,000,000)}$$

**Oxides of Nitrogen Emissions Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
	Emission Per Combustion Turbine Unit				
Lbs/Hr =	289.6	321.0	325.5	332.1	

**CARBON MONOXIDE**

Lbs/Hr = 
$$\frac{(\text{CO Concentration, ppmvd}) * (\text{Exhaust Flow Rate, SCFMD}) * (\text{Mol Wt. CO, Lbs/Lb-Mol}) * 60 \text{ Min/Hr}}{(385 \text{ SCF/Lb-Mol}) * (1,000,000)}$$

**Carbon Monoxide Emission Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
	Emission Per Combustion Turbine Unit				
Lbs/Hr =	59.5	66.6	67.8	69.6	

**VOLATILE ORGANIC COMPOUNDS**

Lbs/Hr = 
$$\frac{(\text{VOC Concentration as Methane, ppmvw}) * (\text{Exhaust Flow Rate, SCFMW}) * (\text{Mol Wt. VOC, Lbs/Lb-Mol}) * 60 \text{ Min/Hr}}{(385 \text{ SCF/Lb-Mol}) * (1,000,000)}$$

**Volatile Organic Compounds Emission Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
	Emission Per Combustion Turbine Unit				
Lbs/Hr =	2.7	3.0	3.0	3.1	

**CALCULATIONS AND COMPUTATIONS**

Project: Florida GE 7FA Turbine  
 Project Number: 6792-140  
 Subject: Gas Turbine Emission Calculations - GE 7FA - 100 % Load Conditions

Computed by: M. Lafond Date: 9/24/00  
 Checked by: M. Griffin Date: 9/26/00

**SULFUR DIOXIDE**

Lbs/Hr = \_\_\_\_\_ (Expected Fuel Oil Sulfur Content, wt % Sulfur) \* (Fuel Feed Rate, lb/Hr) \* (64 Lbs SO<sub>2</sub>/32 Lbs S)

**Sulfur Dioxide Emissions Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
	Emission Per Combustion Turbine Unit				
Lbs/Hr =	90.3	100.2	101.6	103.6	

Note:  
 Sulfur emissions calculated based on Natural Gas sulfur content of 0.02 grains of sulfur/SCF Natural Gas

**SULFURIC ACID MIST**

Lbs/Hr = \_\_\_\_\_ (SO<sub>2</sub> Emission Rate, lb/hr) \* (SO<sub>2</sub> to SO<sub>3</sub> Conversion Rate, lb/hr) \* (98.07 Lbs SO<sub>2</sub>/64.062 Lbs S)

**Sulfuric Acid Mist Emissions Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
	Emission Per Combustion Turbine Unit				
Lbs/Hr =	13.8	15.3	15.6	15.9	

Note:  
 Assume 10% conversion of SO<sub>2</sub> to SO<sub>3</sub>. Assume all SO<sub>3</sub> is converted to H<sub>2</sub>SO<sub>4</sub>.



**CALCULATIONS AND COMPUTATIONS**

Project: Florida GE 7FA Turbine  
 Project Number: 8792-140  
 Subject: Gas Turbine Emission Calculations - GE 7FA - 100 % Load Conditions

Computed by: M. Lafond Date: 9/24/00  
 Checked by: M. Griffin Date: 9/26/00

**PARTICULATE MATTER**

**Particulate Matter Emissions Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
	Emission Per Combustion Turbine Unit				
Lbs/Hr =	34	34	34	34	

**LEAD**

Lbs/Hr = \_\_\_\_\_ (Lead Emission Factor, lb/MMBtu) \* (Fuel Feed Rate, MMBtu/Hr)

**Lead Emissions Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
	Emission Per Combustion Turbine Unit				
Lbs/Hr =	0.025	0.027	0.028	0.028	

Note:  
 Use AP-42 Section 3.1 Emission Factor.                      0.000014 lb/MMBtu

**CALCULATIONS AND COMPUTATIONS**

Project: Florida GE 7FA Turbine  
 Project Number: 8792-140  
 Subject: Gas Turbine Emission Calculations - GE 7FA - 75 % Load Conditions

Computed by: M. Lafond Date: 9/25/00  
 Checked by: M. Griffin Date: 9/28/00

Design Parameters	Units	Design Data				Proposed Permit Limit	Comments
Turbine Load	(%)	100					Manufacturer Supplied Data
Stack Diameter	(Feet)	18					Proposed Design Specification
Fuel Type		Distillate Oil					Proposed Design Specification
Fuel Heating Value	(Btu/lb, LHV)	18200					Manufacturer Supplied Data
Fuel Sulfur Content	(wt % sulfur)	0.05%					Manufacturer Supplied Data
Ambient Temperature	(F)	91	50	42	30		Manufacturer Supplied Data
Relative Humidity	(%)						Manufacturer Supplied Data
CTG - Gross Power Output	(kW)	120,600	136,900	139,000	142,000		
Heat Input Rate	(MMBtu/Hr, LHV)	1,336.2	1,458.0	1,480.4	1,510.9		Manufacturer Supplied Data
Fuel Feed Rate	(lb/Hr)	73,418	80,110	81,341	83,016		Calculated
Exhaust Temperature	(F)	1,186	1,153	1,148	1,142		Manufacturer Supplied Data
Exhaust Velocity	(F/S)	128.3	133.0	134.0	135.5		Calculated
Exhaust Analysis							
Argon		0.85	0.85	0.86	0.86		39.948 lb/lb mol Ar
Nitrogen		70.71	71.57	71.69	71.90		28.0134 lb/lb mol N <sub>2</sub>
Oxygen		11.15	11.13	11.13	11.14		31.998 lb/lb mol O <sub>2</sub>
Carbon Dioxide		5.42	5.60	5.62	5.65		44.009 lb/lb mol CO <sub>2</sub>
Water		11.88	10.86	10.71	10.45		18.0148 lb/lb mol H <sub>2</sub> O
Exhaust Molecular Weight	(Lbs/Lb-Mol)	28.24	28.37	28.39	28.42		Calculated
Exhaust Flow Rate	(Lbs/Hr, Wet)	2,761,000	2,934,000	2,968,000	3,015,000		Manufacturer Supplied Data
	(ACFW)	117,511,976	121,810,383	122,756,013	124,110,414		Calculated
	(ACFMW)	1,958,533	2,030,173	2,045,934	2,068,507		Calculated
	(ACFHD)	103,551,553	108,581,776	109,608,844	111,140,876		Calculated
	(ACFMD)	1,725,859	1,809,696	1,828,814	1,852,348		Calculated
	(SCFW)	37,679,209	39,856,688	40,291,021	40,888,162		Calculated
	(SCFMW)	627,987	664,278	671,517	681,469		Calculated
	(SCFHD)	33,202,919	35,528,252	35,975,853	36,615,349		Calculated
	(SCFMD)	553,382	592,138	599,598	610,256		Calculated
Exhaust Moisture	(%)	11.88	10.86	10.71	10.45		Manufacturer Supplied Data
Exhaust O <sub>2</sub> Dry	(%)	12.85	12.49	12.47	12.44		Calculated
Concentration of NO <sub>x</sub> in Exhaust	(ppmvd @ 15% O <sub>2</sub> )	42	42	42	42		Manufacturer Supplied Data
	(ppmvd)	58.7	59.9	60.0	60.2		Calculated
Concentration of CO in Exhaust	(ppmvd)	21	22	22	22		Manufacturer Supplied Data
	(ppmvd @ 15% O <sub>2</sub> )	15.0	15.4	15.4	15.3		Calculated
Concentration of VOC in Exhaust	(ppmvw)	1.4	1.4	1.4	1.4		Manufacturer Supplied Data
	(ppmvd)	1.8	1.6	1.6	1.6		Calculated
	(ppmvd @ 15% O <sub>2</sub> )	1.1	1.1	1.1	1.1		Calculated

Note:

**CALCULATIONS AND COMPUTATIONS**

Project: Florida GE 7FA Turbine  
 Project Number: 6792-140  
 Subject: Gas Turbine Emission Calculations - GE 7FA - 75 % Load Conditions

Computed by: M. Lafond Date: 9/25/00  
 Checked by: M. Griffin Date: 9/28/00

**OXIDES OF NITROGEN**

$$\text{Lbs/Hr} = \frac{(\text{NOx Concentration, ppmvd}) * (\text{Exhaust Flow Rate, SCFMD}) * (\text{Mol Wt. NOx, Lbs/Lb-Mol}) * 60 \text{ Min/Hr}}{(385 \text{ SCF/Lb-Mol}) * (1,000,000)}$$

**Oxides of Nitrogen Emissions Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
	Emission Per Combustion Turbine Unit				
Lbs/Hr =	232.7	254.0	257.9	263.2	

**CARBON MONOXIDE**

$$\text{Lbs/Hr} = \frac{(\text{CO Concentration, ppmvd}) * (\text{Exhaust Flow Rate, SCFMD}) * (\text{Mol Wt. CO, Lbs/Lb-Mol}) * 60 \text{ Min/Hr}}{(385 \text{ SCF/Lb-Mol}) * (1,000,000)}$$

**Carbon Monoxide Emission Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
	Emission Per Combustion Turbine Unit				
Lbs/Hr =	50.7	56.8	57.5	58.5	

**VOLATILE ORGANIC COMPOUNDS**

$$\text{Lbs/Hr} = \frac{(\text{VOC Concentration as Methane, ppmvw}) * (\text{Exhaust Flow Rate, SCFMW}) * (\text{Mol Wt. VOC, Lbs/Lb-Mol}) * 60 \text{ Min/Hr}}{(385 \text{ SCF/Lb-Mol}) * (1,000,000)}$$

**Volatile Organic Compounds Emission Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
	Emission Per Combustion Turbine Unit				
Lbs/Hr =	2.2	2.3	2.3	2.4	

**CALCULATIONS AND COMPUTATIONS**

Project: Florida GE 7FA Turbine  
 Project Number: 8792-140  
 Subject: Gas Turbine Emission Calculations - GE 7FA - 75 % Load Conditions

Computed by: M. Lafond Date: 9/25/00  
 Checked by: M. Griffin Date: 9/26/00

**SULFUR DIOXIDE**

Lbs/Hr = \_\_\_\_\_ (Expected Fuel Oil Sulfur Content, wt % Sulfur) \* (Fuel Feed Rate, lb/Hr) \* (64 Lbs SO<sub>2</sub>/32 Lbs S)

**Sulfur Dioxide Emissions Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
	Emission Per Combustion Turbine Unit				
Lbs/Hr =	73.3	80.0	81.3	82.9	

**SULFURIC ACID MIST**

Lbs/Hr = \_\_\_\_\_ (SO<sub>2</sub> Emission Rate, lb/hr) \* (SO<sub>2</sub> to SO<sub>3</sub> Conversion Rate, lb/Hr) \* (98.07 Lbs SO<sub>2</sub>/64.062 Lbs S)

**Sulfuric Acid Mist Emissions Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
	Emission Per Combustion Turbine Unit				
Lbs/Hr =	11.2	12.2	12.4	12.7	

Note:  
 Assume 10% conversion of SO<sub>2</sub> to SO<sub>3</sub>. Assume all SO<sub>3</sub> is converted to H<sub>2</sub>SO<sub>4</sub>.

**CALCULATIONS AND COMPUTATIONS**

Project: Florida GE 7FA Turbine  
 Project Number: 6792-140  
 Subject: Gas Turbine Emission Calculations - GE 7FA - 75 % Load Conditions

Computed by: M. Lafond Date: 9/25/00  
 Checked by: M. Griffin Date: 9/28/00

**PARTICULATE MATTER**

**Particulate Matter Emissions Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
	Emission Per Combustion Turbine Unit				
Lbs/Hr =	34	34	34	34	

Notes:

**LEAD**

Lbs/Hr = \_\_\_\_\_ (Lead Emission Factor, lb/MMBtu) \* (Fuel Feed Rate, MMBtu/Hr)

**Lead Emissions Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
	Emission Per Combustion Turbine Unit				
Lbs/Hr =	0.020	0.022	0.022	0.023	

Note:

Use AP-42 Section 3.1 Emission Factor. 0.000014 lb/MMBtu

**CALCULATIONS AND COMPUTATIONS**

Project: Florida GE 7FA Turbine  
 Project Number: 6792-140  
 Subject: Gas Turbine Emission Calculations - GE 7FA - 50 % Load Conditions

Computed by: M. Lafond Date: 9/25/00  
 Checked by: M. Griffin Date: 9/26/00

Design Parameters	Units	Design Data				Proposed Permit Limit	Comments
Turbine Load	(%)	100					Manufacturer Supplied Data
Stack Diameter	(Feet)	18					Proposed Design Specification
Fuel Type		Distillate Oil					Proposed Design Specification
Fuel Heating Value	(Btu/lb, LHV)	18200					Manufacturer Supplied Data
Fuel Sulfur Content	(wt % sulfur)	0.05%					Manufacturer Supplied Data
Ambient Temperature	(F)	91	50	42	30		Manufacturer Supplied Data
Relative Humidity	(%)						Manufacturer Supplied Data
CTG - Gross Power Output	(kW)	80,400.00	91300	92,700.00	94600		
Heat Input Rate	(MMBtu/Hr, LHV)	1,054.8	1,155.9	1,168.9	1,186.3		Manufacturer Supplied Data
Fuel Feed Rate	(lb/Hr)	57,956	63,511	64,225	65,181		Calculated
Exhaust Temperature	(F)	1,200	1,200	1,200	1,193		Manufacturer Supplied Data
Exhaust Velocity	(F/S)	109.0	112.5	112.9	113.4		Calculated
Exhaust Analysis	Argon	0.86	0.86	0.85	0.86		39.948 lb/lb mol Ar
	Nitrogen	71.45	72.18	72.29	72.53		28.0134 lb/lb mol N <sub>2</sub>
	Oxygen	11.91	11.67	11.63	11.64		31.998 lb/lb mol O <sub>2</sub>
	Carbon Dioxide	5.03	5.34	5.39	5.42		44.009 lb/lb mol CO <sub>2</sub>
	Water	10.75	9.95	9.64	9.55		18.0148 lb/lb mol H <sub>2</sub> O
Exhaust Molecular Weight	(Lbs/Lb-Mol)	28.32	28.44	28.46	28.49		Calculated
Exhaust Flow Rate	(Lbs/Hr, Wet)	2,333,000	2,419,000	2,427,000	2,451,000		Manufacturer Supplied Data
	(ACFW)	89,860,109	103,104,272	103,386,331	103,839,200		Calculated
	(ACFMW)	1,664,335	1,718,405	1,723,106	1,730,653		Calculated
	(ACFHD)	89,125,148	82,845,397	83,213,116	83,922,557		Calculated
	(ACFMD)	1,485,419	1,547,423	1,553,552	1,565,376		Calculated
	(SCFW)	31,749,193	32,780,632	32,870,309	33,154,127		Calculated
	(SCFMW)	529,153	546,344	547,838	552,569		Calculated
	(SCFHD)	28,336,155	29,518,959	29,635,870	29,987,908		Calculated
	(SCFMD)	472,269	491,983	493,931	499,798		Calculated
Exhaust Moisture	(%)	10.75	9.95	9.64	9.55		Manufacturer Supplied Data
Exhaust O2 Dry	(%)	13.34	12.96	12.90	12.87		Calculated
Concentration of NOx in Exhaust	(ppmvd @ 15% O2)	42	42	42	42		Manufacturer Supplied Data
	(ppmvd)	53.8	56.5	57.0	57.2		Calculated
Concentration of CO in Exhaust	(ppmvd)	38	31	30	31		Manufacturer Supplied Data
	(ppmvd @ 15% O2)	29.7	23.0	22.1	22.8		Calculated
Concentration of VOC in Exhaust	(ppmvw)	1.4	1.4	1.4	1.4		Manufacturer Supplied Data
	(ppmvd)	1.6	1.6	1.6	1.5		Calculated
	(ppmvd @ 15% O2)	1.2	1.2	1.1	1.1		Calculated

Note:

**CALCULATIONS AND COMPUTATIONS**

Project: Florida GE 7FA Turbine  
 Project Number: 6792-140  
 Subject: Gas Turbine Emission Calculations - GE 7FA - 50 % Load Conditions

Date: 9/25/00  
 Date: 9/26/00

**OXIDES OF NITROGEN**

$$\text{Lbs/Hr} = \frac{(\text{NOx Concentration, ppmvd}) * (\text{Exhaust Flow Rate, SCFMD}) * (\text{Mol Wt. NOx, Lbs/Lb-Mol}) * 60 \text{ Min/Hr}}{(385 \text{ SCF/Lb-Mol}) * (1,000,000)}$$

**Oxides of Nitrogen Emissions Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
Emission Per Combustion Turbine Unit					
Lbs/Hr =	181.9	199.2	201.5	204.6	

**CARBON MONOXIDE**

$$\text{Lbs/Hr} = \frac{(\text{CO Concentration, ppmvd}) * (\text{Exhaust Flow Rate, SCFMD}) * (\text{Mol Wt. CO, Lbs/Lb-Mol}) * 60 \text{ Min/Hr}}{(385 \text{ SCF/Lb-Mol}) * (1,000,000)}$$

**Carbon Monoxide Emission Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
Emission Per Combustion Turbine Unit					
Lbs/Hr =	78.3	66.5	64.6	67.6	

**VOLATILE ORGANIC COMPOUNDS**

$$\text{Lbs/Hr} = \frac{(\text{VOC Concentration as Methane, ppmvw}) * (\text{Exhaust Flow Rate, SCFMW}) * (\text{Mol Wt. VOC, Lbs/Lb-Mol}) * 60 \text{ Min/Hr}}{(385 \text{ SCF/Lb-Mol}) * (1,000,000)}$$

**Volatile Organic Compounds Emission Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
Emission Per Combustion Turbine Unit					
Lbs/Hr =	1.8	1.9	1.9	1.9	

**CALCULATIONS AND COMPUTATIONS**

Project: Florida GE 7FA Turbine Date: 9/25/00  
 Project Number: 6792-140 Date: 9/26/00  
 Subject: Gas Turbine Emission Calculations - GE 7FA - 50 % Load Conditions

**SULFUR DIOXIDE**

Lbs/Hr = \_\_\_\_\_ (Expected Fuel Oil Sulfur Content, wt % Sulfur) \* (Fuel Feed Rate, lb/Hr) \* (64 Lbs SO<sub>2</sub>/32 Lbs S)

**Sulfur Dioxide Emissions Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
Emission Per Combustion Turbine Unit					
Lbs/Hr =	57.9	63.4	64.2	65.1	

Note:  
 Sulfur emissions calculated based on Natural Gas sulfur content of 0.02 grains of sulfur/SCF Natural Gas

**SULFURIC ACID MIST**

Lbs/Hr = \_\_\_\_\_ (SO<sub>2</sub> Emission Rate, lb/hr) \* (SO<sub>2</sub> to SO<sub>3</sub> Conversion Rate, lb/Hr) \* (98.07 Lbs SO<sub>2</sub>/64.062 Lbs S)

**Sulfuric Acid Mist Emissions Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
Emission Per Combustion Turbine Unit					
Lbs/Hr =	8.9	9.7	9.8	10.0	

Note:  
 Assume 10% conversion of SO<sub>2</sub> to SO<sub>3</sub>. Assume all SO<sub>3</sub> is converted to H<sub>2</sub>SO<sub>4</sub>.

**CALCULATIONS AND COMPUTATIONS**

Project: Florida GE 7FA Turbine



Project Number: 6792-140  
Subject: Gas Turbine Emission Calculations - GE 7FA - 50 % Load Conditions

Computed by: M. Lafond  
Checked by: M. Griffin  
Date: 9/25/00  
Date: 9/26/00

**PARTICULATE MATTER**

**Particulate Matter Emissions Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
	Emission Per Combustion Turbine Unit				
Lbs/Hr =	34	34	34	34	

Notes:

**LEAD**

Lbs/Hr = \_\_\_\_\_ (Lead Emission Factor, lb/MMBtu) \* (Fuel Feed Rate, MMBtu/Hr)

**Lead Emissions Summary**

Ambient Temperature	91	50	42	30	Proposed Permit Limit
	Emission Per Combustion Turbine Unit				
Lbs/Hr =	0.016	0.017	0.018	0.018	

Note:

Use AP-42 Section 3.1 Emission Factor. 0.000014 lb/MMBtu

**ENRON - Florida  
Estimated NSPS NO<sub>x</sub> Emission Standard**

<b>Turbine General Electric Model 7FA Natural Gas Firing</b>	
Nominal Maximum Electrical Capacity	174.8 MW
Maximum Energy Input	1629.1 MMBtu/hr (LHV) 1,719,677,960 kJ/hr
Heat Rate	9,320 Btu/kWh 9.8 kJ/Wh
NSPS Subpart GG NO <sub>x</sub> Limit	0.0110% Volume % NO <sub>x</sub> @ 15% O <sub>2</sub> 110 ppmvd @ 15% O <sub>2</sub>

<b>Turbine General Electric Model 7FA Distillate Fuel Oil Firing</b>	
Nominal Maximum Electrical Capacity	182.5 MW
Maximum Energy Input	1825 MMBtu/hr (LHV) 1,926,470,000 kJ/hr
Heat Rate	10,000 Btu/kWh 10.6 kJ/Wh
NSPS Subpart GG NO <sub>x</sub> Limit	0.0102% Volume % NO <sub>x</sub> @ 15% O <sub>2</sub> 102 ppmvd @ 15% O <sub>2</sub>

Note:

These calculations have been performed using nominal turbine data at 50 degrees F conditions and are intended to provide an estimate of 40 CFR 60 Subpart GG NO<sub>x</sub> Emission Limits.

**CALCULATIONS AND COMPUTATIONS**

Project Florida GE 7FA Turbine

Project Number: 6792-140

Computed by: M. Lafond

Date: 9/25/00

Subject Natural Gas Heater - Emission Calculations

Checked by: M. Griffin

Date: 10/6/00

Emission Source:	Natural Gas Heater
Source Type:	Natural Gas Fueled Heater
Heat Input (MMBtu/hr):	13
Number of Units:	1
Sulfur Content of Fuel (grains/scf):	0.02
Fuel Heating Value, HHV (Btu/scf):	1020
LHV (Btu/scf):	908
Operating Hours per Year:	3500
Fuel Feed Rate (scf/HR):	12745

Compound	Emission Factor (a) (Lbs/MMBtu)	Emission Rate - per Unit	
		Hourly (b) (Lbs/Hr)	Annual (c) (Tons/Year)
Criteria Pollutants			
Nitrogen Oxides	0.102	1.3	2.3
Carbon Monoxide	0.09	1.2	2.1
Volatile Organic Carb	0.06	0.78	1.37
Sulfur Oxides (d)	0.01	0.07	0.13
Particulate	0.01	0.13	0.23

Notes:

- (a) Emission Factors based on the information supplied by ENRON on 8/11/99.
- (b) Hourly Emission Rate (Lbs/Hr) = (Heat Input \* Emission Factor)
- (c) Annual Emission Rate (Tons/Yr) = (Hourly Emission Rate, Lbs/Hr) \* (Hour of Operation Per Year, Hr/Yr) / (2,000 Lbs/Ton)
- (d) Sulfur Oxides Emission Rate (Lbs/Hr) based on the sulfur content of the fuel.

**TANKS 4.07 Output and VOC Emissions Calculations for Enron - Florida  
T001 No. 2 Oil Main Tank**

**TANKS Output:**

**Maximum Hourly Emission Rate:**

	July =	744 hours
	July Max Fuel Use =	32,551,686 gallons/month
Greatest monthly total standing plus working loss - July		1338.29 lb/month
	Maximum VOC emission rate =	1.80 lb/hr

**Annual Total Emission Rate:**

Annual total standing plus working losses =	2734.07 lb/year
PTE =	1.4 tons/yr

**Tank Specifications Used:**

- Vertical fixed roof
- Vented to atmosphere, default breather vent +/- 0.03 psig
- Non-heated
- Flat roof
- Shell in good condition
- 65,700,000 gallons/year throughput
- 2,500,000 gallons capacity
  
- 26 turnovers/year (Throughput/capacity)
- Average liquid height in tank 1/2 tank height

**TANKS 4.07 Output and VOC Emissions Calculations for Enron - Florida  
T002 No. 2 Oil Day Tank**

**TANKS Output:**

**Maximum Hourly Emission Rate:**

	July =	744 hours
	July Max Fuel =	32,551,686 gallons/month
Greatest monthly total standing plus working loss - July		582.17 lb/month
	Maximum VOC emission rate =	0.78 lb/hr

**Annual Total Emission Rate:**

Annual total standing plus working losses =	1174.2 lb/year
PTE =	0.59 tons/yr

**Tank Specifications Used:**

- Vertical fixed roof
- Vented to atmosphere, default breather vent +/- 0.03 psig
- Non-heated
- Flat roof
- Shell in good condition
- 65,700,000 gallons/year throughput
- 617,000 gallons capacity
  
- 106 turnovers/year (Throughput/capacity)
- Average liquid height in tank 1/2 tank height

**Florida GE 7FA Turbine  
Summary of Facility HAP Emissions**

		3500 hrs		2000-hrs-NG-& 1500 hrs Oil		CTGs All	Fuel Heater	Facility Total
		Natural Gas	2000 hrs NG	1500 hrs Oil	1500 hrs Oil	Cases		
Total HAPs	tpy	5.0	2.9	3.1	6.0	6.0	0.04	6.0
Max HAP	tpy	2.6	1.5	1.9	1.9	2.6	4.01E-02	2.6
Max HAP Compound		Formaldehyde	Formaldehyde	Manganese	Formaldehyde	Formaldehyde	Hexane	
Major Total HAPs								<b>No</b>
Major Single HAP								<b>No</b>

**Calculations and Computations**  
**HAP Emissions from Simple Cycle CTG Facility**

**Project:** Florida GE 7FA Turbine  
**Project Number:** 6792-140  
**Subject:** Natural Gas Turbine Non-Criteria  
 Regulated Pollutant Emissions

**Computed by:** M. Behnke  
**Checked by:** M. Griffin  
**Date:** 9/21/00

Pollutant	Type <sup>(a)</sup>	Emission Factor			CTG Natural Gas Combustion		Natural Gas Fired CTG Emissions		Facility		Facility
		AP-42 Section 3.1 04/00 - Combustion Turbine Natural Gas			Maximum Heat Input,	Average Heat Input,	Emission Rate, Per Turbine		Emission Rate All 8 CTGs		Major Source
		(lb/10 <sup>3</sup> scf)	(lb/MMBtu) <sup>(h)</sup>	Rating	per turbine (MMBtu/Hr) <sup>(b)</sup>	per turbine (MMBtu/Hr) <sup>(c)</sup>	Hourly <sup>(d)</sup> (lb/hr)	Annual <sup>(e)</sup> (tpy)	Hourly <sup>(f)</sup> (lb/hr)	Annual <sup>(g)</sup> (tpy)	(Y/N)
1,3-Butadiene	HAP		4.30E-07	D	1,892.6	1,830.4	8.14E-04	1.38E-03	2.44E-03	4.13E-03	No
Acetaldehyde	HAP		4.00E-05	C	1,892.6	1,830.4	7.57E-02	1.28E-01	2.27E-01	3.84E-01	No
Acrolein	HAP		6.40E-06	C	1,892.6	1,830.4	1.21E-02	2.05E-02	3.63E-02	6.15E-02	No
Benzene <sup>(i)</sup>	HAP	1.36E-02	1.33E-05	B	1,892.6	1,830.4	2.52E-02	4.27E-02	7.57E-02	1.28E-01	No
Ethylbenzene	HAP		3.20E-05	C	1,892.6	1,830.4	6.06E-02	1.03E-01	1.82E-01	3.08E-01	No
Formaldehyde <sup>(i)</sup>	HAP	2.72E-01	2.66E-04		1,892.6	1,830.4	5.04E-01	8.53E-01	1.51E+00	2.56E+00	No
Naphthalene	HAP		1.30E-06	C	1,892.6	1,830.4	2.46E-03	4.16E-03	7.38E-03	1.25E-02	No
PAHs	HAP		2.20E-06	C	1,892.6	1,830.4	4.16E-03	7.05E-03	1.25E-02	2.11E-02	No
Propylene Oxide	HAP		2.90E-05	D	1,892.6	1,830.4	5.49E-02	9.29E-02	1.65E-01	2.78E-01	No
Toluene <sup>(i)</sup>	HAP	7.10E-02	8.96E-05	B	1,892.6	1,830.4	1.32E-01	2.23E-01	3.95E-01	6.69E-01	No
Xylene	HAP		8.40E-05	C	1,892.6	1,830.4	1.21E-01	2.05E-01	3.63E-01	6.15E-01	No
Hours of Operation Natural Gas CTG 3,500 Number of Turbines 3										Total HAPs 5.0	No
										Maximum Individual HAP 2.6	No
Natural Gas Heating Value <sup>(i)</sup>		1020 Btu/SCF (HHV) 908 Btu/SCF (LHV)									

- Notes:**
- (a) Type = NC for Non-Criteria Pollutants, HAP/POM for compounds included as polycyclic organic matter or HAP for Hazardous Air Pollutant.
  - (b) Maximum heat input rate for turbine is based on HHV data at ambient temperature of -15°F and 100% load operating conditions.
  - (c) Average heat input rate is based on HHV data at an average ambient temperature of 47.1°F and 100% load operating conditions.
  - (d) Emission Factor (lb/MMBtu) = (Emission Factor, lb/10<sup>3</sup> scf) / (1040 Btu/scf)
  - (e) Hourly Emission Rate (lb/hr) = [Heat Input Rate (MMBtu/Hr) \* Emission Factor (lb/MMBtu)]
  - (f) Annual Emission Rate (tpy) = (Average Hourly Emission Rate, lb/hr) \* (2,500 hr/yr) / (2,000 lb/ton)
  - (g) Emission Factors from CARB CATEF emission factor database for natural gas fired combustion turbines.
  - (h) Modified from AP-42 Section 3.1 emissions database for large turbines.
  - (i) Natural gas heating value is taken from a gas analysis report provided by Duke Energy.

**Calculations and Computations  
HAP Emissions from Simple Cycle CTG Facility**

**Project:** Florida GE 7FA Turbine  
**Project Number:** 6792-140  
**Subject:** Natural Gas Turbine Non-Criteria  
 Regulated Pollutant Emissions

**Computed by:** M. Behnke  
**Checked by:** M. Griffin  
**Date:** 9/21/00

Pollutant	Type <sup>(a)</sup>	Emission Factor AP-42 Section 3.1 04/00 - Combustion Turbine Natural Gas			CTG Natural Gas Combustion		Natural Gas Fired CTG Emissions		Facility		Facility
		[lb/10 <sup>6</sup> scf]	[lb/MMBtu] <sup>(d)</sup>	Rating	Maximum Heat Input,	Average Heat Input,	Emission Rate, Per Turbine		Emission Rate All 6 CTGs		Major Source  (Y/N)
					per turbine (MMBtu/Hr) <sup>(b)</sup>	per turbine (MMBtu/Hr) <sup>(c)</sup>	Hourly <sup>(e)</sup> (lb/hr)	Annual <sup>(f)</sup> (tpy)	Hourly <sup>(g)</sup> (lb/hr)	Annual <sup>(g)</sup> (tpy)	
1,3-Butadiene	HAP		4.30E-07	D	1,892.6	1,830.4	8.14E-04	7.87E-04	2.44E-03	2.38E-03	No
Acetaldehyde	HAP		4.00E-05	C	1,892.6	1,830.4	7.57E-02	7.32E-02	2.27E-01	2.20E-01	No
Acrolein	HAP		6.40E-06	C	1,892.6	1,830.4	1.21E-02	1.17E-02	3.63E-02	3.51E-02	No
Benzene <sup>(h)</sup>	HAP	1.36E-02	1.33E-05	B	1,892.6	1,830.4	2.52E-02	2.44E-02	7.57E-02	7.32E-02	No
Ethylbenzene	HAP		3.20E-05	C	1,892.6	1,830.4	6.06E-02	5.86E-02	1.82E-01	1.76E-01	No
Formaldehyde <sup>(i)</sup>	HAP	2.72E-01	2.66E-04	D	1,892.6	1,830.4	5.04E-01	4.87E-01	1.51E+00	1.46E+00	No
Naphthalene	HAP		1.30E-06	C	1,892.6	1,830.4	2.46E-03	2.38E-03	7.38E-03	7.14E-03	No
PAHs	HAP		2.20E-06	C	1,892.6	1,830.4	4.16E-03	4.03E-03	1.25E-02	1.21E-02	No
Propylene Oxide	HAP		2.90E-05	D	1,892.6	1,830.4	5.49E-02	5.31E-02	1.65E-01	1.59E-01	No
Toluene <sup>(h)</sup>	HAP	7.10E-02	6.96E-05	B	1,892.6	1,830.4	1.32E-01	1.27E-01	3.95E-01	3.82E-01	No
Xylene	HAP		6.40E-05	C	1,892.6	1,830.4	1.21E-01	1.17E-01	3.63E-01	3.51E-01	No
Hours of Operation Natural Gas CTG 2,000 Number of Turbines 3									<b>Total HAPs 2.9</b>		No
Natural Gas Heating Value <sup>(j)</sup> 1020 Btu/SCF (HHV) 908 Btu/SCF (LHV)									<b>Maximum individual HAP 1.5</b>		No

- Notes:  
 (a) Type = NC for Non-Criteria Pollutants, HAP/POM for compounds included as polycyclic organic matter or HAP for Hazardous Air Pollutant.  
 (b) Maximum heat input rate for turbine is based on HHV data at ambient temperature of -15°F and 100% load operating conditions.  
 (c) Average heat input rate is based on HHV data at an average ambient temperature of 47.1°F and 100% load operating conditions.  
 (d) Emission Factor (lb/MMBtu) = (Emission Factor, lb/10<sup>6</sup> scf) / (1040 Btu/scf)  
 (e) Hourly Emission Rate (lb/hr) = [Heat Input Rate (MMBtu/Hr) \* Emission Factor (lb/MMBtu)]  
 (f) Annual Emission Rate (tpy) = (Average Hourly Emission Rate, lb/hr) \* (2,000 hr/yr) / (2,000 lb/ton)  
 (g) Emission Factors from CARB CATEF emission factor database for natural gas fired combustion turbines.  
 (h) Modified from AP-42 Section 3.1 emissions database for large turbines.  
 (i) Natural gas heating value is taken from a gas analysis report provided Duke Energy.



**Calculations and Computations**  
**HAP Emissions from Simple Cycle CTG Facility**

**Project:** Florida GE 7FA Turbine  
**Project Number:** 6792-140  
**Subject:** Distillate Oil-Fired Turbine Non-Criteria  
Regulated Pollutant Emissions

**Computed by:** M. Bahnke **Date:** 9/21/00  
**Checked by:** M. Griffin **Date:** \_\_\_\_\_

Pollutant	Type <sup>(a)</sup>	Emission Factor			CTG Distillate Oil Combustion		Distillate Oil-Fired CTG Emissions		Facility		Facility
		AP-42 Section 3.1 04/00 - Combustion Turbine - Distillate Oil			Maximum Heat Input, per turbine (MMBtu/Hr) <sup>(b)</sup>	Average Heat Input, per turbine (MMBtu/Hr) <sup>(c)</sup>	Emission Rate, Per Turbine		Emission Rate All 3 CTGs		Major Source (Y/N)
		(lb/10 <sup>3</sup> gal)	(lb/MMBtu) <sup>(d)</sup>	Rating			Hourly <sup>(e)</sup> (lb/hr)	Annual <sup>(f)</sup> (tpy)	Hourly <sup>(e)</sup> (lb/hr)	Annual <sup>(f)</sup> (tpy)	
1,3-Butadiene	HAP		1.60E-05	D	1,225.8	1,066.4	1.96E-02	1.28E-02	5.88E-02	3.84E-02	No
Benzene	HAP		5.50E-05	C	1,225.8	1,066.4	6.74E-02	4.40E-02	2.02E-01	1.32E-01	No
Formaldehyde	HAP		2.80E-04	B	1,225.8	1,066.4	3.43E-01	2.24E-01	1.03E+00	6.72E-01	No
Naphthalene	HAP		3.50E-05	C	1,225.8	1,066.4	4.29E-02	2.80E-02	1.29E-01	8.40E-02	No
PAHs	HAP		4.00E-05	C	1,225.8	1,066.4	4.90E-02	3.20E-02	1.47E-01	9.60E-02	No
Arsenic	HAP		1.10E-05	D	1,225.8	1,066.4	1.35E-02	8.80E-03	4.04E-02	2.64E-02	No
Beryllium	HAP		3.10E-07	D	1,225.8	1,066.4	3.80E-04	2.48E-04	1.14E-03	7.44E-04	No
Cadmium	HAP		4.80E-06	D	1,225.8	1,066.4	5.88E-03	3.84E-03	1.77E-02	1.15E-02	No
Chromium	HAP		1.10E-05	D	1,225.8	1,066.4	1.35E-02	8.80E-03	4.04E-02	2.64E-02	No
Lead	HAP		1.40E-05	D	1,225.8	1,066.4	1.72E-02	1.12E-02	5.15E-02	3.36E-02	No
Manganese	HAP		7.90E-04	D	1,225.8	1,066.4	9.68E-01	6.32E-01	2.91E+00	1.90E+00	No
Mercury	HAP		1.20E-06	D	1,225.8	1,066.4	1.47E-03	9.60E-04	4.41E-03	2.88E-03	No
Nickel	HAP		4.60E-06	D	1,225.8	1,066.4	5.84E-03	3.68E-03	1.69E-02	1.10E-02	No
Selenium	HAP		2.50E-05	D	1,225.8	1,066.4	3.06E-02	2.00E-02	9.18E-02	6.00E-02	No

Hours of Operation		1,500									
Distillate Oil CTG		3									
Number of Turbines		3									
							<b>Total HAPs</b>		<b>3.1</b>		No
							<b>Maximum Individual HAP</b>		<b>1.9</b>		No
Distillate Oil Heating Value		139 MMBtu/10 <sup>3</sup> gal (HHV)									
		125 MMBtu/10 <sup>3</sup> gal (LHV)									

- Notes:**  
(a) Type = NC for Non-Criteria Pollutants, HAP/POM for compounds included as polycyclic organic matter or HAP for Hazardous Air Pollutant.  
(b) Maximum heat input rate for turbine is based on HHV data at ambient temperature of -15°F and 100% load operating conditions.  
(c) Average heat input rate is based on HHV data at an average ambient temperature of 47.1°F and 100% load operating conditions.  
(d) Emission factors from AP-42, Section 3.1, Tables 3.1-4 and 3.1-5.  
(e) Hourly Emission Rate (lb/hr) = [Heat Input Rate (MMBtu/Hr) \* Emission Factor (lb/MMBtu)]  
(f) Annual Emission Rate (tpy) = (Average Hourly Emission Rate, lb/hr) \* (500 hr/yr) / (2,000 lb/ton)

**Calculations and Computations  
HAP Emissions**

Project: Florida GE 7FA Turbine  
 Project Number: 6792-140  
 Subject: Natural Gas Fuel Heater Non-Criteria Regulated Pollutant Emissions

Computed by: M. Griffin  
 Checked by: \_\_\_\_\_

Pollutant	Type <sup>(a)</sup>	Emission Factor			Auxiliary Boiler Natural Gas Combustion		Auxiliary Boiler Emissions		Facility		Facility Major Source (Y/N)
		AP-42 Section 1.4 03/98 - Natural Gas Combustion			Maximum Heat Input,	Average Heat Input,	Emission Rate, Per Boiler		Emission Rate All CTG/DB/HRSGs		
		(lb/10 <sup>6</sup> scf)	(lb/MMBtu) <sup>(b)</sup>	Rating	per boiler (MMBtu/Hr)	per boiler (MMBtu/Hr)	Hourly <sup>(c)</sup> (lb/hr)	Annual <sup>(d)</sup> (tpy)	Hourly <sup>(c)</sup> (lb/hr)	Annual <sup>(d)</sup> (tpy)	
1,3-Butadiene	HAP				13	13	0.00E+00	0.00E+00	0.00E+00	0.00E+00	No
2-Methylnaphthalene	HAP	2.40E-05	2.35E-08	D	13	13	3.06E-07	5.35E-07	3.06E-07	5.35E-07	No
3-Methylchloranthrene	HAP	1.80E-06	1.76E-09	E	13	13	2.29E-08	4.01E-08	2.29E-08	4.01E-08	No
7,12-Dimethylbenz(a)anthracene	HAP	1.60E-05	1.57E-08	E	13	13	2.04E-07	3.57E-07	2.04E-07	3.57E-07	No
Acenaphthene	HAP	1.80E-06	1.76E-09	E	13	13	2.29E-08	4.01E-08	2.29E-08	4.01E-08	No
Acenaphthylene	HAP	1.80E-06	1.76E-09	E	13	13	2.29E-08	4.01E-08	2.29E-08	4.01E-08	No
Anthracene	HAP	2.40E-06	2.35E-09	E	13	13	3.06E-08	5.35E-08	3.06E-08	5.35E-08	No
Benz(a)anthracene	HAP	1.80E-06	1.76E-09	E	13	13	2.29E-08	4.01E-08	2.29E-08	4.01E-08	No
Benzene	HAP	2.10E-03	2.06E-06	B	13	13	2.68E-05	4.68E-05	2.68E-05	4.68E-05	No
Benzo(a)pyrene	HAP	1.20E-06	1.18E-09	E	13	13	1.53E-08	2.68E-08	1.53E-08	2.68E-08	No
Benzo(b)fluoranthene	HAP	1.80E-06	1.76E-09	E	13	13	2.29E-08	4.01E-08	2.29E-08	4.01E-08	No
Benzo(g,h,i)perylene	HAP	1.20E-06	1.18E-09	E	13	13	1.53E-08	2.68E-08	1.53E-08	2.68E-08	No
Benzo(k)fluoranthene	HAP	1.80E-06	1.76E-09	E	13	13	2.29E-08	4.01E-08	2.29E-08	4.01E-08	No
Chrysene	HAP	1.80E-06	1.76E-09	E	13	13	2.29E-08	4.01E-08	2.29E-08	4.01E-08	No
Dibenzo(a,h)anthracene	HAP	1.20E-06	1.18E-09	E	13	13	1.53E-08	2.68E-08	1.53E-08	2.68E-08	No
Dichlorobenzene	HAP	1.20E-03	1.18E-06	E	13	13	1.53E-05	2.68E-05	1.53E-05	2.68E-05	No
Fluoranthene	HAP	3.00E-06	2.94E-09	E	13	13	3.82E-08	6.69E-08	3.82E-08	6.69E-08	No
Fluorene	HAP	2.80E-06	2.75E-09	E	13	13	3.57E-08	6.25E-08	3.57E-08	6.25E-08	No
Formaldehyde	HAP	7.50E-02	7.35E-05	B	13	13	9.56E-04	1.67E-03	9.56E-04	1.67E-03	No
Hexane	HAP	1.80E+00	1.76E-03	13	13	13	2.29E-02	4.01E-02	2.29E-02	4.01E-02	No
Indeno(1,2,3-cd)pyrene	HAP	1.80E-06	1.76E-09	E	13	13	2.29E-08	4.01E-08	2.29E-08	4.01E-08	No
Naphthalene	HAP	6.10E-04	5.98E-07	E	13	13	7.77E-06	1.36E-05	7.77E-06	1.36E-05	No
Phenanthrene	HAP	1.70E-05	1.67E-08	D	13	13	2.17E-07	3.79E-07	2.17E-07	3.79E-07	No
Pyrene	HAP	5.00E-06	4.90E-09	E	13	13	6.37E-08	1.12E-07	6.37E-08	1.12E-07	No
Toluene	HAP	3.40E-03	3.33E-06	C	13	13	4.33E-05	7.58E-05	4.33E-05	7.58E-05	No
Arsenic	HAP	2.00E-04	1.96E-07	E	13	13	2.55E-06	4.46E-06	2.55E-06	4.46E-06	No
Barium	HAP	4.40E-03	4.31E-06	D	13	13	5.61E-05	9.81E-05	5.61E-05	9.81E-05	No
Beryllium	HAP	1.20E-05	1.18E-08	E	13	13	1.53E-07	2.68E-07	1.53E-07	2.68E-07	No
Cadmium	HAP	1.10E-03	1.08E-06	D	13	13	1.40E-05	2.45E-05	1.40E-05	2.45E-05	No
Chromium	HAP	1.40E-03	1.37E-06	D	13	13	1.78E-05	3.12E-05	1.78E-05	3.12E-05	No
Cobalt	HAP	8.40E-05	8.24E-08	D	13	13	1.07E-06	1.87E-06	1.07E-06	1.87E-06	No
Copper	HAP	8.50E-04	8.33E-07	C	13	13	1.08E-05	1.90E-05	1.08E-05	1.90E-05	No
Lead	HAP	5.00E-04	4.90E-07	D	13	13	6.37E-06	1.12E-05	6.37E-06	1.12E-05	No
Manganese	HAP	3.80E-04	3.73E-07	D	13	13	4.84E-06	8.48E-06	4.84E-06	8.48E-06	No
Mercury	HAP	2.60E-04	2.55E-07	D	13	13	3.31E-06	5.80E-06	3.31E-06	5.80E-06	No
Molybdenum	HAP	1.10E-03	1.08E-06	D	13	13	1.40E-05	2.45E-05	1.40E-05	2.45E-05	No
Nickel	HAP	2.10E-03	2.06E-06	C	13	13	2.68E-05	4.68E-05	2.68E-05	4.68E-05	No
Selenium	HAP	2.40E-05	2.35E-08	E	13	13	3.06E-07	5.35E-07	3.06E-07	5.35E-07	No
Vanadium	HAP	2.30E-03	2.25E-06	D	13	13	2.93E-05	5.13E-05	2.93E-05	5.13E-05	No
Zinc	HAP	2.90E-02	2.84E-05	E	13	13	3.70E-04	6.47E-04	3.70E-04	6.47E-04	No

Hours of Operation Auxiliary Boiler	3,500	Facility Total HAPs	0.04	No
Number of Auxiliary Boilers per Facility	1	Maximum Individual HAP	0.04	No
Natural Gas Heating Value	1020 Btu/SCF (HHV)			

Notes:  
 (a) Type = NC for Non-Criteria Pollutants, HAP/POM for compounds included as polycyclic organic matter or HAP for Hazardous Air Pollutant.  
 (b) Emission Factor (lb/MMBtu) = (Emission Factor, lb/10<sup>6</sup> scf) / (1,020 Btu/scf)  
 (c) Hourly Emission Rate (lb/hr) = [Heat Input (MMBtu/Hr) \* Emission Factor (lb/MMBtu)]  
 (d) Annual Emission Rate (tpy) = (Hourly Emission Rate, lb/hr) \* (8,760 hr/yr) / (2,000 lb/ton)

**Calculations and Computations**

Project: Florida GE 7FA Turbine  
 Project Number: 6792-140  
 Subject: Formaldehyde Emission Factor

Computed by: L. Sherburne  
 Checked by: M. Griffin

Date: 7/19/00  
 Date: 9/21/00

Facility	Manufacturer	Model	Rating (MW)	AP-42 1998	Large
				Draft (lb/Mmcuft)	Turbine (C-70 MW) (lb/Mmcuft)
Gilroy Energy Co./Gilroy, CA	General Electric	Frame 7	87	0.722160	0.722160
Sithe Energies, 32nd St. Naval S/San Diego, CA	General Electric	MS6000	44	0.110160	
SD Gas & Electric Co./San Diego, CA	General Electric	5221	17	0.483480	
Modesto Irrigation District/Mclure/Modesto, CA	General Electric	Frame 7B	50	0.135660	
Willamette Industries, Inc./Oxnard, CA	General Electric	LM2500-PE	67.4	0.044982	
Sycamore Cogen. Co./Bakersfield, CA	General Electric	Frame 7	75	0.085884	0.085884
Calpine / Agnews Cogen./San Jose, CA	General Electric	LM5000	23.33	0.063036	
Dexzel Inc./Bakersfield, CA	General Electric	LM2500	29.1	0.026520	
Procter & Gamble Manufacturing/Sacramento, CA	General Electric	LM2500	20.5	0.088434	
Chevron Inc./Gaviota, CA	Allison	K501	2.5	3.570000	
EII / Stewart & Stevenson/Berkeley, CA	General Electric	LM2500	25	0.480420	
Calpine Corp./Sumas, WA	General Electric	MS7001EA	87.83	0.006834	0.006834
Sargent Canyon Cogen/Bakersfield, CA	General Electric	Frame 6	42.5	0.059568	
Watsonville Cogen, Partnership/Watsonville, CA	General Electric	LM 2500	24	0.091596	
Southern Cal. Edison Co./Long Beach, CA	Brown-Boveri-Sulzer	11-D	61.75	1.326000	
NR/NR	General Electric	Frame 3	7.7	0.265200	
NR/NR	General Electric	Frame 3	7.7	0.427380	
NR/NR	Solar	T12000	9.4	0.015810	
NR/NR	Solar	T12000	9.4	9.618600	
NR/NR	General Electric	LM1500	10.6	4.273800	
NR/NR	General Electric	LM1500	10.6	25.908000	
Southern Cal. Edison Co./Coolwater, CA	Westinghouse	PACE520	63	38.964000	
Southern Cal. Edison Co./Coolwater, CA	Westinghouse	PACE520	63	0.350880	
Imperial Irrigation D / Choachella/Imperial, CA	General Electric	NS5000P	46.3	0.306000	
Bonneville Pacific Corp./Somis, CA	Solar	Mars	9	0.743580	
WSPA/SWEPI GT/Bakersfield, CA	Allison	501 KB5	4	0.013872	
Mean (lb/Mmcuft)				3.39	0.27

Note: The AP-42 1998 Draft document calculates the proposed Formaldehyde Emission factor as an average of all of the test data present in the data base. For the purposes of calculating an appropriate emission factor for this project only the data presented for large turbines has been used.

**APPENDIX C**  
**BACT SUPPORTING INFORMATION**

**Table C-1  
PRICE QUOTE ADJUSTMENTS  
Enron - Florida  
General Electric 7 FA Turbine**

NOx High Temperature SCR - Top Control Option  
Simple Cycle, General Electric 7 EA - Proposed option with DLN to 15 ppm

Hours of Operation	
3,500	
	\$4,069,564 Budgetary cost for SCR (without auxiliaries) <sup>(1)</sup>
	\$1,972,280 Catalyst Support Structure
	\$2,097,284 Catalyst Bed
	<b>\$4,069,564 Budgetary cost for SCR (without auxiliaries)</b>
	\$100,000 Auxiliaries not included in Engelhard quote = (\$10k per tank + \$20K insulation and heating +
	\$20k pumps, piping flow meters, safety equipment) x 2 tanks = \$100k
	\$262,160 Spare Catalyst = 1 spare catalyst on site at all times for 8 turbines
	<hr style="width: 100%; border: 0.5px solid black;"/> \$4,431,724

Carbon Monoxide High Temperature Oxidation Catalyst - Top Control Option  
Simple Cycle, General Electric 7 EA, Baseline and Proposed Control Option

	\$1,319,483 Budgetary cost for CO catalyst (without auxiliaries) <sup>(1)</sup>
	\$638,908 Catalyst Support Structure
	\$668,886 Catalyst Bed
	<b>\$1,319,483 Oxidation System (catalyst and structure)</b>
	\$50,000 Transition = Transition piece, stainless steel, spool piece, = \$50k
	\$20,000 Crane = Crane to handle modules = \$20k
	\$30,000 Fan = Dilution air fan, variable speed drive, ductwork, starter = \$30k
	\$83,336 Spare Catalyst = 1 spare catalyst on site at all times for 8 turbines
	<hr style="width: 100%; border: 0.5px solid black;"/> \$1,502,819

<sup>(1)</sup>The 11/13/98 Engelhard quote was provided for a combined CO oxidation and SCR system.  
The original quotation has been adjusted for separate oxidation and SCR systems.  
The original quotation has also been escalated to reflect current control system costs using the Vavavuk Air Pollution Control Cost Indexes per OAQPS control cost manual.  
The original quotation has also been used to estimate catalyst costs for differing operating scenarios.

**Table C-1A  
Enron - Florida  
General Electric 7 FA Turbine  
Control Equipment Cost Adjustment**

Budgetary Cost	Costs from Engelhard Quote		Estimated Costs <sup>4</sup>	Scaled Estimated Costs <sup>5</sup>
Turbine Operation (hrs/year)	3,500	2,000	3,500	3,500
Base Exhaust Air Flow (lb/hr)	2,728,000			
Actual Exhaust Air Flow (lb/hr)	3,789,000			
<b>Original Quotation Costs</b>				
Total System (SCR & Oxidation Catalyst)	3,600,000	3,000,000		
Replacement CO	450,000	360,000		
Replacement ZNX	1,400,000	1,000,000		
Support Equipment Cost	1,750,000	1,640,000		
Total Catalyst Cost	1,850,000	1,360,000		
Catalyst Cost/Total Cost	51.4%	45.3%		
<b>SCR System Only<sup>2</sup></b>				
SCR Costs from 11/13/98 Quote				
Cost Index <sup>3</sup>	104.2			
Support Equipment	1,320,000	1,210,000	1,320,000	1,833,387
Catalyst Cost	1,400,000	1,000,000	1,400,000	1,944,501
Total Cost	2,720,000	2,210,000	2,720,000	3,777,889
<b>Escalated Cost for June 2000</b>				
Cost Index <sup>3</sup>	112.3			
Support Equipment	1,420,000	1,300,000	1,420,000	1,972,280
Catalyst Cost	1,510,000	1,080,000	1,510,000	2,097,284
Total Cost	2,930,000	2,380,000	2,930,000	4,069,564
<b>Oxidation Catalyst System only<sup>2</sup></b>				
Costs from 11/13/98 Quote				
Cost Index <sup>3</sup>	104.2			
Support Equipment	430,000	430,000	430,000	597,240
Catalyst Cost	450,000	360,000	450,000	625,018
Total Cost	880,000	790,000	880,000	1,222,258
<b>Escalated Cost for June 2000</b>				
Cost Index <sup>3</sup>	112.3			
Support Equipment	460,000	460,000	460,000	638,908
Catalyst Cost	480,000	390,000	480,000	666,686
Total Cost	950,000	850,000	950,000	1,319,483

**Notes:**

- 1 - From original Engelhard quotation, November 13, 1998
- 2 - Original quotation was provided for a combined SCR/Oxidation Catalyst System. For BACT analysis costs have been separated.
- 3 - Vatavuk Air Pollution Control Cost Index for Catalytic Incinerators. Base index 4th quarter 1998, Escalated index 2nd quarter 2000.
- 4 - Costs for reduced operation scenarios calculated assuming linear relationship between hours of operation and equipment cost.
- 5- Original quotation was provided for GE 7 EA Turbines. Costs scaled for GE 7FA based on exhaust flow rate.

$$\text{Scaled Cost} = \text{Original Cost} \times \text{Actual Exhaust Air Flow} / \text{Base Exhaust Air Flow}$$

**TABLE C-2**  
**Enron - Florida**  
**NOx High Temperature SCR - Top Control Option**  
**Simple Cycle, General Electric 7 FA**

Control Efficiency (%)	61%
------------------------	-----

**Facility Input Data**

Operating Schedule	
Shifts per day	3
Hours per day	24
Days per week	7
Total Hours per year	3,500
Natural Gas Firing (Normal Operation)	2,000
Distillate Oil Firing (Normal Operation)	1,500
Source(s) Controlled	One Power Block, 175 MW
NOx From Normal Natural Gas Operation (lb/hr) <sup>1</sup>	79.5
NOx From Distillate Oil Operation (lb/hr)	321.0
NOx From Source(s) (tpy)	300.4
Site Specific Enclosure (Building) Cost	NA
Site Specific Electricity Value (\$/kWh)	0.10
Site Specific Natural Gas Cost (\$/MMBtu)	NA
Site Specific Operating Labor Cost (\$/hr)	30
Site Specific Maint. Labor Cost (\$/hr)	30

<sup>1</sup>NOx emissions are based on data at 100% load and intake air chilled to maximum of 50°F.

**Capital Costs<sup>1</sup>**

Direct Costs		
1.) Purchased Equipment Cost		
a.) Equipment cost + auxiliaries	\$4,431,724	Engelhard Quote plus auxiliaries, A
b.) Instrumentation	\$443,200	0.10 x A
c.) Sales taxes	\$265,900	0.06 x A
d.) Freight	\$221,600	0.05 x A
Total Purchased equipment cost, (PEC)	\$5,362,424	B = 1.21 x A
2.) Direct installation costs		
a.) Foundations and supports	\$429,000	0.08 x B
b.) Handling and erection	\$750,700	0.14 x B
c.) Electrical	\$214,500	0.04 x B
d.) Piping	\$107,200	0.02 x B
e.) Insulation for ductwork	\$53,600	0.01 x B
f.) Painting	\$53,600	0.01 x B
Total direct installation cost	\$1,608,600	0.30 x B
3.) Site preparation, SP	NA	NA
4.) Buildings, Bldg	NA	NA
Total Direct Cost, DC	\$6,971,000	1.30B + SP + Bldg
Indirect Costs (installation)		
5.) Engineering	\$536,200	0.10 x B
6.) Construction and field expenses	\$268,100	0.05 x B
7.) Contractor fees	\$536,200	0.10 x B
8.) Start-up	\$107,200	0.02 x B
9.) Performance test	\$53,600	0.01 x B
10.) Contingencies	\$160,900	0.03 x B
11.) Simple Interest During Construction	\$244,000	DC x 7% x 0.5 years
Total Indirect Cost, IC	\$1,906,200	0.28B
Total Capital Investment (TCI) = DC + IC	\$8,877,200	1.58B + SP + Bldg

<sup>1</sup> See Appendix C, Tables C-1 and C-1A

**TABLE C-2  
Enron - Florida  
NOx High Temperature SCR - Top Control Option  
Simple Cycle, General Electric 7 FA**

Control Efficiency (%)	61%
------------------------	-----

**Annual Costs**

<b>1) Electricity</b>			
Catalyst Press. Drop (in. W.C.)	3.0	Pressure drop - catalyst bed	Vendor, estimate
Power Output of Turbine (kW)	175,000	Output at Average Conditions	Vendor
Power Loss Due to Pressure Drop (%)	0.32%	0.105% for every 1" pressure drop	
Power Loss Due to Pressure Drop (kW)	551		
Unit Cost (\$/kW-hr)	\$0.10	Estimated Market Value	Estimate
Cost of Heat Rate Loss (\$)	\$192,940		
Power Loss Due to Extended Startups (kW-hr)	13,125,000	Extended startup time due to catalyst bed	Estimate
Cost of Extra Startups (\$/yr)	\$1,312,500	\$0.10/kW	
<b>Total Cost (\$/yr)</b>	<b>\$1,505,440</b>		
<b>2) Operating Labor</b>			
SCR Requirement (hr/yr)	218.75	1/2 hr/shift, 3,500 hours per year	Estimate
Ammonia Delivery Requirement (hr/yr)	24	3 deliveries per year, 8 hr/delivery	Estimate
Ammonia Recordkeeping/Reporting (hr/yr)	40.0	One week of reporting	Estimate
Catalyst Cleaning (hr/yr)	80.0	2 workers x 40 hours per year	
Unit Cost (\$/hr)	\$30.00	Facility Data	Estimate
<b>Cost (\$/yr)</b>	<b>\$10,883</b>		
<b>3) Supervisory Labor</b>			
<b>Cost (\$/yr)</b>	<b>\$1,630</b>	15% Operating Labor	OAQPS
<b>4) Maintenance</b>			
SCR Labor Req. (hr/yr)	218.75	1/2 hour per shift	OAQPS
Catalyst Replacement Labor Req. (hr/yr)	106.7	8 workers, 40 hours every 3 yrs	Estimate
Ammonia System Maintenance Labor Req. (hr/yr)	365.0	1 hr/day, 365 day/yr	Estimate
Unit Cost (\$/hr)	\$30.00	Facility Data	Estimate
Labor Cost (\$/yr)	\$20,713		
Material Cost (\$/yr)	\$20,710	100% of Maintenance Labor	OAQPS
<b>Total Cost (\$/yr)</b>	<b>\$41,420</b>		
<b>5) Ammonia Requirement</b>			
Requirement (ton/yr)	100	Ammonia requirement, 0.5436 lb NH3/lb NOx Removed	Vendor
Unit Cost (\$/ton)	\$315	For pure ammonia	Chemical Market Reporter
<b>Total Cost (\$/yr)</b>	<b>\$31,430</b>		
<b>6) Process Air</b>			
Requirement (acftb NH3)	350		Vendor
Requirement (Mscft/yr)	69,843		Vendor
Unit Cost (\$/Mscft)	\$0.20	Peters and Timmerhaus	Standard
<b>Total Cost (\$/yr)</b>	<b>\$13,970</b>		
<b>7) Catalyst Replacement</b>			
Catalyst Cost (\$)	\$2,097,284	Catalyst modules	Vendor
Catalyst Disposal Cost (\$)	\$50,000	Disposal of catalyst modules	Estimate
Sales Tax (\$)	\$104,864	5% sales tax in Indiana	Estimate
Catalyst Life (yrs)	3		OAQPS
Interest Rate (%)	7		
CRF	0.381	Amortization of Catalyst	OAQPS
<b>Annual Cost (\$/yr)</b>	<b>\$858,180</b>	(Volume)(Unit Cost)(CRF)	
<b>8) Indirect Annual Costs</b>			
Overhead	\$32,400	60% of O&M Costs	OAQPS
Administration	\$177,500	2% of Total Capital Investment	OAQPS
Property Tax	\$88,770	1% of Total Capital Investment	OAQPS
Insurance	\$88,770	1% of Total Capital Investment	OAQPS
Capital Recovery	\$955,000	10 yr life; 7% interest (-cat. cost)	OAQPS
<b>Total Indirect (\$/yr)</b>	<b>\$1,342,440</b>		
<b>Total Annualized Cost (\$/yr)</b>	<b>\$3,805,400</b>		
<b>Total NOx Controlled (tpy)</b>	<b>183.5</b>		
<b>Cost Effectiveness (\$/ton)</b>	<b>\$20,700</b>		



**Table C-3  
Enron - Florida  
Carbon Monoxide High Temperature Oxidation Catalyst  
Simple Cycle, General Electric 7 FA**

Control Efficiency (%)	90%
------------------------	-----

**Facility Input Data**

<b>Operating Schedule</b>	
Shifts per day	3
Hours per day	24
Days per week	7
Total Hours per year	3,500
Natural Gas Firing (Normal Operation)	2,000
Distillate Oil Firing (Normal Operation)	1,500
Source(s) Controlled <sup>1</sup>	One Power Block, 175 MW
CO From Normal Natural Gas Operation (lb/hr)	29.6
CO From Distillate Oil Operation (lb/hr)	66.6
CO From Source(s) (tpy)	79.6
Site Specific Enclosure (Building) Cost	NA
Site Specific Electricity Value (\$/kWh)	0.10
Site Specific Natural Gas Cost (\$/MMBtu)	NA
Site Specific Operating Labor Cost (\$/hr)	30
Site Specific Maint. Labor Cost (\$/hr)	30

<sup>1</sup>CO emissions are based on data at 100% load and intake air chilled to maximum of 50°F.

**Capital Costs<sup>1</sup>**

<b>Direct Costs</b>		
1.) Purchased Equipment Cost		
a.) Equipment cost + auxiliaries	\$1,502,819	Scaled Engelhard quote + auxiliaries, A
b.) Instrumentation	\$150,300	0.10 x A
c.) Sales taxes	\$75,100	0.05 x A
d.) Freight	\$90,200	0.06 x A
Total Purchased equipment cost, (PEC)	\$1,818,419	B = 1.21 x A
2.) Direct installation costs		
a.) Foundations and supports	\$145,500	0.08 x B
b.) Handling and erection	\$254,600	0.14 x B
c.) Electrical	\$72,700	0.04 x B
d.) Piping	\$36,400	0.02 x B
e.) Insulation for ductwork	\$18,200	0.01 x B
f.) Painting	\$18,200	0.01 x B
Total direct installation cost	\$545,600	0.30 x B
3.) Site preparation, SP	NA	NA
4.) Buildings, Bldg	NA	NA
<b>Total Direct Cost, DC</b>	<b>\$2,364,000</b>	<b>1.30B + SP + Bldg</b>
<b>Indirect Costs (Installation)</b>		
5.) Engineering	\$181,800	0.10 x B
6.) Construction and field expenses	\$90,900	0.05 x B
7.) Contractor fees	\$181,800	0.10 x B
8.) Start-up	\$36,400	0.02 x B
9.) Performance test	\$18,200	0.01 x B
10.) Contingencies	\$54,600	0.03 x B
11.) Simple Interest During Construction	\$82,700	DC x 7% x 0.5 years
<b>Total Indirect Cost, IC</b>	<b>\$646,400</b>	<b>0.28B</b>
<b>Total Capital Investment (TCI) = DC + IC</b>	<b>\$3,010,400</b>	<b>1.58B + SP + Bldg</b>

<sup>1</sup> See Appendix C, Tables C-1 and C-1A

**Table C-3**  
**Enron - Florida**  
**Carbon Monoxide High Temperature Oxidation Catalyst**  
**Simple Cycle, General Electric 7 FA**

Control Efficiency (%)	90%
------------------------	-----

**Annual Costs**

<b>1) Electricity</b>			
Press. Drop (in. W.C.)	3.0	Pressure drop - catalyst bed	Vendor
Power Output of Turbine (kW)	175,000		
Power Loss Due to Pressure Drop (%)	0.32%	0.105% for every 1" pressure drop	Vendor
Power Loss Due to Pressure Drop (kW)	551		
Unit Cost (\$/kWh)	\$0.10	Estimated Market Value	Estimate
Cost of Heat Rate Loss (\$/yr)	\$182,940		
Power Loss Due to Extended Startups (kW-hr)	13,125,000	Extended startup time due to catalyst bed	Estimate
Cost of Extra Startups (\$/yr)	\$1,312,500	\$0.10/kWh	
<b>Total Cost (\$/yr)</b>	<b>\$1,505,440</b>		
<b>2) Operating Labor</b>			
Requirement (hr/yr)	218.75	1/2 hr/shift, 3,500 hours per year	OAQPS
Unit Cost (\$/hr)	\$30.00	Facility Data	Estimate
Cost (\$/yr)	\$6,560		
<b>3) Supervisory Labor</b>			
Cost (\$/yr)	\$980	15% Operating Labor	OAQPS
<b>4) Maintenance</b>			
Labor Req. (hr/shift)	218.75	1/2 hour per shift	OAQPS
Unit Cost (\$/hr)	\$30.00	Facility Data	Estimate
Labor Cost (\$/yr)	\$6,563		
Material Cost (\$/yr)	\$6,560	100% of Maintenance Labor	OAQPS
<b>Total Cost (\$/yr)</b>	<b>\$13,120</b>		
<b>7) Catalyst Replacement</b>			
Catalyst Cost (\$)	\$666,686	Catalyst modules	Vendor
Catalyst Disposal Cost (\$)	\$50,000	Disposal of catalyst modules	Estimate
Sales Tax (\$)	\$33,334	5% sales tax in Indiana	Estimate
Catalyst Life (yrs)	3	n	OAQPS
Interest Rate (%)	7	i	OAQPS
CRF	0.38	Amortization of Catalyst	OAQPS
Annual Cost (\$/yr)	\$285,800	(Volume)(Unit Cost)(CRF)	
<b>9) Indirect Annual Costs</b>			
Overhead	\$12,400	60% of O&M Costs	OAQPS
Administration	\$60,200	2% of Total Capital Investment	OAQPS
Property Tax	\$30,100	1% of Total Capital Investment	OAQPS
Insurance	\$30,100	1% of Total Capital Investment	OAQPS
Capital Recovery	\$335,200	10 yr life; 7% interest (-cat. cost)	OAQPS
<b>Total Indirect (\$/yr)</b>	<b>\$468,000</b>		
<b>Total Annualized Cost (\$/yr)</b>	<b>\$2,279,900</b>		
<b>Total CO Controlled (tpy)</b>	<b>71.6</b>		
<b>Cost Effectiveness (\$/ton)</b>	<b>\$31,800</b>		

COVER SHEET

**ENGELHARD**

101 WOOD AVENUE  
ISELIN, NJ 08830  
732-205-6000

POWER GENERATION SALES:  
ENGELHARD CORPORATION  
2205 CHEQUERS COURT  
BEL AIR, MD 21015  
PHONE 410-569-0297  
FAX 410-569-1841  
E-Mail Fred\_Booth@ENGELHARD.COM

DATE: November 13, 1998

NO. PAGES

11

(INCLUDING COVER)

TO:

ENGELHARD  
ATTN: Nancy Ellison

FROM:

Fred Booth

Ph 410-569-0297 // FAX 410-569-1841

CONFIDENTIALITY NOTICE

The information in this transmission is intended only for the individual or entity named above. If you have received this information in error, please notify us immediately and send the original transmission to us by mail. If the reader of this message is not the intended recipient, you are hereby notified that any disclosure, dissemination, distribution, or copying of this communication or its contents is strictly prohibited.

RE:

Simple Cycle Turbines  
Oxidation Catalyst Components  
High Temperature SCR Catalyst System Components  
Engelhard Budgetary Proposal

Added data and pricing for 2,000 hr/yr operation.

# ENGELHARD

101 WOOD AVENUE  
ISELIN, NJ 08830  
732-205-5000

POWER GENERATION SALES:  
ENGELHARD CORPORATION  
2205 CHEQUERS COURT  
BEL AIR, MD 21015  
PHONE 410-569-0297  
FAX 410-569-1841  
E-Mail Fred\_Booth@ENGELHARD.COM

November 13, 1998

RE: Simple Cycle Turbines  
Oxidation Catalyst Components  
High Temperature SCR Catalyst System Components  
Engelhard Budgetary Proposal EPB98283-Rev. 1

Dear

We provide Engelhard Budgetary Proposal for Engelhard Camel® CO Oxidation Catalyst System Components and NOxCAT ZNX™ High Temperature SCR Catalyst system components for the above projects. This is per your FAXes of November 10 and 11, 1998.

Our Budgetary Proposal is based on:

- Given data for GE 7EA, Westinghouse 501D5A, and Westinghouse 501F Gas Turbines operating in simple cycle mode for both 3,500 hours/year and 2,000 hours/year operation;
- Oxidation Catalysts for CO reductions as noted;
- Catalyst for NOx reductions as noted with ammonia slip of 5 ppmvd@15%O<sub>2</sub>;
- Delta P through CO and SCR systems of Nominal 4"WG;
- Assumed internally insulated ducts with cross sections at the catalyst as illustrated. Note that all transitions are based on assumed turbine discharge cross section of 15 ft. x 15 ft.;
- Scope as noted. Please note that we have assumed horizontal gas flow through the CO / SCR reactor and the use of 28% aqueous ammonia. The systems for the GE 7EA and Westinghouse 501F require the use of an ambient air cooling system to reduce the gas temperature to the SCR catalyst.
- Three (3) Year Performance Guarantee (expected life five to seven years).

We request the opportunity to work with you on this project.

Sincerely yours,

ENGELHARD CORPORATION



Frederick A. Booth  
Sales Engineer

cc: Nancy Ellison - Proposal Administrator

**ENGELHARD CORPORATION**  
**CAMET<sup>™</sup> CO CATALYST SYSTEM**  
**NOxCAT ZNX<sup>™</sup> HIGH TEMPERATURE SCR NOx ABATEMENT CATALYST SYSTEM**

Engelhard Corporation ("Engelhard") offers to supply to Buyer the CAMET<sup>™</sup> metal substrate CO Catalyst System components and the NOxCAT ZNX<sup>™</sup> ceramic substrate SCR system components summarized herein.

**NOxCAT ZNX<sup>™</sup> High Temperature SCR Catalyst System: Scope of Supply**

1. Engelhard CAMET<sup>®</sup> CO and NOxCAT ZNX<sup>™</sup> SCR catalyst in modules;
2. Internal support structures for catalyst modules (frame);
3. Internally insulated reactor ductwork - with stainless steel liner sheets - to house CO catalyst modules, AIG, and SCR Catalyst modules;
4. Inlet and outlet transition duct sections - internally insulated with stainless steel liner - inlet flow straightener in inlet transition section;
5. Ammonia Injection Grid (AIG);
6. AIG manifold with flow control valves ;
7. NH<sub>3</sub>/Air dilution skid: Anhydrous Ammonia to skid;
8. Ambient air cooling system components as required..

	<u>GE 7EA</u>	<u>West 501D5A</u>	<u>West 501F</u>
<b>BUDGET PRICES: Per Turbine- 3,500 hr/yr</b>			
Items 1 - 7 above - complete system	\$3,600,000	\$5,000,000	\$5,500,000
Replacement CO Modules	\$ 450,000	\$ 750,000	\$ 500,000 /0.75 = 667,000
Replacement ZNX Modules	\$1,400,000	\$2,000,000	\$1,800,000
<b>Per Turbine- 2,000 hr/yr</b>			
Items 1 - 7 above - complete system	\$3,000,000	\$3,600,000	\$3,800,000
Replacement CO Modules	\$ 360,000	\$ 450,000	\$ 420,000
Replacement ZNX Modules	\$1,000,000	\$1,500,000	\$1,400,000

**WARRANTY AND GUARANTEE:**

Mechanical Warranty: One year of operation\* or 1.5 years after catalyst delivery, whichever occurs first.  
Performance Guarantee: Three (3) years of operation\* or 3.5 years after catalyst delivery, whichever occurs first. Catalyst warranty is prorated over the guaranteed life

**DOCUMENT / MATERIAL DELIVERY SCHEDULE**

Drawings / Documentation - 6 - 8 weeks after notice to proceed and Engelhard receipt of all engineering specifications and details

Operating manuals  
Material Delivery

20 - 24 weeks after approval and release for fabrication

**SYSTEM DESIGN BASIS:**

Gas Flow from:	GE Fr7 and Westinghouse 501F - with ambient air cooling
Gas Flow from:	Westinghouse 501D5A
Gas Flow:	Assumed Horizontal
Fuel:	Natural Gas
Gas Flow Rate (At catalyst face):	See Performance data
Temperature (At catalyst face):	See Performance data
CO Concentration (At catalyst face):	See Performance data
CO Reduction:	See Performance data
NOx Concentration (At catalyst face):	See Performance data
NOx Reduction:	See Performance data
NH <sub>3</sub> Slip:	5 ppmvd@15%O <sub>2</sub>
Pressure Drop through SCR	Nom. 4"WG





Simple Cycle Turbines  
 CAMET® CO Catalyst Systems  
 ZNX™ SCR Catalyst Systems

Engelhard Budgetary Proposal

November 13, 1998

Performance Data	Westinghouse 601D5A			No. Units - 4		3,500 hr / yr	
AMBIENT	90	90	90	90	90	90	90
LOAD	BASE	BASE	BASE	BASE	75%	75%	75%
TURBINE EXHAUST TEMPERATURE, F	1,020	1,025	998	1,001	1,050	1,050	1,050
TURBINE EXHAUST FLOW, lb/hr	2,911,027	2,858,612	3,112,010	3,072,727	2,341,894	2,440,885	2,440,885
TURBINE EXHAUST GAS ANALYSIS, % VOL. N2	70.58	70.87	71.99	72.17	70.98	72.12	72.12
O2	12.13	12.27	12.44	12.53	12.39	12.44	12.44
CO2	3.42	3.40	3.46	3.44	3.34	3.46	3.46
H2O	12.98	12.57	11.21	10.95	12.42	11.08	11.08
Ar	0.89	0.89	0.90	0.91	0.89	0.90	0.90
AMBIENT AIR FLOW, lb/hr	0	0	0	0	0	0	0
TOTAL FLOW - TURBINE EXHAUST + AMBIENT - lb/hr	2,911,027	2,858,612	3,112,010	3,072,727	2,341,894	2,440,885	2,440,885
AMBIENT + EXHAUST GAS ANALYSIS, % VOL. N2	70.58	70.87	71.99	72.17	70.98	72.12	72.12
O2	12.13	12.27	12.44	12.53	12.39	12.44	12.44
CO2	3.42	3.40	3.46	3.44	3.34	3.46	3.46
H2O	12.98	12.57	11.21	10.95	12.42	11.08	11.08
Ar	0.89	0.89	0.90	0.91	0.89	0.90	0.90
CALCULATED AIR + GAS MOL. WT.	27.85	27.90	28.06	28.08	27.91	28.07	28.07
GIVEN: TURBINE CO, ppmvd @ 15% O <sub>2</sub>	25.0	25.0	25.0	25.0	150.0	150.0	150.0
CALC.: TURBINE CO, lb/hr	75.1	72.8	80.6	79.0	353.8	380.8	380.8
GIVEN: TURBINE NO <sub>x</sub> , ppmvd @ 15% O <sub>2</sub>	25.0	25.0	25.0	25.0	25.0	25.0	25.0
CALC.: TURBINE NO <sub>x</sub> , lb/hr	123.4	119.7	132.3	129.7	96.7	104.2	104.2
CALC.: CO, ppmvd @ 15% O <sub>2</sub> - AT CATALYST FACE	25.0	25.0	25.0	25.0	150.0	150.0	150.0
CALC.: NO <sub>x</sub> , ppmvd @ 15% O <sub>2</sub> - AT CATALYST FACE	25.0	25.0	25.0	25.0	25.0	25.0	25.0
FLUE GAS TEMP. @ SCR CATALYST, F	1,020	1,025	998	1,001	1,050	1,050	1,050
<b>DESIGN REQUIREMENTS</b>							
<u>CO CATALYST</u> CO OUT, ppmvd @ 15% O <sub>2</sub>	7.5	7.5	7.5	7.5	45.0	45.0	45.0
<u>SCR CATALYST</u> NO <sub>x</sub> OUT, ppmvd @ 15% O <sub>2</sub>	5.0	5.0	5.0	5.0	5.0	5.0	5.0
NH <sub>3</sub> SLIP, ppmvd @ 15% O <sub>2</sub>	5	5	5	5	5	5	5
<b>CO and SCR PRESSURE DROP, 1.0" WG - Max.</b>							
<b>GUARANTEED PERFORMANCE DATA</b>							
<u>CO CATALYST</u> CO CONVERSION - % Max.	70.0%	70.0%	70.0%	70.0%	70.0%	70.0%	70.0%
CO OUT, ppmvd @ 15% O <sub>2</sub> - Max.	7.5	7.5	7.5	7.5	45.0	45.0	45.0
CO OUT, lb/hr - Max.	22.6	21.9	24.2	23.7	108.0	114.2	114.2
CO PRESSURE DROP, 0.5" WG - Max.							
<u>SCR CATALYST</u> NO <sub>x</sub> CONVERSION, % - Min.	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%
NO <sub>x</sub> OUT, lb/hr - Max.	24.7	23.9	26.6	25.9	19.3	20.8	20.8
NO <sub>x</sub> OUT, ppmvd @ 15% O <sub>2</sub> - Max.	5.0	5.0	5.0	5.0	5.0	5.0	5.0
EXPECTED AQUEOUS NH <sub>3</sub> (28% SOL.) FLOW, lb/hr	163	158	175	171	128	138	138
NH <sub>3</sub> SLIP, ppmvd @ 15% O <sub>2</sub> - Max.	5	5	5	5	5	5	5

C-12



Simple Cycle Turbines  
 CAMET<sup>®</sup> CO Catalyst Systems  
 ZNX<sup>™</sup> SCR Catalyst Systems

Engelhard Budgetary Proposal

November 13, 1988

Performance Data	Westinghouse 601F					No. Units - 2					3,500 hr / yr
AMBIENT	110	89	89	0	0	110	89	89	0	0	
LOAD	BASE	BASE	BASE	BASE	BASE	76%	76%	76%	76%	76%	
FUEL	NG	NG	NG	NG	NG	NG	NG	NG	NG	Oil	
TURBINE EXHAUST TEMPERATURE, F	1,136	1,112	1,109	1,089	1,027	1,160	1,160	1,160	1,103	1,068	
TURBINE EXHAUST FLOW, lb/hr	3,288,109	3,477,889	3,624,958	3,608,842	3,688,464	2,740,032	2,762,167	2,813,621	3,135,522	3,185,695	
TURBINE EXHAUST GAS ANALYSIS, % VOL. N2	72.11	74.08	74.33	76.09	74.94	72.77	74.07	74.31	75.06	74.91	
O2	11.81	12.31	12.38	12.44	12.68	12.27	12.31	12.32	12.56	12.55	
CO2	3.85	3.87	3.88	3.94	3.98	3.71	3.87	3.90	3.98	3.14	
H2O	11.33	8.81	8.93	7.09	6.84	10.34	8.82	8.54	7.88	8.48	
Ar	0.89	0.89	0.93	0.94	0.94	0.91	0.93	0.93	0.94	0.94	
AMBIENT AIR FLOW, lb/hr	435,941	348,549	333,030	185,534	7,897	444,828	431,748	432,388	282,267	148,048	
TOTAL FLOW - TURBINE EXHAUST + AMBIENT - lb/hr	3,704,050	3,824,218	3,857,988	3,672,476	3,696,361	3,184,860	3,223,908	3,248,007	3,397,889	3,332,833	
AMBIENT + EXHAUST GAS ANALYSIS, % VOL. N2	73.16	74.72	74.92	76.38	74.88	73.93	75.01	75.22	75.63	75.19	
O2	12.81	12.69	12.91	12.72	12.67	13.16	13.17	13.17	12.85	12.88	
CO2	3.41	3.62	3.58	3.78	3.78	3.20	3.38	3.39	3.68	4.91	
H2O	10.02	8.02	7.78	7.25	6.37	8.82	7.85	7.42	7.07	6.17	
Ar	0.80	0.85	0.85	0.90	0.94	0.79	0.81	0.81	0.87	0.90	
CALCULATED AIR + GAS MOL. WT.	28.16	28.38	28.42	28.61	28.61	28.28	28.41	28.44	28.52	28.81	
GIVEN: TURBINE CO, ppmvd @ 18% O2	15.0	16.0	15.0	15.0	60.0	15.0	15.0	16.0	16.0	60.0	
CALC.: TURBINE CO, lb/hr	65.7	68.9	68.8	60.2	209.4	44.8	47.3	47.6	64.4	183.7	
GIVEN: TURBINE NOx, ppmvd @ 18% O2	25.0	25.0	25.0	25.0	42.0	25.0	25.0	25.0	25.0	42.0	
CALC.: TURBINE NOx, lb/hr	182.6	181.3	183.7	184.9	288.9	122.6	129.6	131.3	148.6	263.6	
CALC.: CO, ppmvd @ 18% O2 - AT CATALYST FACE	14.1	14.6	14.6	14.6	50.0	14.3	14.3	14.3	14.6	49.3	
CALC.: NOx, ppmvd @ 18% O2 - AT CATALYST FACE	24.0	24.3	24.3	24.6	42.0	23.8	23.9	23.9	24.4	41.4	
FLUE GAS TEMP. @ SCR CATALYST, F	1,026	1,025	1,025	1,026	1,026	1,026	1,026	1,026	1,026	1,026	
<b>DESIGN REQUIREMENTS</b>											
CO CATALYST CO OUT, ppmvd @ 18% O2	7.2	7.3	7.3	7.4	25.0	7.1	7.2	7.2	7.3	24.7	
SCR CATALYST NOx OUT, ppmvd @ 18% O2	9.6	9.7	9.7	9.9	18.8	9.5	9.6	9.6	9.8	18.6	
NH3 SLIP, ppmvd @ 18% O2	6	6	6	6	6	6	6	6	6	6	
<b>CO and SCR PRESSURE DROP, 4.0 "WG - Max.</b>											
<b>GUARANTEED PERFORMANCE DATA</b>											
CO CATALYST CO CONVERSION - % Max.	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	81.0%	80.0%	80.0%	80.0%	
CO OUT, ppmvd @ 18% O2 - Max.	7.2	7.3	7.3	7.4	28.0	7.1	7.2	7.2	7.3	24.7	
CO OUT, lb/hr - Max.	27.6	28.6	29.8	30.1	104.7	22.4	23.6	24.0	27.2	91.8	
CO PRESSURE DROP, 0.6 "WG - Max.											
SCR CATALYST NOx CONVERSION % - Min.	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	
NOx OUT, lb/hr - Max.	81.0	84.8	88.8	95.9	118.8	49.0	51.8	52.5	59.6	101.4	
NOx OUT, ppmvd @ 18% O2 - Max.	9.6	9.7	9.7	9.9	18.8	9.5	9.6	9.6	9.8	18.6	
EXPECTED AQUEOUS NH3 (26% SOL.) FLOW, lb/hr	183	172	174	176	274	131	138	140	158	241	
NH3 SLIP, ppmvd @ 18% O2 - Max.	6	6	6	6	6	6	6	6	6	6	

C-44



# ENGELHARD

Simple Cycle Turbines  
 CAMET<sup>®</sup> CO Catalyst Systems  
 ZNX<sup>™</sup> SCR Catalyst Systems

Engelhard Budgetary Proposal

November 13, 1998

Performance Data	GE TEA				No. Units - 8				2,000 hr / yr	
	59	70	80	90	95	90	90	90	90	90
AMBIENT LOAD	BASE	BASE	BASE	BASE	BASE	BASE	76%	82%	86%	
TURBINE EXHAUST TEMPERATURE, F	998	972	1,012	1,019	1,023	1,019	1,060	1,100	1,084	
TURBINE EXHAUST FLOW, lb/hr	2,368,000	2,674,000	2,240,000	2,181,000	2,181,000	2,181,000	1,728,000	1,487,000	1,328,000	
TURBINE EXHAUST GAS ANALYSIS, % VOL										
N <sub>2</sub>	74.86	75.45	74.11	73.63	73.18	73.63	73.46	73.67	73.77	
O <sub>2</sub>	13.65	13.89	13.71	13.59	13.60	13.59	13.38	13.71	14.28	
CO <sub>2</sub>	3.15	3.20	3.12	3.10	3.09	3.10	3.19	3.04	2.78	
H <sub>2</sub> O	7.22	6.85	6.18	6.90	6.35	6.90	6.09	6.79	6.27	
Ar	0.90	0.91	0.88	0.88	0.88	0.88	0.89	0.89	0.89	
AMBIENT AIR FLOW, lb/hr	0	0	0	0	0	0	111,576	129,392	90,000	
TOTAL FLOW - TURBINE EXHAUST + AMBIENT - lb/hr	2,368,000	2,674,000	2,240,000	2,181,000	2,181,000	2,181,000	1,838,576	1,608,392	1,398,000	
AMBIENT + EXHAUST GAS ANALYSIS, % VOL										
N <sub>2</sub>	74.86	75.45	74.11	73.63	73.18	73.63	73.91	74.18	74.09	
O <sub>2</sub>	13.65	13.89	13.71	13.59	13.60	13.59	13.70	14.12	14.48	
CO <sub>2</sub>	3.15	3.20	3.12	3.10	3.09	3.10	3.00	2.80	2.66	
H <sub>2</sub> O	7.22	6.85	6.18	6.90	6.35	6.90	6.93	6.09	7.91	
Ar	0.90	0.91	0.88	0.88	0.88	0.88	0.84	0.82	0.85	
CALCULATED AIR + GAS MOL. WT.	28.46	28.64	28.35	28.27	28.22	28.27	28.29	28.32	28.33	
GIVEN: TURBINE CO, ppmvd	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	
CALC.: TURBINE CO, lb/hr	53.6	69.0	60.8	49.2	48.4	49.2	39.8	33.1	30.1	
GIVEN: TURBINE NO <sub>x</sub> , ppmvd @ 15% O <sub>2</sub>	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	
CALC.: TURBINE NO <sub>x</sub> , lb/hr	63.7	69.6	60.8	49.2	48.6	49.2	40.1	32.6	28.0	
CALC.: CO, ppmvd @ 15% O <sub>2</sub> - AT CATALYST FACE	24.7	24.4	24.7	24.7	24.8	24.7	23.3	21.3	27.2	
CALC.: NO <sub>x</sub> , ppmvd @ 15% O <sub>2</sub> - AT CATALYST FACE	15.0	15.0	15.0	15.0	15.0	15.0	14.7	14.5	11.2	
FLUE GAS TEMP. @ SCR CATALYST, F	998	972	1,012	1,019	1,023	1,019	1,025	1,025	1,025	
<b>DESIGN REQUIREMENTS</b>										
CO CATALYST CO OUT, ppmvd @ 15% O <sub>2</sub>	12.3	12.2	12.4	12.3	12.3	12.3	11.7	12.2	13.6	
SCR CATALYST NO <sub>x</sub> OUT, ppmvd @ 15% O <sub>2</sub>	7.5	7.5	7.5	7.5	7.5	7.5	7.3	7.3	20.0	
NH <sub>3</sub> SLIP, ppmvd @ 15% O <sub>2</sub>	5	5	5	5	5	5	5	5	5	
<b>CO and SCR PRESSURE DROP, 4.0 "WG - Max.</b>										
<b>GUARANTEED PERFORMANCE DATA</b>										
CO CATALYST CO CONVERSION - % Max.	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%	
CO OUT, ppmvd @ 15% O <sub>2</sub> - Max.	12.3	12.2	12.4	12.3	12.3	12.3	11.7	12.2	13.6	
CO OUT, lb/hr - Max.	26.9	28.8	25.4	24.6	24.2	24.8	19.4	19.8	15.1	
CO PRESSURE DROP, 0.6 "WG - Max.										
SCR CATALYST NO <sub>x</sub> CONVERSION, % - Min.	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%	
NO <sub>x</sub> OUT, lb/hr - Max.	28.8	28.8	25.3	24.8	24.8	24.8	20.1	16.2	37.5	
NO <sub>x</sub> OUT, ppmvd @ 15% O <sub>2</sub> - Max.	7.5	7.5	7.5	7.5	7.5	7.5	7.3	7.3	20.0	
EXPECTED AQUEOUS NH <sub>3</sub> (28% SOL.) FLOW, lb/hr	69	65	68	54	53	54	45	38	61	
NH <sub>3</sub> SLIP, ppmvd @ 15% O <sub>2</sub> - Max.	5	5	5	5	5	5	5	5	5	

2 AC



Simple Cycle Turbines  
 GOMET<sup>®</sup> CO Catalyst Systems  
 ZNX<sup>™</sup> SCR Catalyst Systems

Engelhard Budgetary Proposal

November 13, 1998

Performance Data		Westinghouse 801D5A				No. Units - 4	
	AMBIENT LOAD	80	90	80	80	80	80
	TURBINE EXHAUST TEMPERATURE, F	BASE 1,020	BASE 1,025	BASE 998	BASE 1,001	78% 1,000	78% 1,050
	TURBINE EXHAUST FLOW, lb/hr	2,911,027	2,853,612	3,112,010	3,072,727	2,341,894	2,440,865
TURBINE EXHAUST GAS ANALYSIS, % VOL.							
	N <sub>2</sub>	70.58	70.87	71.99	72.17	70.98	72.12
	O <sub>2</sub>	12.13	12.27	12.44	12.63	12.39	12.44
	CO <sub>2</sub>	3.42	3.40	3.48	3.44	3.34	3.48
	H <sub>2</sub> O	12.98	12.87	11.21	10.88	12.42	11.08
	Ar	0.89	0.89	0.90	0.91	0.89	0.90
	AMBIENT AIR FLOW, lb/hr	0	0	0	0	0	0
TOTAL FLOW - TURBINE EXHAUST + AMBIENT - lb/hr		2,911,027	2,853,612	3,112,010	3,072,727	2,341,894	2,440,865
AMBIENT + EXHAUST GAS ANALYSIS, % VOL.							
	N <sub>2</sub>	70.88	70.87	71.99	72.17	70.98	72.12
	O <sub>2</sub>	12.13	12.27	12.44	12.63	12.39	12.44
	CO <sub>2</sub>	3.42	3.40	3.48	3.44	3.34	3.48
	H <sub>2</sub> O	12.98	12.87	11.21	10.88	12.42	11.08
	Ar	0.89	0.89	0.90	0.91	0.89	0.90
CALCULATED AIR + GAS MOL. WT.		27.88	27.80	28.06	28.06	27.91	28.07
GIVEN: TURBINE CO, ppmvd @ 15% O <sub>2</sub>		25.0	25.0	25.0	25.0	150.0	150.0
CALC.: TURBINE CO, lb/hr		76.1	72.8	80.8	79.0	363.3	385.8
GIVEN: TURBINE NO <sub>x</sub> , ppmvd @ 15% O <sub>2</sub>		25.0	25.0	25.0	25.0	25.0	25.0
CALC.: TURBINE NO <sub>x</sub> , lb/hr		123.4	119.7	132.3	128.7	98.7	104.2
CALC.: CO, ppmvd @ 15% O <sub>2</sub> - AT CATALYST FACE		25.0	25.0	25.0	25.0	150.0	150.0
CALC.: NO <sub>x</sub> , ppmvd @ 15% O <sub>2</sub> - AT CATALYST FACE		25.0	25.0	25.0	25.0	25.0	25.0
FLUE GAS TEMP. @ SCR CATALYST, F		1,020	1,025	998	1,001	1,000	1,050
<b>DESIGN REQUIREMENTS</b>							
CO CATALYST CO OUT, ppmvd @ 15% O <sub>2</sub>		15.0	15.0	15.0	15.0	90.0	90.0
SCR CATALYST NO <sub>x</sub> OUT, ppmvd @ 15% O <sub>2</sub>		10.0	10.0	10.0	10.0	10.0	10.0
NH <sub>3</sub> SLIP, ppmvd @ 15% O <sub>2</sub>		5	5	5	5	5	5
CO and SCR PRESSURE DROP, 4.0" WG - Max.							
<b>GUARANTEED PERFORMANCE DATA</b>							
CO CATALYST CO CONVERSION - % Max.		40.0%	40.0%	40.0%	40.0%	48.0%	40.0%
CO OUT, ppmvd @ 15% O <sub>2</sub> - Max.		15.0	15.0	15.0	15.0	90.0	90.0
CO OUT, lb/hr - Max.		45.1	43.7	46.3	47.4	212.0	228.3
CO PRESSURE DROP, 0.6" WG - Max.							
SCR CATALYST NO <sub>x</sub> CONVERSION, % - Min.		60.0%	60.0%	80.0%	80.0%	80.0%	80.0%
NO <sub>x</sub> OUT, lb/hr - Max.		49.3	47.9	52.9	51.9	38.7	41.7
NO <sub>x</sub> OUT, ppmvd @ 15% O <sub>2</sub> - Max.		10.0	10.0	10.0	10.0	10.0	10.0
EXPECTED AQUEOUS NH <sub>3</sub> (28% SOL.) FLOW, lb/hr		130	126	140	137	102	110
NH <sub>3</sub> SLIP, ppmvd @ 15% O <sub>2</sub> - Max.		5	5	5	5	5	5

2,000 hr / yr

C-48

# ENGELHARD

Simple Cycle Turbines  
 CAMET® CO Catalyst Systems  
 ZNX™ SCR Catalyst Systems

Engelhard Budgetary Proposal

November 13, 1990

Performance Data	Westinghouse 501F					No. Units - 2		2,000 hr / yr		
AMBIENT	110	85	88	0	0	110	85	88	0	0
LOAD	BASE	BASE	BASE	BASE	BASE	75%	75%	75%	75%	75%
FUEL	NG	NG	NG	NG	Oil	NG	NG	NG	NG	Oil
TURBINE EXHAUST TEMPERATURE, F	1,136	1,112	1,108	1,068	1,027	1,180	1,180	1,180	1,103	1,068
TURBINE EXHAUST FLOW, lb/hr	3,288,109	3,477,888	3,824,958	3,809,942	3,888,454	2,740,032	2,792,187	2,813,821	3,135,822	3,188,888
TURBINE EXHAUST GAS ANALYSIS, % VOL.										
N2	72.11	74.08	74.33	75.89	74.84	72.77	74.07	74.31	76.08	74.81
O2	11.81	12.31	12.38	12.44	12.88	12.27	12.31	12.32	12.38	12.55
CO2	3.88	3.87	3.88	3.84	3.85	3.71	3.87	3.90	3.88	3.84
H2O	11.33	8.81	8.80	7.89	8.38	10.34	8.82	8.84	7.88	8.48
Ar	0.90	0.93	0.93	0.94	0.94	0.91	0.93	0.93	0.94	0.94
AMBIENT AIR FLOW, lb/hr	438,841	348,848	333,830	188,834	7,897	444,828	431,748	432,388	282,387	148,848
TOTAL FLOW - TURBINE EXHAUST + AMBIENT - lb/hr	3,704,860	3,824,218	3,867,888	3,872,478	3,888,351	3,184,860	3,223,888	3,248,887	3,397,888	3,332,833
AMBIENT + EXHAUST GAS ANALYSIS, % VOL.										
N2	73.18	74.72	74.92	76.38	74.88	78.93	78.01	78.22	78.63	76.18
O2	12.81	12.89	12.81	12.72	12.87	13.18	13.17	13.17	12.85	12.83
CO2	3.41	3.82	3.88	3.78	3.87	3.20	3.38	3.39	3.88	4.91
H2O	10.82	8.82	7.78	7.28	8.37	8.92	7.88	7.42	7.87	8.17
Ar	0.88	0.88	0.88	0.88	0.84	0.78	0.81	0.81	0.87	0.88
CALCULATED AIR + GAS MOL. WT.	28.18	28.38	28.47	28.81	28.81	28.28	28.41	28.44	28.82	28.81
GIVEN: TURBINE CO, ppmvd @ 18% O2	18.0	18.0	18.0	18.0	80.0	18.0	18.0	18.0	18.0	80.0
CALC.: TURBINE CO, lb/hr	68.7	68.8	68.8	68.2	288.4	44.8	47.8	47.8	64.4	183.7
GIVEN: TURBINE NOx, ppmvd @ 18% O2	28.0	28.0	28.0	28.0	42.0	28.0	28.0	28.0	28.0	42.0
CALC.: TURBINE NOx, lb/hr	182.8	181.3	183.7	184.8	288.8	122.8	128.8	131.3	148.8	283.8
CALC.: CO, ppmvd @ 18% O2 - AT CATALYST FACE	14.4	14.6	14.6	14.6	80.0	14.3	14.3	14.3	14.8	49.3
CALC.: NOx, ppmvd @ 18% O2 - AT CATALYST FACE	24.0	24.3	24.3	24.8	42.0	23.8	23.8	23.8	24.4	41.4
FLUE GAS TEMP. @ SCR CATALYST, F	1,028	1,028	1,028	1,028	1,028	1,028	1,028	1,028	1,028	1,028
<b>DESIGN REQUIREMENTS</b>										
CO CATALYST CO OUT, ppmvd @ 18% O2	10.1	10.2	10.2	10.4	36.0	10.0	10.0	10.0	10.2	34.8
SCR CATALYST NOx OUT, ppmvd @ 18% O2	14.4	14.6	14.6	14.8	28.2	14.3	14.3	14.8	14.8	24.8
NH3 SLIP, ppmvd @ 18% O2	8	8	8	8	8	8	8	8	8	8
<b>CO and SCR PRESSURE DROP, 4.0 "WG - Max.</b>										
<b>GUARANTEED PERFORMANCE DATA</b>										
CO CATALYST CO CONVERSION - % Max.	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%
CO OUT, ppmvd @ 18% O2 - Max.	10.1	10.2	10.2	10.4	36.0	10.0	10.0	10.0	10.2	34.8
CO OUT, lb/hr - Max.	38.0	41.2	41.8	42.2	148.8	31.3	33.1	33.8	38.0	128.8
CO PRESSURE DROP, 0.8 "WG - Max.										
SCR CATALYST NOx CONVERSION, % - Min.	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%
NOx OUT, lb/hr - Max.	81.8	88.8	88.2	88.8	173.4	73.8	77.7	78.8	88.3	182.1
NOx OUT, ppmvd @ 18% O2 - Max.	14.4	14.8	14.8	14.8	28.2	14.3	14.3	14.3	14.8	24.8
EXPECTED AQUEOUS NH3 (28% SOL.) FLOW, lb/hr	122	128	131	131	188	88	104	108	118	174
NH3 SLIP, ppmvd @ 18% O2 - Max.	8	8	8	8	8	8	8	8	8	8

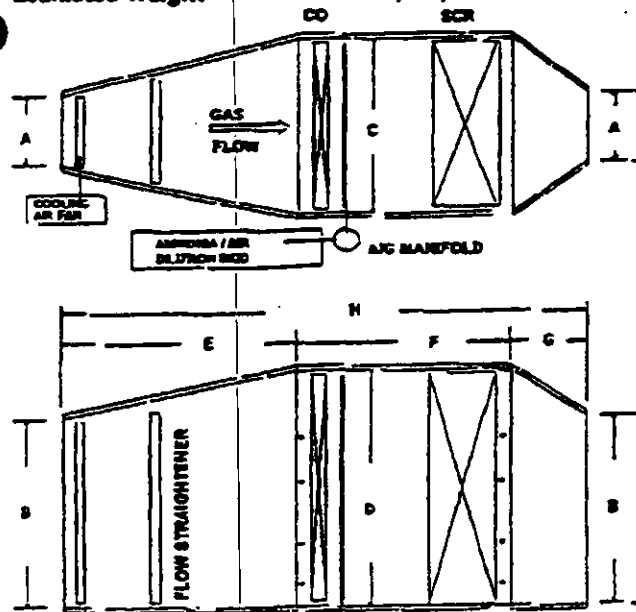
C-50

The equipment supplied is installed by others in accordance with the Engelhard design and installation instructions.

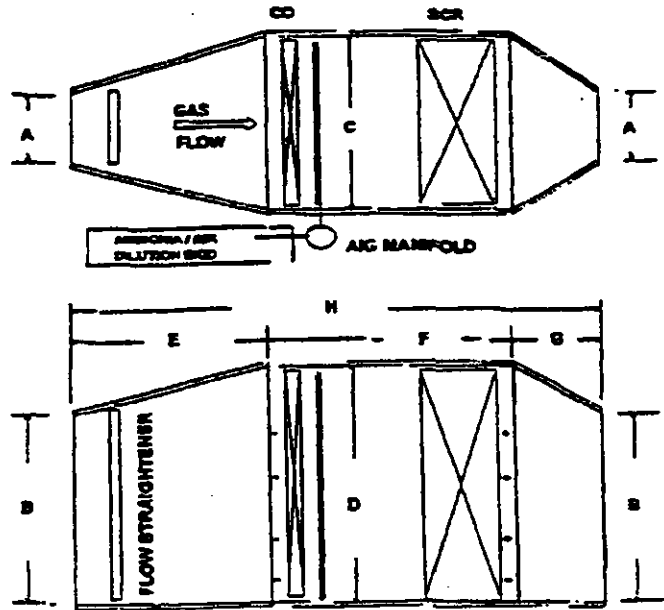
**Assumed Dimensions / Sketch:**

<b>GE7EA</b>	3,500 hr/yr
Turbine Discharge Width (A)	15'-0"
Turbine Discharge Height	(B) 15'-0"
Reactor Inside Liner Width	(C) 41'-6"
Reactor Inside Liner Height	(D) 32'-3"
Inlet Transition Length	(E) 31'-0"
Reactor Depth	(F) 15'-0"
Outlet Transition Length	(G) 13'-3"
Total Depth	(H) 59'-3"
Estimated Weight	1,100,00 lb.

<b>West 501F</b>	3,500 hr/yr
Turbine Discharge Width (A)	15'-0"
Turbine Discharge Height	(B) 15'-0"
Reactor Inside Liner Width	(C) 55'-6"
Reactor Inside Liner Height	(D) 35'-6"
Inlet Transition Length	(E) 36'-3"
Reactor Depth	(F) 15'-0"
Outlet Transition Length	(G) 20'-3"
Total Depth	(H) 71'-6"
Estimated Weight	1,400,000 lb.

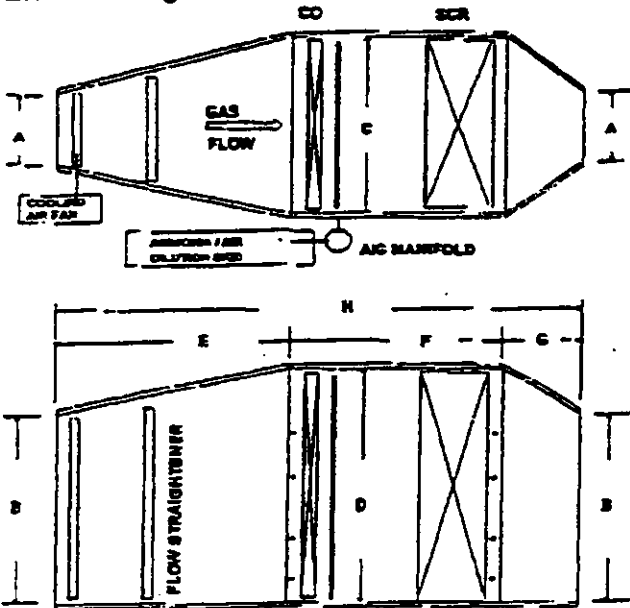


<b>West 501DSA</b>	3,500 hr/yr
Turbine Discharge Width (A)	15'-0"
Turbine Discharge Height	(B) 15'-0"
Reactor Inside Liner Width	(C) 58'-3"
Reactor Inside Liner Height	(D) 35'-6"
Inlet Transition Length	(E) 38'-6"
Reactor Depth	(F) 15'-0"
Outlet Transition Length	(G) 21'-6"
Total Depth	(H) 75'-0"
Estimated Weight	1,400,000 lb.

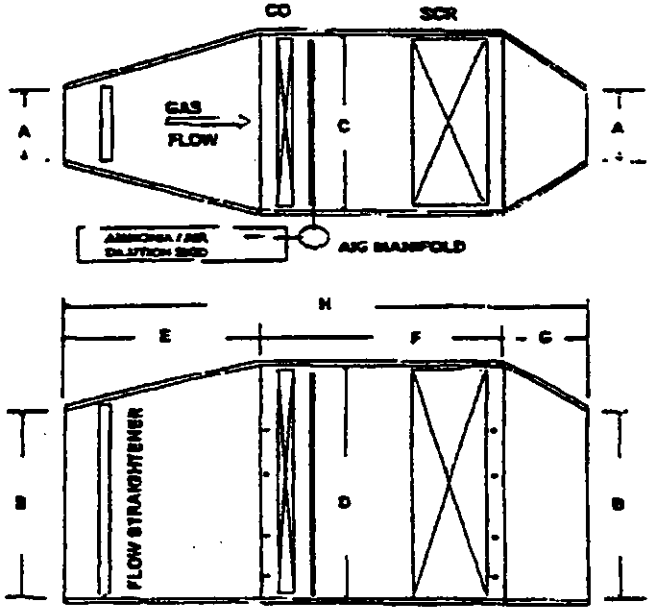


<b>GE7EA</b>	2,000 hr/yr
Turbine Discharge Width (A)	15'-0"
Turbine Discharge Height	(B) 15'-0"
Reactor Inside Liner Width	(C) 39'-6"
Reactor Inside Liner Height	(D) 29'-0"
Inlet Transition Length	(E) 25'-6"
Reactor Depth	(F) 15'-0"
Outlet Transition Length	(G) 12'-3"
Total Depth	(H) 52'-8"
Estimated Weight	1,000,00 lb.

<b>West 501E</b>	2,000 hr/yr
Turbine Discharge Width (A)	15'-0"
Turbine Discharge Height	(B) 15'-0"
Reactor Inside Liner Width	(C) 51'-0"
Reactor Inside Liner Height	(D) 32'-3"
Inlet Transition Length	(E) 32'-0"
Reactor Depth	(F) 15'-0"
Outlet Transition Length	(G) 18'-0"
Total Depth	(H) 65'-0"
Estimated Weight	1,200,000 lb.



<b>West 501D5A</b>	2,000 hr/yr
Turbine Discharge Width (A)	15'-0"
Turbine Discharge Height	(B) 15'-0"
Reactor Inside Liner Width	(C) 47'-9"
Reactor Inside Liner Height	(D) 32'-3"
Inlet Transition Length	(E) 30'-8"
Reactor Depth	(F) 15'-0"
Outlet Transition Length	(G) 16'-8"
Total Depth	(H) 62'-3"
Estimated Weight	1,100,000 lb.



**Excluded from Scope of Supply:**  
 Ammonia storage and pumping  
 Electrical grounding equipment  
 Foundations  
 All other items not specifically listed in Scope of Supply

Any interconnecting field piping or wiring  
 Utilities  
 All Monitors

**APPENDIX D**  
**BPIP MODEL OUTPUT FILE**

BPIP (Dated: 95086)

DATE : 10/24/ 0

TIME : 8:14:43

C:\ISView3\projects\Enron\Enron Midway\midgep.bpv

=====  
BPIP PROCESSING INFORMATION:  
=====

The ST flag has been set for processing for an ISCST2 run.

Inputs entered in Meters will be converted to meters using  
a conversion factor of 1.0000. Output will be in meters.

The UTM variable is set to UTM. The input is assumed to be in  
UTM coordinates. BPIP will move the UTM origin to the first pair of  
UTM coordinates read. The UTM coordinates of the new origin will  
be subtracted from all the other UTM coordinates entered to form  
this new local coordinate system.

Plant north is set to 0.00 degrees with respect to True North.

C:\ISView3\projects\Enron\Enron Midway\midgep.bpv

PRELIMINARY\* GEP STACK HEIGHT RESULTS TABLE  
(Output Units: meters)

Stack Name	Stack Height	Stack-Building Base Elevation Differences	GEP** EQN1	Preliminary* GEP Stack Height Value
STCK1	24.38	0.00	41.15	65.00
STCK2	24.38	0.00	41.15	65.00
STCK3	24.38	0.00	41.15	65.00

\* Results are based on Determinants 1 & 2 on pages 1 & 2 of the GEP  
Technical Support Document. Determinant 3 may be investigated for  
additional stack height credit. Final values result after  
Determinant 3 has been taken into consideration.

\*\* Results were derived from Equation 1 on page 6 of GEP Technical  
Support Document. Values have been adjusted for any stack-building  
base elevation differences.

Note: Criteria for determining stack heights for modeling emission  
limitations for a source can be found in Table 3.1 of the  
GEP Technical Support Document.

BPIP (Dated: 95086)

DATE : 10/24/ 0

TIME : 8:14:43

C:\ISCView3\projects\Enron\Enron Midway\midgep.bpv

BPI? output is in meters

SO BUILDHGT STCK1	8.23	8.23	8.23	8.23	8.23	8.23
SO BUILDHGT STCK1	13.72	13.72	13.72	13.72	13.72	8.23
SO BUILDHGT STCK1	8.23	8.23	8.23	8.23	8.23	8.23
SO BUILDHGT STCK1	8.23	8.23	8.23	8.23	8.23	8.23
SO BUILDHGT STCK1	16.46	16.46	16.46	16.46	16.46	16.46
SO BUILDHGT STCK1	16.46	16.46	16.46	8.23	8.23	8.23
SO BUILDWID STCK1	20.84	21.37	21.25	20.48	19.09	17.12
SO BUILDWID STCK1	18.53	15.68	14.31	15.68	17.84	17.12
SO BUILDWID STCK1	19.09	20.48	21.25	21.37	20.84	19.68
SO BUILDWID STCK1	20.84	21.37	21.25	20.48	19.09	17.12
SO BUILDWID STCK1	16.57	15.68	14.31	15.68	16.57	16.79
SO BUILDWID STCK1	16.69	16.63	15.52	21.37	20.84	19.68
SO BUILDHGT STCK2	8.23	14.67	14.67	14.67	14.67	14.67
SO BUILDHGT STCK2	13.72	13.72	13.72	13.72	13.72	8.23
SO BUILDHGT STCK2	8.23	8.23	8.23	8.23	8.23	0.00
SO BUILDHGT STCK2	8.23	8.23	13.72	16.46	16.46	16.46
SO BUILDHGT STCK2	16.46	16.46	16.46	16.46	16.46	16.46
SO BUILDHGT STCK2	16.46	16.46	13.75	8.23	8.23	0.00
SO BUILDWID STCK2	21.29	57.40	58.82	60.67	60.67	58.82
SO BUILDWID STCK2	18.07	15.48	14.11	15.48	18.13	17.36
SO BUILDWID STCK2	19.39	20.84	21.65	21.80	21.29	0.00
SO BUILDWID STCK2	20.84	21.37	16.12	16.20	16.84	16.96
SO BUILDWID STCK2	16.39	15.48	14.11	15.48	16.39	17.34
SO BUILDWID STCK2	17.25	16.63	15.03	21.80	21.29	0.00
SO BUILDHGT STCK3	8.23	8.23	14.67	14.67	14.67	14.67
SO BUILDHGT STCK3	14.67	14.67	14.67	13.75	13.75	8.23
SO BUILDHGT STCK3	8.23	8.23	8.23	8.23	8.23	0.00
SO BUILDHGT STCK3	8.23	8.23	14.67	16.46	16.46	16.46
SO BUILDHGT STCK3	16.46	16.46	16.46	16.46	16.46	8.23
SO BUILDHGT STCK3	8.23	13.72	13.72	13.72	13.72	0.00
SO BUILDWID STCK3	21.67	22.08	58.82	60.67	60.67	58.82
SO BUILDWID STCK3	57.40	60.16	61.08	15.95	17.98	17.19
SO BUILDWID STCK3	19.33	20.89	21.82	22.08	21.67	0.00
SO BUILDWID STCK3	21.29	21.80	58.82	16.07	16.69	16.79
SO BUILDWID STCK3	16.90	15.95	14.51	15.95	16.90	17.19
SO BUILDWID STCK3	19.33	39.62	41.31	41.74	40.90	0.00



BPIP (Dated: 95086)

DATE : 10/24/ 0

TIME : 8:14:43

C:\ISCView3\projects\Enron\Enron Midway\midgep.bpv

=====  
BPIP PROCESSING INFORMATION:  
=====

The ST flag has been set for processing for an ISCST2 run.

Inputs entered in Meters will be converted to meters using  
a conversion factor of 1.0000. Output will be in meters.

The UTM variable is set to UTM. The input is assumed to be in  
UTM coordinates. BPIP will move the UTM origin to the first pair of  
UTM coordinates read. The UTM coordinates of the new origin will  
be subtracted from all the other UTM coordinates entered to form  
this new local coordinate system.

The new local coordinates will be displayed in parentheses just below  
the UTM coordinates they represent.

Plant north is set to 0.00 degrees with respect to True North.

=====  
INPUT SUMMARY:  
=====

Number of buildings to be processed : 16

EXHDUCT1 has 1 tier(s) with a base elevation of 0.00 Meters

BUILDING NAME	TIER NUMBER	BLDG-TIER NUMBER	TIER HEIGHT	NO. OF CORNERS	CORNER X	COORDINATES Y
EXHDUCT1	1	1	8.23	4	556674.30	3028588.23 meters
					( 0.00	0.00) meters
					556693.98	3028588.23 meters
					( 19.68	0.00) meters
					556693.98	3028579.82 meters
					( 19.68	-8.41) meters
					556674.30	3028579.82 meters
					( 0.00	-8.41) meters

EXHDUCT2 has 1 tier(s) with a base elevation of 0.00 Meters

BUILDING NAME	TIER NUMBER	BLDG-TIER NUMBER	TIER HEIGHT	NO. OF CORNERS	CORNER X	COORDINATES Y
EXHDUCT2	1	5	8.23	4	556674.30	3028552.00 meters

( 0.00 -36.24) meters  
 556694.44 3028552.00 meters  
 ( 20.14 -36.24) meters  
 556694.44 3028543.58 meters  
 ( 20.14 -44.65) meters  
 556674.30 3028543.58 meters  
 ( 0.00 -44.65) meters

EXHDUCT3 has 1 tier(s) with a base elevation of 0.00 Meters

BUILDING NAME	TIER NUMBER	BLDG-TIER NUMBER	TIER HEIGHT	NO. OF CORNERS	CORNER X	COORDINATES Y
EXHDUCT3	1	9	8.23	4	556674.30	3028515.29 meters
					( 0.00	-72.94) meters
					556694.91	3028515.29 meters
					( 20.60	-72.94) meters
					556694.91	3028507.34 meters
					( 20.60	-80.89) meters
					556674.30	3028507.34 meters
					( 0.00	-80.89) meters

TURBENC2 has 1 tier(s) with a base elevation of 0.00 Meters

BUILDING NAME	TIER NUMBER	BLDG-TIER NUMBER	TIER HEIGHT	NO. OF CORNERS	CORNER X	COORDINATES Y
TURBENC2	1	13	13.72	4	556694.51	3028551.33 meters
					( 20.21	-36.90) meters
					556708.22	3028551.33 meters
					( 33.92	-36.90) meters
					556708.22	3028543.65 meters
					( 33.92	-44.59) meters
					556694.51	3028543.65 meters
					( 20.21	-44.59) meters

TURBENC3 has 1 tier(s) with a base elevation of 0.00 Meters

BUILDING NAME	TIER NUMBER	BLDG-TIER NUMBER	TIER HEIGHT	NO. OF CORNERS	CORNER X	COORDINATES Y
TURBENC3	1	17	13.75	4	556694.91	3028514.83 meters
					( 20.60	-73.40) meters
					556708.09	3028514.83 meters
					( 33.79	-73.40) meters
					556708.09	3028507.61 meters
					( 33.79	-80.63) meters
					556694.91	3028507.61 meters
					( 20.60	-80.63) meters

AIRINT2 has 1 tier(s) with a base elevation of 0.00 Meters

BUILDING NAME	TIER NUMBER	BLDG-TIER NUMBER	TIER HEIGHT	NO. OF CORNERS	CORNER X	COORDINATES Y
---------------	-------------	------------------	-------------	----------------	----------	---------------

AIRINT2      1            21          16.46      4

					556708.36	3028554.58 meters
				(	34.05	-33.65) meters
					556717.50	3028554.58 meters
				(	43.19	-33.65) meters
					556717.50	3028540.47 meters
				(	43.19	-47.77) meters
					556708.36	3028540.47 meters
				(	34.05	-47.77) meters

TURBENC1 has 1 tier(s) with a base elevation of 0.00 Meters

BUILDING NAME	TIER NUMBER	BLDG-TIER NUMBER	TIER HEIGHT	NO. OF CORNERS	CORNER X	COORDINATES Y
TURBENC1	1	25	13.72	4		
					556694.05	3028588.17 meters
				(	19.74	-0.07) meters
					556708.49	3028588.17 meters
				(	34.19	-0.07) meters
					556708.49	3028580.95 meters
				(	34.19	-7.29) meters
					556694.05	3028580.95 meters
				(	19.74	-7.29) meters

AIRINT1 has 1 tier(s) with a base elevation of 0.00 Meters

BUILDING NAME	TIER NUMBER	BLDG-TIER NUMBER	TIER HEIGHT	NO. OF CORNERS	CORNER X	COORDINATES Y
AIRINT1	1	29	16.46	4		
					556708.49	3028591.35 meters
				(	34.19	3.11) meters
					556717.63	3028591.35 meters
				(	43.33	3.11) meters
					556717.63	3028577.04 meters
				(	43.33	-11.20) meters
					556708.49	3028577.04 meters
				(	34.19	-11.20) meters

AIRINT3 has 1 tier(s) with a base elevation of 0.00 Meters

BUILDING NAME	TIER NUMBER	BLDG-TIER NUMBER	TIER HEIGHT	NO. OF CORNERS	CORNER X	COORDINATES Y
AIRINT3	1	33	16.46	4		
					556708.09	3028518.47 meters
				(	33.79	-69.76) meters
					556717.63	3028518.47 meters
				(	43.33	-69.76) meters
					556717.63	3028503.96 meters
				(	43.33	-84.27) meters
					556708.09	3028503.96 meters
				(	33.79	-84.27) meters

WATERTNK has 1 tier(s) with a base elevation of 0.00 Meters

BUILDING NAME	TIER NUMBER	BLDG-TIER NUMBER	TIER HEIGHT	NO. OF CORNERS	CORNER X	COORDINATES Y
WATERTNK	1	37	14.63	8		
					556808.00	3028493.70 meters
				(	133.69	-94.54) meters
					556804.95	3028486.48 meters
				(	130.65	-101.76) meters
					556797.73	3028483.43 meters
				(	123.42	-104.81) meters
					556790.51	3028486.48 meters
				(	116.20	-101.76) meters
					556787.46	3028493.70 meters
				(	113.15	-94.54) meters
					556790.51	3028500.92 meters
				(	116.20	-87.32) meters
					556797.73	3028503.96 meters
				(	123.42	-84.27) meters
					556804.95	3028500.92 meters
				(	130.65	-87.32) meters

FUELSTNK has 1 tier(s) with a base elevation of 0.00 Meters

BUILDING NAME	TIER NUMBER	BLDG-TIER NUMBER	TIER HEIGHT	NO. OF CORNERS	CORNER X	COORDINATES Y
FUELSTNK	1	41	14.63	8		
					556819.59	3028435.46 meters
				(	145.29	-152.77) meters
					556814.89	3028424.27 meters
				(	140.58	-163.97) meters
					556803.69	3028419.56 meters
				(	129.39	-168.67) meters
					556792.49	3028424.27 meters
				(	118.19	-163.97) meters
					556787.79	3028435.46 meters
				(	113.49	-152.77) meters
					556792.49	3028446.66 meters
				(	118.19	-141.58) meters
					556803.69	3028451.36 meters
				(	129.39	-136.87) meters
					556814.89	3028446.66 meters
				(	140.58	-141.58) meters

FUELDTNK has 1 tier(s) with a base elevation of 0.00 Meters

BUILDING NAME	TIER NUMBER	BLDG-TIER NUMBER	TIER HEIGHT	NO. OF CORNERS	CORNER X	COORDINATES Y
FUELDTNK	1	45	12.19	8		
					556771.82	3028436.59 meters
				(	97.52	-151.65) meters
					556769.31	3028430.56 meters
				(	95.00	-157.68) meters
					556763.28	3028428.04 meters
				(	88.97	-160.19) meters

556757.25 3028430.56 meters  
 ( 82.94 -157.68) meters  
 556754.73 3028436.59 meters  
 ( 80.43 -151.65) meters  
 556757.25 3028442.62 meters  
 ( 82.94 -145.62) meters  
 556763.28 3028445.13 meters  
 ( 88.97 -143.10) meters  
 556769.31 3028442.62 meters  
 ( 95.00 -145.62) meters

CTRLBLNG has 1 tier(s) with a base elevation of 0.00 Meters

BUILDING NAME	TIER NUMBER	BLDG-TIER NUMBER	TIER HEIGHT	NO. OF CORNERS	CORNER X	COORDINATES Y
CTRLBLNG	1	49	13.72	4	556684.04	3028456.27 meters
					( 9.74	-131.97) meters
					556722.86	3028456.27 meters
					( 48.56	-131.97) meters
					556722.86	3028440.90 meters
					( 48.56	-147.34) meters
					556684.04	3028440.90 meters
					( 9.74	-147.34) meters

BLDG14 has 1 tier(s) with a base elevation of 0.00 Meters

BUILDING NAME	TIER NUMBER	BLDG-TIER NUMBER	TIER HEIGHT	NO. OF CORNERS	CORNER X	COORDINATES Y
BLDG14	1	53	14.67	8	556645.02	3028476.80 meters
					( -29.28	-111.43) meters
					556636.01	3028455.27 meters
					( -38.29	-132.96) meters
					556614.48	3028446.26 meters
					( -59.82	-141.97) meters
					556592.95	3028455.27 meters
					( -81.36	-132.96) meters
					556583.94	3028476.80 meters
					( -90.36	-111.43) meters
					556592.95	3028498.33 meters
					( -81.36	-89.90) meters
					556614.48	3028507.34 meters
					( -59.82	-80.89) meters
					556636.01	3028498.33 meters
					( -38.29	-89.90) meters

CHILLER1 has 1 tier(s) with a base elevation of 0.00 Meters

BUILDING NAME	TIER NUMBER	BLDG-TIER NUMBER	TIER HEIGHT	NO. OF CORNERS	CORNER X	COORDINATES Y
CHILLER1	1	57	2.44	4	556584.27	3028617.65 meters
					( -90.03	29.42) meters

556600.70 3028617.65 meters  
 ( -73.60 29.42) meters  
 556600.70 3028521.19 meters  
 ( -73.60 -67.04) meters  
 556584.27 3028521.19 meters  
 ( -90.03 -67.04) meters

CHILLER2 has 1 tier(s) with a base elevation of 0.00 Meters  
 BUILDING TIER BLDG-TIER TIER NO. OF CORNER COORDINATES  
 NAME NUMBER NUMBER HEIGHT CORNERS X Y

CHILLER2 1 61 2.44 4  
 556608.78 3028617.32 meters  
 ( -65.52 29.08) meters  
 556626.21 3028617.32 meters  
 ( -48.10 29.08) meters  
 556626.21 3028587.51 meters  
 ( -48.10 -0.73) meters  
 556608.78 3028587.51 meters  
 ( -65.52 -0.73) meters

Number of stacks to be processed : 3

STACK NAME	STACK		STACK X	COORDINATES Y
	BASE	HEIGHT		
STCK1	0.00	24.38 Meters	556670.26	3028584.26 meters
			( -4.04	-3.97) meters
STCK2	0.00	24.38 Meters	556670.06	3028547.82 meters
			( -4.24	-40.42) meters
STCK3	0.00	24.38 Meters	556670.06	3028511.32 meters
			( -4.24	-76.92) meters

No stacks have been detected as being atop any structures.

Overall GEP Summary Table  
 (Units: meters)

StkNo: 1 Stk Name:STCK1 Stk Ht: 24.38 Prelim. GEP Stk.Ht: 65.00  
 GEP: BH: 16.46 PBW: 16.47 \*Eqnl Ht: 41.15  
 \*adjusted for a Stack-Building elevation difference of 0.00  
 No. of Tiers affecting Stk: 1 Direction occurred: 314.50  
 Bldg-Tier nos. contributing to GEP: 21

StkNo: 2 Stk Name:STCK2 Stk Ht: 24.38 Prelim. GEP Stk.Ht: 65.00  
 GEP: BH: 16.46 PBW: 16.46 \*Eqnl Ht: 41.15  
 \*adjusted for a Stack-Building elevation difference of 0.00  
 No. of Tiers affecting Stk: 1 Direction occurred: 223.25  
 Bldg-Tier nos. contributing to GEP: 29

StkNo: 3 Stk Name:STCK3 Stk Ht: 24.38 Prelim. GEP Stk.Ht: 65.00  
GEP: BH: 16.46 PBW: 16.47 \*Eqnl Ht: 41.15  
\*adjusted for a Stack-Building elevation difference of 0.00  
No. of Tiers affecting Stk: 1 Direction occurred: 225.50  
Bldg-Tier nos. contributing to GEP: 21

**APPENDIX E**  
**DETAILED ISCST3 MODELING RESULTS**



**ISCST3 Model Results for the Proposed Combustion Turbines**

**Table E-1 Distillate Oil**

Distillate Oil - Class II Receptors								
Normalized Concentration ( $\mu\text{g}/\text{m}^3$ per g/sec)*							Location	
100% Load	1987	1988	1989	1990	1991	Maximum	UTM X	UTM Y
1-Hr	0.5219	0.62008	0.571	0.63242	0.4234	0.632	555670	3029848.0
3-Hr	0.2571	0.25993	0.24	0.24747	0.2636	0.264	562670	3012548.0
8-Hr	0.13872	0.15639	0.1494	0.14115	0.1245	0.156	538670	3024548.0
24-hr	0.05595	0.05553	0.0527	0.06462	0.0515	0.065	540670	3038548.0
Annual	0.00435	0.00441	0.0047	0.0047	0.0048	0.005	547670	3033548.0
75% Load	1987	1988	1989	1990	1991	Maximum	UTM X	UTM Y
1-Hr	1.22439	0.6363	0.5868	0.71752	1.5901	1.590	556770	3028648.0
3-Hr	0.40813	0.29918	0.2802	0.28341	0.53	0.530	556770	3028648.0
8-Hr	0.16111	0.1804	0.1742	0.15719	0.2897	0.290	556730.56	3028620.5
24-hr	0.07015	0.06893	0.0617	0.07387	0.0966	0.097	556730.56	3028620.5
Annual	0.0051	0.00519	0.0056	0.00543	0.0057	0.006	547670	3033548.0
50% Load	1987	1988	1989	1990	1991	Maximum	UTM X	UTM Y
1-Hr	1.42526	0.98102	0.8377	0.84463	1.8415	1.842	556770	3028648.0
3-Hr	0.47509	0.33903	0.3213	0.32084	0.6874	0.687	556470	3028548.0
8-Hr	0.23613	0.20455	0.1994	0.2076	0.3416	0.342	556730.56	3028620.5
24-hr	0.07871	0.07947	0.0712	0.08313	0.1385	0.138	556580.94	3028572.5
Annual	0.00575	0.00599	0.0063	0.0062	0.0065	0.006	547670	3033548.0

\* Based on 1 g/sec for each turbine stack (3)

ISCST3 Model Results for the Proposed Combustion Turbines

Table E-2 Natural Gas

Natural Gas - Class II Receptors								
Normalized Concentration ( $\mu\text{g}/\text{m}^3$ per g/sec)*							Location	
100% Load	1987	1988	1989	1990	1991	Maximum	UTM X	UTM Y
1-Hr	0.524	0.622	0.573	0.634	0.432	0.634	555670	3029848.0
3-Hr	0.261	0.264	0.244	0.251	0.269	0.269	562670	3012548.0
8-Hr	0.142	0.159	0.152	0.142	0.126	0.159	538670	3024548.0
24-hr	0.057	0.060	0.054	0.066	0.052	0.066	540670	3038548.0
Annual	0.00442	0.0045	0.0049	0.00477	0.00491	0.005	547670	3033548.0
75% Load	1987	1988	1989	1990	1991	Maximum	UTM X	UTM Y
1-Hr	1.253	0.639	0.589	0.720	1.626	1.626	556770	3028648.0
3-Hr	0.418	0.305	0.286	0.289	0.542	0.542	556770	3028648.0
8-Hr	0.166	0.184	0.178	0.160	0.296	0.296	556730.56	3028620.5
24-hr	0.071	0.070	0.063	0.075	0.099	0.099	556730.56	3028620.5
Annual	0.00516	0.00528	0.0057	0.0055	0.00575	0.006	547670	3033548.0
50% Load	1987	1988	1989	1990	1991	Maximum	UTM X	UTM Y
1-Hr	1.459	1.006	0.840	0.847	1.883	1.883	556770	3028648.0
3-Hr	0.486	0.345	0.328	0.327	0.705	0.705	556470	3028548.0
8-Hr	0.242	0.208	0.203	0.213	0.350	0.350	556730.56	3028620.5
24-hr	0.081	0.081	0.073	0.085	0.142	0.142	556580.94	3028572.5
Annual	0.00589	0.00612	0.0064	0.00636	0.00665	0.007	547670	3033548.0

\* Based on 1 g/sec for each turbine stack (3)

**APPENDIX F**  
**KEY TO ISCST3 MODELING FILES ON CD-ROM**

STATE OF FLORIDA  
DEPARTMENT OF ENVIRONMENTAL PROTECTION  
NOTICE OF FINAL PERMIT

In the Matter of an  
Application for Permit by:


Mr. Ben Jacoby, Director  
Midway Development Company, L.L.C.  
1400 Smith Street  
Houston, Texas 77002-7631

DEP File No. 1110099-002-AC (PSD-305)  
Midway Energy Center, Units 1 - 3  
St. Lucie County

Enclosed is the Final Permit Number PSD-FL-305 to construct three 170-megawatt dual-fuel combustion turbines with inlet chillers, three 80-foot stacks, a natural gas heater, a 2.5 million gallon fuel oil storage tank, and a 0.6 million gallon fuel oil day storage tank for the Midway Energy Center to be located in St. Lucie County. This permit is issued pursuant to Chapter 403, Florida Statutes.

Any party to this order (permit) has the right to seek judicial review of the permit pursuant to Section 120.68, F.S., by the filing of a Notice of Appeal pursuant to Rule 9.110, Florida Rules of Appellate Procedure, with the Clerk of the Department in the Legal Office; and by filing a copy of the Notice of Appeal accompanied by the applicable filing fees with the appropriate District Court of Appeal. The Notice of Appeal must be filed within 30 (thirty) days from the date this Notice is filed with the Clerk of the Department.

Executed in Tallahassee, Florida.

  
C.H. Fancy, P.E., Chief  
Bureau of Air Regulation

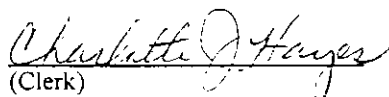
CERTIFICATE OF SERVICE

The undersigned duly designated deputy agency clerk hereby certifies that this NOTICE OF FINAL PERMIT (including the FINAL permit) was sent by certified mail\* and copies were mailed by U.S. Mail before the close of business on 2/14/01 to the person(s) listed:

Ben Jacoby, MDC\*  
Gregg Worley, EPA  
John Bunyak, NPS  
Isidore Goldman, DEP SED  
Chair, St. Lucie County BCC  
Blair Burgess, P.E., ENSR

Clerk Stamp

**FILING AND ACKNOWLEDGMENT FILED**, on this date, pursuant to §120.52, Florida Statutes, with the designated Department Clerk, receipt of which is hereby acknowledged.

  
(Clerk) 2/14/01 (Date)

**SENDER: COMPLETE THIS SECTION**

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Mr. Ben Jacoby, Director  
 Midway Development Co., L.L.C.  
 1400 Smith St.  
 Houston, Texas 77002-7631

2. Article Number (Copy from service label)  
 7099 3400 0000 1449 3799

**COMPLETE THIS SECTION ON DELIVERY**

A. Received by (Please Print Clearly) H. Wyatt B. Date of Delivery 2-20-01

C. Signature H. Wyatt  Agent  Addressee

D. Is delivery address different from item 1?  Yes  No  
 If YES, enter delivery address below:

3. Service Type  
 Certified Mail  Express Mail  
 Registered  Return Receipt for Merchandise  
 Insured Mail  C.O.D.

4. Restricted Delivery? (Extra Fee)  Yes

PS Form 3811, July 1999

Domestic Return Receipt

102595-99-M-1789

U.S. Postal Service		
CERTIFIED MAIL RECEIPT		
(Domestic Mail Only; No Insurance Coverage Provided)		
Article Sent To: Mr. Ben Jacoby, Director		
Postage	\$	Midway
Certified Fee		Postmark
Return Receipt Fee (Endorsement Required)		mark
Restricted Delivery Fee (Endorsement Required)		
Total Postage & Fees	\$	
Name (Please Print Clearly to be completed by mailer) Mr. Ben Jacoby		
Street and apt. or P.O. Box 1400 Smith St.		
City, State, Zip+4 Houston, Texas 77002-7631		
PS Form 3800, July 1999		See Reverse for Instructions

7099 3400 0000 1449 3799

**FINAL DETERMINATION**  
**File No. 1110099-002-AC (PSD-FL-305)**  
**MIDWAY DEVELOPMENT COMPANY, L.L.C.**  
**510 MW SIMPLE CYCLE FACILITY**

The Department distributed a Public Notice package on December 18, 2000 for the project to construct a nominal 510-megawatt (MW) natural gas and fuel oil-fired simple cycle facility to be known as the Midway Energy Center near Port St. Lucie and Fort Pierce in St. Lucie County. The project consists of three nominal 170 MW General Electric 7FA combustion turbine-electrical generators, three 150-foot stacks, a 2.5 million gallon fuel oil storage tank, a 0.6 million gallon fuel oil "day" tank, and other ancillary equipment.

The Public Notice of Intent to Issue was published on December 21, 2000 in The Tribune. Written comments were received from EPA Region IV and the applicant, Midway Development Company, L.L.C (Midway - an affiliate of Enron North America).

The written comments (in italics) are addressed below. Each is followed by the Department's response.

**EPA Comments**

1. *Section III. Emission Units Specific Conditions, Applicable Standards and Regulations, 6.: 40 C.F.R. Subpart Dc is an applicable requirement for the gas heater. In 40 C.F.R. § 60.41c, a steam generating unit is defined as a device that combusts any fuel and produces steam or heat water or any other heats transfer medium. Heat transfer medium is defined as any material that is used to transfer heat from one point to another point. The natural gas heaters meet the definition of steam generating unit; therefore, they are an affected facility as defined in 40 C.F.R. § 60.40c(a). Also, pursuant to 40 C.F.R. § 60.48c(g), the permittee must record the amount of each fuel combusted each day. Please include this applicable requirement in the permit.*

The Department agrees with EPA and the requirements of 40 CFR Subpart Dc will be included for the heaters.

2. *Section III. Emission Units Specific Conditions, General Operation Requirements, 13. Maximum allowable hours: To limit the potential to emit, the operation limitations (hours of operation per year) should be expressed in terms of 12 consecutive months, rather than calendar year. This 12-month consecutive limit prevents the enforcing agency from having to wait for long periods of time to establish a continuing violation before initiating enforcement.*

The Department agrees with EPA and the hours per year will be changed to read 12 consecutive months.

3. *Section III. Emission Units Specific Conditions, Excess Emissions, 25. The Florida Department of Environmental Protection should include definitions of what constitutes "startup" and "shutdown" as referenced in this section.*

The Department does not allow extended operation at low loads, during which such emissions typically occur. The facility must also employ good operating practices to allow excess emissions.

At the same time, the Department is aware that emissions are less from the GE 7FA units at low loads (< 50 percent of full load) than previously believed. This is based on reports from new installations including JEA.

The Department will progressively implement EPA's comments for future projects as we get emissions data from facilities required to demonstrate compliance by CEMS. As drafted, the permit includes Specific Conditions (22, 23, 24, 44, 45) related to excess emissions during startup, shutdown, and valid, documented malfunctions. See condition 43 of Section III of this permit for provisions that relate to excluding periods of CEM system data recorded for NO<sub>x</sub> and CO for episodes of startup, shutdown and malfunction. However, these periods are recorded and reported as excess emissions as stated in conditions 24 and 45.

Gas turbine startup is the commencement of operation of a gas turbine which has shut down or ceased operation for a period of time sufficient to cause temperature, pressure, or pollution control device imbalances, which may result in elevated emissions. Shutdown is the process of bringing a gas turbine off line and ending fuel combustion.

**Midway's comments:**

4. Section II. Administrative Requirements, Specific Condition (SC) 8 (page 5 of 15): At our request, the permit expiration date was extended. However, we believe it was the Department's intent to revise the language as follows: "The expiration date is June 30, 2003. Physical construction shall be complete by December 31, 2002~~3~~."

The typographical error was corrected to read 2002.

5. Section III. General Operation Requirements, SC 13 and 14 (pages 7 and 8 of 15): As suggested in a separate letter to the Department, dated January 23, 2001, it's requested that the language in SC 13 and 14 be revised. The suggested language below provides the Department with reasonable assurance that the intent is for natural gas to be the primary fuel for this proposed project:

Specific Condition 13 - Maximum allowable hours: The three stationary gas turbines shall operate no more than an average of 3,500 hours per installed unit during any calendar year, as may be adjusted in condition 14 below, based on oil fired run hours. ~~The three stationary gas turbines shall operate no more than an average of 1000 hours per installed unit on fuel oil during any calendar year. No single combustion turbine shall operate more than 5,000 hours in a single year. [Applicant Request, Rule 62-210.200, F.A.C. (Definitions - Potential Emissions), Rule 62-212.400, F.A.C. (BACT)]~~

Specific Condition 14 - Fuel oil usage: ~~The amount of back-up fuel (fuel oil) burned at the site (in BTU's) shall not exceed the amount of natural gas (primary fuel) burned at the site (in BTU's) during any consecutive 12-month period. The Department may waive this requirement during the first 24 months of operation based on natural gas availability.~~

In order to encourage the maximum use of natural gas as fuel, during any calendar year the three stationary gas turbines shall operate on fuel oil for no more than an average of 1000 hours per installed unit. Furthermore, during any calendar year, the maximum allowable operating hours referenced in condition 13 above shall be reduced by two hours for each oil fired hour in excess of an average of 500 per installed unit. For example, if the three stationary gas turbines operate on fuel oil in any calendar year for an average of 550 hours per installed unit, the total maximum allowable operating hours shall be decreased to 3,400.

[Rule 62-212.400, F.A.C. (BACT)]

*Note: In a phone conversation with Midway representatives on February 8, the company further proposed to reduce to 250 hours the level at which the "2 for 1" trigger would kick in. Therefore if the three stationary gas turbines operate on fuel oil in any calendar year for the permitted average of 1000 hours per installed unit, the total maximum allowable operating hours shall be decreased to 2,000 hours.*

The Department met with Midway representatives on January 17 to discuss these matters. The Department emphasized that a major part of the Best Available Control Technology (BACT) is the use of natural gas. The company argued that there is not yet enough firm supply of natural gas to insure that in a given year or in a given 12-month period they can commit to firing more gas than fuel oil.

Apparently Florida Gas Transmission (FGT) Phase IV and V (and proposed Phase VI) Expansions extend to points North and West of the planned Midway site. Therefore Midway will rely on interruptible supply from the existing FGT capacity in Southeast Florida if it chooses to purchase gas from FGT. This situation could change as FGT considers possible future capacity expansion in Southeast Florida.

The approved Gulfstream Pipeline will extend from Manatee County and includes segments to St. Lucie and Belle Glade. This presents another opportunity for Midway to obtain gas. Additionally, Enron (parent of Midway) has announced a possible project involving construction of a liquefied natural gas (LNG) handling terminal in the Bahamas together with a pipeline to the Southeast Florida Coast.

If the company actually uses more fuel oil than gas, then a better effort needs to be made to reduce emissions while firing fuel oil. For example, nitrogen oxides (NO<sub>x</sub>) emissions while firing fuel oil are 42 parts per million by volume dry (ppmvd), whereas emissions while firing natural gas are only 9 ppmvd.

Midway and other companies argue that the NO<sub>x</sub> guarantee while burning fuel oil is still 42 ppmvd from General Electric. They are not willing to commit to further wet injection to reduce emissions to less than the guaranteed values. However, it is clear that lower emissions are feasible with wet injection than indicated by the guarantees. For example, initial compliance tests on a GE 7FA simple cycle combustion turbine at the JEA Kennedy Plant indicated NO<sub>x</sub> emissions of 30 ppmvd @15% O<sub>2</sub>. The added costs in terms of reduced lifetime and increased maintenance are unknown.



There is already a requirement (within Section III, Condition 19) for Midway to develop a NO<sub>x</sub> reduction plan when the hours of oil firing reach 500 hours per year per unit. If the Department determines that a lower NO<sub>x</sub> emissions standard is warranted for oil firing, this permit shall be revised.

The Department concludes that Midway's proposed draft permit revision, the fuel oil use hammers, and the various gas supply options will encourage Enron to make sure more gas becomes available for its planned Midway Project as well as for its other projects planned in Broward County. The permit will be modified accordingly.

It is noted that Midway's potential to emit will be significantly reduced because maximum oil use will reduce total hours of operation by an average of 1500 per unit. For example, potential NO<sub>x</sub> emissions from the facility will be reduced from roughly 735 tons per year to approximately 600 tons per year.

6. Section III, SC 17 (page 8 of 15): *The permit language states that "The permittee shall provide manufacturer's emissions vs. load diagrams for the DLN and wet injection systems prior to their installation." Past requests of the manufacturer for these types of diagrams have been unsuccessful. Typically, the manufacturer will provide emission estimates at various load points corresponding to various inlet temperature cases. These emission values, that are the basis for this permit, were previously provided in the permit application. It's requested that the word "diagrams" in the above sentence be replaced with the word "estimates".*

The Department has regularly obtained such diagrams from operators throughout the State. The Department will to change the language from "prior to installation" to "upon installation and completion of testing" for submittal of the required diagrams.

7. Section III, SC 19 (page 9 of 15): *The language concerning fuel oil firing should be revised as follows: "In addition, NO<sub>x</sub> emissions calculated as NO<sub>2</sub> shall exceed neither 332 lb/hr nor 42 ppmvd at 15% O<sub>2</sub> to be demonstrated by initial stack test."*

The Department revised this condition to include the word initial as suggested. Reference to Method 20 will be added for consistency with the previous condition.

8. Section III, SC 20 (page 9 of 15): *The CO emission limit for fuel oil presented in the permit application was based on 20 ppmvd. At a temperature of 30 °F, this corresponds to 69.6 lb/hour, not 46 lb/hour, as shown in the draft permit. The 20 ppm concentration is based on 100% load. Concentrations of CO are estimated to be as high as 22 ppm at 75% load factor and 30 ppm at 50% load factor. The peak emission estimate is 78.3 lb/hour at 50% load and 91°F. Based on these factors we request that the permit limit for oil firing be expressed as follows: "The concentration of CO in the stack exhaust gas shall exceed neither 12 ppmvd nor 31 lb/hr (gas) and neither 20 ppmvd nor 70 lb/hour (fuel oil) to be demonstrated by stack tests at full load operation."*

This condition will be revised as suggested. The Department notes, however, that initial testing of General Electric 7FA combustion turbines indicates emissions in the range of 0.5 to 2 ppm whether burning natural gas or fuel oil. Such results have been observed at TECO Polk Power, JEA and City of Tallahassee facilities.

The Department will monitor long-term performance on CO at some of the combined cycle units that have continuous emissions monitors. This may result in lower emission limits issued to applicants for combustion turbine projects in the future.

9. *Section III. SC 27 (page 10 of 15): The last sentence should be revised as follows: "...periods of startup, shutdown, malfunction, shall be monitored, recorded, and reported as excess emissions when emission levels exceed the permitted standards listed in Specific Condition No. 18 and 19."*

This condition was revised to read 19.

10. *Section III. SC 29 (page 11 of 15): The permit language indicates that emission testing by EPA Reference Methods 9 and 10 (for visible emissions and CO emissions, respectively) are to be conducted both initially and annually for both fuels. In the past, the Department has issued permits (e.g., Hines Energy Complex) with language that requires that annual testing be done on fuel oil (the backup fuel) only if a threshold number of operating hours on oil is exceeded (e.g., 400 hr/CT) during a rolling 12-month period. This is because it's a financial hardship to require operation on the more expensive fuel. It's requested that the conditions be revised to include annual testing for VE and CO emissions on oil, only if a CT exceeds 400 hours of operation in a 12-month rolling period.*

The Department does not consider it to be a financial hardship for Midway to test for CO and VE while firing fuel oil and it is not clear that fuel oil is exclusively just the back-up fuel. In the case of Hines, the allowable hours on fuel oil operation are much lower than the hours on natural gas operation. At Midway, the fuel oil firing can be very significant compared with natural gas. Additionally, permitted CO emissions are much higher than for the fuel oil case than for the natural gas case.

11. *Section III. SC 33 (page 11 of 15): It's requested that the same language be included here regarding the annual testing requirement for visible emissions while firing oil.*

See discussion in 10 above.

12. *Section III. SC 36 (page 12 of 15): The second sentence should be revised as follows: "...corrected for the average inlet ~~ambient~~ air temperature during the test..."*

The Department will revise this condition as suggested.

13. *Section III. SC 45 (page 13 of 15): The last sentence states that "these excess emissions periods shall be reported as required in Specific Conditions 24 and 46." The reference to SC 24 appears to be incorrect, as it refers to the limitation for visible emissions.*

The reference to Specific Condition 24 in Specific Condition 45 will be revised to read Specific Condition 27.

14. *Section III. SC 46 (page 14 of 15): Although the language is intended to instruct on the procedure to determine compliance with the 24-hour rolling average, the second sentence refers to a separate compliance determination being conducted at the "end of each operating day". This language is appropriate in the context of a 24-hour*

*block average, but should be deleted from SC 46, which is addressing rolling averages.*

This condition was revised to read 24-hour block average.

15. *Section III. SC 47 (page 14 of 15): The Specific Conditions referenced in the last sentence of this condition (20, 21 and 29) all appear to be incorrect. The conditions need to be cross-referenced correctly or deleted. Also, the appropriate DEP office to notify would be the Southeast District, not the South District.*

This condition was revised to read reference to Specific Conditions 18, 19 and 24. The District office was changed as suggested.

16. *Section III. SC 49 (page 14 of 15): Some of the text appears to be missing. There doesn't appear to be any schedule for testing of sulfur or nitrogen in natural gas in the bulleted items. In fact, the bulleted items appear to be related to compliance with the Acid Rain requirements of Parts 72 and 75, not with Part 60 Subpart GG compliance (which is what requires a Custom Fuel Schedule).*

17. *Section III. SC 50 (page 15 of 15): It's requested that the requirement to conduct sampling and analysis for fuel bound nitrogen content be deleted. Typically, the requirement to monitor water-to-fuel ratio, combined with the requirement to analyze for fuel bound nitrogen content, provides a surrogate for NO<sub>x</sub> compliance. As recognized by the Department in the language of SC 48, the NO<sub>x</sub> CEMS are to be used in lieu of the water/fuel monitoring system for reporting excess emissions. Given that NO<sub>x</sub> CEMS will be used for compliance, the monitoring of the fuel bound nitrogen content serves no useful purpose, and should not be required.*

The Department replaced the above conditions with the new condition (SC 49) below. The requirements of the 40CFR60, Subpart GG will be attached as Appendix GG. This new Appendix includes all the Department requirements regarding this Subpart GG.

New Specific Condition 49:

**Fuel Sulfur Records:** The permittee shall demonstrate compliance with the fuel sulfur limits specified in this permit by maintaining the following records of the sulfur contents.

Compliance with the fuel sulfur limit for *natural gas* shall be demonstrated by keeping reports obtained from the vendor indicating the sulfur content of the natural gas being supplied from the pipeline for each month of operation. Methods for determining the sulfur content of the natural gas shall be ASTM methods D4084-82, D3246-81 or more recent versions.

Compliance with the *fuel oil* sulfur limit shall be demonstrated by taking a sample, analyzing the sample for fuel sulfur, and reporting the results to each Compliance Authority before initial startup. Sampling the fuel oil sulfur content shall be conducted in accordance with ASTM D4057-88, Standard Practice for Manual Sampling of Petroleum and Petroleum Products, and one of the following test methods for sulfur in petroleum products: ASTM D129-91, ASTM D1552-90, ASTM D2622-94, or ASTM D4294-90. More recent versions of these methods may be used. For each subsequent

fuel delivery, the permittee shall maintain a permanent file of the certified fuel sulfur analysis from the fuel vendor. At the request of a Compliance Authority, the permittee shall perform additional sampling and analysis for the fuel sulfur content.

The above methods shall be used to determine the fuel sulfur content in conjunction with the provisions of 40 CFR 75 Appendix D. [Rules 62-4.070(3) and 62-4.160(15), F.A.C.]

18. *Particulate Limits: The Department has determined that measurement of front-half catch by EPA Method 5 is sufficient to demonstrate the BACT emission limit for PM<sub>10</sub>.*

EPA Method 5 measuring the front-half catch only is now specified for compliance with the PM<sub>10</sub> standard. Because the back-half catch is excluded, the emission limits are reduced from 18 to 10 and from 34 to 17 pounds per hour while firing natural gas and fuel oil respectively. These values are equal to previous BACT determination for GE 7FA simple cycle units.

## **CONCLUSION**

The Department will issue the permit with the changes noted above.

10/31/00

## Key to files on CDROM - Midway Energy, L.L.C. Florida

- *Directory : \Midway\GEP-BPIP - contains BPIP input and output files*

### File Naming Convention:

Midgep.bpi - BPIP input file  
Midgep.sum - BPIP input summary  
Midgep.bpo - BPIP output file

- *Directory : \Midway\ISCST3\Natural Gas - contains ISCST3 input and output files for Natural Gas modeled with an emission rate of 1 g/sec.*

### File Naming Convention:

NG10087 - Natural Gas with turbines at 100% load with 1987 metdata, repeat for '88, '89, '90 and '91  
NG07587 - Natural Gas with turbines at 75% load with 1987 metdata, repeat for '88, '89, '90 and '91  
NG05087 - Natural Gas with turbines at 50% load with 1987 metdata, repeat for '88, '89, '90 and '91

- *Directory : \Midway\ISCST3\Distillate Oil - contains ISCST3 input and output files for Distillate Oil modeled with an emission rate of 1 g/sec.*

### File Naming Convention:

O110087 - Distillate Oil with turbines at 100% load with 1987 metdata, repeat for '88, '89, '90 and '91  
O107587 - Distillate Oil with turbines at 75% load with 1987 metdata, repeat for '88, '89, '90 and '91  
O105087 - Distillate Oil with turbines at 50% load with 1987 metdata, repeat for '88, '89, '90 and '91

- *Directory : \Midway\metdata - contains five years ISCST3 meteorological data, 1987-1991, West Palm Beach International Airport*

### File Naming Convention:

12844-87 - 1987 meteorological data, repeat for '88, '89, '90 and '91

\*\*\*\*\*