Utility Board of the City of Key West
City Electric System

Prevention of Significant Deterioration
Application for Modification
Stock Island Power Plant
Gas Turbine Project

May 1993

Submitted to:
The Florida Department of Environmental Regulation

Prepared by

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Denver, Colorado

PREVENTION OF SIGNIFICANT DETERIORATION
PERMIT APPLICATION
COMBUSTION TURBINE RELOCATION
UTILITY BOARD OF THE CITY OF KEY WEST

PREVENTION OF SIGNIFICANT DETERIORATION PERMIT APPLICATION COMBUSTION TURBINE RELOCATION UTILITY BOARD OF THE CITY OF KEY WEST

TABLE OF CONTENTS

PREVENTION OF SIGNIFICANT DETERIORATION
PERMIT APPLICATION
COMBUSTION TURBINE RELOCATION
UTILITY BOARD OF THE CITY OF KEY WEST

TABLE OF CONTENTS

**PREVENTION OF SIGNIFICANT DETERIORATION
PERMIT APPLICATION
COMBUSTION TURBINE RELOCATION
UTILITY BOARD OF THE CITY OF KEY WEST**

TABLE OF CONTENTS

PREVENTION OF SIGNIFICANT DETERIORATION
PERMIT APPLICATION
COMBUSTION TURBINE RELOCATION
UTILITY BOARD OF THE CITY OF KEY WEST

LIST OF TABLES

PREVENTION OF SIGNIFICANT DETERIORATION
PERMIT APPLICATION
COMBUSTION TURBINE RELOCATION
UTILITY BOARD OF THE CITY OF KEY WEST

LIST OF FIGURES

GLOSSARY OF TERMS

TERM	MEANING

Commonly Used Abbreviations

BACT	Best Available Control Technology
CAA	Clean Air Act
CAAA	Clean Air Act Amendments of 1990
CASAC	Clean Air Scientific Advisory Committee
CEM	Continuous Emission Monitors
CES	City Electric System
CFR	Code of Federal Regulations
DEG	Diesel-Electric Generator
FDER	Florida Department of Environmental Regulation
ISO	International Standards Organization
LAER	Lowest Achievable Emission Rate
MSL	Mean Sea Level
NAAQS	National Ambient Air Quality Standards
NESHAP	National Emission Standards for Hazardous Air Pollutants
NOAA	National Oceanic and Atmospheric Administration
NSPS	New Source Performance Standards
NSR	New Source Review
NWS	National Weather Service
PSD	Prevention of Significant Deterioration
SCR	Selective Catalytic Reduction
SIL	Significant Impact Levels
SIP	State Implementation Plan
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UTM	Universal Transverse Mercator

GLOSSARY OF MEASUREMENT UNITS AND CHEMICAL COMPOUNDS

TERM	MEANING
Physical Quantity Abbreviations	
ACFM	actual cubic feet per minute
Btu	British thermal unit
°F	Fahrenheit degrees
ft2	square fee
g/hp-hr	grams per horsepower hour
g/s	grams per second
gpm	gallons per minute
HHV	Higher heating value
K	Kelvin degrees
kW	kilowatt
kWh	Kilowatt-hour
kWm	Kilowatts-mechanical power
lb/hr	pounds per hour
LHV	lower heating value
M	Meter
m/s	meters per second
m^3/s	cubic meters per second
MW	megawatts
ppm	parts per million
ppmvd	parts per million by volume on a dry basis
psig	pounds per square inch, gage
SCFM	standard cubic feet per minute (referenced to 68°F and 1 atmosphere)
TPY	tons per year
$\mu g/m^3$	micrograms per cubic meter
Pollutants and Chemical Compounds	
CO	carbon monoxide
H_2SO_4	sulfuric acid
N_2	nitrogen
NO	nitric oxide
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
O_2	oxygen
O_3	ozone
Pb	lead
PM	particulate matter
PM_{10}	particulate matter less than 10 microns in aerodynamic diameter

CONVERSIONS AND NOTES

In One	There Are
Joule	9.486×10^{-4} Btu
Calorie	3.969×10^{-3} Btu
Watt	9.486×10^{-4} Btu/s
Watt	1.341×10^{-3} hp
Atmosphere	14.696 lb_f/in^2
Atmosphere	29.921 in Hg @ 0°C
Cubic meter	35.3145 ft^3
Meter	3.2808 ft
Kilogram	2.20462 lb_m
Gallon of water at 4°C	8.345 lb_m

The following equation is used to correct a dry gas concentration of a pollutant (C_1) at a measured fraction of O_2 to a reference of 15% O_2:

$$C_2 = C_1 \times 5.9 \div (20.9 - O_2)$$

Where:

C_1 = Pollutant concentration in dry gas at measured level of O_2

C_2 = Pollutant concentration at 15% O_2

O_2 = Percent O_2 measured

CONVERSIONS AND NOTES (cont.)

The following equation is used to correct a wet gas concentration of a pollutant (C_1) at a measured fraction of O_2 to a reference of dry gas at 15% O_2:

$$C_2 = C_1 \times 5.9 \div [20.9-(O_2 /(1-H_2O))]$$

Where: C_1 = Pollutant concentration in wet gas at measured level of O_2

C_2 = Pollutant concentration at dry condition at 15% O_2

O_2 = Percent O_2 - measured

H_2O = Fraction H_2O in wet gas

NOTE: In this application, standard temperature and pressure are 68°F and 1 atmosphere unless otherwise noted.

Section 1.0
EXECUTIVE SUMMARY

R.W. BECK AND ASSOCIATES

SECTION 1.0

EXECUTIVE SUMMARY

This Prevention of Significant Deterioration (PSD) permit application is submitted for the construction and operation of a gas turbine which will be relocated approximately four miles from the Utility Board of the City of Key West - City Electric System's Key West Power Plant to their Stock Island Power Plant.

The following sections are included in this application:

- **Section 1 - Executive Summary:** Provides an overview of the project and conclusions of analyses.
- **Section 2 - Description of Project:** Provides description of project location, technical aspects, operation, materials usage, pollutant emissions, and schedule.
- **Section 3 - Laws and Regulations:** Provides discussion of major air pollution laws and regulations regarding stationary sources and describes applicability.
- **Section 4 - Best Available Control Technology Analysis:** Provides an analysis of available pollution control technologies for the criteria pollutants with respect to technical feasibility, cost, energy, and environmental considerations.
- **Section 5 - Air Quality Impact Analysis:** Provides discussion of air dispersion modeling methods and estimated impacts resulting from the operation of the gas turbine. Also included in this section are additional related analyses concerning growth, visibility, soils and vegetation, and threatened and endangered species.

1.1 APPLICANT

The applicant is the Utility Board of the City of Key West - City Electric System (CES). The address is:

Mr. Skip Jansen
Utility Board of the City of Key West
1001 James Street
P.O. Drawer 6100
Key West, FL 33041

Questions concerning this application should be addressed to Mr. Ed Settle or Mr. Mike Henderson with R.W. Beck and Associates in Denver, Colorado at (303) 299-5200.

1.2 PROJECT DESCRIPTION

In an effort to consolidate operations, CES is proposing to move a gas turbine (GT) approximately four miles from the Key West Power Plant (where it is currently permitted and operating) to the existing Stock Island Power Plant. CES is proposing only to relocate the GT, and is not proposing to modify operation of the unit with respect to fuel consumption or emissions limits as supported by the BACT analysis. The Stock Island Power Plant currently consists of a nominal 37 MW steam-electric generating unit, two nominal 8.6 MW medium speed diesel-electric generating units, three nominal 2 MW high speed generating units, fuel storage tanks, and other electrical generating support equipment. The steam-electric unit burns No. 6 heavy fuel oil, and the diesel-electric units burn No. 2 fuel oil.

The GT proposed for relocation is a General Electric Frame 5 model PG5341 with a nominal base load rating of 23.5 MW at ISO conditions. The GT will be operated in the same manner as at the Key West Power Plant, burning 0.5% sulfur fuel oil and utilizing water injection for NO_x emissions control. However, CES is requesting a fuel consumption limit of 7.1 million gallons per year for the GT (which corresponds to the 2888.5 hours of full-load operation per year limit in its current permit), rather than an hours of operation limit. The GT will be significant with respect to PSD review thresholds for emission rates of SO_2, NO_x, CO, and PM.

1.3 LAWS AND REGULATIONS

The project is subject to review under Prevention of Significant Deterioration (PSD) regulations found at 40 CFR 52.21. The BACT and Air Quality analyses were performed in accordance with PSD regulations as well as USEPA published guidelines on cost estimating methods and air quality modeling. The project is not in and will not significantly affect a nonattainment area and is not, therefore, subject to nonattainment review. The construction and operation of the project will comply with all applicable rules and standards.

1.4 BEST AVAILABLE CONTROL TECHNOLOGY

Among the requirements of the PSD regulations is a Best Available Control Technology (BACT) analysis to demonstrate that the control of air contaminant emissions from the proposed unit will represent BACT. USEPA policy requires that BACT analyses utilize a "top-down" procedure which requires identifying and implementing the most stringent, technically feasible control, unless economic, environmental, or energy costs can be shown to be excessive. The BACT analysis presented in Section 4 utilizes the method outlined in the most recent USEPA guidance document.

Emission rates for the GT were based on vendor performance data for similar units. The following key emission limits and other requirements are proposed as BACT by CES for the GT:

- Water injection will be used to control NO_x emissions to 75 ppmvd @ 15% O_2. The actual water injection ratio shall be determined during initial compliance testing (pursuant to 40 CFR 60.335(a)(1)(iii)).

- Pursuant to 40 CFR 60.334(a) a system shall be operated to continuously monitor and record the fuel consumption and the ratio of water to fuel being injected into the turbine. These records shall be retained for two years and made available to the FDER pursuant to 40 CFR 60.7(c).

- CO emissions will be controlled by good combustion practice and variable water injection, and will be limited to 20 ppmvd @ 15% O_2, with the exception that the emissions may increase to 136 ppmvd @ 15% O_2 during part load operation.

- The maximum sulfur content of the No. 2 fuel oil burned shall not exceed 0.5% by weight.

- Particulate emissions will be limited to 18 lbs/hr.

1.5 AIR QUALITY IMPACT ANALYSIS

The air quality analysis predicts that the relocation of the GT from the Key West Power Plant to the Stock Island Power Plant will not cause or significantly contribute to any violations of national and state ambient air quality standards (AAQS) or the PSD Class I and Class II increments.

Results of the refined modeling analysis showed that the highest-high and highest-second-high impacts resulting from worst-case GT operations are predicted to be less than the regulatory modeling levels of significance for NO_x, CO, and PM. Although the highest 3-hour SO_2 impact exceeded the regulatory modeling level of significance and therefore required an interactive analysis to assure compliance with the AAQS and Class II increments, the highest-second-high SO_2 impact was less than 30% of the regulatory modeling level of significance. Results of the interactive analysis for SO_2 revealed impacts of only approximately 0.08% of the 3-hour AAQS and approximately 0.2% of the PSD Class II increment, thus assuring compliance with the AAQS and Class II increments. Further, results of the Class I increment analysis show no significant effect from moving the GT from Key West to Stock Island.

In addition and related to the air quality analysis, qualitative analyses regarding growth, visibility, soils, vegetation, and threatened and endangered species were performed. Based on the low air quality impacts predicted by the air quality modeling, no significant impacts on soils, vegetation, or threatened and endangered species are expected to result from construction activities or operation of the GT.

Section 2.0

DESCRIPTION OF PROJECT

R.W. BECK AND ASSOCIATES

SECTION 2.0

DESCRIPTION OF PROJECT

2.1 PROJECT LOCATION

In an effort to consolidate operations, the Utility Board of the City of Key West - City Electric System (CES) is proposing to move a gas turbine (GT), which is currently located and operating at the Key West Power Plant, approximately four miles to the existing Stock Island Power Plant. Moving the GT to the Stock Island plant is desirable because the move will consolidate electric generation efforts, water and fuel storage facilities are already in place, use of a developed site will expedite construction and operation of the unit, and the facility will be compatible with the surrounding land use since existing power generating units occupy the site. Additionally, the relocation will move an existing source from an area of higher population density to an area of lower population density. It is important to stress that CES is not proposing to modify the turbine as it currently operates with respect to fuel consumption or emissions limitations. Only a consolidation of operations by moving the GT across town, is proposed.

The GT is an important component of the CES electrical generation. Key West has a unique electrical tie to the mainland. The lack of a transmission loop from Key West to the mainland reinforces the requirements for generating reliability and operational flexibility. In general, CES must have a greater redundancy in the electrical generating system than mainland utilities, and, therefore, all of the existing units, including the GT, must be operational.

The Stock Island Power Plant comprises roughly 50 acres and is located approximately one mile east of the City of Key West, Monroe County, Florida. The site is a peninsula bounded by Safe Harbor and Hawk Channel. Across Safe Harbor to the west of the site is Cow Key, and to the north of the site is the main portion of Stock Island. The latitude of the site is 24°33'49"N, and the longitude of the site is 81°44'03"W. In Universal Transverse Mercator (UTM) coordinates, the facility is located in Zone 17, 425 km East and 2716 km North. The surrounding topography is essentially flat and varies from sea level to approximately 5 feet above mean sea level (msl) with a small plot of land rising to approximately 10 feet msl. Figure 2-1 is a proximity map of Key West, Stock Island, and the CES power plants.

2.2 FACILITY DESCRIPTION

2.2.1 General Facility Characteristics

The Stock Island Power Plant falls under the Standard Industrial Classification (SIC) code 49 and consists of a nominal 37 MW steam-electric generating unit (the Ralph

Garcia Steam Plant), two nominal 8.6 MW medium speed diesel-electric generating units, three nominal 2 MW high speed diesel-electric generating units, fuel storage tanks, and other electrical generating support equipment. Figure 2-2 depicts the preliminary site layout of the GT in relation to the existing equipment at the site.

The diesel-electric generators at the plant burn No. 2 fuel oil and the steam unit burns No. 6 heavy fuel oil. The fuel supply for the diesel engines is provided by two 500,000 gallon fuel tanks onsite. It is expected that the GT would also be tied into those fuel tanks. The existing steam-electric generating unit at the plant requires demineralized water for boiler operation. Since water injection is applied to the GT to suppress NOx formation, provisions will be made at the site for the increased demineralized water demand. Existing on-site electrical equipment (switchgear, transformers, etc.) is expected to be sufficient for the GT integration.

The GT will be in the standard metal enclosure typical of the Frame 5 series of engines. The building is approximately 40 m long, and is approximately 8 m high at its highest point. The exhaust stack for the unit is 10.7 m high. The stack is rectangular with dimensions of 3.6 m by 3.0 m for a total discharge area of 10.87 m^2 and an equivalent stack diameter of 3.72 m.

2.2.2 Turbine Technical Description

The GT is a General Electric Frame 5 model PG5341 with a nominal base load rating of 23.5 MW at ISO conditions. The GTs in the Frame 5 series are ideally suited for peak load demands based on performance, reliability, power output, and economic and environmental considerations. The GT combusts No. 2 diesel fuel with a lower heating value (LHV) of 18,500 Btu/lb.

The performance of a GT is affected by ambient temperature because hot air is less dense than cold air. Thus, a cubic meter of cold air holds a greater mass of oxygen than a cubic meter of hot air. Because the turbine is rigidly coupled to the electrical generator, it draws a constant volume of air into the compressor. On a cold day, a greater mass of oxygen is available in this constant volume for combustion, and more fuel may be injected into the combustion chamber. The result is greater power output and improved engine performance.

The ambient conditions at the plant site, discussed in greater detail in Section 5, are generally bracketed by ambient temperatures from 59°F to 90°F. Table 2-1 shows the expected performance of the GT based on those two temperature extremes and generating loads of 50%, 75%, and 100% of base load. The data includes the heat rate based on the LHV of the fuel, fuel consumption, water consumption, and power output for both dry operation and operation with water injection.

As previously mentioned, the GT will be water injected to suppress the formation of NOx. Because water injection increases the mass flow through the expansion section of the combustion turbine, the power output is increased as a result. However, the water does not contribute to energy-producing combustion reactions. Rather, it decreases the engine efficiency (increases the heat rate of the turbine), and more fuel must be burned for equivalent power output compared to dry operation.

2.2.3 Anticipated Turbine Operation

The GT is currently permitted to operate during peak load demand for 2888.5 full-load hours per year, which corresponds to fuel consumption of 7.1 million gallons per year. CES is requesting essentially the same limit on the GT when it is moved to Stock Island, except with a limit on fuel consumption (7.1 million gallons per year) rather than on hours of operation. As a peak load unit, operation is typically much less than the permitted use. The actual fuel use for the GT at Key West from 1988 through 1992 is shown in Table 2-2 along with the percentage use based on the limitation of 7.1 million gallons. The maximum operation of the unit in the five years occurred during 1992 when the GT consumed less than 1.1 million gallons. This equates to less than 450 hours of full-load operation. Although the unit has historically operated less than 450 full-load hours per year, the unit must be available for the requested hours of operation in the event of long-term unscheduled outages of the steam-electric or diesel units. Furthermore, a limitation on annual fuel consumption will simplify compliance tracking while enhancing operational flexibility.

2.2.4 Start-up and Shutdown

The start-up sequence for the GT is automatic. A diesel engine spins the turbine at a preset speed (to provide minimum compressor function) and fuel is admitted and ignited by electric spark. The control system then brings the unit to a full speed no-load state, synchronizing the generator with the transmission grid. Approximately ten minutes is required to bring the turbine up to speed and synchronize the generator. Once synchronized, fuel flow is steadily increased until desired load is achieved. Full load can be achieved within five to ten minutes of achieving full speed. Water injection for Nox control is initiated after synchronization at a preset load (fuel flow), typically about 5 MW load, and is automatically controlled to maintain a preset water/fuel ratio based on test results.

When operating, the unit is continuously monitored by the control system for electrical output, lube oil temperature and pressure, exhaust temperature, water/fuel ratio, fuel pressure, and other parameters. Abnormal indications of any parameter will initiate an alarm in the control building. Serious excursions, such as low oil pressure, will initiate an automatic shutdown of the turbine. Normal shutdown sequence consists of restricting fuel flow to decrease power output followed by isolation of the generator from the electric grid and complete fuel shut-off. Cool down may take as long as 48 hours, during which time the turbine must be slowly rotated with a hydraulic rachet to prevent asymmetrical cooling and permanent strains.

2.2.5 Maintenance

The GT is maintained on an as-needed basis. Periodic inspections are performed routinely, scheduled both regularly (e.g., quarterly) and by usage hours (e.g., every 2,000 hours of operation). When significant maintenance is required, specialized personnel are called in. Major maintenance is generally conducted under contract with experienced GT maintenance companies.

2.2.6 Resource Consumption

The GT is currently equipped for water injection to suppress the formation of thermal NOx. At full load and ISO conditions, the maximum water injection rate will be approximately 14 gpm. If the GT is operated for a full day, the demand for demineralized water will be approximately 20,000 gallons. To supply this amount of water, CES will be leasing a mobile demineralization system.

The GT will be fueled with No. 2 distillate fuel oil with a nominal lower heating value of 18,500 Btu/lb. At 59°F and operating at base load with water injection, the unit will consume approximately 2470 gal/hr and 59,000 gal/day of fuel. CES is requesting that the annual fuel consumption for the GT be limited to approximately 7.1 million gallons. This corresponds to operation at base load and ISO conditions for 2888.5 hours per year consistent with the existing permit.

2.2.7 Pollutant Emissions

Emission rates of SO_2, NO_x, CO, and PM will be significant with respect to PSD review thresholds (see Section 3). Table 2-3 presents pollutant emission rates for a GE PG5341 at 59°F and 90°F and operating loads of 50, 75, and 100 percent of base load rating. SO_2 emissions will be controlled by limiting the maximum sulfur content of the No. 2 fuel oil to 0.5 percent by weight. Emissions of NO_x are proposed to be controlled by water injection. Emissions of CO and PM will be controlled by variable water injection and good combustion practices. Emissions are given in pounds per hour and parts per million by volume on a dry basis corrected to 15 percent oxygen (ppmvd @ 15% O_2)

2.3 PROJECT SCHEDULE

Construction on the relocation of the GT will commence after PSD approval is received, and will take about three months. PSD approval is expected by July 1993. Thus, commercial operation of the GT at its new location is expected to resume no later than October 1993.

Table 2-1

Combustion Turbine Performance (1)

Load Condition	Output (kW)	Heat Rate (Btu/Kw-h) (2)	Fuel Flow (lb/hr)	Water Flow (lb/hr)	Exhaust Flow (ACFM)	Exhaust Temperature (°F)
59°F						
100	23,520	12,709	16,158	0	577,554	905
75	17,640	13,556	12,926	0	412,963	760
50	11,760	15,378	9,775	0	364,072	620
90°F						
100	20,592	13,183	14,674	0	551,347	922
75	15,444	14,061	11,738	0	419,948	856
50	10,296	15,951	8,877	0	347,040	631
59°F						
100	24,169	12,892	16,843	6,737	580,406	901
75	18,127	13,752	13,475	5,390	415,066	757
50	12,085	15,600	10,191	4,076	365,335	617
90°F						
100	21,160	13,372	15,295	6,118	553,907	918
75	15,870	14,264	12,236	4,894	421,925	852
50	10,580	16,181	9,254	3,702	348,160	629

1) Information based on GE Frame 5 model 5341.

2) Heat rate based on lower heating value.

Table 2-2

Historical GT Operation

Year	Fuel Use (Gallons)	Percent of Limit [1]
1988	599,953	8.4
1989	596,794	8.4
1990	543,610	7.6
1991	887,607	12.5
1992	1,095,300	15.4

[1] *Based on consuming 7.1 million gallons.*

Table 2-3

Pollutant Emission Rates

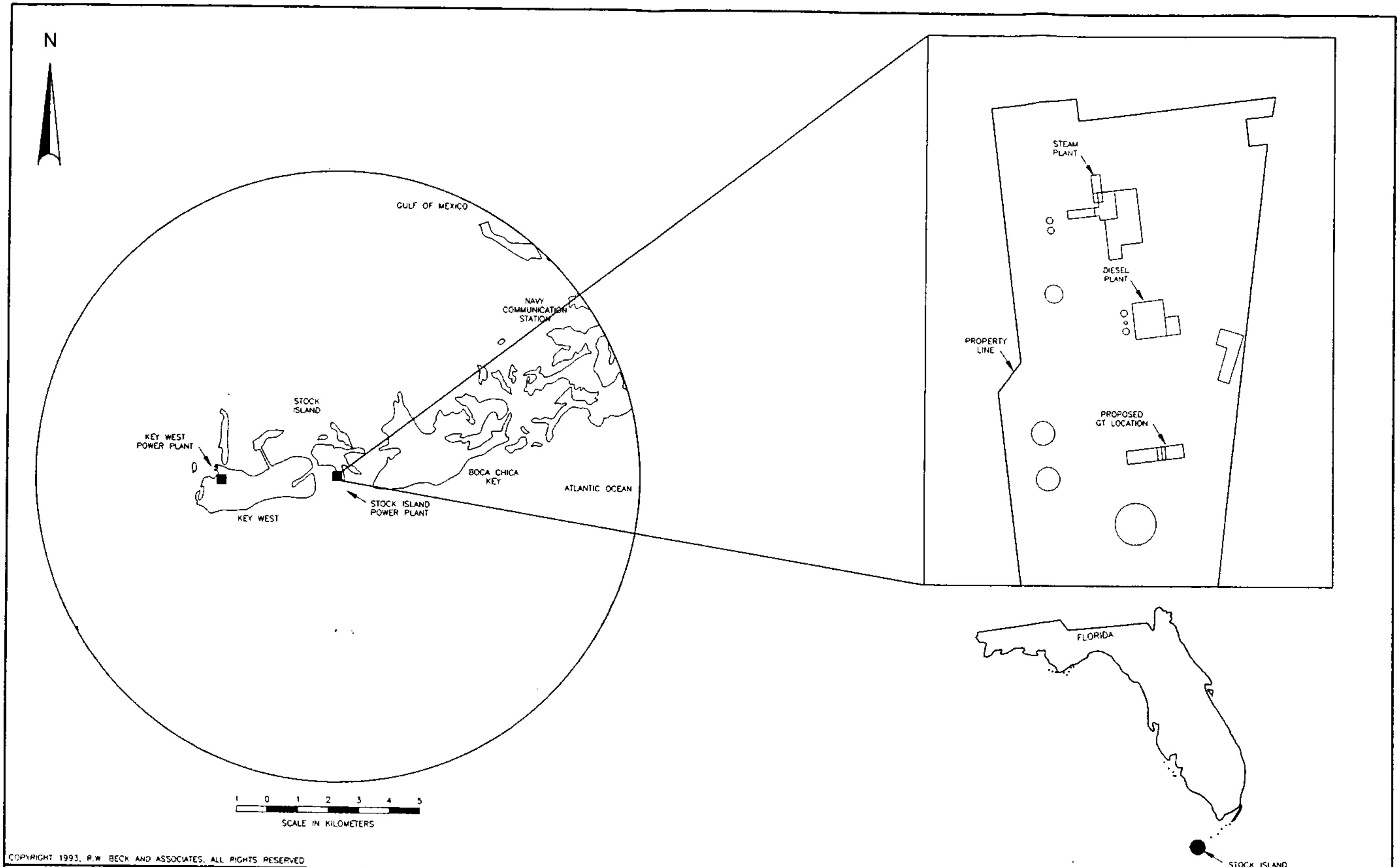
Ambient Temperature	Load	NO_x		CO		SO_2		PM		UHC	
		ppm	lb/hr	ppm	lb/hr	ppm	lb/hr	ppm	lb/hr	ppm	lb/hr
DRY OPERATION											
59°F	100	220	269	10	7	95	162	N/A	18	7	3
	75	200	196	25	15	95	129	N/A	18	9	3
	50	180	133	75	34	95	98	N/A	18	12	3
90°F	100	170	189	10	7	95	147	N/A	18	7	3
	75	150	133	25	14	95	117	N/A	18	9	3
	50	130	87	75	31	95	89	N/A	18	12	3
WITH WATER INJECTION											
59°F	100	75	96	20	16	95	168	N/A	18	7	3
	75	75	76	70	43	95	135	N/A	18	12	4
	50	75	58	136	64	95	102	N/A	18	24	6
90°F	100	75	87	15	11	95	153	N/A	18	7	3
	75	75	69	46	26	95	122	N/A	18	9	3
	50	75	53	100	43	95	93	N/A	18	17	4

Emissions based on GE Frame 5 model PG5341

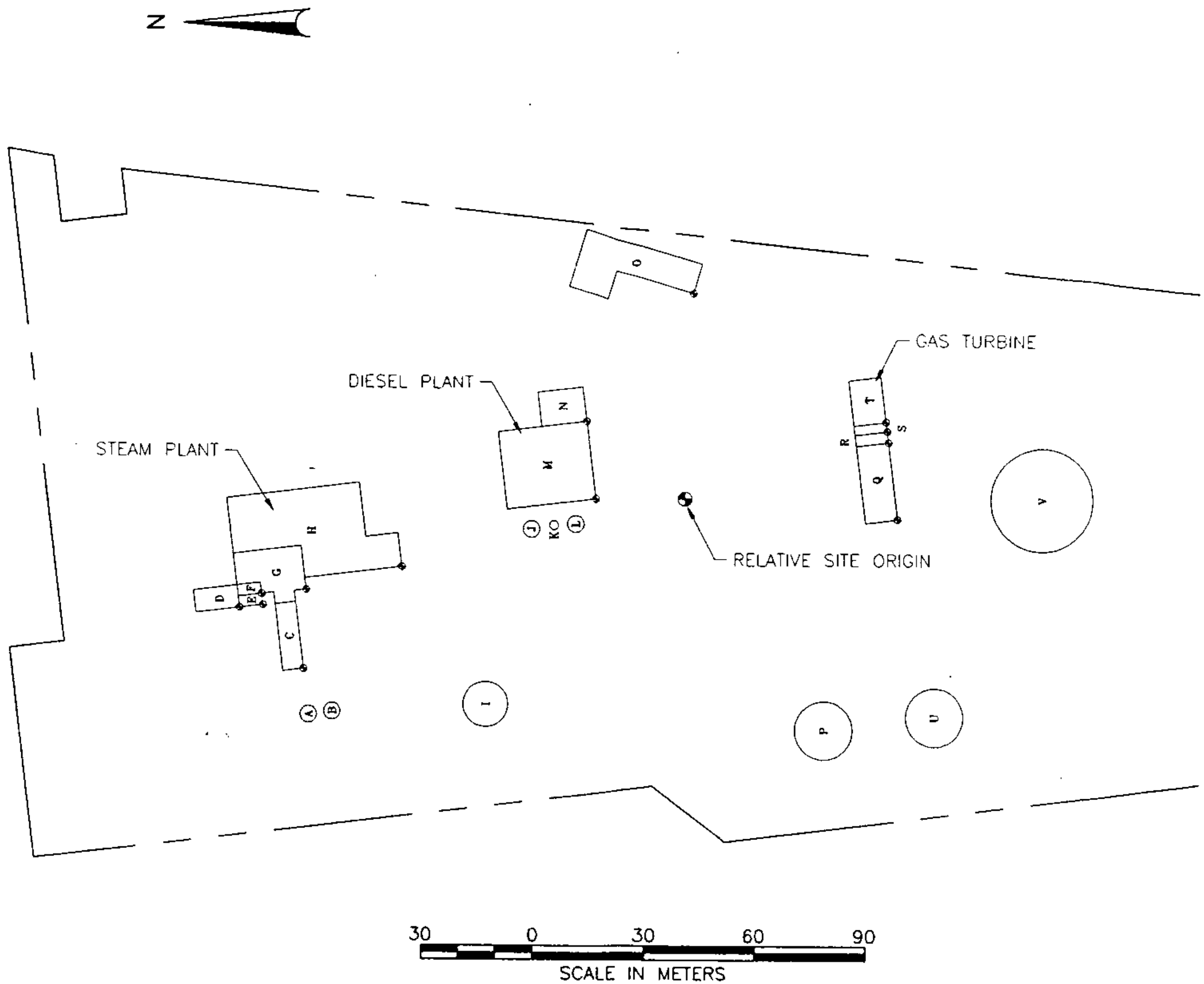
All ppm in ppmvd @ 15% O_2

NO_x as nitrogen dioxide (NO_2)

Unburned hydrocarbons expressed as methane.



REVISIONS	DATE	BY	CKD.	APP	APP.	DRAWN CHECKED APPROVED APPROVED DATE	R.W. BECK AND ASSOCIATES	STOCK ISLAND GENERATING FACILITY	FIGURE 2-1 PROXIMITY MAP AND SITE PLAN	SCALE AS SHOWN NO. 3068-SK-1 REV.



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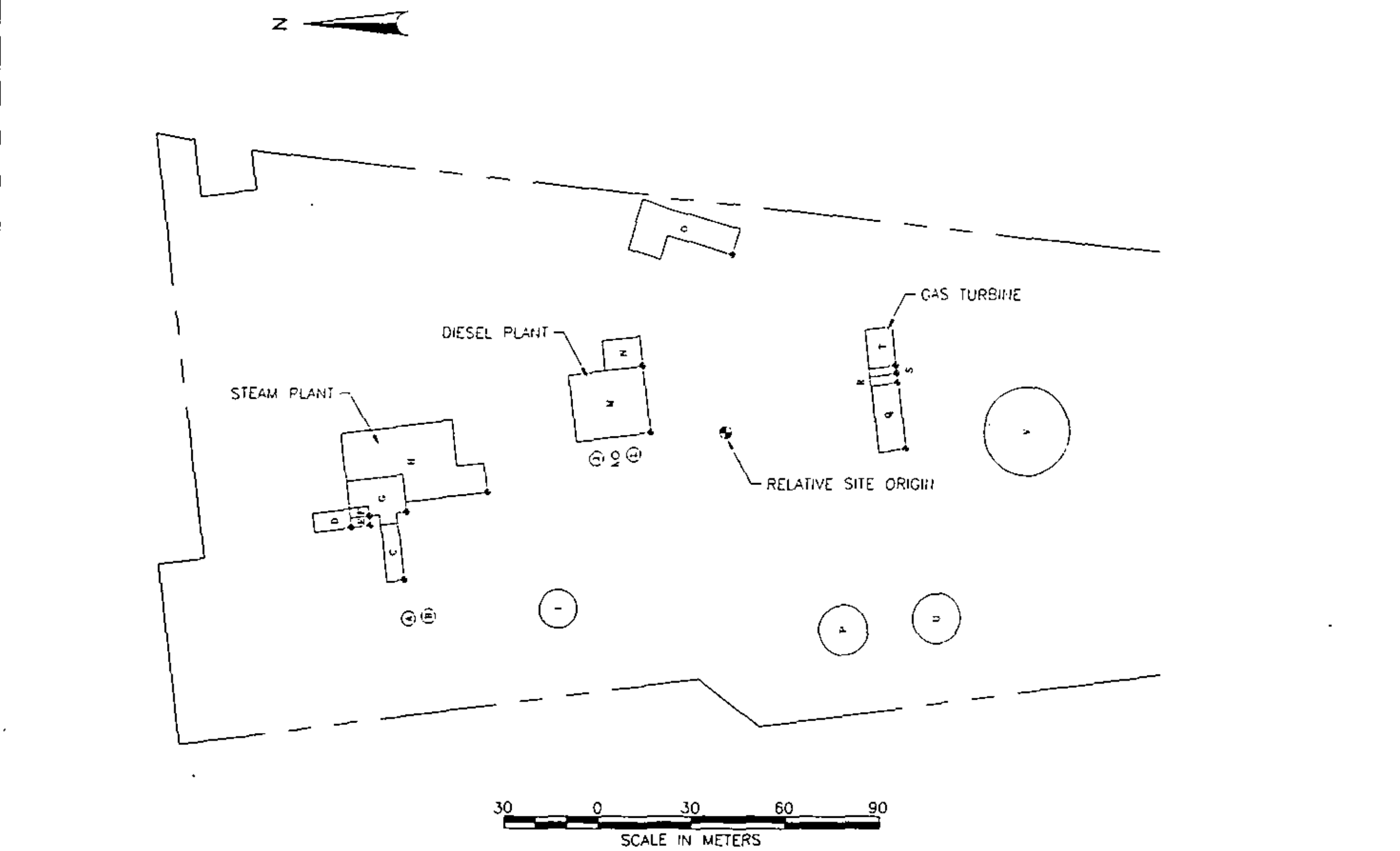
STOCK ISLAND GENERATING FACILITY

Figure 2-2
FACILTY STRUCTURES

SCALE
NO 3068-SK-2
REV.



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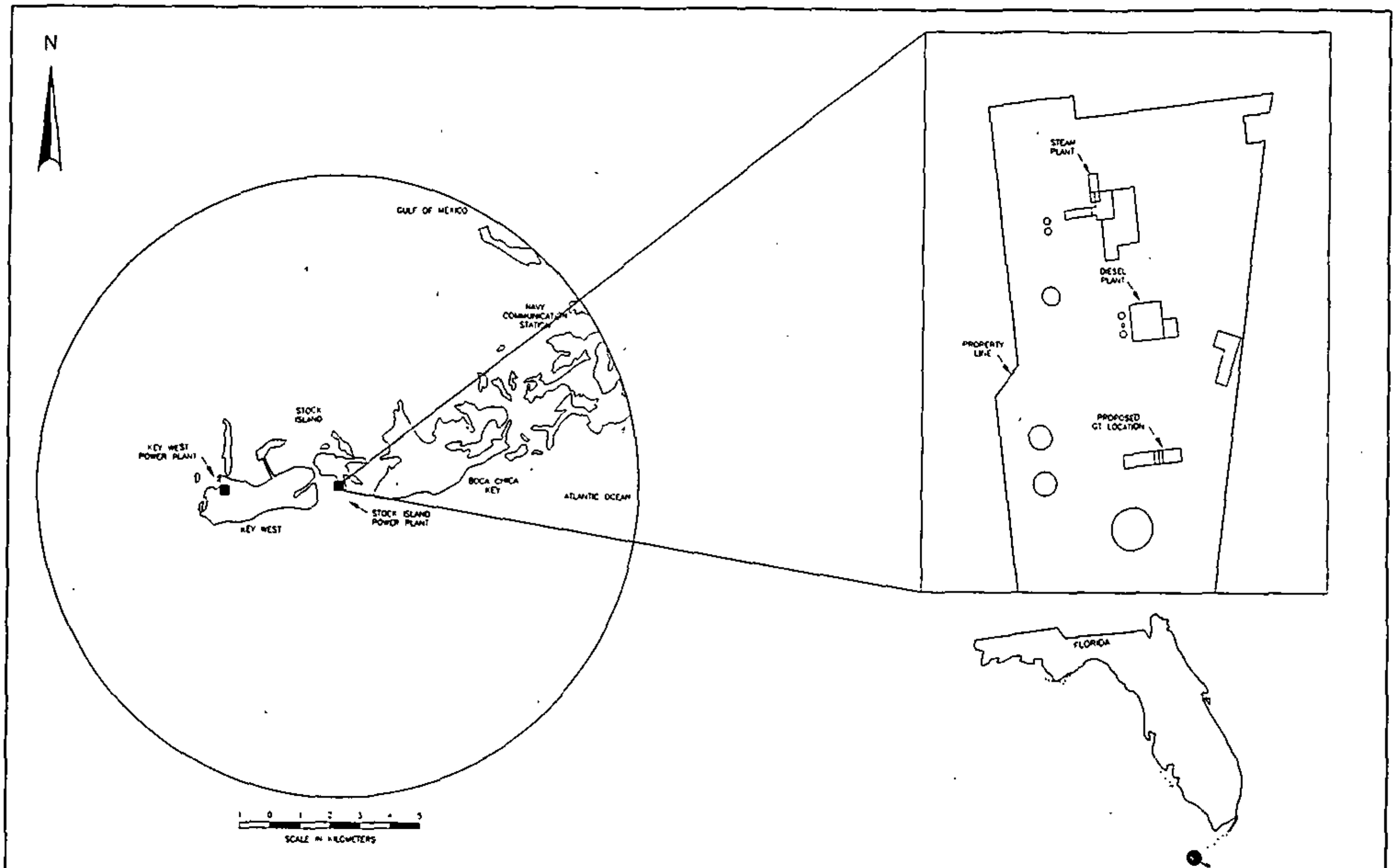
STOCK ISLAND
GENERATING FACILITY

Figure 2-2
FACILTY STRUCTURES

SCALE
NO
REV



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STOCK ISLAND GENERATING FACILITY

FIGURE 2-1
PROXIMITY MAP AND SITE PLAN

SCALE AS SHOWN
NO. 3068-S<-1
REV.

Section 3.0

LAWS AND REGULATIONS

R.W. BECK
AND ASSOCIATES

SECTION 3.0

LAWS AND REGULATIONS

The gas turbine must be constructed and operated in accordance with applicable laws, regulations, standards, policies and guidelines. This section discusses the general framework of air quality laws and regulations and the applicability of those laws and regulations to the project with respect to air pollutant emissions.

3.1 STATE REGULATIONS

The basic impetus for the legislation of state laws and regulations controlling the emission of air pollutants is derived from federal implementation of the Clean Air Act (CAA). Under federal guidance state governments must formulate a procedure to carry out the federal mandate in the form of a state implementation plan or SIP. Once approved by the USEPA, the state then retains primacy to implement the federal mandate while adapting specific rules and regulations to meet individual state requirements which are at least as stringent as those promulgated at the federal level. A fundamental example of rule adaptation is the setting of ambient air quality standards (AAQS). Florida has implemented a more stringent set of ambient air quality standards than those promulgated at the federal level.

In many instances the state has adopted the federal rules virtually verbatim, as with standards for hazardous air pollutants. In some cases, minor procedural modifications are added to conform to individual governmental requirements and procedures. The following discussion on state regulations includes the primary application and permitting requirements associated with licensing a source of air emissions in the state of Florida. Federal regulations are referenced, where appropriate, to explain procedure and applicability of other general permitting concepts presented in this section. This application conforms to the more stringent of both state and federal practices.

The Florida Department of Environmental Regulation (FDER) requires an Air Construction Permit as part of the New Source Review (NSR) for any source expected to emit any air pollutant prior to the commencement of construction or modification. General requirements for the NSR and the construction permit are listed in former Chapters 17-2 (now sub-divided and codified as Chapters 17-209, 17-210, 17-212, 17-252, 17-273, 17-275, 17-296, and 17-297) and 17-4 of the Florida Administrative Code (F.A.C.). The construction permit is issued for a specific time period that allows sufficient time for construction or modification of the proposed source. The construction permit requires compliance testing associated with applicable emission limitations at operation startup. Upon expiration of the Air Construction Permit or completion of compliance testing, an Air Operation Permit is issued for a period of five years according to 17-210.300, F.A.C. The Air Operation permit shall specify the proper operating and maintenance procedures for any air pollution control equipment as well as the manner, volume and frequency of air pollutants expected to be emitted. During start-up, shutdown and malfunctions, excess emissions greater than those specified in the Air Operation permit are allowed under Rule 17-210.700, F.A.C. for a period of less than two hours out of 24, if best operational practices are employed.

New Source and Pre-Construction Review (17-212.400(1-5), F.A.C.) for sources emitting more than 250 TPY of any pollutant include the following demonstrations: Combined impacts from the proposed and existing sources must be less than ambient air quality standards; expected air pollutant impacts must be less than area specific PSD increment levels; all pollutants emitted in significant quantities are subject to BACT review and impact analysis; an exemption in ambient air monitoring is allowed if the impacts are below the prescribed *de minimus* levels; and an ambient impact analysis must be performed in conjunction with determinations of impacts on visibility, soils and vegetation. Information on the nature, location, design capacity, mode of operation and impact calculations associated with input values must be included so that the state permitting agency can review the validity of the submitted analyses.

The FDER regulations set specific limits on significant emission rates for individual pollutants (Table 17-212.400-2, F.A.C.). FDER will also make a BACT determination utilizing previous USEPA determinations and guidelines, emission limiting standards and BACT determinations made by other states, other available scientific, engineering, and technical materials, and the social and economic impact of such technology, as outlined in Rule 17-212.410, F.A.C.

The state regulatory body has also adopted two important federal provisions which will impact the permitting of the proposed project. Rule 17-296.810, F.A.C., adopts, by reference, the national emission standards for hazardous air pollutants (NESHAP) promulgated under the Code of Federal Regulations, Title 40, Part 61.02 (40 CFR 61.02) per section 112 of the CAA. Emission standards have been defined for the following pollutants: asbestos, inorganic arsenic, beryllium, mercury and vinyl chloride. NESHAPs are generally promulgated on a source specific basis, however NESHAPs do not apply to the proposed project.

The other significant provision incorporated by reference (Rule 17-296.800) is the federal New Source Performance Standards (NSPS). The NSPS appear in 40 CFR 60. Subpart GG, 40 CFR 60.330-60.335 consists of the Standards of Performance for Stationary Gas Turbines. NSPS for combustion turbines includes emission standards for both NO_x and SO_2.

3.2 ATTAINMENT AND NONATTAINMENT AREAS

The CAA required the USEPA to establish maximum acceptable ambient concentrations, referred to as the National Ambient Air Quality Standards (NAAQS), for several criteria pollutants. The criteria pollutants are currently SO_2, NO_x, PM, CO, lead (Pb), and ozone (O_3). PM is currently regulated as total suspended particulates (TSP) and particulate matter with an aerodynamic diameter less than 10 microns (PM_{10}). NO_x is regulated as the surrogate NO_2, and O_3 is regulated through emissions of precursor volatile organic compounds.

The AAQS form the basis for the entire air quality program. Two classes of ambient air quality standards have been established: primary standards and secondary standards. The primary standards are concentration levels of pollutants in the ambient air averaged over a specific period of time that are judged necessary to protect public health with an adequate margin of safety. The secondary standards are concentration levels judged necessary to protect public welfare from any known or anticipated adverse effects of pollution (public welfare includes consideration of visibility, climate, vegetation, and many other non-health based criteria). The NAAQS are set forth in 40 CFR 50.4 through 50.12. The air quality analysis in Section 5 demonstrates that the project will comply with both the NAAQS and Florida AAQS.

Under the CAA, each state is required to attain the AAQS as a minimum. Standards for short-term averaging intervals can be exceeded once per year. A second exceedance of the AAQS in a year constitutes a violation. In general, no new source can cause or contribute to a violation of the AAQS. An area that does not meet the AAQS for a given criteria pollutant is designated as nonattainment for that pollutant. If the standards are being met, the area is designated as attainment, and if the status of attainment has not been verified through data collection, the area is unclassified. For permitting purposes, an unclassified area is treated as an attainment area. A region can be designated nonattainment for one pollutant, attainment for another pollutant, and unclassified for yet another pollutant.

3.3 PREVENTION OF SIGNIFICANT DETERIORATION

For areas where the air quality is better than the AAQS, ie., attainment areas, the USEPA has promulgated regulations to prevent further "significant" deterioration of the air quality in that area. A proposed major new or modified source in an attainment or unclassified area must obtain a PSD permit (40 CFR 52.21) before construction is allowed to begin. A "major stationary source," as defined by the PSD regulations, is any source belonging to a list of 28 specified source categories which has potential emissions of 100 TPY or more of any pollutant regulated under the PSD program. A large fossil fuel-fired steam-electric generating unit is an example of one of the 28 specified source categories. Any source category which is not included on the list, but has potential emissions of 250 TPY or more of any pollutant regulated under the PSD program, is also considered a major stationary source. A combustion turbine is an example of a source category subject to the 250 TPY threshold. Potential to emit is based on the maximum design capacity of a source, subject to federally enforceable permit limitations on such capacity (e.g., limits on the annual hours of operation) and takes into account pollution control efficiency.

Determining whether a modification to an existing source is either "major" or "minor" depends on the type of modification and whether the existing source is "major" or "minor" under the PSD regulations. A modification is defined as any physical or operational change that would cause an increase in the potential emissions of any regulated pollutant. Certain changes are excluded by the regulations from being defined as a modification. For example, an increase in the number of actual operating hours of an existing source is not considered a modification if such an increase is not specifically prohibited by a federally enforceable condition in the existing source permit.

If an existing minor source, as defined by the PSD regulations, is to undergo a physical or operational change that would cause an increase in potential emissions of any pollutant regulated under the PSD program, it would not be considered a major modification unless the net emissions increase, if taken by itself, would constitute a major source. On the other hand, if an existing major source, as defined under the PSD regulations, is to undergo either a physical or operational change that would cause an increase in potential emissions of any pollutant regulated under the PSD program, it is considered a major modification if the net emissions increase at the source is equal to or exceeds the significant emission rates for the regulated pollutants. Table 3-1 shows the significant emission rates for the applicable pollutants regulated by the FDER under the PSD program. Once a new or modified source is classified as "major," PSD NSR must be conducted for each pollutant identified in Table 3-1 with potential emissions equal to or greater than their respective significant emission rates.

3.3.1 PSD Applicability

Currently, the Stock Island power plant consists of five diesel engines and a steam unit which are considered a single source under PSD rules. Review of Table 3-2 shows that this source exceeds 250 TPY for at least one of the criteria pollutants; thus classifying the generating station as major facility for PSD permitting purposes. Emissions from the relocated GT are also presented in Table 3-2. The emissions of CO, SO_2, NO_x and PM from the GT exceed their respective significance levels and are thereby subject to PSD review and approval as a major modification to a major source. Lead emissions (not shown on Table 3-2), are considered insignificant based on the USEPA emission factor of 8.9 lbs/10^{12} Btu for distillate oil which results in approximately 0.004 tons per year vs. the 0.6 tons per year significance level. The provisions of PSD review primarily include installation of the best available control technology (BACT) and demonstration of compliance with ambient air quality standards and PSD increments. Applicable control technologies and demonstration of compliance with air quality standards are discussed in Sections 4 and 5, respectively.

3.3.2 Best Available Control Technology

The complete BACT analysis is provided in Section 4. Potential emissions from the GT will be significant for SO_2, NO_x, PM, and CO. Therefore, the design of the GT must incorporate BACT for those pollutants (40 CFR 52.21(j)). BACT is defined under the PSD regulations as:

> "an emissions limitation based on the maximum degree of reduction for each pollutant subject to regulation under the Clean Air Act which would be emitted from any proposed major stationary source or major modification which the Administrator, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such source or modification through application of production processes or available methods, systems, and techniques, including fuel cleaning or treatment or innovative fuel combustion techniques for control of such pollutant. In no event shall application of best available control technology result in emissions of any pollutant which would exceed the emissions allowed by any applicable standard under 40 CFR Parts 60 and 61. If the Administrator determines that technological or economic limitations on the application of measurement methodology to a particular emissions unit would make the imposition of an emissions standard infeasible, a design, equipment, work practice, operational standard, or combination thereof, may be prescribed instead to satisfy the requirement for the application of best available control technology. Such standard shall, to the degree possible, set forth the emissions reduction achievable by implementation of such design, equipment, work practice or operation, and shall provide for compliance by means which achieve equivalent results."

The FDER provides a similar definition of BACT in Rule 17-212.200(16).

The PSD Regulations require that the BACT determination shall not allow emissions in excess of any emission standard established under the NSPS or any other applicable section of the Regulations. The BACT requirements are intended to ensure that the control systems incorporated in the design of the GT reflect the latest in control technology used in a particular industry, in keeping with local air quality, energy, economic, and other environmental considerations. An evaluation of best available air pollution control systems is required, beginning with an analysis of those control systems "capable of lowest achievable emission rate," and continuing the evaluation to the most practical control technology available. This process is referred to as the "top-down approach" and is consistent with USEPA and FDER policy. The analysis is not required if there are no alternative control systems capable of greater pollution control efficiency than the system proposed.

3.3.3 Air Quality Analysis

An air quality impact analysis is required under the PSD regulations for those criteria pollutants which are emitted in significant amounts from a proposed new facility or a modification of an existing facility. A dispersion modeling analysis must be performed to demonstrate that the predicted ambient ground-level pollutant concentrations, caused by emissions from a proposed project in combination with background concentrations resulting from interacting sources, do not cause or contribute to a violation of the AAQS. Regulatory modeling levels of significance have been established as a guide to assist in the evaluation of a source's impact on ambient air quality (40 CFR 51.165(b)(2)). Air quality impacts below the regulatory levels of significance are not considered to cause or contribute to any violations of the AAQS. Those levels of significance have been considered in this report as discussed in Section 5.

Sections 160 - 169A of the Clean Air Act established the PSD program to prevent significant deterioration of air quality in "clean" areas. PSD Class I areas are "pristine" areas such as national parks and wilderness areas. These areas are afforded the greatest degree of air quality protection which exceeds federal AAQS. Any source located within 100 km of a Class I area must perform analyses to be submitted to the Federal Land Manager in order to determine whether the proposed source emissions will have an impact on Class I air quality.

The PSD increment program is one of the indicators of air quality degradation. A PSD increment establishes a ceiling for further air pollution and site specific increments are set for NO_x, SO_2 and PM. In addition to increment consumption, the Federal Land Manager considers visibility requirements as set forth in section 169A as well as other issues concerning habitat and vegetation that are related to air quality. Therefore, if a proposed project meets the specific increment consumption levels, but adversely affects air quality, the project may not be authorized.

The Florida Everglades, located approximately 100 km northeast of the Stock Island plant site is classified as a Class I area (Rule 17-275.800). The proximity of the plant site to the Class I area requires a determination of impacts. The results of this determination are discussed in Section 5. PSD increment consumption must also be examined for the surrounding Class II areas. The baseline concentration for each criteria pollutant is the concentration of that pollutant as recorded in January 1975. All changes at any major stationary source consume or expand increment. After the submission of the first PSD permit application in a designated area, all changes of any major or minor source also consume and expand increment. Increment consumption analyses are further discussed in Section 5.

3.4 NONATTAINMENT REVIEW

A major new source or a modification located in or having a significant air quality impact on a nonattainment area is typically subject to specific regulations under nonattainment review. Nonattainment area regulations have somewhat different definitions of major new source and major modification than the PSD regulations. However, the proposed site location and surrounding area has been designated as attainment, which precludes the project from undergoing nonattainment review.

3.5 NEW SOURCE PERFORMANCE STANDARDS

The CAA required USEPA to promulgate national emission standards for stationary sources of air pollution. The New Source Performance Standards (NSPS) are applicable to specific categories or sources and apply to new sources of air pollution as well as to modified or reconstructed existing sources. NSPS refer to "affected facilities" and "existing facilities." An affected facility means any apparatus to which a standard is applicable. An existing facility means any apparatus of the type for which a standard has been developed, but was constructed before the date of that standard. NSPS applies to new, modified or reconstructed sources for which a standard applies.

For the purposes of the NSPS, a modification is a physical or operational change to an existing facility that causes an increase in the emission rate (in mass per unit time) of any pollutant to which a standard applies. Reconstruction means the replacement of components of an existing facility whose fixed capital cost of the new components exceeds 50 percent of the fixed capital cost that would be required to construct a comparable, entirely new facility. A reconstructed facility becomes an affected facility irrespective of any changes in emission rates.

The NSPS appear in 40 CFR 60. Subpart GG, 40 CFR 60.330-60.335 consists of Standards of Performance for Stationary Gas Turbines. NSPS for gas turbines include standards for NO_x and SO_2 emissions.

<u>NSPS - NO_x</u>

The Standard for NO_x, 40 CFR 60.332, limits NO_x emissions. For gas turbines with heat input at peak load greater than 100×10^6 Btu/hr based on the LHV of the fuel fired, the limit is a level of 0.0075 percent by volume on a dry basis corrected to 15% O_2 and ISO conditions, plus an allowance for fuel-bound nitrogen:

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

where:

STD = allowable NO_x emissions, percent by dry volume corrected to 15% O_2.
Y = manufacturer's rated or actual measured heat rate, kilojoules per watt-hour.
F = allowance for fuel-bound nitrogen

The minimum 0.0075 percent is increased depending on the particular turbine's rated or measured heat rate at peak load, in inverse proportion to the heat rate (Y) up to a maximum of 14.4 kilojoules per watt-hour (13,658 Btu/kWh) at ISO (59°F ambient temperature, 60% relative humidity) conditions. The proposed PG5341 has a heat input at baseload of approximately 299 MMBtu/hr (LHV) and a heat rate of 12,709 Btu/kWh.

The allowance (F) for fuel-bound nitrogen ranges from:

$F = 0$
for fuel-bound nitrogen content of the fuel (N) less than or equal to 0.015 percent by weight.

$F = 0.04\ (N)$
for N greater than 0.015 and less than or equal to 0.1.

$F = 0.004 + 0.0067\ (N - 0.1)$
for N greater than 0.1 and less than equal to 0.25.

$F = 0.005$
for N greater than 0.25.

A typical ultimate analysis for No. 2 fuel oil shows the nitrogen content to be 0.006% by weight. For this fuel, F would equal zero. NO_x emissions allowed by NSPS for the proposed gas turbine would be 0.0081% or 81 ppmvd corrected to 15% O_2 and ISO conditions. It should be noted that while a typical analysis of No. 2 fuel oil shows a very small nitrogen content, it varies widely and could affect the standard. NO_x emissions from the proposed turbine will be less than the applicable NSPS.

NSPS - SO_2

The Standard for SO_2, 40 CFR 60.333, limits SO_2 emissions from turbines to a maximum of 0.015 percent by dry volume, or 150 ppmvd @ 15% O_2. The Standard also limits fuel sulfur content to a maximum of 0.8 percent by weight.

Sulfur content of the No. 2 fuel oil for use at the proposed project will not exceed 0.5 percent by weight. Corresponding SO_2 emissions will be approximately 95 ppmvd @ 15% O_2, i.e., less than the applicable NSPS.

3.6 NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS

Under Section 112 of the CAA, the EPA is required to publish a list identifying hazardous air pollutants for which National Emission Standards for Hazardous Air Pollutants (NESHAP) would be developed. Emission standards have been promulgated for specific industries for the following pollutants : asbestos, inorganic arsenic, beryllium, mercury and vinyl chloride (40 CFR 61). None of the promulgated NESHAPs apply to the proposed project.

Table 3-1

Regulated Significant Emissions Rates

Pollutant	Emissions Rate (tons/yr)
Carbon monoxide (CO)	100
Nitrogen oxides (NO_x)	40
Sulfur dioxide (SO_2)	40
Particulate Matter (Total)	25
Particulate Matter (PM-10)	15
Ozone (VOC)	40 (of VOCs)

Source: Table FAC 212.400-2

Table 3-2

Emissions Rates From Stock Island and Proposed Gas Turbine

Pollutant	Emissions (TPY) Stock Island: Diesel Engines[1]	Emissions (TPY) Stock Island: Steam Unit	Emissions (TPY) Stock Island: Total(1)	Gas Turbine	Significance Rate (TPY)
CO	100	42	142	152	100
NO_x	301	1,330	1,631	138	40
SO_2	82	5,230	5,312	243	40
PM (Total)	16	191	207	43	25
PM (PM_{10})	16	191	207	43	15
O_3 (VOC)	50	17	67	15	40

(1) Does not include high speed diesel engines at Stock Island since data demonstrate conclusively that the generating station is a major stationary source.

Section 4.0

BEST AVAILABLE CONTROL TECHNOLOGY ANALYSIS

R.W. BECK AND ASSOCIATES

SECTION 4.0

BEST AVAILABLE CONTROL TECHNOLOGY ANALYSIS

4.1 SUMMARY OF BACT ANALYSIS

This Best Available Control Technology (BACT) analysis is submitted as part of the Prevention of Significant Deterioration (PSD) application. The modification to the Stock Island Facility will consist of moving one General Electric Frame 5 (PG5341) simple cycle gas turbine generator to the Facility from the nearby Key West Power Plant. No changes to operation of the GT are proposed since the relocation is only a consolidation of operations. Although the power plants are close to each other, they are not contiguous. The gas turbine generator is rated at 24,169 kW electrical output at 59 °F ambient temperature with a heat input of 311.6 MMBtu/hr and water injection ratio of 0.4 lb water/lb fuel. Diesel fuel oil (#2 oil with a maximum sulfur content of 0.5%) will be the fuel burned. Water injection will be used to control oxides of nitrogen (NO_x) to approximately 75 parts per million on a dry basis (ppmvd) at 15% O_2. The information contained herein is based on vendor supplied performance data and a concept design for the Facility.

4.2 BACT REQUIREMENT

PSD review and approval is required for those pollutants emitted from the proposed unit in significant quantities. Among the requirements for PSD approval, a BACT analysis must be performed to demonstrate that the control of those air pollutant emissions from the proposed unit will represent BACT. BACT is determined on a case-by-case basis, and is defined as an emission limitation based on the maximum achievable degree of reduction of any regulated air contaminant emitted from or which results from the source, taking into account technical feasibility, as well as economic, energy, and environmental impacts. Additionally, the BACT determination can be no less stringent than the New Source Performance Standards (NSPS) promulgated for the source being analyzed. NSPS for the proposed gas turbine apply only to NO_x and SO_2 emissions, and are addressed in detail in Section 3.0 of this application.

Based on USEPA policy, a BACT analysis should utilize a "top-down" procedure which requires identifying and implementing the most stringent, technically feasible control unless economic, energy, or environmental impacts can be shown to be excessive. If the impacts associated with the most stringent control are shown to be excessive, the next most stringent level of control is analyzed to determine economic, energy, and environmental impacts. This procedure is followed until the most effective, technically feasible control is identified for which the impacts are not excessive (USEPA, 1990). This "top-down" procedure has been implemented in the BACT analysis presented herein.

4.3 IMPACT ANALYSIS APPROACH

A BACT analysis uses impact considerations to exclude certain feasible control technologies which have excessive economic, energy, or environmental impacts. The approach to the economic analysis is to document estimates of capital and operating expenditures for each pollution control technology determined to be technically feasible for the proposed generating unit. Capital costs include both the purchase cost of the various components of the complete control system as well as installation costs. The annual operating costs consist of the financial requirements to operate the control system including overhead, maintenance, labor, raw materials, utilities, and other expenses incurred over the life of the project as a result of the application of the control technology. The general approach to cost estimating for a BACT analysis is outlined in the OAQPS Cost Manual (USEPA, 1990).

After the capital and operating expenses are determined for the pollution control alternatives, the cost effectiveness of each alternative is calculated based on the annualized cost of the control system (annualized capital costs and annual operating costs) and the associated annual pollutant reduction. Cost effectiveness is calculated by dividing the total annualized cost of an alternative by the tons of pollutant removed by that alternative per year. The incremental cost effectiveness is calculated as the differential cost between two pollution control alternatives divided by the net reduction in emissions between the alternatives. Both overall and incremental cost effectiveness can be examined in order to justify elimination of a control option.

Energy impacts are a result of decreased engine efficiency under some alternate pollution control technology scenarios. Energy impacts have been set forth below and have been converted to an economic basis and included in the economic analysis. Environmental impacts differ for each control alternative and are related to emission rates, with greater impacts associated with high emissions. These impacts are also discussed for the various control alternatives.

4.4 EMISSION RATES

Emission rates for the gas turbine (GT) were based on vendor performance data for similar units. Table 4-1 presents expected worst-case hourly and annual pollutant emission rates for the proposed gas turbine with uncontrolled emissions, as well as emissions controlled by use of water injection. The calculation of tons per year removed for the purposes of control equipment cost effectiveness is based on the values in Table 4-1 as limited by the annual consumption of 7.1 million gallons of fuel.

In Table 4-1, hydrocarbon values represent total unburned hydrocarbons (UHC). Nonmethane volatile organic compounds (VOC) emitted from gas turbines when firing distillate fuels typically comprise only 30% to 60% of the total UHC. Emissions of SO_2 were calculated from fuel flow based on the unit burning No. 2 fuel oil with a sulfur content of 0.5 percent by weight. It was conservatively assumed that all of the sulfur in the fuel would oxidize and be emitted as SO_2.

The GT is currently permitted to operate for a maximum of 2888.5 hours per year consistent with a peak load unit. This corresponds to a fuel consumption limitation of 7.1 million gallons per year at full load and ISO conditions. In an effort to provide greater operating flexibility, to implement more efficient and simplified compliance tracking, and to be consistent with recent permits emphasizing enforceable conditions, CES is requesting that the unit only be limited to burning 7.1 million gallons of fuel per year and not be restricted by hours of operation. This is a rational approach since the unit cycles with load and is affected by ambient conditions. The BACT analysis presented below and the air quality analysis presented in Section 5 incorporate this fuel restriction.

Annual emissions presented in Table 4-1 were calculated based on consumption of 7.1 million gallons of fuel at base load or 50% load, depending on the pollutant, so as to represent worst case possible annual emissions for each pollutant. Additionally, emissions were evaluated at an ambient temperature of 59°F because it represents worst case emissions, as it is less than the monthly average temperature in Key West, Florida of approximately 77°F. The emission levels in Table 4-1 indicate that emissions are significant with respect to PSD thresholds for four pollutants (NO_x, CO, SO_2 and PM_{10}). Therefore, each of these pollutants requires a BACT determination.

4.5 ORGANIZATION OF BACT ANALYSIS

The following sections discuss alternative control techniques and devices for the proposed gas turbine and provide an analysis of the impacts of these alternative control technologies. Each section of the analysis for each pollutant includes an introduction, the control levels of previously permitted projects from review of BACT/LAER Clearinghouse information, the BACT/LAER Information System (BLIS) database and other sources, a description of the various control technologies and their respective technical feasibility, and an analysis of economic, energy, and environmental impacts. Control methods and devices found to be technically infeasible are identified and the basis for the finding is discussed. Technically infeasible controls are excluded from further analysis. The remaining control options are listed in order of most stringent to least stringent. Starting with the most stringent, each control option is evaluated with respect to its economic, energy, and environmental impacts. The first acceptable option is chosen as BACT without analyzing the remaining less effective control strategies.

4.6 BACT FOR NITROGEN OXIDES

4.6.1 Introduction

Oxides of nitrogen (NO_x) are formed in combustion sources by the thermal oxidation of nitrogen in the combustion air and the reduction and subsequent oxidation of fuel bound nitrogen. The predominant mechanism for NO_x formation in the turbine is through thermal oxidation of nitrogen in the combustion air. The rate of formation of thermal NO_x is a function of the residence time, free oxygen, turbulence, and peak flame temperature. Primary control techniques for thermal NO_x are aimed at minimizing one or more of these variables. Other secondary control methods, involving post-combustion techniques, remove NO_x from the exhaust gas stream. All NO_x emissions are considered nitrogen dioxide (NO_2) emissions.

4.6.2 Permitted Control Levels - Previous BACT Determinations

A search of BACT/LAER Clearinghouse documents published by the USEPA was performed to investigate recent BACT determinations for gas turbines. Several permits not discussed in the documents have been collected and are noted herein. Permitting agencies were also contacted for information. Additionally, a review of USEPA's new BLIS database was performed to identify BACT determinations made for gas turbines within the last five years. Review of the BLIS, however, was complicated by a lack of comprehensive, uniform, and sometimes accurate data reporting for each determination. It was, therefore, difficult to ascertain all pertinent information concerning each determination, such as whether a particular unit is simple cycle, combined cycle, oil fired only, gas and oil fired, etc.

NO_x emission limits identified in BACT determinations for gas turbines ranged from 6 to 225 ppmvd @ 15% O_2. Those units which employed selective catalytic reduction (SCR) for NO_x emissions control were found to have emission limits in the range of 6 to 25 ppmvd @ 15% O_2. The majority of the remaining projects identified in the BACT/LAER Clearinghouse and BLIS utilized water injection or steam injection as their primary method of control for NO_x emissions, with the balance using low NO_x combustors. NO_x emission limits from these units generally ranged from 25 to 100 ppmvd @ 15% O_2.

NO_x emission limits from simple-cycle and combined-cycle units which were identified to fire oil only, or oil as a secondary fuel, ranged from 42 ppm to 100 ppm during oil firing. BACT determinations for the only GE frame 5 machines identified were 65 ppm and 59 ppm. The units limited to 59 ppm are further discussed below. Three latest technology (100 MW unit capability) machines in Virginia achieve 42 ppm with an advanced combustion system. Three mid-range machines in Connecticut (identified in conversation with the Agency) also achieve 42 ppm with advanced combustors. Table 4-2 includes determinations (41 gas turbines) with specified NO_x limits on oil, separated into oil fueled only and primary gas fueled. All of the units have water or steam injection.

A distinguishing factor between the projects identified in the BACT/LAER Clearinghouse and BLIS, and the proposed project, is that the facilities where SCR has been applied are fired on natural gas as their primary fuel and are equipped with a heat recovery steam generator (HRSG). While only limited data is available regarding SCR application with liquid fuel firing, experience shows that fouling and degradation can occur (see Section 4.6.3). No projects were identified where SCR was used in conjunction with liquid fuel as the primary fuel or with simple cycle turbines. Further, the permits reviewed which required SCR when operating on gas, provided for bypass of the SCR system when firing oil.

Two projects of interest which have recently been permitted in Florida include the Pasco Cogeneration Project and the Hardee Power Station. The Pasco project is a 108 MW combined cycle cogeneration facility which consists of two gas turbines exhausting through two heat recovery steam generators (HRSGs). The Hardee project is a 295 MW combined cycle cogeneration facility which consists of two gas turbines which exhaust through one HRSG and a 75 MW stand-alone gas turbine. Both facilities fire primarily natural gas, with No. 2 fuel oil as backup. BACT for NO_x for both projects was determined to be water injection, with an emission limit of 42 ppmvd @ 15% O_2 during oil firing for the Pasco project and 65 ppmvd @ 15% O_2 during oil firing for the Hardee project. It should be noted that both of these projects utilize newer model gas turbines with advanced combustors. By design these engines emit less NO_x emissions than do older gas turbines (such as the gas turbine proposed herein), and thus are capable of achieving relatively low NO_x emissions when using water injection.

An additional project of interest is the Dededo Generating Station located on Guam. The station will consist of two simple cycle GE Frame 5 (PG5371) gas turbines fired only on No. 2 fuel oil. BACT for NO_x from these two units was determined by USEPA Region IX to be 59 ppmvd @ 15% O_2 using water injection. However, to date, a final permit has not been issued, and neither of these units have been tested under NSPS emissions testing requirements to verify whether they are able to comply with this limit.

In summary, based on the BACT/LAER Clearinghouse and BLIS review, emission limits for facilities operating on natural gas with an SCR are in the range of 6 to 25 ppmvd @ 15% O_2. Facilities operating on natural gas not equipped with SCR have emission limits in the range of 25 to 42 ppmvd @ 15% O_2, when equipped with water or steam injection. Facilities operating on distillate oil and equipped with water or steam injection have limits from 65 to 100 ppmvd @ 15% O_2, with a limited number of new units having limits in the range of 42 to 65 ppmvd @ 15% O_2.

4.6.3 Technical Analysis

Control technologies available for gas turbines, from the most stringent to the least stringent level of control, are identified as follows:

1. Selective Catalytic Reduction (SCR)
2. Low NO_x combustors

3. Water or Steam Injection

These alternatives are described below.

Selective Catalytic Reduction

SCR technology has been applied effectively to natural gas-fired, combined cycle gas turbine systems. In SCR systems, ammonia is injected into the flue gas upstream of the catalyst bed, where NO_x and ammonia react on the catalyst surface forming nitrogen and water. There are several types of commercially available SCR catalysts including platinum-based, vanadium-based, and zeolite and ceramic molecular sieve-based catalysts. The commercial availability varies for each type of flue gas to be treated. Each catalyst exhibits advantages and disadvantages in terms of operating temperature, ammonia/NO_x ratio, and optimum oxygen concentration. The function of the catalyst is to effectively lower the activation energy of the NO_x reduction reaction. Thus, the reaction is allowed to proceed at lower temperatures than normally required.

The rate at which the reactions proceed that reduce NO_x to molecular nitrogen and water are, even on the catalyst surface, a function of reactant concentration and temperature. A characteristic common to all types of SCR systems is the narrow "window" of temperatures in which the reactions are optimized. According to catalyst vendors, the optimum temperature range for operating an SCR system is between 550°F - 770°F. Operation above the optimum temperature could result in the formation of NO_x from ammonia as well as damage to the SCR system. Operation below the minimum temperature results in no substantial reduction of NO_x. The SCR process typically employs a relatively low ammonia to NO_x stoichiometric ratio (a molar ratio of between 1.0 to 1.2). In order for this system to be effective as a pollution control technique, the injected ammonia must be carefully balanced with the NO_x concentration in the exhaust gas stream. Too much ammonia results in the discharge of unreacted ammonia. This phenomenon is referred to as "ammonia slip." Because the NO_x reduction is a complex function of both the temperature and reactant concentration, the proper control of an SCR unit is far more complex for a relatively dynamic simple cycle gas turbine than for a relatively stable combined cycle power plant. Even in an optimally tuned and operated system, ammonia slip is almost certain to occur.

The SCR catalyst is subject to loss of catalyst activity over time. Since the catalyst itself is the most costly part of the process, steps to prevent catalyst deactivation must be taken to optimize economical operation of the process. Catalyst deactivation occurs through either physical masking or chemical poisoning. The former is generally the result of either prolonged exposure to excess temperature or masking of the catalyst due to adhesion of particulate matter on the catalyst surface. Chemical poisoning is caused by the irreversible reaction of the catalyst with contaminant(s) in the gas stream, and is a permanent condition. The presence of heavy metals in a gas stream is often responsible for the permanent deactivation of a catalyst through poisoning. It is typical for catalyst suppliers to assign a two to three year lifetime to catalyst systems employed on gas turbines firing natural gas, which correlates to a loss of approximately

33 to 50 percent of catalyst life per year. The loss rate associated with operation on diesel fuel oil is expected to be much higher. In fact, limited experience on liquid fuel fired units indicates significant operating problems. In addition, because of the presence of trace amounts of certain metals and sulfur naturally occurring in distillate fuel, the potential for catalyst deactivation is increased over natural gas firing. The sulfur content of the No. 2 fuel oil which will be fired is approximately 0.5%. Catalyst poisoning and contamination when firing distillate oil is expected to be substantially worse than the poisoning which occurs when firing natural gas, in part because of the lack of sulfur in natural gas.

Limited data is available which describes the effects of the reaction products of ammonia with SO_2 and sulfur trioxide (SO_3) on the SCR catalyst during distillate oil firing. However, it has been reported that the United Airlines Cogeneration Facility in San Francisco experienced severe operating problems with SCR unit fouling during light oil (Jet A) firing (Jet A fuel contains less sulfur, ash, and trace elements than No. 2 fuel oil). In the case of United, the facility was permitted to fire primarily natural gas with low sulfur Jet A fuel as back up. During the first year of operation when back up oil was fired for approximately 2,500 hours, the entire catalyst was replaced three times. Subsequently the facility will no longer fire oil.

With respect to specific application on gas turbines, SCR is considered a proven technology for base load natural gas-fired combined cycle turbine operation. Base load plants operate at relatively constant energy output throughout the year, and the temperature profile in the HRSG of the base load combined cycle plant remains constant with time. Because of the temperature profile through the HRSG, the SCR can be placed in the optimum location to ensure the proper operating temperature for maximum NO_x reduction. This is in contrast to simple cycle peaking gas turbines such as the one proposed herein. A distinct difference between the two modes of operation (base load combined cycle vs. simple cycle) involves the exhaust gas temperature. The exhaust temperature associated with simple cycle operation is higher than the exhaust temperature associated with combined cycle operation employing an HRSG. Without the HRSG, the exhaust gas can be well over 900°F, which poses the risk of permanently damaging the catalyst and is high enough that the ammonia can be oxidized to NO_x. The HRSG allows attainment of, and provides relative stability within the optimum temperature range for catalyst operation, which is typically in the 550°F - 770°F range.

Virtually all of the recent experience with the application of SCR to combustion sources has been associated with natural gas fired combined cycle installations with the SCR system installed in the HRSG. While vendors at the present time are working to develop high temperature catalysts, we are not aware of any high temperature catalyst application on any simple cycle combustion units. Hence, operating experience is not available for the specific application involved in this project.

Therefore, based on the high temperature of the exhaust gas, the sulfur content of the available fuel, the experience at the United facility, the lack of any BACT determination requiring SCR on a simple cycle gas turbine, the commercial unavailability of an SCR system for this type of application, and the potential environmental impacts associated with SCR catalyst materials and reagents, SCR is not a technically feasible option for this application.

Dry Low-NO_x Burners

Dry low-NO_x burners are referred to as dry since no water or steam is utilized in achieving the NO_x reduction. Many of these burners work by first burning the fuel without sufficient air to complete the combustion reaction. This substoichiometric firing results in lower initial temperature. More air is then added further downstream, where the temperature is still high enough to complete the combustion process. Other systems pre-mix combustion air and natural gas to reduce "hot spots" in the combustion process. These burners produce an overall decreased temperature in the combustion zone resulting in lower thermal NO_x production.

The dry low-NO_x combustors are primarily utilized when natural gas is the fuel fired. Emission levels of approximately 25 ppmvd @ 15% O_2 are guaranteed by major manufacturers such as GE and Asea Brown Boveri. However, when the fuel fired is distillate oil, water or steam injection must be utilized along with dry low-NO_x combustors to obtain emission levels comparable to those which are obtained by the use of conventional combustors with the application of water or steam injection. Therefore, the use of a dry combustor when firing fuel oil does not offer any distinct advantages over conventional water or steam injection systems. Further, and more importantly, dry low-NO_x burners are not available for the proposed gas turbine. Thus dry low NO_x burner technology is not evaluated further in this BACT analysis.

Water or Steam Injection

Water injection and steam injection are the most commonly used technologies for NO_x control on simple cycle and combined cycle gas turbines, respectively. Water or steam can be injected directly into the combustion zone to reduce flame temperature, thereby limiting the amount of thermal NO_x formed. When firing natural gas, this is accomplished by injection through separate concentric annular spaces in the fuel manifold. On liquid fuel, the fuel and water (or steam) are premixed and injected through the same nozzles. The water or steam injected into the gas turbine is emitted through the gas turbine stack as steam along with the flue gas from the combustion process.

Major manufacturers such as General Electric, Westinghouse, and ASEA Brown Boveri, have recently begun to offer commercial guarantees of 25 ppmvd @ 15% O_2 using steam or water injection for large gas turbines fired with natural gas. The distinction between water and steam injection is important because the technologies of maintaining efficient combustion while injecting the two diluents are somewhat different, and steam from an HRSG is unavailable to the proposed gas turbine. It is more difficult to achieve high NO_x control efficiency and maintain required combustion performance with water injection than with steam. This is because the water droplets have a greater tendency to quench the combustion process, which decreases efficiency and results in higher CO emissions. Therefore, demonstrated experience with water injection to extremely low levels of NO_x is not readily available. Although the aforementioned manufacturers have stated that they will offer NO_x emission guarantees of 25 ppmvd @ 15% O_2 on new engines, and have done so in certain cases, the commercial operating experience at these levels is limited. All of these progressive reductions in NO_x to date, primarily with gas fuel, have been accomplished by improvements in the combustor design to allow increases in water-to-fuel ratios without significant interference in the combustion process. However, these decreases in NO_x have come with the penalty or trade-off of increases in CO emissions. Additionally, it is important to recognize the consequences of water injection to very low levels of NO_x on a gas turbine. Water injection causes the combustor and the hot gas path to wear faster than dry operation. The result is more frequent inspections, maintenance, overhauls, and reduced turbine life. This adds a significant operating expense, and the turbine may be out of service for extended periods during the inspections, maintenance, and overhauls.

It should be noted that NO_x levels of between 25 and 42 ppm have been obtained only when firing natural gas. When firing distillate oil, the typical manufacturers' guarantees vary between 42 and 75 ppmvd @ 15% O_2. It is emphasized that the levels near 42 ppmvd @ 15% O_2 are guaranteed only for fuels containing less than approximately 0.015 percent fuel bound nitrogen. It is not uncommon for fuel oil to contain 0.03% to 0.05% nitrogen, which will increase NO_x emissions. Most of these units burn natural gas as a primary fuel source with fuel oil as back-up. Additionally, it is important to note that these NO_x guarantees are for relatively new machines, and that the gas turbine proposed herein was first installed and operational in December 1978. Therefore, based on typical manufacturer's guarantees, review of other BACT determinations for simple cycle gas turbines firing oil, and consideration of the type and age of the unit proposed herein, water injection to 65 ppmvd @ 15% O_2 is the maximum technically feasible NO_x emission limit achievable by the gas turbine proposed herein.

4.6.4 Economic, Energy, and Environmental Considerations

Economic, energy, and environmental impact analyses are not provided for SCR or dry low-NO_x burners because they have been shown to be technically infeasible and impractical for this application. Water injection and steam injection are the most stringent remaining control technologies available, and are similarly effective in controlling NO_x emissions. A water injection system is already incorporated in the proposed gas turbine capable of meeting its currently permitted NO_x emissions limitation of 75 ppmvd @ 15% O_2 (specific condition 2). Although steam could be headered to the GT from the Stock Island steam unit, such action would decrease the reliability of the GT since the steam unit would be an integral part of the GT operation. Therefore, water injection was analyzed for economic, energy, and environmental impacts.

The capital costs and annualized costs for NO_x control by water injection have been estimated by accounting for relevant factors outlined in the USEPA OAQPS Cost Manual (presented in Tables 4-3 and 4-4, respectively). The costs are itemized to include capital and installation costs of equipment required such as turbine modifications, ancillary equipment, and additional instrumentation. Direct and indirect operation costs primarily include operating personnel, maintenance, replacement parts, energy penalties and utilities. Table 4-5 depicts the capital costs estimated for NO_x control by water injection to 65 ppmvd @ 15% O_2 and 75 ppmvd @ 15% O_2 for the proposed gas turbine. The difference in capital expenditures is related to the modifications which must be made to the existing unit to achieve 65 ppm NO_x. Table 4-6 depicts the annualized costs for both cases, as well as the incremental costs to reduce NO_x emissions from 75 ppmvd @ 15% O_2 to 65 ppmvd @ 15% O_2 for the proposed unit.

Energy impacts associated with water injection consist primarily of a fuel penalty due to an increase in the heat rate of the gas turbine. This impact has been included in the operating cost of the system. The primary environmental impact associated with water injection into a gas turbine is an increase in CO emissions. This is due to reduced combustion flame temperature as a result of water injection. Both of these environmental impacts can be expected to increase as NO_x emissions are decreased.

Water Injection to 65 ppmvd @ 15% O_2

NO_x emissions reduction to 65 ppmvd @ 15% O_2 for the proposed unit is technically feasible. However, meeting this limit would require modifications to the turbine's existing water injection system and an increase in demineralized water supply. The total capital cost for a water injection system capable of meeting 65 ppmvd @ 15% O_2 is estimated at $820,000. The total annualized cost is estimated at $727,000 per year. This equates to a cost per ton NO_x removed of $2,754 based on full load operation and the annual fuel consumption limit. The incremental cost for additional water injection capacity to reduce NO_x emissions from the current 75 ppmvd @ 15% O_2 to 65 ppmvd @ 15% O_2 is estimated to be $15,505 per ton. This cost is excessive. Further, given the unit's historical operation at less than 500 hours per year, modifying the engine to achieve 65 ppmvd @ 15% O_2 would be even less cost effective than shown here. Therefore, water injection to NO_x emissions of 75 ppmvd @ 15% O_2 was evaluated.

Water Injection to 75 ppmvd @ 15% O_2

The Key West GT is currently equipped to meet this NO_x limitation. The total capital cost for a water injection system capable of meeting 75 ppmvd @ 15% O_2 is estimated at $720,000 and the total annualized cost is estimated at $519,000 per year. This equates to a cost per ton NO_x removed of $2,070 based on full load operation and the annual fuel consumption limit. This is considered cost effective. The gas turbine is currently equipped with a water injection system capable of meeting this NO_x limitation. The environmental and energy impacts associated with this control option are not considered excessive, and in fact are of a lesser magnitude than would be the case for water injection to 65 ppmvd @ 15% O_2. Consequently, no other control technologies are evaluated in this analysis. Water injection to 75 ppmvd @ 15% O_2 is the most stringent, technically feasible, cost-effective control, and has met the criteria used to determine BACT.

4.6.5 NOx BACT Conclusions

The most stringent control technology option for NO_x associated with combustion source operation is the SCR system. The SCR system should not be judged as representing BACT because:

1. SCR has not been commercially used on simple cycle units fired with liquid fuel.
2. The exhaust temperature of simple cycle units is higher than the optimum temperature of the conventional catalyst and cycling operation will significantly decrease catalyst life.
3. Although manufacturers are presently developing high temperature catalysts, such catalysts have not yet been used on comparable units.
4. Contaminants such as trace metals, ash, and sulfur in the fuel oil would deactivate the catalyst.
5. The potential adverse environmental impacts associated with ammonia slip, ammonia transportation, handling and storage, and catalyst disposal are greater than other control alternatives.

The next most stringent control technology after SCR is dry low-NO_x combustors. This technology should not be viewed as representing BACT for NO_x control because:

1. Dry low-NO_x burners are currently unavailable for retrofit on GE Frame 5 gas turbines.
2. Dry low-NO_x burners when firing fuel oil do not offer significant advantages over conventional water or steam injection.

The next most stringent control technology is water injection to 65 ppmvd @ 15% O_2. This technology should not be viewed as representing BACT for NO_x control because:

1. Its incremental cost effectiveness ratio when compared to water injection to 75 ppmvd @ 15% O_2 is not within reasonable limits when compared to similar units and similar applications.
2. As a peak load unit with equipment currently meeting 75 ppmvd @ 15% O_2, it is unreasonable to perform costly modification to reduce NO_x by 10 ppmvd.
3. Injection to 65 ppmvd @ 15% O_2 would double the water-fuel ratio, thereby substantially increasing CO emissions from the unit, decreasing engine efficiency, increasing maintenance requirements, and increasing the use of water resources.

The next most stringent control technology is water injection to 75 ppmvd @ 15% O_2. This technology should be judged as representing BACT for NO_x control because:

1. Its cost effectiveness ratio is within reasonable limits when compared to similar units and similar applications.

2. The unit is currently permitted for water injection to 75 ppmvd @ 15% O_2, and this emission level has been demonstrated by this turbine.

3. The 75 ppmvd @ 15% O_2 is within the range of BACT for similar units burning distillate oil as the primary fuel source.

4. The 75 ppmvd @ 15% O_2 is below the NSPS standard of 81 ppmvd @ 15% O_2 for this source.

5. The 75 ppmvd @ 15% O_2 assures that the CES can continue reliable operation of its gas turbine.

6. Water injection has minimal adverse environmental impacts with the exception of increased CO emissions at part load. NO_x control to 75 ppmvd @ 15% O_2 gives adequate reduction without increasing CO emissions to unacceptable levels.

7. As the air quality analysis in Section 5 demonstrates, the unit has a very low NO_x impact on the ambient air.

8. A NO_x limit of 75 ppmvd @ 15% O_2 will provide a good balance between reliability, cost effectiveness, and environmental considerations.

4.7 BACT FOR CARBON MONOXIDE

4.7.1 Introduction

Emissions of CO are a result of the incomplete combustion of carbon and organic compounds. CO emissions are a function of oxygen availability (excess air), flame temperature, residence time, and turbulence. Primary CO control consists of proper turbine design and operation to ensure conditions exist for adequate combustion of the fuel. The most stringent and only post-combustion control technology of emissions of CO is the use of catalytic oxidation along with proper turbine operation.

4.7.2 Permitted Control Levels - Previous BACT/Determinations

Table 4-2 includes all BACT determinations with specified CO limits on oil, separated into oil fired only and gas fired as the primary fuel. The conclusion that can be drawn from the large variation in values (9-170 ppm) is that regulatory emphasis is placed on NO_x rather than CO, and that very few oxidation catalysts have been installed. What is not indicated in the values (excepting proposed limits for the Guam units) is that CO substantially increases with part-load operation and increased water injection rates.

4.7.3 Technical Analysis

Control technologies available for gas turbines, from the most stringent to the least stringent level of control, are identified as follows:

1. Catalytic Oxidation
2. Good Combustion Practice

These alternatives are described below.

<u>Catalytic Oxidation</u>

Catalytic oxidation is the control alternative used to obtain the most stringent control level for CO emissions from combustion sources. As with the use of SCR for the control of NO_x, catalytic oxidation is a process which employs a catalyst material containing active sites where the reactant species are adsorbed. These active sites lower the activation energy of the oxidation reaction and permit combination of the reaction species at lower gas temperatures than would be required for uncatalyzed oxidation. The effective temperature range for catalytic oxidation is between 600°F - 1150°F, and CO oxidation occurs at any temperature above 600°F.

Oxidation catalysts can often achieve 80% conversion of carbon monoxide to carbon dioxide. However, a catalyst designed for 80% conversion at one inlet loading, exhaust temperature, and flow will not give 80% conversion at another inlet loading, exhaust temperature, and flow. Therefore, because of the broad range of exhaust temperatures, flows, and CO concentrations due to varying loads, an average value of 60% conversion can be assumed as representative performance of a catalyst for the proposed gas turbine.

As with SCR systems, an oxidative catalyst is subject to loss of activity over time. Catalyst deactivation occurs through physical deactivation and chemical poisoning. Physical deactivation results from prolonged exposure to high temperatures causing active sites to fuse (referred to as sintering); fouling of the catalyst due to entrainment and buildup of particulate matter; and wearing of the catalyst due to particulate abrasion. Chemical poisoning is caused by the reaction of the catalyst with contaminants in the gas stream. Poisoning is typically irreversible making catalyst replacement necessary. As fuel is burned, trace metals are discharged with the exhaust gas stream and are responsible for the catalyst poisoning. For sulfur containing fuels, the oxidizing catalysts increase the reaction of SO_2 to SO_3, which subsequently combines with water vapor gas to form sulfuric acid. Corrosion of equipment and heat transfer surfaces, as well as catalyst deactivation is thus a concern for using a CO catalyst with sulfur-containing fuels. The fuel for the proposed project has a sulfur content of 0.5%, and consequently, significant problems may be expected with the use of the catalyst. The oxidative catalyst on a natural gas fired turbine is projected by vendors to be effective for approximately five years. Due to the use of No. 2 fuel oil, the sulfur content of the fuel oil, and the higher particulate mass emission rates, the catalyst effectiveness will likely decline at a more rapid rate.

Therefore, due to the accelerated deterioration of the catalyst when firing fuel oil, and because oxidation catalysts have not been commercially utilized on simple cycle units fired exclusively on oil, an oxidation catalyst is not a technically feasible option for this application.

Good Combustion Practice

Good combustion practice simply consists of achieving the lowest possible CO emissions by means of proper engine design, operation, and maintenance. When water injection is used on a gas turbine to control NO_x emissions (as is proposed herein), proper operation can consist, in part, of utilizing a variable water injection rate to minimize CO emissions while still controlling NO_x emissions to permitted limits. This is desirable because while NO_x emissions increase with load, CO emissions decrease with load and are dramatically higher at partial loads. Additionally, CO emissions increase with increases in water injection rates, as water injection reduces combustion efficiency. Therefore, because NO_x emissions are lower at partial loads, water injection rates can be decreased while still maintaining permitted limits, thereby reducing CO emissions. Hence, variable water injection provides a good balance between control of NO_x emissions and CO emissions.

4.7.4 Economic, Energy, and Environmental Considerations

Economic, energy, and environmental impact analyses are not provided for an oxidation catalyst because it has been shown to be technically infeasible. There are no adverse economic, energy or environmental impacts associated with good combustion practice. In fact, good combustion practice in conjunction with variable water injection reduces energy consumption and thus cost, and as stated previously, provides a good balance between control of NO_x emissions and CO emissions.

4.7.5 CO BACT Conclusion

The most stringent control technology for CO associated with gas turbine operation is an oxidation catalyst. An oxidation catalyst should not be judged as representing BACT because:

1. Oxidation catalysts have not been commercially utilized on simple cycle units fired exclusively with liquid fuel.

2. The potential exists for corrosion problems due to oxidation of SO_2 in the flue gas and subsequent formation of sulfuric acid.

BACT should be determined to be the minimum emission rate achievable through good combustion practice and variable water injection rate. Because CES needs the ability to operate this turbine at partial load, CO emissions may occasionally increase over the levels typical of 100% base load operation. Therefore, BACT should be determined to be 20 ppmvd @ 15% O_2 with the exception that the emissions may increase to 136 ppmvd @ 15% O_2 during part load operation, based on the data shown in Table 2-3.

4.8 BACT FOR SULFUR DIOXIDE

The proposed fuel to be utilized for the gas turbine operation is No. 2 fuel oil with a sulfur content limit of 0.5%. This is the same fuel sulfur content limit that the GT is currently permitted to fire at the Key West facility and the unit has had no violations thereunder. A review of the BACT/LAER Clearinghouse information and BLIS database revealed no sources which used any post-combustion SO_2 removal control such as scrubbers. The primary control mechanism for SO_2 is to control the sulfur content of the fuel. Gas turbines operate with large amounts of excess air, typically more than 200 percent, as compared to boilers which operate in the 15 to 30 percent excess air range. Therefore, the volume of flue gas resultant from gas turbines for a given megawatt output is substantially higher than the flue gas resultant from conventional boilers. Consequently, the volume of flue gas, along with the high temperature of the exhaust flow from simple cycle units and the low sulfur content of the fuel oil, render any type of post-combustion SO_2 control available impracticable.

BACT determinations identified for gas turbines consisted of firing No. 2 fuel oil with sulfur content limits ranging from 0.05% to 0.5%, with the majority in the 0.3% to 0.5% range. The USEPA has recently promulgated regulations to limit the sulfur content of mobile source (diesel) fuel to 0.05% by weight (very low sulfur). However, because the target of the regulations is mobile source emissions, it is unclear whether there will be sufficient supply of 0.05% sulfur fuel oil for stationary sources. According to the CES fuel supplier (Coastal Fuels), they cannot currently guarantee fuel with a sulfur content of less than 0.5%. Several other local fuel oil suppliers were contacted to determine the availability and cost of lower sulfur fuel oils for delivery to the project. Of those contacted, two suppliers were able to provide lower sulfur fuel oil to the project.

A mainland fuel supplier (CITGO) indicated that they could deliver 0.2% sulfur fuel oil to Stock Island by tank truck for approximately $31.50 per barrel (Bbl.), but that they couldn't guarantee 0.2% sulfur fuel oil in bulk shipped via barge. Stock Island's current price for 0.5% sulfur fuel oil in bulk shipped by barge is $25.94/Bbl. Therefore, based on annual fuel consumption of 7.1 million gallons, the net incremental cost for SO_2 reduction using 0.2% sulfur fuel oil is approximately $6,461/ton, which is excessive. Further, transporting fuel oil to the site by truck from the mainland rather than by barge presents significant operating inconveniences, as well as additional environmental impacts. Tanker trucks traveling to Key West would be limited to approximately 7,200 gallons (less than three hours of turbine operation) due to bridge restrictions. Once the trucks arrive on site, it would require approximately 90 minutes to unload the fuel. Thus, it would require approximately 115 deliveries taking 21 eight hour days to fill the fuel tanks to a level allowing two weeks of continuous gas turbine operation. Additional environmental impacts include exhaust and fugitive road emissions from the numerous tanker trucks (approximately 989 per year), plus the increased risk of fuel spills during frequent loading and unloading operations. Another supplier (Amoco) reported that they could deliver 0.3% sulfur fuel oil to the project via barge. The delivered cost for this fuel would be approximately \$27.09. Therefore, the net incremental cost for SO_2 reduction using 0.3% sulfur fuel oil is approximately \$2,004 per ton. This cost is also considered excessive.

The fuel oil currently burned at Stock Island Power Plant is guaranteed to 0.5% sulfur by weight. In addition to the excessive incremental cost of the lower sulfur fuel oils and the operating inconveniences and environmental impacts associated with transportation and delivery of the 0.2% sulfur fuel oil, limiting the GT to a lower sulfur fuel would require two separate fuel storage systems on the island. Further, as the air quality analysis in Section 5 demonstrates, standards and increments will be protected if the GT burns fuel with a sulfur content equal to or less than 0.5%. Therefore, BACT for SO_2 should be determined to be controlling the sulfur content of the fuel to a maximum of 0.5% by weight.

4.9 BACT CONTROL FOR PARTICULATE MATTER

Review of the BACT/LAER Clearinghouse and BLIS database indicate that no post-combustion particulate control such as an electrostatic precipitator is employed on gas turbines. The high gas velocities and volumetric flow rates, as indicated in Section 4.7, along with the use of low ash content fuels and the high combustion efficiency of the gas turbine make the application of post-combustion particulate control devices technically impractical. Complete combustion ensures minimum possible emissions of carbonaceous and condensable particulate matter. The proposed limit for the gas turbine is in the range of identified limits determined as BACT for similar units, and is an effective balance between control of emissions of NO_x and PM. For example, the BACT determination for the units on Guam restricts emissions from those engines to 20 lb/hr. Therefore, limiting the turbine to emissions of 18 lb/hr of PM_{10} through good combustion practices should be considered BACT.

Table 4-1

Pollutant Summary
Realistic Upper-Bound Emissions

Pollutant	Uncontrolled Emissions (lbs/hr) (1)	Uncontrolled Emissions (TPY) (2)	Controlled Emissions (5) (lbs/hr) (1)	Controlled Emissions (5) (TPY)	Significant (TPY)
NO_x (3)	269/133	389	96/58	138	40
CO (4)	7/34	81	16/64	152	100
SO_2 (3)	162/98	234	168/102	243	40
PM_{10} (4)	18	43	18	43	15
UHC (4)	3/3	7	3/6	15	40

1) First number is at 100% load and 59°F. Second number is at 50% load and 59°F.
2) Level from which top down cost effectiveness is calculated.
3) Annual emissions based on consumption of 7.1 million gallons of fuel oil at full load.
4) Annual emissions based on consumption of 7.1 million gallons of fuel oil at 50% load.
5) Based on water injection reducing NO_x to 75 ppmvd @ 15% O_2.

Table 4-2

Summary of BACT Determinations
Simple-Cycle Combustion Turbines Firing Oil

Date	Location	Size (1)	Vendor	NO_x (ppmvd @15% O2) (2)	CO (ppmvd @15% O2) (3)	Control Equipment	Comment
Oil as Primary Fuel							
11/88	NY	3 x 75 MW	GE Frame 7	55	10	Water injection	NO_x corrected to 65 ppm
06/89	HI	1 x 18 MW	Solar	42	NA	Water injection	Aero-derivative
(4)	Guam	2 x 23 MW	GE Frame 5	59	20-170(5)	Water injection	Not yet tested
Gas as Primary Fuel							
03/85	AK	1 x 38 MW	NA	75	NA	Water injection	
04/85	CA	1 x 26 MW	GE Frame 5	65	NA	Water injection	
03/87	AK	1 x 80 MW	NA	75	44	Water injection	
03/87	CA	4 x 75 MW	NA	NA	10	Water injection, CO Catalyst	
03/88	NY	2 x 16 MW	NA	75	72	Water injection, CO Catalyst	
08/88	DE	3 x 100 MW	Siemens	42	15	Water injection, low-NOx burner	
09/88	FL	2 x 35 MW	NA	65	10	Steam injection	
11/88	NY	1 x 40 MW	GE Frame 6	65	NA	Steam injection	
08/89	CO	2 x 22 MW	NA	65	NA	Steam injection	Not constructed
02/89	NY	1 x 40 MW	GE Frame 6	65	9	Water injection	
09/89	NC	1 x 40 MW	GE Frame 6	65	9	Water injection	
09/89	NC	1 x 75 MW	GE Frame 7	65	9	Water injection	
09/89	VA	2 x 50 MW	NA	65	18	Water injection	
10/89	CT	1 x 60 MW	NA	62	44	Steam injection	
07/90	VT	2 x 4 MW	NA	60	83	Water injection	
10/90	WI	4 x 75 MW	NA	65	10	Water injection	
03/91	VA	3 x 100 MW	NA	42	30	Water injection	
1991	CT	3 x 50 MW	Westinghouse	42	NA	Water injection, low-NO_x burner	

Notes
(1) Where MMBtu/hr specified, heat rate of 12,500 Btu/kWh assumed.
(2) Where lb/MMBtu specified, 0.1 lb/MMBtu = 25 ppm assumed.
(3) Where lb/MMBtu specified, 0.1 lb/MMBtu = 40 ppm assumed.
(4) Final permit not yet issued.
(5) 20 at full load; 170 at part load.
(6) "NA" means Not Available or Not Applicable.

Table 4-3

Capital Cost Estimation Factors

	Factor
DIRECT COSTS	
1) Purchased Equipment	
a) Basic Equipment	Vendor Data
b) Auxiliaries	Vendor Data
c) Instrumentation	0.10(1a+1b)
d) Structural Support	0.10(1a+1b)
e) Freight	0.05 (sum 1a...1d)
2) Direct Installation	0.25 - 0.30 (sum 1a...1e)
Total Direct Cost (TDC)	(1) + (2)
INDIRECT COSTS	
3) Indirect Installation	
a) Engineering	(0.05 to 0.10) (TDC)
b) Construction and Field Expenses	0.10(TDC)
c) Construction Fee	0.05(TDC)
d) Contingencies	0.20(TDC)
4) Start-up and Testing	0.01(TDC)
Total Indirect Costs (TIC)	(3) + (4)
Total Capital Costs	TDC + TIC

Source: EPA OAQPS Cost Manual, 1990

Table 4-4

Annualized Cost Factors

	Factor
DIRECT OPERATING COSTS	
1) Labor a. Operating b. Supervisor	 $40.00/man-hour 15% of Operating Labor
2) Maintenance	5% of Direct Costs
3) Replacement Parts	3% of Direct Costs
4) Utilities a) Electricity b) Water c) Fuel Penalty d) Demineralizer System Lease	 $0.07/kW-hr $5.57/1000 gal. ~650 Btu/lb water $17.50/1000 gal,
5) Water Injection O&M Penalty	$100k/Combustor Inspection
INDIRECT OPERATING COSTS	
6) Overhead	30% of Labor + 12% Maintenance
7) Property Tax	1% Total Capital Cost
8) Insurance	1% Total Capital Cost
9) Administration	2% Total Capital Cost
10) Capital Recovery	Capital Recovery x TDC
Total Annualized Cost	sum (1..10)
Cost Effectiveness	Annual Cost/Tons Removed

Source: EPA OAQPS Cost Manual, 1990

Table 4-5

Capital Costs for NO_x Controls
General Electric PG5341
($1,000)

	Water Injection to 75 ppm	Water Injection to 65 ppm
DIRECT COSTS		
1) Purchased Equipment		
a) Water Injection Modifications to CTG	301	343
b) Demineralizer	0	0
c) Instrumentation	30	34
d) Structural Support	30	34
e) Freight	18	21
2) Direct Installation	114	130
Total Direct Costs	493	562
INDIRECT COSTS		
3) Indirect Installation		
a) Engineering	49	56
b) Construction and Field Expenses	49	56
c) Construction Fee	25	28
d) Contingencies	99	112
4) Start-up and Testing	5	6
Total Indirect Costs	227	258
Total Capital Costs	720	820

Table 4-6

Annualized Costs for NO_x Controls
General Electric PG5341
($1000)

	Water Injection to 75 ppm	Water Injection to 65 ppm
DIRECT OPERATING COSTS		
1) Labor		
a) Operator @ 0.5 man @ $40/man-hr	58	58
b) Supervisor @ 15% of Operating Labor	9	9
2) Maintenance @ 5% of Direct Costs	25	28
3) Replacement Parts @ 3% of Direct Costs	15	17
4) Utilities		
a) Electricity $0.07/kWh	20	30
b) Raw Water @ $0.00557/gal	14	28
c) Fuel Penalty @ ~ 650 Btu/lb water	66	135
d) Demineralizer System Lease @ 0.0175/gal	41	85
5) O&M Penalty for Water Injection @ $100k per Combustion Inspection	150	200
INDIRECT OPERATING COSTS		
6) Overhead @ 30% of Labor and 12% of Maintenance	23	23
7) Property Tax @ 1% of Total Capital Cost	7	8
8) Insurance @ 1% of Total Capital Costs	7	8
9) Administration @ 2% of Total Capital Costs	14	16
10) Annualized Capital Cost Based on 20-Year Term @ 7.5% Annual Interest	71	80
Total Annualized Costs	519	727
Tons Removed	251	264
Top-Down Dollars Per Ton Removal (1)	2,070	2,754
Incremental Dollars Per Ton (2)		15,505

(1) This value represents the cost for removal based on fuel consumption of 7.1 million gallons of fuel per year at full load operation. Reduced fuel consumption will substantially decrease cost effectiveness, as most of the costs are not variable with operation.

(2) Incremental dollars per ton calculated by dividing the difference in annual cost of each control by the difference in annual tons removed by each control.

Section 5.0

AIR QUALITY IMPACT ANALYSIS

R.W. BECK AND ASSOCIATES

SECTION 5.0

AIR QUALITY IMPACT ANALYSIS

As discussed in Section 3, though the GT is currently operating near the Stock Island Power Plant, by strict interpretation of the regulations, the relocation of the GT will constitute a modification of a major source. Under the provisions of the regulations for Prevention of Significant Deterioration (PSD) of air quality, an air quality assessment is required as technical support for the PSD permit application. The primary objective of this air quality assessment is to demonstrate compliance with applicable PSD Class I and Class II increments and national and state ambient air quality standards (AAQS) for those pollutants emitted from the source in quantities defined by the regulations as significant (40 CFR 52.21(b)(23)(i) and Table 17-212.400-2,F.A.C). For this project, those pollutants include SO_2, NO_x, PM, and CO. Emissions of lead and VOC are expected to be less than the significant emission rates also identified in 40 CFR 52.21(b)(23)(i) Table 17-212.400-2, F.A.C.

Dispersion modeling has been conducted to determine the significance of the impacts from the GT on the regional ambient air quality due to the emissions of the aforementioned criteria pollutants. This section of the application presents the results of the comprehensive air quality assessment which indicates that the installation of the source will not cause or contribute to a violation of the AAQS. The analysis also demonstrates that Class I and Class II increments will be protected.

A dispersion modeling protocol dated January 5, 1993 was developed prior to initiation of the air quality modeling to ensure that the modeling methods and results would be satisfactory to FDER as the reviewing agency (see Appendix B). This air quality assessment has followed that protocol and subsequent discussions with the FDER.

5.1 ENVIRONMENTAL BASELINE CONDITIONS

5.1.1 Climatology

An important consideration for any dispersion modeling analysis is the climate of the area under study. The mathematical models have been developed primarily on the basis of empirical analyses of the physical situation. Thus, the climate of Key West, Florida is discussed below in sufficient detail to establish a framework for selection and application of the appropriate mathematical model(s).

Stock Island and Key West are located at the southern end of the Florida Keys. The Florida Keys are a narrow series of low-lying tropical islands stretching south and southwest from mainland Florida, separating the Gulf of Mexico from the Straits of Florida and Atlantic Ocean. The climate of the area is characteristic of a tropical region. It is dominated by the Gulf Stream which flows around the western tip of Cuba, through the Straits of Florida, and northward along the lower east coast. The Gulf Stream exerts a warming influence on this area largely because the predominate wind direction is from the east, bringing consistently warm and humid conditions throughout the year. The National Weather Service (NWS) station at Key West is located just to the east of the city and approximately one mile west-southwest of Stock Island. According to the NWS, the recording instruments are situated at the international airport in an area clear of obstructions.

Key West experiences tropical conditions year-round with abundant rainfall. The year can be divided into two seasons -- the so-called "rainy season" (a 5-month period, June through October) and the long, relatively dry season (7-month period, November through May). The start and end of the rainy season varies considerably from year to year.

Table 5-1 presents the "normal" temperature, precipitation and wind data available from the 1974 National Oceanic and Atmospheric Administration (NOAA) publication titled *Climates of the States* for Key West, Florida covering approximately 30 years of recorded data (1931-1960).

The dispersion modeling analysis discussed herein uses five years (1981-1985) of recorded surface and upper air observations from the NWS station at Miami, Florida. The comparison presented below supports the use of Miami data since Miami is climatologically similar to Key West.

Temperature, Humidity, and Precipitation

The consistent temperature profile for Key West varies from a low of approximately 65°F to a high of approximately 90°F. The daily temperature range changes from a daytime high and nighttime low of approximately 75°F and 65°F, respectively, in January, to 90°F and 80°F, respectively, in August. For the period of record, the lowest recorded temperature was 46°F recorded in January 1971, and the highest temperature recorded was 95°F recorded in August 1957. There is little variation in the relative humidity at Key West which is typically near 65 percent during the noon-day hours and climbs to approximately 80 percent at night.

Precipitation in Key West dominates the determination of the seasons. The average annual rainfall is approximately 40 inches. During the rainy season from approximately June through October, about 65 percent of the annual rainfall occurs. During the relatively dry season, the remainder of the year, approximately 35 percent of the annual average rainfall occurs. There is a transition phase between these two seasons. Most of the rainfall is derived from local showers and thundershowers of short duration, but usually of heavy intensity. Day-long rains are generally associated with tropical disturbances or continental systems and are infrequent. Hurricanes occasionally pass over Key West bringing violent winds and torrential rain. The hurricane season is from June through November.

Wind Speed and Direction

The dominant winds at Key West are from an east-southeasterly direction, with an easterly component all year long. Winds from the southeast and east-southeast occur approximately two-thirds of the year. For the period of record reported in the NOAA publication, the prevailing wind direction was from the southeast or east-southeast from February through September and from northeast or east-northeast for the remainder of the year. This follows with the cold intrusions from the north in the winter causing more of a northerly component, and then a more southerly component in the warmer months. Figure 5-1 is the Miami, Florida wind rose which also shows the east-southeast predominance from 1981-1985. As previously mentioned, a breakdown of this pattern occasionally occurs and may be associated with any disturbance such as a hurricane.

Wind speeds at Key West can be variable, but tend to be quite constant with the NOAA period of record mean wind speed of 11.3 mph. High local winds of short duration occur occasionally in connection with thunderstorms, cold fronts and tropical disturbances.

The small size of the islands in the Key West area together with the dominance of the "easterly" winds essentially prevents the development of any important sea breeze effects (sea breezes are local airflows resulting from diurnal temperature variations between substantial land masses and large bodies of water).

Miami, Florida Climatological Data

The dispersion modeling analysis uses Miami, Florida NWS recorded surface and upper air observations for the period 1981 to 1985. Miami and Key West have similar climates as shown below with 1931-1960 data. Table 5-2 presents average temperature, precipitation and wind data available from the 1974 NOAA publication titled *Climates of the States* for Miami covering approximately 30 years of recorded data (1931-1960). Table 5-1 (Key West) and Table 5-2 (Miami) yield the following comparison.

Annual Values	Location	
	Key West	Miami
Daily Maximum Temperature	80.8°F	83.1°F
Daily Minimum Temperature	72.9°F	67.1°F
Mean Temperature	76.8°F	75.1°F
Average Relative Humidity	75%	74%
Average Precipitation	39.99 inches	59.76 inches
Average Wind Speed	11.3 mph	9.0 mph
Prevailing Wind Direction	ESE	ESE

The table above shows only minor differences between the two locations. Miami's values reflect the more continental and northern location, though still tropical. This results in slightly warmer daytime temperatures, cooler nighttime temperatures and a slightly lower annual mean temperature and relative humidity for the Miami area. Precipitation is higher in Miami, caused primarily by a somewhat higher incidence of convective thunderstorms due to increased surface heating with the larger land mass. Key West, being an island, has slightly stronger winds with less friction over the ocean. Miami has more of a northerly component in the winter because of cold intrusions from the north, even though the prevailing direction for both locations is east-southeast. Tropical disturbances can occur at both locations with similar frequencies.

Miami and Key West have only slight differences in climate and, therefore, are considered similar. Both will have similar dispersion climatologies, thus validating the use of Miami meteorological data for the dispersion modeling analysis. Since previous analyses of Stock Island sources have used Miami data for 1981 through 1985, this analysis is consistent with the previous studies.

Dispersion Climatology

Dispersion of air pollutants in the lowest levels of the atmosphere is accomplished by airflow (wind) and the mixing within the airflow (turbulence). The "mixing height", generally controlled by the vertical temperature profile, represents a ceiling up to which dominated by the Gulf Stream which flows around the western tip of Cuba, through the Straits of Florida, and northward along the lower east coast. The Gulf Stream exerts a warming influence on this area largely because the predominate wind direction is from the east, bringing consistently warm and humid conditions throughout the year. The National Weather Service (NWS) station at Key West is located just to the east of the city and approximately one mile west-southwest of Stock Island. According to the NWS, the recording instruments are situated at the international airport in an area clear of obstructions.

Key West experiences tropical conditions year-round with abundant rainfall. The year can be divided into two seasons -- the so-called "rainy season" (a 5-month period, June through October) and the long, relatively dry season (7-month period, November through May). The start and end of the rainy season varies considerably from year to year.

Table 5-1 presents the "normal" temperature, precipitation and wind data available from the 1974 National Oceanic and Atmospheric Administration (NOAA) publication titled *Climates of the States* for Key West, Florida covering approximately 30 years of recorded data (1931-1960).

The dispersion modeling analysis discussed herein uses five years (1985-1989) of recorded surface and upper air observations from the NWS station at Key West.

Temperature, Humidity, and Precipitation

The consistent temperature profile for Key West varies from a low of approximately 65°F to a high of approximately 90°F. The daily temperature range changes from a daytime high and nighttime low of approximately 75°F and 65°F, respectively, in January, to 90°F and 80°F, respectively, in August. For the period of record, the lowest recorded temperature was 46°F recorded in January 1971, and the highest temperature recorded was 95°F recorded in August 1957. There is little variation in the relative humidity at Key West which is typically near 65 percent during the noon-day hours and climbs to approximately 80 percent at night.

Precipitation in Key West dominates the determination of the seasons. The average annual rainfall is approximately 40 inches. During the rainy season from approximately June through October, about 65 percent of the annual rainfall occurs. During the relatively dry season, the remainder of the year, approximately 35 percent of the annual average rainfall occurs. There is a transition phase between these two seasons. Most of the rainfall is derived from local showers and thundershowers of short duration, but usually of heavy intensity. Day-long rains are generally associated with tropical disturbances or continental systems and are infrequent. Hurricanes occasionally pass over Key West bringing violent winds and torrential rain. The hurricane season is from June through November.

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Wind speeds at Key West can be variable, but tend to be quite constant with the NOAA period of record mean wind speed of 11.3 mph. High local winds of short duration occur occasionally in connection with thunderstorms, cold fronts and tropical disturbances.

The small size of the islands in the Key West area together with the dominance of the "easterly" winds essentially prevents the development of any important sea breeze effects (sea breezes are local airflows resulting from diurnal temperature variations between substantial land masses and large bodies of water).

Miami, Florida Climatological Data

Miami and Key West have similar climates as shown below with 1931-1960 data. Table 5-2 presents average temperature, precipitation and wind data available from the 1974 NOAA publication titled *Climates of the States* for Miami covering approximately 30 years of recorded data (1931-1960). Table 5-1 (Key West) and Table 5-2 (Miami) yield the following comparison.

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The table above shows only minor differences between the two locations. Miami's values reflect the more continental and northern location, though still tropical. This results in slightly warmer daytime temperatures, cooler nighttime temperatures and a slightly lower annual mean temperature and relative humidity for the Miami area. Precipitation is higher in Miami, caused primarily by a somewhat higher incidence of convective thunderstorms due to increased surface heating with the larger land mass. Key West, being an island, has slightly stronger winds with less friction over the ocean. Miami has more of a northerly component in the winter because of cold intrusions from the north, even though the prevailing direction for both locations is east-southeast. Tropical disturbances can occur at both locations with similar frequencies.

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Dispersion Climatology

Dispersion of air pollutants in the lowest levels of the atmosphere is accomplished by airflow (wind) and the mixing within the airflow (turbulence). The "mixing height", generally controlled by the vertical temperature profile, represents a ceiling up to which abundant horizontal and vertical mixing can occur. The height of the ceiling above ground level defines the boundary layer. The height is highest on afternoons with abundant sunshine and during periods of strong winds, and is lowest during nighttime hours and periods of light winds.

The dispersion of air pollutants is caused by two types of turbulence: mechanical and thermal. Mechanical turbulence is associated with the general air flow over a rough surface (land). Thermal or convective turbulence is associated with the vertical temperature gradient which is caused by solar radiation (insolation) of the earth's surface, heating of the air near the ground, and a subsequent rise of the warm air parcel due to the changing density of the air.

Pasquill developed a stability classification scheme which provides an indicator of the amount of turbulence in the atmosphere. Stability classes A, B, and C describe situations with predominantly convective turbulence and are associated with low wind speeds and strong insolation. Such conditions are considered unstable and provide effective dispersion. Stability class D is considered to be neutral stability. This condition can occur at any time and is associated with strong winds, mechanical turbulence, and weak insolation. The least effective dispersion will occur for stability classes E and F which typically occur during nighttime conditions with light winds and clear skies. Table 5-3 shows a summary of stability conditions, wind speeds, and wind directions for Miami for the period 1981 through 1985. Stability class D is the most common condition and favors effective dispersion of pollutants in the atmosphere.

5.1.2 Topographical Features

Key West and the surrounding islands are essentially flat. The Stock Island Power Plant site is less than 2 m msl. One point on Key West, seven km from the project site, rises to 3m. Since the variation in terrain is minimal and is less than the height of the GT exhaust stack (10.7m), the use of a flat terrain dispersion model is appropriate for the analysis.

5.1.3 Meteorological Land Use Classification

The meteorological land use classification is used to determine the profile of the vertical wind speed and associated mechanical turbulence due to surface roughness. The wind speed profile is then used to extrapolate wind speeds at various heights for use in the estimates of atmospheric pollutant dispersion. USEPA *Guideline on Air Quality Models* stipulates that the land use within the total area circumscribed by a 3-km radius around the source be classified using Auer's scheme of meteorological land use typing proposed in the *Journal of Applied Meteorology* (1976). Auer's classifications are as follows:

Type	Description
I1	Heavy Industrial
I2	Light/Moderate Industrial
C1	Commercial
R1	Common Residential
R2/R3	Compact Residential
R4	Estate Residential
A1	Metropolitan Natural
A2	Agricultural Rural
A3/A4	Undeveloped
A5	Water Surfaces

According to the Guidelines, if more than 50 percent of the total area in the circle is classified by land use as I1, I2, C1, R2, or R3, urban dispersion coefficients should be used in the modeling, otherwise, appropriate rural dispersion coefficients should be used. A USGS 7.5-minute series topographical map was used to estimate the land use around the project site as more than 50% in type "A5: Water Surfaces". Therefore, default rural dispersion coefficients were used in the analysis.

5.1.4 Background Ambient Air Quality

Key West is designated attainment or unclassified (PM_{10}) for all criteria pollutants (chapter 17-275). This designation is consistent with several features of the area. First, there are no very large sources of air pollution nearby. Second, there is no significant terrain which could trap pollution and cause exceedances of the AAQS. Third, the prevailing winds are east and southeast bringing fairly clean air in the absence of pollutant transport regions.

No on-site ambient air quality data is available for the Stock Island Power Plant. The SO_2, NO_x, and CO background data for this ambient air quality was taken from the PSD application submitted for the medium-speed diesel engines and reflects a conservative value. The use of the value was considered acceptable by FDER since the value was conservative. This data is summarized in Table 5-4. FDEP has been requested to supply PM_{10} background data for the Monroe County monitoring site.

5.2 MODELING METHOD

5.2.1 Model Selection

Mathematical models are the primary tools for air quality assessments to simulate the dispersion of the effluent plumes into the atmosphere. It is, therefore, important to choose models which will appropriately simulate the actual physical situation in the region of the project. The choice of models is primarily based on two considerations: 1) the level of detail and accuracy needed for the analysis, and 2) the topographical characteristics of the area. Analyses requiring extensive detail and accuracy require increasingly sophisticated models. It is accepted practice to utilize less sophisticated modeling techniques, so called "screening", as a first determination of compliance of a source with the AAQS. Screening models typically over-estimate pollutant concentrations.

Regulatory modeling levels of significance have been established as a guide to assist in the evaluation of a source's impact on ambient air quality (40 CFR 51.165(b)(2)). Air quality impacts below the regulatory levels of significance are not considered to cause or contribute to any violations of ambient air quality. These regulatory modeling levels of significance are presented in Table 5-5 for the pollutants assessed in this analysis. Generally speaking, if the results of a screening analysis indicate that the predicted ground-level concentrations are below the significance levels, then no further analysis is required. If, on the other hand, the ground level concentrations are above such significance levels, then more refined analyses are conducted using more detailed models with real time meteorology.

A screening analysis, described in detail below, was performed and the results compared to the modeling levels of significance. The primary purpose of the screening analysis was to identify the worst-case operating conditions for the GT. The results identified the relative magnitude of the impacts and the concentration gradient relative to downwind distance. Using the identified worst-case conditions, the sophistication of the modeling analysis was increased to assess the impacts further. This increased sophistication is referred to as the "refined analysis".

As agreed to in the modeling protocol, the USEPA-approved dispersion models selected for the air quality analysis were EPA SCREEN2 (Dated 92245) and Industrial Source Complex-Short Term 2(ISCST2) (Dated 93109). These models use a steady-state, bivariate Gaussian distribution algorithm to estimate ground-level concentrations and are appropriate in areas classified as rural according to Auer's land use classifications. ISCST2 can accept either assumed default meteorology or sequential, hourly meteorological data, and can analyze the effects of multiple point source interaction. ISCST2 is recommended by *Guideline on Air Quality Models* (USEPA 1987, 1990, 1993) to model terrain elevations between the stack base and the stack height. This modeling analysis used regulatory default options, and no modifications were made to the models.

5.2.2 Meteorological Data

The primary difference between a screening analysis and a refined analysis is typically the meteorological data used in the modeling. Screening analyses have been conducted with EPA SCREEN2 to determine 1-hour concentration averages by using "worst-case" meteorological assumptions. The meteorology used in the screening analysis is internal to EPA SCREEN. The data is set forth in *Guidelines For Air Quality Maintenance Planning and Analysis: Procedures for Evaluating Air Quality Impact of New Stationary Sources* (Draft, EPA 1988) and is as follows:

Stability Class	Wind Speed (m/s)
A	1,3
B	1,3,5
C	1,3,5,10
D	1,3,5,10,20
E	1,3,5
F	1,3,4

The refined analysis presented herein used five complete years (1985 through 1989) of wind and stability data consisting of actual surface observations from Key West and twice-per-day upper air soundings concurrently recorded at a station in Miami. These data used in previous analyses of the Stock Island site, have been summarized in the classical windrose (Figure 5-1) and in Table 5-2. Default wind speed profile exponents (indicative of increasing wind speed with increasing distance from the surface) and vertical potential temperature gradients (indicative of decreasing temperature with increasing distance above the surface) were used in the modeling. Since five years of meteorology were processed and short-term standards and increments may be exceeded once per year, the maximum second-highest concentration for the short-term averaging times was selected as the predicted air quality impact of the source analyses and compared to the short-term standards and increments in accordance with USEPA-approved practices and consistent with the modeling protocol. The annual average is the highest predicted concentrations averaged over the year for a given receptor.

5.2.3 Averaging Intervals

Screening analyses performed with EPA SCREEN2 result in 1-hour concentration averages. However, many of the AAQS apply to different averaging intervals so that the results must be modified to reflect other averaging intervals. The USEPA has suggested using scaling factors based on modeling experience. Therefore, EPA SCREEN-predicted concentrations were multiplied by the following scaling factors to obtain representative concentrations at other averaging intervals:

Averaging Interval	Scaling Factor
3-hour	0.9
8-hour	0.7
24-hour	0.4
Annual	0.1

5.2.4 Source Data

The Key West GT and project site are described in Section 2 of this application. The installation of one nominal 23-MW GE Frame 5 gas turbine is proposed for this site. Emissions of NO_x from the unit will be controlled by water injection and the sulfur content of the No. 2 fuel oil to be burned in the engine will not exceed 0.05 percent. Emissions estimates are consistent with the BACT analysis presented in Section 4. According to design, the GT will have a single exhaust. The modeling parameters presented in Table 5-6 represent the GT operating at 59°F and 90°F at loads of 50%, 75%, and 100% of capacity.

The GT was predicted to have a small area of significance at the property boundary. Therefore, an interactive analysis of that area of significance was performed to assure compliance with AAQS and PSD Class II increments. FDER indicated that no major sources of air pollution have been built in the area since the construction of the diesel facility at Stock Island. Therefore, the interactive sources used in the PSD application for the diesel units were used in this analysis to assess the interactive impacts. Source parameters for the interactive units are presented in Table 5-7.

5.2.5 Stack Height Considerations

According to 40 CFR 51.100(hh) (as well as similar FDER Rule 17-210.550), a good engineering practice (GEP) stack height is the greater of:

65 meters

or $H_g = H_b + 1.5L$

where: H_g = the GEP stack height,
H_b = the height of the dominant nearby building, and

L = the lesser dimension of the height or projected width of the dominant nearby building.

A stack constructed below 65 meters conforms to the regulations for GEP stack height.

As is shown in Tables 5-6 and 5-7, the GT stack and the stacks of the interactive sources are less than 65 meters. Therefore, the stacks conform to the regulations and guidelines for GEP.

Structures tend to disrupt air flow across a region and create turbulence around the structure. This disruption is referred to as the building wake effect or building downwash effect. This effect can result in high local ground-level pollutant concentrations if the emission point of the source is not far enough above or away from the structure to avoid the effect. A stack constructed at a height approximately 2.5 times above the height of a nearby building is not likely to be affected by structural turbulence. If a stack is located with 5L of a building, and the building height is greater than approximately 40 percent of the stack height, then the stack is considered to be affected by building downwash.

The ISCST2 model used in the ambient air quality assessment uses a combination of two algorithms for predicting air quality impacts and the associated building wake effects. The Schulman-Scire algorithm is applicable when the stack height is less than 1.5 H_b and takes into account wind-direction-specific building heights and widths when determining wake effects. The Huber-Snyder algorithm is applicable when the stack height is between 1.5 H_b and 2.5 H_b and uses the actual building height and maximum projected width for all wind directions. Software packages are available to determine the values of the building heights and widths which can influence each stack and one such package (GEP version 2.2, Trinity Inc. 1992) has been used for this analysis to estimate the wake effects caused by the structures at the Stock Island Power Plant. All structures at the Stock Island Power Plant were included in the air analysis (see Figure 2-2).

5.2.6 Receptor Networks

EPA SCREEN2 generates a receptor network internally to assess impacts from a source. The receptors used in EPA SCREEN2 were default receptors spaced 100 meters apart out to 3,000 meters and 1,000 meters apart from 3,000 meters to 10,000 meters. Since there is minimal terrain variation, no elevations were input for the receptors.

A cartesian coordinate receptor grid centered at the Stock Island Power Plant (Figure 5-2) was used for the ambient air quality analysis. It was defined with 1000-meter spacing out to 10 kilometers to determine the facility's area of impact. Additionally , a refined receptor grid with 50-meter spacing was defined out to 0.2 kilometers and 100-meter spacing from 0.2 kilometers to 0.5 kilometers. Within this refined grid, receptors were placed at 20-

meter intervals along the property boundary. This grid system provided sufficient resolution and downwind coverage to identify the areas of expected maximum concentrations.

5.3 RESULTS OF MODELING ANALYSIS

5.3.1 Screening Analysis

The screening analysis was conducted with EPA SCREEN2 to determine the worst-case operating conditions considering loads of 50%, 75%, and 100% and ambient temperatures of 59°F and 90°F. The matrix of impacts related to emissions of NO_x, CO, PM, and SO_2 from the GT are presented in Table 5-8. The 1-hour averages modeled concentration were multiplied by the USEPA scaling factors to arrive at the appropriate averaging interval.

The results of the screening level modeling are summarized and compared to the modeling levels of significance in Table 5-9. At least three important conclusions can be drawn from the screening analysis:

(1) The emissions of SO_2, NO_x, PM, and CO from the GT are predicted by the screening analysis to have an significant impact on the ambient air quality. Therefore, SO_2, NO_x, PM, and CO were considered in the refined analysis.

(2) For NO_x and SO_2, the worst-case operating conditions are predicted to occur at 75 percent load). For CO and PM, the worse-case operating conditions are predicted to occur at 50 percent load

(3) ISCST2 should be used in the refined analysis.

5.3.2 Refined Analysis

The screening analysis results indicated that the SO_2, NO_x, PM, and CO ground-level concentration were predicted to be above the regulatory levels of significant impact. Therefore, impacts from the emissions of SO_2, NO_x, PM and CO were analyzed further in a refined model.

The stack parameters used in the refined analysis to represent the GT at the Stack Island Facility were representative of the worst-case condition for SO_2 and NO_x (75 % load) determined by the screening analysis described in section 5.3.1. The refined analysis consisted of a determination of the real-time predicted impacts from the GT and the medium-speed diesels compared to PSD Class II increments followed by an interactive source analysis with all Stock Island sources to assure that the GT will not cause or contribute to any violations of the NAAQS.

INCREMENT ANALYSIS

The increment sources, which include proposed GT and Medium Speed Diesels (MSD), were modeled to identify the highest second highest (HSH) impact for each pollutant and each averaging interval. The results are summarized in Tables 5-10, 5-11, and 5-12. These impacts were compared directly to the allowable PSD Class II increments.

3-HOUR SO_2

The HSH impact of 42.8 $\mu g/m^3$ was predicted for SO_2 over a 3-hour averaging period for data year 1987 at the property boundary. This results is approximately 8 percent of the allowable increment.

24-HOUR SO_2

The HSH impact of 9.9 $\mu g/m^3$ was modeled for SO_2 over 24-hour averaging period for data year 1987 at the property boundary. This result is approximately 11 percent of the allowable increment.

ANNUAL AVERAGE SO_2

The maximum annual averaged SO_2 increment consumption of 0.1 $\mu g/m^3$ was predicted at X = -2,000 meters and Y = 1,000 meters. This result is less than 1 percent of the allowable increment.

ANNUAL AVERAGE NO_x

The maximum annual average NO_x increment consumption was predicted to be 3.2 $\mu g/m^3$ at X = 2,000 meters and Y = 1,000 meters. This impact is less than 12 percent of the allowable increment.

24-HOUR PM

The HSH impact of 14.6 μg/m^3 was modeled for SO_2 over 24-hour averaging period for data year 1987 at the property boundary. This result is approximately 40 percent of the allowable increment.

ANNUAL AVERAGE PM

The maximum annual averaged PM increment consumption of 0.4 μg/m^3 was predicted at X = -2,000 meters and Y = 1,000 meters. This result is less than 3 percent of the allowable increment.

INTERACTIVE ANALYSIS

An interactive source analysis was conducted. All the sources addressed in the analysis are listed in Table 5-6 and 5-7. The stack parameters for GT were representative of the worst-case condition for SO_2 and NO_x (75 % load) All other stack's emission parameters were associated with the maximum hourly operating rates. The background ambient air quality data listed in Table 5-4 was added to the modeled ground level concentration in order to demonstrate that the total concentration is in compliance with the NAAQS.

3-HOUR SO_2

The HSH impact for the 3-hour averaging interval was 450.8 μg/m^3 for data year 1988 and occurred at X =-200.0 meters and Y = 50.0 meters. This impact combined with a background value of 325 μg/m^3 demonstrates compliance with the NAAQS for SO_2 given the conservative nature of the models and the analysis. The 3-hour NAAQS for SO_2, which is a secondary standard, is 1,300 μg/m^3.

24-HOUR SO_2

The HSH impact for the 24-hour averaging interval was 84.4 μg/m^3 for the data year 1987 and occurred at X =-200.0 meters and Y = 50.0 meters. This impact combined with a background value of 65 μg/m^3 demonstrates compliance with the NAAQS for SO_2 given the conservative nature of the models and the analysis. The 24-hour NAAQS for SO_2 is 365 μg/m^3.

ANNUAL AVERAGE SO_2

The maximum impact for the annual averaging interval was 12.8 $\mu g/m^3$ for the five year period and occurred at X =-2,000 meters Y = 1,000 meter. This impact combined with a background value of 15 $\mu g/m^3$ demonstrates compliance with the NAAQS for SO_2 given the conservative nature of the models and the analysis. The annual average NAAQS for SO_2 is 80 $\mu g/m^3$.

ANNUAL AVERAGE NITROGEN OXIDES

The highest predicted impacts was 71.8 $\mu g/m^3$ for the five year period at the property boundary, of which the contribution from the High Speed Diesels (HSD) is 33.6 $\mu g/m^3$. This result was based on all Stock Island power plant sources operating at 100 percent load and assuming 8,760 operating hours per year. The New Source Review (NSR) Workshop Manual (1990) indicates that the actual operating factor averaged over the most recent two years can be applied to the nearby background sources in a long-term impact analysis. The HSD are nearby background sources in this analysis. The actual fuel use for HSD in 1993 and 1994 were 256,484 gallons and 227,223 gallons. The potential maximum fuel usage for the USD is 3,643,017 gallons. Therefore the average actual operation factor for HSD is 0.066. When this operation factor is applied to the HSD, the maximum impact is reduced to 40.4 $\mu g/m^3$. This impact combined with a background value of 35 $\mu g/m^3$ demonstrates compliance with the NAAQS (100 $\mu g/m^3$).

24-HOUR PARTICULATE MATTER

The HSH 24-hour impact was 176.5 $\mu g/m^3$ for data year 1985 at X = 100.0 meters and Y = 50.0 meters, entirely from the HSD on that day. The HSD only operate during the day time (from 9 a.m. to 5 p.m. local time). When this operating hour limit is applied to the HSD, the HSH 24-hour impact is reduced to 104.9 $\mu g/m^3$. This impact is well within the 24-hour NAAQS (150 $\mu g/m^3$). No background value was reported by FDEP.

ANNUAL AVERAGE PARTICULATE MATTER

The maximum annual average impact was 4.8 $\mu g/m^3$ for the five year period at the property boundary. This impact is well below the annual PM_{10}) NAAQS (50 $\mu g/m^3$). No background value was reported by FDEP.

1-HOUR CO

The HSH impact for the 1-hour averaging interval was 3,712 $\mu g/m^3$ for data year 1985 and occurred at X = 100.0 meters and Y = 50.0 meters. This impact combined with a background value of 11,000 $\mu g/m^3$ demonstrates compliance with the NAAQS for CO given the conservative nature of the models and the analysis. The 1-hour NAAQS for CO, which is a secondary standard, is 40,000 $\mu g/m^3$.

8-HOUR CO

The HSH impact for the 8-hour averaging interval was 1,208 $\mu g/m^3$ for the data year 1987 and occurred at X = 100 meters and Y = 50 meters. This impact combined with the background value of 5,500 $\mu g/m^3$ demonstrates compliance with the NAAQS for CO given the conservative nature of the models and the analysis. The 8-hour NAAQS for CO is 10,000 $\mu g/m^3$.

Class I Increment Analysis

The National Park Service (NPS) has developed a draft guidance document for assessing source impacts on Class I areas. Modeling levels of significance, similar to those applicable in Class II areas, have been developed by the NPS for Class I areas. Those levels of significance were used in this application to show that the net effect of moving the GT from Key West to Stock Island will be insignificant. The State of Virginia has also developed levels of significance for Class I areas. USEPA has accepted the use of Virginia's significance levels for Class I analyses, while Florida is leaning toward those developed by the NPS.

The receptors used in this analysis were identical to those used in the previous PSD application for the Stock Island diesel engines. The receptors represent the intersection of the direction radials from 10° to 60° and the nearest boundary of the Everglades Class I area (see Figure 5-2). It should be noted for clarification that the boundary is over water. The receptors are identified in Table 5-15. Table 5-16 sets forth the current predicted impact of the Key West GT on the Everglades, the projected impact based on the GT located at Stock Island, and the net difference in the highest impacts at each receptor. The tables compare the net impacts with the NPS-developed levels of significance. The distance between Stock Island and the Everglades is approximately 100 km. At this distance, the relocation of the GT from Key West to Stock Island (approximately 6 km) in a lateral direction will not change the impacts on the Class I area. It will have the affect of shifting the area of significance by approximately the same distance. Thus, the net differences shown in the tables are not a result of increases in ambient impact, but are related to the minor shift in impacts while keeping the receptors constant. As the tables show, the analysis demonstrates that moving the GT from Key West to Stock Island will not significantly affect the Class I area.

5.4 OTHER AIR QUALITY RELATED ISSUES

5.4.1 Land Use Compatibility

As described in Section 2, the GT will be relocated to the existing Stock Island Power Plant. Since the existing plant is an industrial application, the relocation of the GT to Stock Island is considered to be compatible with the intended industrial use as an electrical generating facility. Further, the Stock Island location is an area of lower population density than the Key West location.

5.4.2 Growth

Growth in a region can cause increases in ambient pollutant concentrations due to mobile sources, construction, and other growth-related aspects. The GT is being relocated to Stock Island, but the limitation on fuel consumption will be equivalent to the operating hours limitation currently enforced with the unit operating at full load. Therefore, the project is not expected to promote growth which could have a significant secondary impact on the regional ambient air quality.

5.4.3 Visibility

The GT's impact on visibility is not expected to change due to the relocation from Key West to Stock Island. Highest-second-high impacts from the GT are predicted to be less than the AAQS, Class II increments and modeling levels of significance for all pollutants and all averaging intervals in the surrounding PSD Class II area. Further, the net change in the impacts of the GT on the Class I area are predicted to be below the NPS modeling levels of significance. The GT will comply with visible emission standards. Therefore, visibility will not be affected by the relocation of the GT.

5.4.4 Soils and Vegetation

The impacts from the GT relocated to Stock Island will affect the same general area as the GT at Key West. Much of the surrounding area is open ocean. Since the GT is predicted to have an insignificant impact on the ambient air quality, the GT will not significantly affect soils and vegetation.

5.4.5 Aquatic Life

Much of the emissions from the GT will be dispersed over open ocean. Since all of the long-term impacts are predicted to be far less than the modeling levels of significance, the GT will not have a long-term affect on aquatic life. The short-term significant SO_2 impact occurred once in five years of meteorology. Given the natural levels of sulfates in the ocean, this is not expected to be a significant concern.

5.4.6 Monitoring Requirements

The modeling analysis presented herein demonstrates that the impacts from the relocated GT are below the *de minimis* monitoring concentrations (40 CFR 152.21(i)(8)(i) and F.A.C. Table 17-212.400-3) for CO and NO_x as presented in Table 5-14. For SO_2, one receptor had modeled concentration over the *de minimis* monitoring level. It occurred only once in the five-year period (1985-1989). This receptor located on the property boundary of Stock Island. For PM_{10}, there are eight days over five years period (1985-1989) when modeled concentration were over the *de minimis* monitoring level. However, all the violations occurred on the Stock Island property boundary. We believe preconstruction monitoring for SO_2, NO_x, CO and PM_{10} should not be required. A letter requesting a waiver from the preconstruction monitoring requirements was submitted to FDER on January 29, 1993 (see Appendix C). The conclusions presented in the letter have not changed. Further, the AAQS are not shown to be threatened and compliance with the AAQS will be maintained.

We understand that DEP is collecting PM_{10} data in Monroe County which is representative of background and more useful than attempting to quantify source-specific impact from a source not permitted to operate routinely. Modeling results indicate that increasing the combustion turbine stack height from 35 feet to 42 feet reduces the impact below the monitoring significance level.

Table 5-1

Climatological Data for Key West, Florida
(1931 - 1960)

Month	Average Temperature (°F)			Average Precipitation (inches)	Average Wind Speed (mph)	Prevailing Wind Direction
	Maximum	Minimum	Mean			
January	73.7	65.4	69.6	1.53	12.2	NE
February	74.6	66.1	70.4	1.98	12.3	SE
March	76.5	68.4	72.5	1.77	12.6	SE
April	79.6	72.0	75.8	2.48	12.7	ESE
May	82.7	75.3	79.0	2.73	11.1	ESE
June	85.6	78.0	81.8	3.97	9.9	SE
July	87.4	79.1	83.3	4.16	10.1	ESE
August	88.0	79.1	83.6	4.33	9.4	ESE
September	86.5	78.1	82.3	6.73	10.3	ESE
October	82.5	75.4	79.0	5.82	11.4	ENE
November	77.5	70.7	74.1	2.80	12.0	ENE
December	74.5	66.7	70.6	1.69	12.0	NE
Annual	80.8	72.9	76.8	39.99	11.3	ESE

Source: United States, National Oceanic and Atmospheric Administration, *Climates of the States*, 1974.

Table 5-2

Climatological Data for Miami, Florida
(1931 - 1960)

Month	Average Temperature (°F)			Average Precipitation (inches)	Average Wind Speed (mph)	Prevailing Wind Direction
	Maximum	Minimum	Mean			
January	75.8	57.9	66.9	2.03	9.4	NNW
February	77.0	58.8	67.9	1.87	10.1	ESE
March	79.8	61.1	70.5	2.27	10.3	SE
April	82.6	65.8	74.2	3.88	10.4	SE
May	85.4	69.7	77.6	6.44	9.4	ESE
June	88.0	73.5	80.8	7.37	8.1	SE
July	88.8	74.7	81.8	6.75	7.8	SE
August	89.7	74.9	82.3	6.97	7.6	SE
September	88.0	74.6	81.3	9.47	8.2	ESE
October	84.7	70.9	77.8	8.21	9.1	ENE
November	80.2	64.6	72.4	2.83	9.2	N
December	77.1	59.1	68.1	1.67	8.8	N
Annual	83.1	67.1	75.1	59.76	9.0	ESE

Source: United States, National Oceanic and Atmospheric Administration, *Climates of the States*, 1974.

abundant horizontal and vertical mixing can occur. The height of the ceiling above ground level defines the boundary layer. The height is highest on afternoons with abundant sunshine and during periods of strong winds, and is lowest during nighttime hours and periods of light winds.

The dispersion of air pollutants is caused by two types of turbulence: mechanical and thermal. Mechanical turbulence is associated with the general air flow over a rough surface (land). Thermal or convective turbulence is associated with the vertical temperature gradient which is caused by solar radiation (insolation) of the earth's surface, heating of the air near the ground, and a subsequent rise of the warm air parcel due to the changing density of the air.

Pasquill developed a stability classification scheme which provides an indicator of the amount of turbulence in the atmosphere. Stability classes A, B, and C describe situations with predominantly convective turbulence and are associated with low wind speeds and strong insolation. Such conditions are considered unstable and provide effective dispersion. Stability class D is considered to be neutral stability. This condition can occur at any time and is associated with strong winds, mechanical turbulence, and weak insolation. The least effective dispersion will occur for stability classes E and F which typically occur during nighttime conditions with light winds and clear skies. Table 5-3 shows a summary of stability conditions, wind speeds, and wind directions for Miami for the period 1981 through 1985. Stability class D is the most common condition and favors effective dispersion of pollutants in the atmosphere.

5.1.2 Topographical Features

Key West and the surrounding islands are essentially flat. The Stock Island Power Plant site is less than 2 m msl. One point on Key West, seven km from the project site, rises to 3m. Since the variation in terrain is minimal and is less than the height of the GT exhaust stack (10.7m), the use of a flat terrain dispersion model is appropriate for the analysis.

5.1.3 Meteorological Land Use Classification

The meteorological land use classification is used to determine the profile of the vertical wind speed and associated mechanical turbulence due to surface roughness. The wind speed profile is then used to extrapolate wind speeds at various heights for use in the estimates of atmospheric pollutant dispersion. USEPA *Guideline on Air Quality Models* stipulates that the land use within the total area circumscribed by a 3-km radius around the source be classified using Auer's scheme of meteorological land use typing proposed in the *Journal of Applied Meteorology* (1976). Auer's classifications are as follows:

Type	Description
I1	Heavy Industrial
I2	Light/Moderate Industrial
C1	Commercial
R1	Common Residential
R2/R3	Compact Residential
R4	Estate Residential
A1	Metropolitan Natural
A2	Agricultural Rural
A3/A4	Undeveloped
A5	Water Surfaces

According to the Guidelines, if more than 50 percent of the total area in the circle is classified by land use as I1, I2, C1, R2, or R3, urban dispersion coefficients should be used in the modeling, otherwise, appropriate rural dispersion coefficients should be used. A USGS 7.5-minute series topographical map was used to estimate the land use around the project site as more than 50% in type "A5: Water Surfaces". Therefore, default rural dispersion coefficients were used in the analysis.

5.1.4 Background Ambient Air Quality

Key West is designated attainment or unclassified (PM_{10}) for all criteria pollutants (chapter 17-275). This designation is consistent with several features of the area. First, there are no very large sources of air pollution nearby. Second, there is no significant terrain which could trap pollution and cause exceedances of the AAQS. Third, the prevailing winds are east and southeast bringing fairly clean air in the absence of pollutant transport regions.

With the exception of the 3-hour averaging interval for SO_2, background monitoring data have not been included in this submittal since the GT is predicted to have an insignificant impact on the ambient air quality. The SO_2 background data for the 3-hour averaging interval was taken from the PSD application submitted for the medium-speed diesel engines and reflects a conservative value. The use of the value was considered acceptable by FDER since the value was conservative. However, given the designation and features of the area presented above, the AAQS are not considered to be threatened. Ambient monitoring requirements and a request for waiver of preconstruction monitoring requirements are discussed further in Section 5.5.5.

5.2 MODELING METHOD

5.2.1 Model Selection

Mathematical models are the primary tools for air quality assessments to simulate the dispersion of the effluent plumes into the atmosphere. It is, therefore, important to choose models which will appropriately simulate the actual physical situation in the region of the project. The choice of models is primarily based on two considerations: 1) the level of detail and accuracy needed for the analysis, and 2) the topographical characteristics of the area. Analyses requiring extensive detail and accuracy require increasingly sophisticated models. It is accepted practice to utilize less sophisticated modeling techniques, so called "screening", as a first determination of compliance of a source with the AAQS. Screening models typically over-estimate pollutant concentrations.

Regulatory modeling levels of significance have been established as a guide to assist in the evaluation of a source's impact on ambient air quality (40 CFR 51.165(b)(2)). Air quality impacts below the regulatory levels of significance are not considered to cause or contribute to any violations of ambient air quality. These regulatory modeling levels of significance are presented in Table 5-4 for the pollutants assessed in this analysis. Generally speaking, if the results of a screening analysis indicate that the predicted ground-level concentrations are below the significance levels, then no further analysis is required. If, on the other hand, the ground level concentrations are above such significance levels, then more refined analyses are conducted using more detailed models with real time meteorology.

A screening analysis, described in detail below, was performed and the results compared to the modeling levels of significance. The primary purpose of the screening analysis was to identify the worst-case operating conditions for the GT. The results identified the relative magnitude of the impacts and the concentration gradient relative to downwind distance. Using the identified worst-case conditions, the sophistication of the modeling analysis was increased to assess the impacts further. This increased sophistication is referred to as the "refined analysis".

As agreed to in the modeling protocol, the USEPA-approved dispersion models selected for the air quality analysis were EPA SCREEN and Industrial Source Complex-Short Term (ISCST). These models use a steady-state, bivariate Gaussian distribution algorithm to estimate ground-level concentrations and are appropriate in areas classified as rural according to Auer's land use classifications. ISCST can accept either assumed default meteorology or sequential, hourly meteorological data, and can analyze the effects of multiple point source interaction. ISCST is recommended by *Guideline on Air Quality Models* (USEPA 1987) to model terrain elevations between the stack base and the stack height. This modeling analysis used regulatory default options, and no modifications were made to the models.

USEPA has recently updated the ISCST model, and the update has been released as ISC2. The differences between the old version and the new version include updated algorithms for predicting area and volume source impacts, modified downwash algorithms for non-buoyant plumes, and an updated Huber-Snyder algorithm which incorporates wind-direction-specific building heights and widths similar to the Schulman-Scire algorithm. No changes were made to the primary algorithms associated with point source impacts such as those from stacks associated with power generating equipment. Packaged software is available which provides expanded capabilities to the programs on the USEPA Bulletin Board. This software, which allows each model run to include several averaging intervals and multiple receptors, is not yet available for ISC2. Therefore, this analysis used ISCST v.90346 to capitalize on the expanded capabilities of the packaged software without compromising the integrity of the analysis.

5.2.2 Meteorological Data

The primary difference between a screening analysis and a refined analysis is typically the meteorological data used in the modeling. Screening analyses have been conducted with EPA SCREEN to determine 1-hour concentration averages by using "worst-case" meteorological assumptions. The meteorology used in the screening analysis is internal to EPA SCREEN. The data is set forth in *Guidelines For Air Quality Maintenance Planning and Analysis: Procedures for Evaluating Air Quality Impact of New Stationary Sources* (Draft, EPA 1988) and is as follows:

Stability Class	Wind Speed (m/s)
A	1,3
B	1,3,5
C	1,3,5,10
D	1,3,5,10,20
E	1,3,5
F	1,3,4

The refined analysis presented herein used five complete years (1981 through 1985) of wind and stability data consisting of actual surface observations and twice-per-day upper air soundings concurrently recorded at a station in Miami. These data used in previous analyses of the Stock Island site, have been summarized in the classical windrose (Figure 5-1) and in Table 5-2. Default wind speed profile exponents (indicative of increasing wind speed with increasing distance from the surface) and vertical potential temperature gradients (indicative of decreasing temperature with increasing distance above the surface) were used in the modeling. Since five years of meteorology were processed and short-term standards and increments may be exceeded once per year, the maximum second-highest concentration for the short-term averaging times was selected as the predicted air quality impact of the source analyses and compared to the short-term standards and increments in accordance with USEPA-approved practices and consistent with the modeling protocol. The annual average is the highest predicted concentrations averaged over the year for a given receptor.

5.2.3 Averaging Intervals

Screening analyses performed with EPA SCREEN result in 1-hour concentration averages. However, many of the AAQS apply to different averaging intervals so that the results must be modified to reflect other averaging intervals. The USEPA has suggested using scaling factors based on modeling experience. Therefore, EPA SCREEN-predicted concentrations were multiplied by the following scaling factors to obtain representative concentrations at other averaging intervals:

Averaging Interval	Scaling Factor
3-hour	0.9
8-hour	0.7
24-hour	0.4
Annual	0.1

5.2.4 Source Data

The Key West GT and project site are described in Section 2 of this application. The installation of one nominal 23-MW GE Frame 5 gas turbine is proposed for this site. Emissions of NO_x from the unit will be controlled by water injection and the sulfur content of the No. 2 fuel oil to be burned in the engine will not exceed 0.5 percent. Emissions estimates are consistent with the BACT analysis presented in Section 4. According to design, the GT will have a single exhaust. The modeling parameters presented in Table 5-5 represent the GT operating at 59°F and 90°F at loads of 50%, 75%, and 100% of capacity. Annual impacts were adjusted for each operating condition to conform with the requested annual fuel consumption limitation of 7.1 million gallons.

The GT was predicted to have a small area of significance at the property boundary for the 3-hour SO_2 averaging interval. Therefore, an interactive analysis of that area of significance was performed to assure compliance with AAQS and PSD Class II increments. FDER indicated that no major sources of air pollution have been built in the area since the construction of the diesel facility at Stock Island. Therefore, the interactive sources used in the PSD application for the diesel units were used in this analysis to assess the 3-hour SO_2 interactive impacts. Source parameters for the interactive units are presented in Table 5-6.

5.2.5 Stack Height Considerations

According to 40 CFR 51.100(hh) (as well as similar FDER Rule 17-210.550), a good engineering practice (GEP) stack height is the <u>greater</u> of:

65 meters

or $H_g = H_b + 1.5L$

where: H_g = the GEP stack height,
H_b = the height of the dominant nearby building, and
L = the lesser dimension of the height or projected width of the dominant nearby building.

A stack constructed below 65 meters conforms to the regulations for GEP stack height.

As is shown in Tables 5-5 and 5-6, the GT stack and the stacks of the interactive sources are less than 65 meters. Therefore, the stacks conform to the regulations and guidelines for GEP.

Structures tend to disrupt air flow across a region and create turbulence around the structure. This disruption is referred to as the building wake effect or building downwash effect. This effect can result in high local ground-level pollutant concentrations if the emission point of the source is not far enough above or away from the structure to avoid the effect. A stack constructed at a height approximately 2.5 times above the height of a nearby building is not likely to be affected by structural turbulence. If a stack is located with 5L of a building, and the building height is greater than approximately 40 percent of the stack height, then the stack is considered to be affected by building downwash.

The ISCST model used in the ambient air quality assessment uses a combination of two algorithms for predicting air quality impacts and the associated building wake effects. The Schulman-Scire algorithm is applicable when the stack height is less than 1.5 H_b and takes into account wind-direction-specific building heights and widths when determining wake effects. The Huber-Snyder algorithm is applicable when the stack height is between 1.5 H_b and 2.5 H_b and uses the actual building height and maximum projected width for all wind directions. Software packages are available to determine the values of the building heights and widths which can influence each stack and one such package has been used for this analysis to estimate the wake effects caused by the structures at the Stock Island Power Plant. The exhaust plume from the GT is expected to be influenced by the nearby fuel oil storage tank. However, since the prevailing winds are east and southeast, the tank rarely influences the plume from the GT. The GT enclosure will also effect GT plume downwash. All structures at the Stock Island Power Plant were included in the air analysis (see Figure 5-2).

5.2.6 Receptor Networks

EPA SCREEN generates a receptor network internally to assess impacts from a source. The receptors used in EPA SCREEN were default receptors spaced 100m apart out to 3,000m and 500m apart from 3,000m to 10,000m. Since there is minimal terrain variation, no elevations were input for the receptors.

The receptor grid for the refined air quality analysis consisted of a polar coordinate system centered on the project site. The grid system consisted of 36 direction radials separated by 10-degree increments. Receptors were placed at ground level at successive 500m intervals out to 5,000m, and 1,000m intervals from 5,000 to 20,000m. Additional receptors were placed at the property boundaries intersecting the 36 direction radials and between the boundary and first 500m ring (approximately 200m out). This coarse grid analysis provided sufficient resolution and downwind coverage to identify the areas of expected maximum concentrations.

5.3 RESULTS OF MODELING ANALYSIS

5.3.1 Screening Analysis

The screening analysis was conducted with EPA SCREEN to determine the worst-case operating conditions considering loads of 50%, 75%, and 100% and ambient temperatures of 59°F and 90°F. The matrix of impacts related to emissions of NO_x, CO, PM, and SO_2 from the GT are presented in Table 5-7. The 1-hour averages at an emission rate of 1 g/s were multiplied by the pollutant emission rate and adjusted according to the USEPA scaling factors to arrive at the appropriate averaging interval. Annual concentrations were prorated to conform to the annual fuel consumption limitation of 7.1 million gallons.

Three important conclusions were drawn by assessing the results of the screening analysis. First, with the exception of SO_2, the impacts were predicted by the screening analysis to be below the regulatory modeling levels of significance. Second, the impacts were predicted to peak at less than 1,300m. Therefore, the grid for the refined analysis which extended out to 20,000m was more than adequate to cover the impacts from the GT. Third, worst-case impacts occurred at 50 percent load. Short-term highs were predicted to occur at 59°F, and long-term highs were predicted to occur at 90°F. The refined analysis considered both ambient temperatures. The results of the screening analysis are summarized and compared to the modeling levels of significance in Table 5-8.

5.3.2 Refined Analysis

Facility Impacts

ISCST was used with real-time meteorological data to account for the consistency of the meteorology from the east and southeast. Further, the influence of structural downwash on the GT exhaust plume was included in the refined calculations. Table 5-9 presents the highest-high and highest-second-high concentrations for the worst-case GT operating conditions. As is shown in the table, the GT impacts are again predicted to be less than the regulatory modeling levels of significance for NO_x, CO, and PM. Additionally, the modeling predicted that the 24-hour and annual SO_2 impacts from the GT will be less than the respective modeling levels of significance. However, the highest 3-hour SO_2 impact of 34.8 $\mu g/m^3$ exceeded the significance level of 25 $\mu g/m^3$ and required an interactive analysis to assure compliance with the AAQS and Class II increments. It is important to note that the highest-second-high (HSH) impact from the GT on a 3-hour basis was only 7.4 $\mu g/m^3$ or less than 30% of the regulatory modeling level of significance.

Interactive Analysis

An interactive analysis was conducted to assure compliance with the AAQS and the PSD Class II increments. Using the real-time meteorology, the GT had a significant impact only for the 3-hour SO_2 averaging interval. Further, the area of significance was less than 200m^2 and at the immediate edge of the property boundary. The grid for the interactive analysis consisted of the property boundary within and just outside of the area of significance and additional receptors beyond the area of significance. The maximum fine grid resolution was 100m. The GT was modeled with the interactive sources previously discussed using the year of meteorology (1981) which resulted in the significant impact. The interactive impact was 34.8 $\mu g/m^3$ indicating that the other sources did not contribute to the impact of the GT. The HSH impact in the area of significance was less than 1 $\mu g/m^3$. This impact is approximately 0.08% of the 3-hour AAQS (1,300 $\mu g/m^3$) and approximately 0.2% of the PSD Class II increment. The impact analysis, therefore, demonstrates that the GT will not cause or contribute to violations of the AAQS or PSD Class II increments.

Class I Increment Analysis

The National Park Service (NPS) has developed a draft guidance document for assessing source impacts on Class I areas. Modeling levels of significance, similar to those applicable in Class II areas, have been developed by the NPS for Class I areas. Those levels of significance were used in this application to show that the net effect of moving the GT from Key West to Stock Island will be insignificant. The State of Virginia has also developed levels of significance for Class I areas. USEPA has accepted the use of Virginia's significance levels for Class I analyses, while Florida is leaning toward those developed by the NPS.

The receptors used in this analysis were identical to those used in the previous PSD application for the Stock Island diesel engines. The receptors represent the intersection of the direction radials from 10° to 60° and the nearest boundary of the Everglades Class I area (see Figure 5-3). It should be noted for clarification that the boundary is over water. The receptors are identified in Table 5-10. Table 5-11 sets forth the current predicted impact of the Key West GT on the Everglades, the projected impact based on the GT located at Stock Island, and the net difference in the highest impacts at each receptor for ambient temperatures of 59°F and 90°F, respectively. The tables compare the net impacts with the NPS-developed levels of significance. The distance between Stock Island and the Everglades is approximately 100 km. At this distance, the relocation of the GT from Key West to Stock Island (approximately 6 km) in a lateral direction will not change the impacts on the Class I area. It will have the affect of shifting the area of significance by approximately the same distance. Thus, the net differences shown in the tables are not a result of increases in ambient impact, but are related to the minor shift in impacts while keeping the receptors constant. As the tables show, the analysis demonstrates that moving the GT from Key West to Stock Island will not significantly affect the Class I area.

5.4 OTHER AIR QUALITY RELATED ISSUES

5.4.1 Land Use Compatibility

As described in Section 2, the GT will be relocated to the existing Stock Island Power Plant. Since the existing plant is an industrial application, the relocation of the GT to Stock Island is considered to be compatible with the intended industrial use as an electrical generating facility. Further, the Stock Island location is an area of lower population density than the Key West location.

5.4.2 Growth

Growth in a region can cause increases in ambient pollutant concentrations due to mobile sources, construction, and other growth-related aspects. The GT is being relocated to Stock Island, but the limitation on fuel consumption will be equivalent to the operating hours limitation currently enforced with the unit operating at full load. Therefore, the project is not expected to promote growth which could have a significant secondary impact on the regional ambient air quality.

5.4.3 Visibility

The GT's impact on visibility is not expected to change due to the relocation from Key West to Stock Island. Highest-second-high impacts from the GT are predicted to be less than the AAQS, Class II increments and modeling levels of significance for all pollutants and all averaging intervals in the surrounding PSD Class II area. Further, the net change in the impacts of the GT on the Class I area are predicted to be below the NPS modeling levels of significance. The GT will comply with visible emission standards. Therefore, visibility will not be affected by the relocation of the GT.

5.4.4 Soils and Vegetation

The impacts from the GT relocated to Stock Island will affect the same general area as the GT at Key West. Much of the surrounding area is open ocean. Since the GT is predicted to have an insignificant impact on the ambient air quality, the GT will not significantly affect soils and vegetation.

5.4.5 Aquatic Life

Much of the emissions from the GT will be dispersed over open ocean. Since all of the long-term impacts are predicted to be far less than the modeling levels of significance, the GT will not have a long-term affect on aquatic life. The short-term significant SO_2 impact occurred once in five years of meteorology. Given the natural levels of sulfates in the ocean, this is not expected to be a significant concern.

5.4.6 Monitoring Requirements

The modeling analysis presented herein demonstrates that the impacts from the relocated GT are below the *de minimis* monitoring concentrations (40 CFR 152.21(i)(8)(i) and F.A.C. Table 17-212.400-3) for all pollutants and all averaging intervals as presented in Table 5-12. A letter requesting a waiver from the preconstruction monitoring requirements was submitted to FDER on January 29, 1993 (see Appendix C). The conclusions presented in the letter have not changed, therefore, the waiver should be granted and preconstruction monitoring should not be required. Further, the AAQS are not shown to be threatened and compliance with the AAQS will be maintained.

Table 5-1

Climatological Data for Key West, Florida
(1931 - 1960)

Month	Average Temperature (°F)			Average Precipitation (inches)	Average Wind Speed (mph)	Prevailing Wind Direction
	Maximum	Minimum	Mean			
January	73.7	65.4	69.6	1.53	12.2	NE
February	74.6	66.1	70.4	1.98	12.3	SE
March	76.5	68.4	72.5	1.77	12.6	SE
April	79.6	72.0	75.8	2.48	12.7	ESE
May	82.7	75.3	79.0	2.73	11.1	ESE
June	85.6	78.0	81.8	3.97	9.9	SE
July	87.4	79.1	83.3	4.16	10.1	ESE
August	88.0	79.1	83.6	4.33	9.4	ESE
September	86.5	78.1	82.3	6.73	10.3	ESE
October	82.5	75.4	79.0	5.82	11.4	ENE
November	77.5	70.7	74.1	2.80	12.0	ENE
December	74.5	66.7	70.6	1.69	12.0	NE
Annual	80.8	72.9	76.8	39.99	11.3	ESE

Source: United States, National Oceanic and Atmospheric Administration, *Climates of the States*, 1974.

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Table 5-2

Climatological Data for Miami, Florida
(1931 - 1960)

Month	Average Temperature (°F)			Average Precipitation (inches)	Average Wind Speed (mph)	Prevailing Wind Direction
	Maximum	Minimum	Mean			
January	75.8	57.9	66.9	2.03	9.4	NNW
February	77.0	58.8	67.9	1.87	10.1	ESE
March	79.8	61.1	70.5	2.27	10.3	SE
April	82.6	65.8	74.2	3.88	10.4	SE
May	85.4	69.7	77.6	6.44	9.4	ESE
June	88.0	73.5	80.8	7.37	8.1	SE
July	88.8	74.7	81.8	6.75	7.8	SE
August	89.7	74.9	82.3	6.97	7.6	SE
September	88.0	74.6	81.3	9.47	8.2	ESE
October	84.7	70.9	77.8	8.21	9.1	ENE
November	80.2	64.6	72.4	2.83	9.2	N
December	77.1	59.1	68.1	1.67	8.8	N
Annual	83.1	67.1	75.1	59.76	9.0	ESE

Source: United States, National Oceanic and Atmospheric Administration, *Climates of the States*, 1974.

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Summary of Miami, Florida Dispersion Climatology 1981-1985

MIAMI
FIVE YEAR WINDROSE
1981 - 1985

STABILITY CLASS 1 .43%

SPEED	N .02	NNE .01	NE .02	ENE .01	E .01	ESE .04	SE .07	SSE .06	S .06	SSW .01	SW .02	WSW .01	W .02	WNW .04	NW .03	NNW .02
ws<=1	.00	.00	.00	.00	.00	.00	.01	.00	.01	.01	.00	.00	.00	.01	.00	.00
1> ws< 3	.01	.01	.02	.01	.01	.04	.07	.05	.05	.00	.02	.01	.01	.03	.02	.01
3>=ws> 5	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
5>=ws> 7	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
7>=ws> 9	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
9>=ws> 999	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

STABILITY CLASS 2 5.77%

SPEED	N .26	NNE .21	NE .21	ENE .36	E .46	ESE .80	SE 1.00	SSE .67	S .30	SSW .15	SW .20	WSW .18	W .18	WNW .18	NW .31	NNW .29
ws<=1	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
1> ws< 3	.10	.07	.07	.07	.08	.14	.15	.15	.09	.06	.10	.08	.08	.08	.11	.09
3>=ws> 5	.15	.14	.13	.29	.37	.65	.83	.51	.21	.09	.10	.10	.09	.10	.20	.20
5>=ws> 7	.00	.00	.00	.00	.01	.01	.02	.01	.00	.00	.00	.00	.00	.00	.00	.00
7>=ws> 9	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
9>=ws> 999	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

STABILITY CLASS 3 15.41%

SPEED	N .87	NNE .55	NE .63	ENE 1.31	E 1.76	ESE 2.30	SE 2.69	SSE 1.57	S .67	SSW .33	SW .32	WSW .26	W .35	WNW .38	NW .62	NNW .80
ws<=1	.02	.02	.00	.00	.00	.00	.01	.00	.00	.01	.01	.00	.00	.01	.00	.02
1> ws< 3	.14	.13	.08	.10	.12	.15	.18	.20	.13	.07	.08	.08	.08	.11	.13	.13
3>=ws> 5	.55	.27	.31	.50	.73	.98	1.15	.79	.31	.15	.14	.11	.14	.16	.32	.47
5>=ws> 7	.16	.12	.20	.60	.76	1.02	1.26	.53	.21	.09	.07	.06	.10	.09	.15	.18
7>=ws> 9	.00	.01	.02	.08	.13	.12	.08	.04	.01	.00	.01	.01	.02	.01	.01	.00
9>=ws> 999	.00	.00	.02	.02	.01	.01	.01	.00	.01	.01	.01	.00	.01	.00	.01	.00

STABILITY CLASS 4 38.43%

SPEED	N 2.71	NNE 1.21	NE 2.59	ENE 4.84	E 5.41	ESE 5.45	SE 4.29	SSE 2.29	S 1.26	SSW .79	SW .85	WSW .72	W .79	WNW .91	NW 1.62	NNW 2.69
ws<=1	.01	.02	.00	.00	.01	.01	.02	.00	.01	.00	.01	.01	.01	.01	.03	.04
1> ws< 3	.41	.21	.18	.16	.19	.26	.22	.29	.20	.10	.11	.09	.08	.13	.22	.29
3>=ws> 5	.94	.46	.51	1.01	1.23	1.31	1.12	.78	.53	.27	.26	.18	.22	.26	.45	.78
5>=ws> 7	.93	.40	1.15	2.16	2.56	2.53	2.04	.90	.41	.25	.28	.22	.26	.25	.58	1.03
7>=ws> 9	.39	.11	.61	1.28	1.20	1.13	.80	.26	.09	.12	.12	.16	.13	.15	.24	.46
9>=ws> 999	.03	.02	.15	.23	.22	.22	.09	.05	.03	.05	.08	.06	.08	.11	.10	.09

STABILITY CLASS 5 18.87%

SPEED	N 1.87	NNE .81	NE 1.05	ENE 1.81	E 2.54	ESE 2.52	SE 1.56	SSE 1.04	S .68	SSW .50	SW .46	WSW .41	W .45	WNW .61	NW .81	NNW 1.74
ws<=1	.05	.02	.01	.02	.02	.02	.01	.01	.00	.02	.01	.01	.02	.01	.04	.05
1> ws< 3	.69	.38	.26	.34	.51	.54	.47	.44	.32	.24	.21	.18	.19	.19	.34	.70
3>=ws> 5	.97	.38	.63	1.20	1.64	1.63	.92	.54	.34	.22	.21	.20	.21	.36	.36	.83
5>=ws> 7	.15	.04	.15	.24	.38	.33	.15	.05	.02	.03	.02	.02	.03	.05	.08	.16
7>=ws> 9	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
9>=ws> 999	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

STABILITY CLASS 6 15.97%

SPEED	N 1.79	NNE .84	NE .68	ENE .90	E 1.58	ESE 1.90	SE .97	SSE .87	S .73	SSW .49	SW .65	WSW .50	W .58	WNW .56	NW 1.10	NNW 1.82
ws<=1	.11	.03	.03	.04	.04	.05	.04	.03	.03	.03	.04	.04	.05	.03	.06	.07
1> ws< 3	1.31	.63	.46	.58	1.05	1.31	.70	.68	.55	.36	.49	.38	.42	.40	.83	1.41
3>=ws> 5	.37	.18	.18	.28	.48	.53	.23	.16	.14	.10	.13	.09	.10	.13	.21	.34
5>=ws> 7	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
7>=ws> 9	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
9>=ws> 999	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

STABILITY CLASS 7 5.12%

SPEED	N .63	NNE .21	NE .10	ENE .13	E .41	ESE .37	SE .32	SSE .36	S .26	SSW .21	SW .23	WSW .22	W .27	WNW .22	NW .46	NNW .72
ws<=1	.17	.06	.02	.03	.09	.11	.05	.10	.07	.07	.06	.05	.10	.04	.14	.17
1> ws< 3	.46	.16	.08	.10	.31	.26	.24	.25	.19	.14	.17	.16	.17	.18	.32	.55
3>=ws> 5	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
5>=ws> 7	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
7>=ws> 9	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
9>=ws> 999	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
TOTAL	8.13	3.85	5.29	9.36	12.17	13.38	10.91	6.85	3.96	2.48	2.74	2.31	2.63	2.90	4.95	8.28

SPEED		
ws<=1	2.82	.00
1> ws< 3	28.27	.57
3>=ws> 5	35.83	1.43
5>=ws> 7	23.52	1.41
7>=ws> 9	7.83	.63
9>=ws> 999	1.73	.17
	100.00	4.21 average

Total number of hours = 43824.

Table 5-4

Modeling Levels of Significance

Pollutant	Averaging Interval	Level of Significance ($\mu g/m^3$)
NO_x	Annual	1
CO	1-Hour 8-Hour	2000 500
PM	24-Hour Annual	5 1
SO_2	3-Hour 24-Hour Annual	25 5 1

Table 5-5

GT Modeling Parameters

Stack Height (m)	Stack Diameter (m)	Load Condition		Stack Velocity (m/s)	Stack Temperature (k)	Emissions (g/s) [1]			
						NO_x	CO	PM	SO_2
10.7	3.72	59	100	25.2	756	12.05	1.96	2.27	21.22
			75	18.0	676	9.64	5.48	2.27	16.98
			50	15.9	598	7.29	8.05	2.27	12.83
		90	100	24.0	766	10.94	1.33	2.27	19.27
			75	18.3	729	8.76	3.27	2.27	15.42
			50	15.1	605	6.62	5.37	2.27	11.67

(1) Emissions are short-term peak emissions rates not prorated for annual fuel consumption limitations.

Table 5-6

Interactive Source Parameters

Source	Stack Height (m)	Stack Diameter (m)	Stack Velocity (m/s)	Stack Temperature (k)	SO_2 Emissions (g/s)
Stock Island Medium-Speed Diesels	30.48	1.67	30.48	588	12.7
Stock Island Steam Unit	31.7	1.52	44.8	460	150.6
Stock Island High Speed Diesels	6.1	1.8	11.6	617	3.2

Table 5-7
Screening Analysis Results

Ambient Temp (F)	Operating Load (%)	Predicted Impact (ug/m3)	Pollutant	Emission Rate (g/s)	Concentration (ug/m3) 1-hour	3-hour	8-hour	24-hour	Annual
59	100	0.69	NOx	12.05					0.28
			CO	1.96	1.35		0.95		
			SO2	21.17		13.19		5.86	0.48
			PM	2.27				0.63	0.05
	75	1.06	NOx	9.64					0.42
			CO	5.48	5.78		4.04		
			SO2	17.01		16.15		7.18	0.74
			PM	2.27				0.96	0.10
	50	1.48	NOx	7.29					0.59
			CO	8.05	11.89		8.32		
			SO2	12.85		17.08		7.59	1.03
			PM	2.27				1.34	0.18
90	100	0.72	NOx	10.94					0.28
			CO	1.33	0.96		0.67		
			SO2	19.28		12.44		5.53	0.50
			PM	2.27				0.65	0.06
	75	0.96	NOx	8.76					0.38
			CO	3.27	3.13		2.19		
			SO2	15.37		13.26		5.89	0.67
			PM	2.27				0.87	0.10
	50	1.56	NOx	6.62					0.62
			CO	5.37	8.39		5.88		
			SO2	11.72		16.47		7.32	1.10
			PM	2.27				1.42	0.21

Table 5-8

Summary of Screening Analysis

Pollutant	Averaging Interval	Regulatory Level of Significance (μg/m³)	Worst Case Impact (μg/m³)	Load (%)	Ambient Temperature (F)
NO_x	Annual	1	0.6	50	90
CO	1-Hour 8-Hour	2000 500	11.9 8.3	50 50	59 59
PM	24-Hour Annual	5 1	1.4 0.2	50 50	90 90
SO_2	3-Hour 24-Hour Annual	25 5 1	17.1 7.6 1.1	50 50 50	59 59 90

Note: Impacts predicted with default meteorology.

Table 5-9

Refined Impacts

Pollutant	Averaging Interval	High						Second High					
		59°F, 50%			90°F, 50%			59°F, 50%			90°F, 50%		
		Impact (μg/m³)	Receptor (m, deg)	Year	Impact (μg/m³)	Receptor (m, deg)	Year	Impact (μg/m³)	Receptor (m, deg)	Year	Impact (μg/m³)	Receptor (m, deg)	Year
SO_2	3-hr 24-hr Annual	21.6 2.8 0.14	80,70 80,70 7000,290	1981 1981 1982	34.8 4.5 0.13	80,70 80,70 8000,290	1981 1981 1982	12.8 1.8	6000,290 10,000,300	1982 1984	7.4 1.7	9000,300 10,000,300	1982 1984
NO_x	Annual	0.08	7000,290	1982	0.07	8000,290	1982						
PM	24-hr Annual	0.49 0.025	80,70 7000,290	1981 1982	0.88 0.026	80,70 8000,290	1981 1982	0.32	10,000,300	1984	0.33	10,000,300	1984
CO	1-hr 8-hr	40.7 5.8	80,70 80,70	1981 1981	47.9 6.8	80,70 80,70	1981 1981	7.1 2.7	14,000,70 8,000,170	1985 1983	4.9 1.8	14,000,70 8,000,170	1985 1983

Table 5-10

Everglades Class I Receptors

	Radial (deg)	Distance (m)
1.	10	148,000
2.	20	140,000
3.	30	122,000
4.	40	99,000
5.	50	100,000
6.	60	92,000

Table 5-11

Everglades Class I Impacts
($\mu g/m^3$)

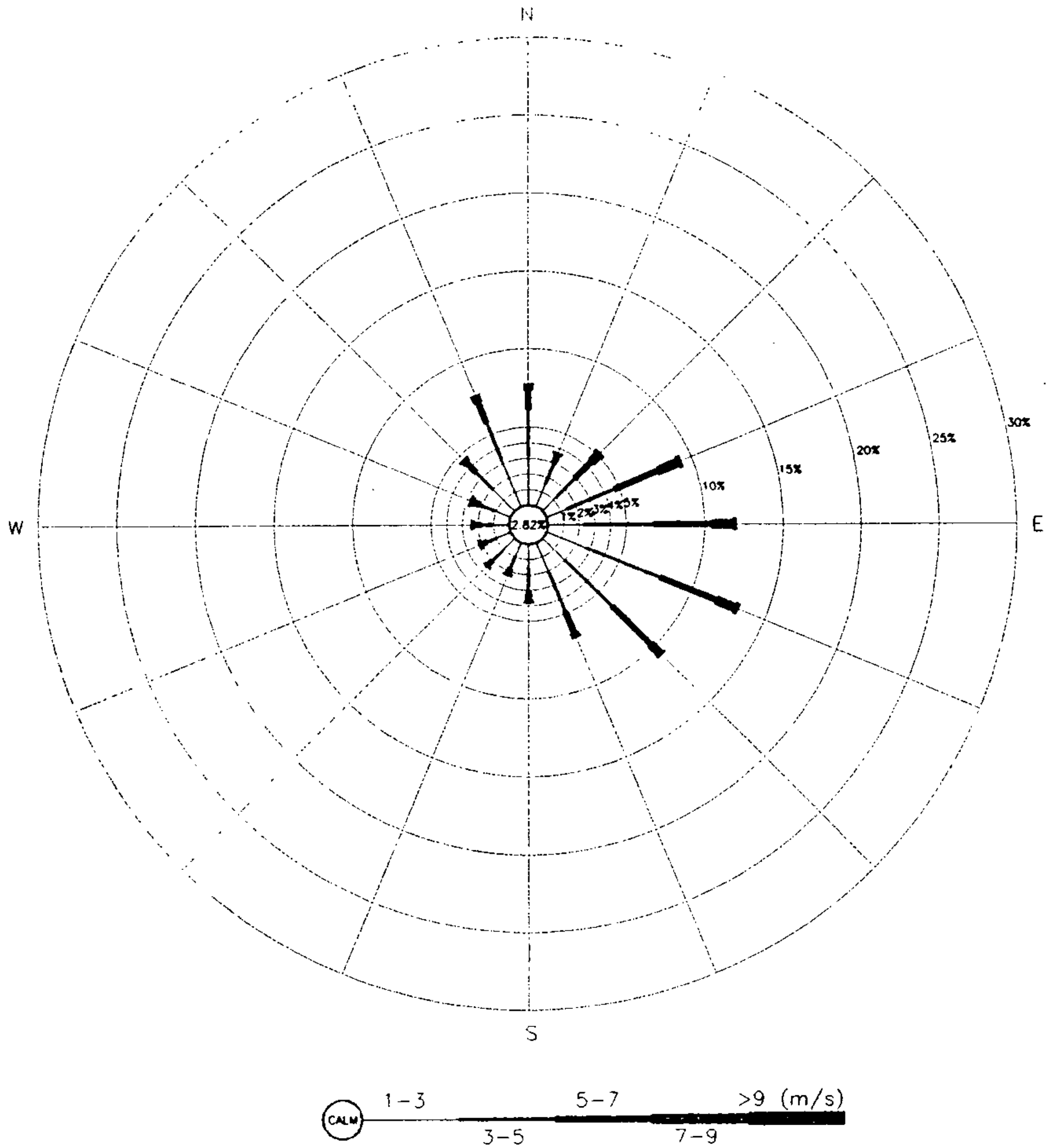
Pollutant	Averaging Interval	Key West (KW) Highest Impact [1]	Stock Island (SI) Highest Impact [1]	Difference (SI-KW)	Class I LOS [2]	Class I LOS [3]
SO_2	3-hr 24-hr Annual [4]	2.53 0.42 0.00490	2.46 0.46 0.00483	-0.07 0.04 -0.00007	0.48 0.07 0.025	1.23 0.275 0.1
NO_x	Annual [4]	0.00278	0.00274	-0.00004	0.025	0.1
PM_{10}	24-hr Annual [4]	0.08 0.00095	0.09 0.00094	0.01 -0.00001	0.33 0.1	1.35 0.27

(1) *Highest impacts were found to be at the condition of 90°F - 50% load.*
(2) *National Park Service (NPS)*
(3) *USEPA accepted values.*
(4) *Modeled annual values prorated to account for operating limits.*

Table 5-12

PSD *de minimis* Monitoring Concentrations

Pollutant	Averaging Interval	*de minimis* Concentrations ($\mu g/m^3$)	Facility Impact ($\mu g/m^3$)
NO_x	Annual	14	0.08
CO	8-Hour	575	47.9
SO_2	24-Hour	13	4.5
PM	24-Hour	10	0.88



REVISIONS	DATE	BY	CKD.	APP.	APP.	DRAWN CHECKED APPROVED APPROVED DATE	R.W. BECK AND ASSOCIATES

STOCK ISLAND GENERATING FACILITY	FIGURE 5-1 MIAMI WIND ROSE (1981-1985)	SCALE NO. 3068-SK-3	REV. 0

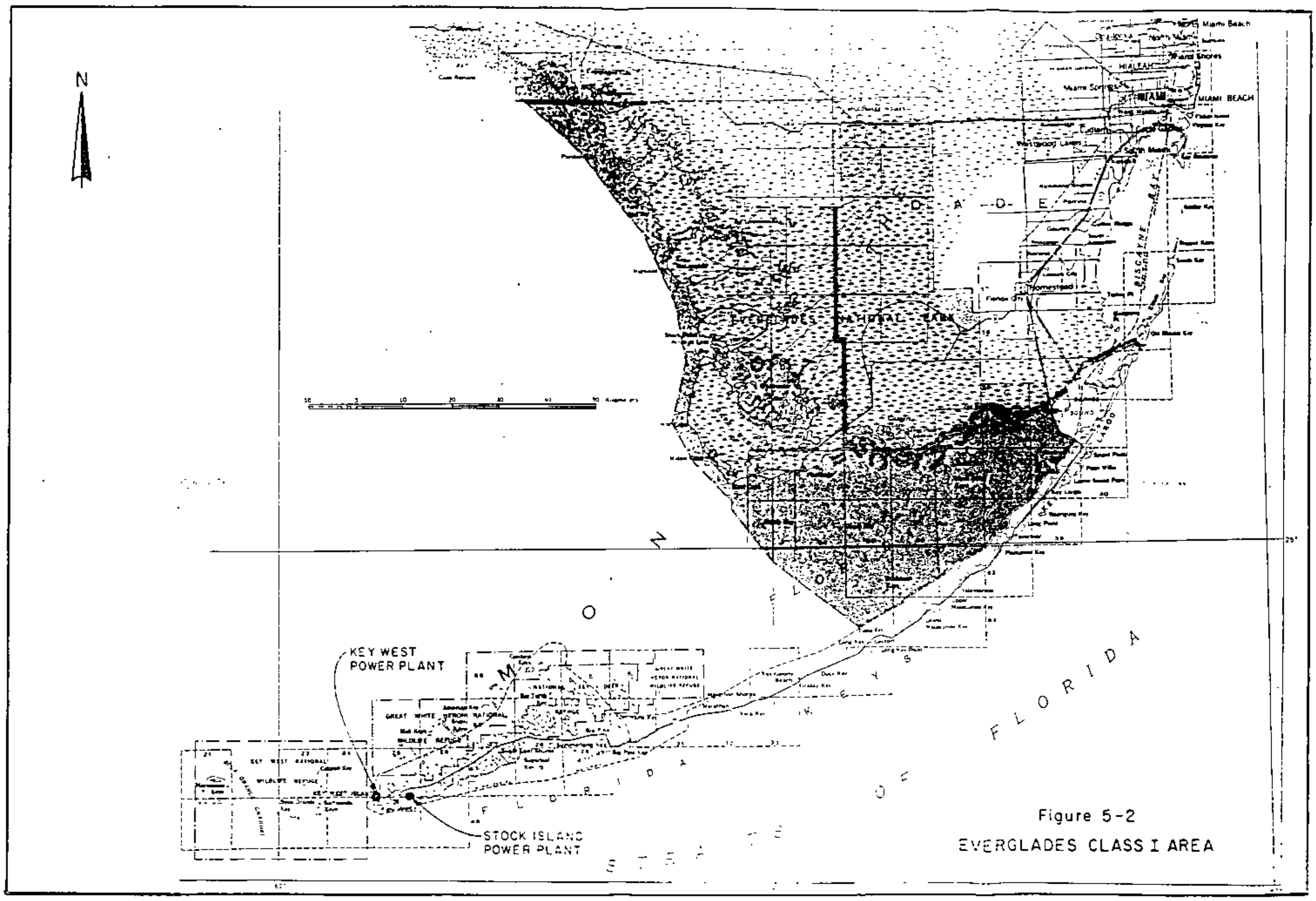


Figure 5-2
EVERGLADES CLASS I AREA

Appendix A
APPLICATION FORM

R.W. BECK
AND ASSOCIATES

APPENDIX A

Florida Department of Environmental Regulation

Twin Towers Office Bldg • 2600 Blair Stone Road • Tallahassee, Florida 32399-2400

Lawton Chiles, Governor

Carol M. Browner, Secretary

AC 44-245399
PSD-FL-210

$1500 pd.
2-14-94
Rcpt. #224209

APPLICATION TO OPERATE/CONSTRUCT AIR POLLUTION SOURCES

SOURCE TYPE: Electric Generating Plant [ ] New[1] [X] Existing[1]

APPLICATION TYPE: [ ] Construction [ ] Operation [X] Modification

COMPANY NAME: Key West, City Electric System COUNTY: Monroe

Identify the specific emission point source(s) addressed in this application (i.e. Lime Kiln No. 4 with Venturi Scrubber; Peaking Unit No. 2, Gas Fired) Combustion Turbine

SOURCE LOCATION: Street Front Street City Key West

UTM: East 425 KM North 2716KM

Latitude 24 ° 33 ' 49 "N Longitude 81 ° 44 ' 03 "W

APPLICANT NAME AND TITLE: Robert R. Padron, Manager

APPLICANT ADDRESS: 1006 James Street, Key West, Florida 33041

SECTION I: STATEMENTS BY APPLICANT AND ENGINEER

A. APPLICANT

I am the undersigned owner or authorized representative* of City Electric System

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

*Attach letter of authorization

Signed: [signature]

Robert R. Padron, Manager
Name and Title (Please Type)

Date: 5-26-93 Telephone No. 305/294-5272

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

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

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

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

Signed ______________________

Garry D. Cornish
Name (Please Type)

R. W. Beck & Associates
Company Name (Please Type)

1125 17th Street, Suite 1900 Denver, CO 80202
Mailing Address (Please Type)

lorida Registration No. 44404 Date: June 26, 1991 Telephone No. 303/299-5200

SECTION II: GENERAL PROJECT INFORMATION

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

Ih order to consolidate operations, CES is planning to move an existing permitted and operating nominal 23-MW combustionturbine from the Key West Power Plant to the Stock Island Power Plant. The project will result in full compliance.

. Schedule of project covered in this application (Construction Permit Application Only)

Start of Construction 8/1/93 Completion of Construction 12/1/93

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

Water injection annualized cost at requested permit levels = $519,000 per year.
(Includes direct and indirect capital and O&M)

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

Construction Permit No. AC44-5733 issued 3/14/79, expired 9/14/79.
Operating Permit No. A044-147179, expires 4/4/93.

E. Requested permitted equipment operating time: hrs/day 24; days/wk 7; wks/yr *; if power plant, hrs/yr *; if seasonal, describe: ***CES requests that the unit only be limited to 7.1 million gallons of fuel consumption per year. This equates to 2888.5 hours at full load and ISO conditions.**

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

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

H. Do "Reasonably Available Control Technology" (RACT) requirements apply to this source? **No**

a. If yes, for what pollutants? ______

b. If yes, in addition to the information required in this form, any information requested in Rule 17-2.650 must be submitted.

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

Please see supporting documentation entitled "Prevention of Significant Deterioration, Application for Modification, Stock Island Power Plant Gas Turbine Project, May 1993".

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

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

Description	Contaminants Type	Contaminants % Wt	Utilization Rate - lbs/hr	Relate to Flow Diagram

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

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

2. Product Weight (lbs/hr): __________

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

See attached Table of Emissions (Table 2-3)

Name of Contaminant	Emission[1] Maximum lbs/hr	Emission[1] Actual T/yr	Allowed[2] Emission Rate per Rule 17-2	Allowable[3] Emission lbs/hr	Potential[4] Emission ~~lbs/yr~~	Potential[4] Emission T/yr	Relate to Flow Diagram
NOx	96	138	81ppm	104	269	389	
CO	64	152	N/A	N/A	34	81	
SO2	168	243	150ppm	265	162	234	
PM_{10}	18	47	20% Opacity	N/A	18	47	
UHC	6	16	N/A	N/A	3	8	

[1] See Section V, Item 2.

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

[3] Calculated from operating rate and applicable standard.

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

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

Name and Type (Model & Serial No.)	Contaminant	Efficiency	Range of Particles Size Collected (in microns) (If applicable)	Basis for Efficiency (Section V Item 5)
Water Injection	NOx	65%		Vendor Data & Tests

E. Fuels

Type (Be Specific)	Consumption*		Maximum Heat Input (MMBTU/hr)
	avg/hr	max./hr	
No. 2 Fuel Oil		2,466 gal.	312

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

Fuel Analysis:

Percent Sulfur: 0.5 Percent Ash: 0.0

Density: 6.83 lbs/gal Typical Percent Nitrogen: 0.006

Heat Capacity: 18,500 (LHV) BTU/lb 126,355 (LHV) BTU/gal

Other Fuel Contaminants (which may cause air pollution): ____________

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

Annual Average ____________ Maximum ____________

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

Demineralizer regeneration waste - disposed offsite by others

Demineralizer filter backwash - discharge to evaporation pond

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

Stack Height: 35 ft. Stack Diameter: 12.2 eq. ft. ft.

Gas Flow Rate: 580,406 ACFM 210,000 DSCFM Gas Exit Temperature: 918 °F.

Water Vapor Content: 8 % Velocity: 83 FPS

*See Table 5-5

SECTION IV: INCINERATOR INFORMATION

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

Description of Waste ______

Total Weight Incinerated (lbs/hr) ______ Design Capacity (lbs/hr) ______

Approximate Number of Hours of Operation per day ______ day/wk ______ wks/yr. ______

Manufacturer ______

Date Constructed ______ Model No. ______

	Volume $(ft)^3$	Heat Release (BTU/hr)	Fuel Type	Fuel BTU/hr	Temperature (°F)
Primary Chamber					
Secondary Chamber					

Stack Height: ______ ft. Stack Diamter: ______ Stack Temp. ______

Gas Flow Rate: ______ ACFM ______ DSCFM* Velocity: ______ FPS

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

Type of pollution control device: [ ] Cyclone [ ] Wet Scrubber [ ] Afterburner

[ ] Other (specify) ______

Brief description of operating characteristics of control devices: ________________________

____

____

____

____

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

____

____

____

____

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

SECTION V: SUPPLEMENTAL REQUIREMENTS

Please provide the following supplements where required for this application.

1. Total process input rate and product weight -- show derivation [Rule 17-2.100(127)]

2. To a construction application, attach basis of emission estimate (e.g., design calculations, design drawings, pertinent manufacturer's test data, etc.) and attach proposed methods (e.g., FR Part 60 Methods 1, 2, 3, 4, 5) to show proof of compliance with applicable standards. To an operation application, attach test results or methods used to show proof of compliance. Information provided when applying for an operation permit from a construction permit shall be indicative of the time at which the test was made.

3. Attach basis of potential discharge (e.g., emission factor, that is, AP42 test).

4. With construction permit application, include design details for all air pollution control systems (e.g., for baghouse include cloth to air ratio; for scrubber include cross-section sketch, design pressure drop, etc.)

5. With construction permit application, attach derivation of control device(s) efficiency. Include test or design data. Items 2, 3 and 5 should be consistent: actual emissions = potential (1-efficiency).

6. An 8 1/2" x 11" flow diagram which will, without revealing trade secrets, identify the individual operations and/or processes. Indicate where raw materials enter, where solid and liquid waste exit, where gaseous emissions and/or airborne particles are evolved and where finished products are obtained.

7. An 8 1/2" x 11" plot plan showing the location of the establishment, and points of airborne emissions, in relation to the surrounding area, residences and other permanent structures and roadways (Example: Copy of relevant portion of USGS topographic map).

8. An 8 1/2" x 11" plot plan of facility showing the location of manufacturing processes and outlets for airborne emissions. Relate all flows to the flow diagram.

9. The appropriate application fee in accordance with Rule 17-4.05. The check should be made payable to the Department of Environmental Regulation.

10. With an application for operation permit, attach a Certificate of Completion of Construction indicating that the source was constructed as shown in the construction permit.

SECTION VI: BEST AVAILABLE CONTROL TECHNOLOGY

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

[x] Yes [ ] No

Contaminant	Rate or Concentration
NOx	81 ppmvd @ 15% O_2
SO_2	150 ppmvd @ 15% O_2

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

[ ] Yes [X] No

Contaminant	Rate or Concentration

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

Contaminant	Rate or Concentration
NOx	75 ppmvd @ 15% O_2
*CO	20-136 ppmvd @ 15% O_2
SO_2	168 lbs/hr
PM_{10}	18 lbs/hr

*See Section 4.7.5 of attached PSD application.

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

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

*Explain method of determining

5. Useful Life: 6. Operating Costs:

7. Energy: 8. Maintenance Cost:

9. Emissions:

Contaminant	Rate or Concentration

10. Stack Parameters

a. Height: ft. b. Diameter: ft.

c. Flow Rate: ACFM d. Temperature: °F.

e. Velocity: FPS

E. Describe the control and treatment technology available (As many types as applicable, use additional pages if necessary). **See Section 4.0 BACT Analysis, of PSD documentation for modification**

1.

a. Control Device: b. Operating Principles:

c. Efficiency:[1] d. Capital Cost:

e. Useful Life: f. Operating Cost:

g. Energy:[2] h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

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

2.

a. Control Device: b. Operating Principles:

c. Efficiency:[1] d. Capital Cost:

e. Useful Life: f. Operating Cost:

g. Energy:[2] h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

[1]Explain method of determining efficiency.
[2]Energy to be reported in units of electrical power - KWH design rate.

j. Applicability to manufacturing processes:

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

3.

a. Control Device: b. Operating Principles:

c. Efficiency:[1] d. Capital Cost:

e. Useful Life: f. Operating Cost:

g. Energy:[2] h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

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

4.

a. Control Device: b. Operating Principles:

c. Efficiency:[1] d. Capital Costs:

e. Useful Life: f. Operating Cost:

g. Energy:[2] h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

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

F. Describe the control technology selected: **See section 4.0, BACT Analysis, of attached PSD documentation for modification.**

1. Control Device: **Water injection** 2. Efficiency:[1] **65% [% Eff.=$(1-\frac{\text{Actual}}{\text{Potential}})$ *100**

3. Capital Cost: **$720,000** 4. Useful Life: **20 Year**

5. Operating Cost: **$258,000** 6. Energy:[2]

7. Maintenance Cost: **$190,000** 8. Manufacturer: **General Electric**

9. Other locations where employed on similar processes:

a. (1) Company: **See Section 4.0 BACT Analysis**

(2) Mailing Address:

(3) City: (4) State:

[1]Explain method of determining efficiency.
[2]Energy to be reported in units of electrical power - KWH design rate.

(5) Environmental Manager:

(6) Telephone No.:

(7) Emissions:[1]

Contaminant	Rate or Concentration

(8) Process Rate:[1]

b. (1) Company:

(2) Mailing Address:

(3) City: (4) State:

(5) Environmental Manager:

(6) Telephone No.:

(7) Emissions:[1]

Contaminant	Rate or Concentration

(8) Process Rate:[1]

10. Reason for selection and description of systems: **See Section 4.0, BACT Analysis, of attached PSD documentation for modification.**

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

SECTION VII - PREVENTION OF SIGNIFICANT DETERIORATION

A. Company Monitored Data **N/A**

1. ______ no. sites ______ TSP ______ ( ) SO^2* ______ Wind spd/dir

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

Other data recorded ______________________

Attach all data or statistical summaries to this application.

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

2. Instrumentation, Field and Laboratory **N/A**

a. Was instrumentation EPA referenced or its equivalent? [ ] Yes [ ] No

b. Was instrumentation calibrated in accordance with Department procedures?

[ ] Yes [ ] No [ ] Unknown

B. Meteorological Data Used for Air Quality Modeling

1. 5 Year(s) of data from 1 / 1 / 81 (month day year) to 12 / 31 / 85 (month day year)

2. Surface data obtained from (location) **Miami**

3. Upper air (mixing height) data obtained from (location) **Miami**

4. Stability wind rose (STAR) data obtained from (location) **Miami**

C. Computer Models Used **(No modifications)**

1. **EPA Screen** Modified? If yes, attach description.

2. **ISCST** Modified? If yes, attach description.

3. ______ Modified? If yes, attach description.

4. ______ Modified? If yes, attach description.

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

D. Applicants Maximum Allowable Emission Data **(See table 5-5)**

Pollutant	Emission Rate	
TSP	______	grams/sec
SO^2	______	grams/sec

E. Emission Data Used in Modeling **(See Tables 5-5 and 5-6)**

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

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

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

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

Appendix B
MODELING PROTOCOL

R.W. BECK
AND ASSOCIATES

R.W. BECK
AND ASSOCIATES

Bank One Building, Suite 1900 ■ 1125 Seventeenth Street ■ Denver, Colorado 80202-2615 ■ USA
Telephone (303) 299-5200 ■ Fax (303) 297-2811

CC-5801-DB6-AB 5 January 1993

Mr. Cleve Holladay
Florida Department of Environmental Regulation
2600 Blair Stone Road
Tallahassee, Florida 32399

Subject: Relocation of Key West Gas Turbine

Dear Mr. Holladay:

The City Electric System (CES) in Key West is planning to relocate a combustion turbine generator (CTG) from the Key West Power Plant to the Stock Island Power Plant. The CTG is currently operating under Permit Number AO44-55430 issued 13 May 1983. Based on a determination by Florida Department of Environmental Regulation (FDER), the relocation of the CTG to the Stock Island Plant will require review and approval under the requirements for Prevention of Significant Deterioration (PSD).

An integral part of the information required for a PSD application is the air quality assessment. Air quality impact modeling will be performed to verify compliance with ambient air quality standards (AAQS) and PSD increments during operation of the Plant. This letter describes the general procedures which we intend to follow to perform the air quality modeling and will serve as a modeling protocol. Please review our approach and let us know if you concur with our dispersion modeling methods as applied to the proposed project.

The modification will involve installation of the CTG which is a General Electric Frame 5 simple cycle turbine with a nominal generating capacity of 24 MW at ISO conditions and an hourly heat input of approximately 322 million Btu (MMBtu) at maximum continuous rated operation. Natural gas is not available at the Plant, and, therefore, the CTG will continue to burn No. 2 distillate fuel oil with a maximum sulfur content of 0.5 percent. The unit will also continue to operate as a peaking source limited to the current permit limit of approximately 2900 hours of operation per year.

The USEPA Air Quality Modeling Guidelines stipulate that the land use within the total area circumscribed by a 3-km radius about the source be classified using Auer's scheme of meteorological land use typing proposed in the *Journal of Applied Meteorology* (1976). A USGS 7.5-minute series topographical map was used to determine that more than 50 percent of the land use around the plant is classified as "A5: Water Surfaces". On this basis, rural dispersion coefficients will be used as an indicator of surface roughness.

The air quality analysis will include a discussion of conformance with good engineering practice (GEP) stack height considerations. Additionally, the effects of building downwash on the units at the plant will be included in the modeling through the appropriate downwash algorithms.

The modeling analysis will consist of three primary components:

(1) A screening analysis of the CTG only to determine the unit's worst-case operating load and the significance of the ambient impacts,

(2) A refined analysis of the CTG only to assess the area of significance and to define receptor grids for any applicable interactive analysis, and

(3) An interactive analysis of those pollutants for which the CTG is predicted by the modeling to exceed the regulatory modeling levels of significance. The interactive analysis will assure compliance with AAQS and PSD increments.

EPA SCREEN will be used for the screening analysis to calculate one-hour concentration averages using "worst-case" meteorological assumptions and regulatory default options. The one-hour averages will be converted to averages representing other averaging intervals by using the following factors:

Averaging Interval	Factor
1-hour	1.0
3-hour	0.9
8-hour	0.7
24-hour	0.4
Annual	0.1

ISCST will be used for the refined analysis and the interactive analysis. The terrain around the site is nearly flat, therefore, the use of a complex terrain model is not necessary and receptor elevations will not be included. The refined analyses will use real-time meteorological data collected in Miami in 1981 through 1985. This data was used in a previous analysis for the site (PSD review for two diesel engine generators approved 6 June 1989 as Permit Numbers AC 44-152197, PSD-FL-135) and is readily available for use. Regulatory default options will be selected, and the refined analyses will proceed from a coarse grid to a fine grid with a resolution of 100 meters.

Interactive analyses will be conducted if the CTG is predicted by the modeling to exceed the regulatory modeling levels of significance. If the impacts from the CTG are predicted to be below the levels of significance, the demonstration that the CTG will not cause or contribute to a violation of AAQS or PSD increments will be deemed complete and no further modeling will be conducted. Modeling parameters representing interactive sources will be obtained through FDER.

Impacts from the CTG on the Everglades National Park will be compared to the PSD Class I levels of significance (USEPA Memorandum, Calcagni to Maslany, September 10, 1991). If the CTG's impacts exceed the levels of significance, an interactive increment analysis will be conducted.

As we have discussed over the phone, we are tentatively planning on a meeting the morning of 19 January 1993 at the FDER offices in Tallahassee. Skip Jansen from City Electric System and Mike Henderson and I from Beck will attend the meeting. We hope to discuss the overall PSD application, the modeling protocol presented herein, the approach to the best available control technology determination, and a preconstruction monitoring exemption. Please call me (303/299-5280) or Mike Henderson (303/299-5234) if you have any questions or comments.

Very truly yours,

R. W. BECK AND ASSOCIATES

D. Edward Settle

D. Edward Settle
Scientist
Environmental Services

DES:lef (F:\CC5801.DB6\LEF001ES.LTR)
cc: Skip Jansen
Mike Henderson

Appendix C
PRECONSTRUCTION MONITORING WAIVER

R.W. BECK AND ASSOCIATES

R.W. BECK
AND ASSOCIATES

Denver National Bank Building, Suite 1900 ■ 1125 Seventeenth Street ■ Denver, Colorado 80202-2615 ■ USA
Telephone (303) 299-5200 ■ Fax (303) 297-2811

CC-5801-DB6-AB

January 29, 1993

Mr. Cleve Holladay
Florida DER
2600 Blair Stone Road
Tallahassee, Florida 32399

Subject: Ambient Air Monitoring Exemption

Dear Mr. Holladay:

This letter presents preliminary calculations to support a monitoring exemption for the relocation of the gas turbine from the Key West Power Plant to the Stock Island Power Plant. Under FAC 17-2.500(3)(e), FDER has the discretionary authority to waive the preconstruction monitoring requirements for a project which is subject to the provisions of Prevention of Significant Deterioration (PSD). The calculations herein are based on: (1) currently available exhaust parameters and emission rates representing full load and 2888.5 hours of operation per year, and (2) meteorological data collected in Miami from 1981 through 1985. Although the final air quality analysis supporting the PSD permit application will be more extensive than the analysis presented herein, we do not anticipate that the final analysis will affect the conclusions supporting the monitoring exemption.

The pollutants for which PSD will likely apply for this project on the basis of annual emissions are nitrogen oxides (NO_x), sulfur dioxide (SO_2), and particulate matter (PM_{10}) as shown in Table 1. The impacts for each of these pollutants and the appropriate averaging intervals are presented in Table 2 and compared to the PSD *de minimis* monitoring thresholds. As the table shows, the impacts from the gas turbine are predicted to be well within the *de minimis* concentrations and, therefore, this project should be granted a waiver from the preconstruction monitoring requirements.

It should be noted that the gas turbine is being relocated from a site approximately four miles from the Stock Island Power Plant. Therefore, it is expected that the impact from the gas turbine on the regional air quality will not be substantially different than its current impact. This further supports the conclusions that a monitoring exemption should be granted for this project.

January 29, 1993

Based on the results presented herein, please issue a letter stating your concurrence with a monitoring exemption. Should you require further information to complete your determination, please call me at 303/299-5280.

Sincerely,

R. W. BECK AND ASSOCIATES

D. Edward Settle
Senior Scientist
Environmental Services

DES:lef (F:\CC5801.DB6\LEF002ES.LTR)
cc: M. Henderson
S. Jansen
J. Greenshields
D. Tremor

Table 1

TURBINE EMISSIONS ESTIMATES

Pollutant	Significant Emission Rates (TPY)	Estimated Emission [1] (TPY)
SO_2 [2]	40	250
NO_x	40	150
PM [3]	25/15	20
CO	100	14
UHC [4]	40	6

(1) *Based on preliminary data and 2888.5 hours of full load operation.*

(2) *Based on 0.5%S fuel oil.*

(3) *All PM emissions assumed to be PM_{10}, significant rates for PM and PM_{10}, respectively.*

(4) *UHC represents total hydrocarbons, whereas non-methane hydrocarbons are regulated.*

Table 2

PREDICTED GAS TURBINE IMPACTS

Pollutant	Averaging Interval	*de minimis* [1] Concentration ($\mu g/m^3$)	Turbine Impact ($\mu g/m^3$)
SO_2	24-hr	13	1.1
NO_x	Annual	14	0.1
PM	24-hr	10	0.1

(1) *Source: Table 500-3, Florida Air Pollution Rules.*

Table 5-5
Summary of Miami, Florida Dispersion Climatology 1981-1985

MIAMI
FIVE YEAR WINDROSE
1981 - 1985

STABILITY CLASS 1 .43%

SPEED	N .02	NNE .01	NE .02	ENE .01	E .01	ESE .04	SE .07	SSE .06	S .06	SSW .01	SW .02	WSW .01	W .02	WNW .04	NW .03	NNW .02
ws<=1	.00	.00	.00	.00	.00	.00	.01	.00	.01	.01	.00	.00	.00	.01	.00	.00
1> ws< 3	.01	.01	.02	.01	.01	.04	.07	.05	.05	.00	.02	.01	.01	.03	.02	.01
3>=ws> 5	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
5>=ws> 7	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
7>=ws> 9	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
9>=ws> 999	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

STABILITY CLASS 2 5.77%

SPEED	N .26	NNE .21	NE .21	ENE .36	E .46	ESE .80	SE 1.00	SSE .67	S .30	SSW .15	SW .20	WSW .18	W .18	WNW .18	NW .31	NNW .29
ws<=1	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
1> ws< 3	.10	.07	.07	.07	.08	.14	.15	.15	.09	.06	.10	.08	.08	.08	.11	.09
3>=ws> 5	.15	.14	.13	.29	.37	.65	.83	.51	.21	.09	.10	.10	.09	.10	.20	.20
5>=ws> 7	.00	.00	.00	.00	.01	.01	.02	.01	.00	.00	.00	.00	.00	.00	.00	.00
7>=ws> 9	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
9>=ws> 999	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

STABILITY CLASS 3 15.41%

SPEED	N .87	NNE .55	NE .63	ENE 1.31	E 1.76	ESE 2.30	SE 2.69	SSE 1.57	S .67	SSW .33	SW .32	WSW .26	W .35	WNW .38	NW .62	NNW .80
ws<=1	.02	.02	.00	.00	.00	.00	.01	.00	.00	.01	.01	.00	.00	.01	.00	.02
1> ws< 3	.14	.13	.08	.10	.12	.15	.18	.20	.13	.07	.08	.08	.08	.11	.13	.13
3>=ws> 5	.55	.27	.31	.50	.73	.98	1.15	.79	.31	.15	.14	.11	.14	.16	.32	.47
5>=ws> 7	.16	.12	.20	.60	.76	1.02	1.26	.53	.21	.09	.07	.06	.10	.09	.15	.18
7>=ws> 9	.00	.01	.02	.08	.13	.12	.08	.04	.01	.00	.01	.01	.02	.01	.01	.00
9>=ws> 999	.00	.00	.02	.02	.01	.01	.01	.00	.01	.01	.01	.00	.01	.00	.01	.00

STABILITY CLASS 4 38.43%

SPEED	N 2.71	NNE 1.21	NE 2.59	ENE 4.84	E 5.41	ESE 5.45	SE 4.29	SSE 2.29	S 1.26	SSW .79	SW .85	WSW .72	W .79	WNW .91	NW 1.62	NNW 2.69
ws<=1	.01	.02	.00	.00	.01	.01	.02	.00	.01	.00	.01	.01	.01	.01	.03	.04
1> ws< 3	.41	.21	.18	.16	.19	.26	.22	.29	.20	.10	.11	.09	.08	.13	.22	.29
3>=ws> 5	.94	.46	.51	1.01	1.23	1.31	1.12	.78	.53	.27	.26	.18	.22	.26	.45	.78
5>=ws> 7	.93	.40	1.15	2.16	2.56	2.53	2.04	.90	.41	.25	.28	.22	.26	.25	.58	1.03
7>=ws> 9	.39	.11	.61	1.28	1.20	1.13	.80	.26	.09	.12	.12	.16	.13	.15	.24	.46
9>=ws> 999	.03	.02	.15	.23	.22	.22	.09	.05	.03	.05	.08	.06	.08	.11	.10	.09

STABILITY CLASS 5 18.87%

SPEED	N 1.87	NNE .81	NE 1.05	ENE 1.81	E 2.54	ESE 2.52	SE 1.56	SSE 1.04	S .68	SSW .50	SW .46	WSW .41	W .45	WNW .61	NW .81	NNW 1.74
ws<=1	.05	.02	.01	.02	.02	.02	.01	.01	.00	.02	.01	.01	.02	.01	.04	.05
1> ws< 3	.69	.38	.26	.34	.51	.54	.47	.44	.32	.24	.21	.18	.19	.19	.34	.70
3>=ws> 5	.97	.38	.63	1.20	1.64	1.63	.92	.54	.34	.22	.21	.20	.21	.36	.36	.83
5>=ws> 7	.15	.04	.15	.24	.38	.33	.15	.05	.02	.03	.02	.02	.03	.05	.08	.16
7>=ws> 9	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
9>=ws> 999	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

STABILITY CLASS 6 15.97%

SPEED	N 1.79	NNE .84	NE .68	ENE .90	E 1.58	ESE 1.90	SE .97	SSE .87	S .73	SSW .49	SW .65	WSW .50	W .58	WNW .56	NW 1.10	NNW 1.82
ws<=1	.11	.03	.03	.04	.04	.05	.04	.03	.03	.03	.04	.04	.05	.03	.06	.07
1> ws< 3	1.31	.63	.46	.58	1.05	1.31	.70	.68	.55	.36	.49	.38	.42	.40	.83	1.41
3>=ws> 5	.37	.18	.18	.25	.48	.53	.23	.16	.14	.10	.13	.09	.10	.13	.21	.34
5>=ws> 7	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
7>=ws> 9	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
9>=ws> 999	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

STABILITY CLASS 7 5.12%

SPEED	N .63	NNE .21	NE .10	ENE .13	E .41	ESE .37	SE .32	SSE .36	S .26	SSW .21	SW .23	WSW .22	W .27	WNW .22	NW .46	NNW .72
ws<=1	.17	.06	.02	.03	.09	.11	.08	.10	.07	.07	.06	.05	.10	.04	.14	.17
1> ws< 3	.46	.16	.08	.10	.31	.26	.24	.25	.19	.14	.17	.16	.17	.18	.32	.55
3>=ws> 5	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
5>=ws> 7	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
7>=ws> 9	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
9>=ws> 999	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
TOTAL	8.13	3.85	5.29	9.36	12.17	13.78	10.31	6.55	3.96	2.48	2.74	2.31	2.63	2.90	4.95	8.08

SPEED		
ws<=1	2.82	.00
1> ws< 3	28.27	.57
3>=ws> 5	35.83	1.43
5>=ws> 7	[illegible]	1.41
7>=ws> 9	7.55	.63
9>=ws> 999	1.73	.27
	100.00	4.21 average

Total number of hours = 43824

Table 5-4

Ambient Air Quality Background Data

Pollutant	Average Time (hr)	Background ($\mu g/m^3$)
CO	8 1	5,500 11,000
NO_2	8,760	35
SO_2	8,760 24 3	15 65 325
PM_{10}	8,760 24	Value requested from FDEP

Table 5-5

Levels of Significance

Pollutant	Averaging Interval	Modeling Level of Significance (μg/m³)	Monitoring Level of Significance (μg/m³)
NO_x	Annual	1	14
CO	1-Hour 8-Hour	2000 500	NA 575
PM	24-Hour Annual	5 1	10 NA
SO_2	3-Hour 24-Hour Annual	25 5 1	NA 13 NA

Table 5-8

GT Screening Results

Load Condition (%)	Ambient Temperature (K)	Maximum Concentration ($\mu g/m^3$)				
			SO_2	NO_x	C0	PM_{10}
100	288	1-hr. avg.	421	909	148	171
		3-hr. avg.	378.9			
		8-hr. avg.	294.7		103.6	
		24-hr. avg.	168.4			68.4
		Ann. avg.	42.1	90.9		17.1
75	288	1-hr. avg.	458	1032	587	243
		3-hr. avg.	412.2			
		8-hr. avg.	320.6		410.9	
		24-hr. avg.	183.2			97.2
		Ann. avg.	45.8	103.2		24.3
50	288	1-hr. avg.	383	842	980	262
		3-hr. avg.	344.7			
		8-hr. avg.	268.1		686	
		24-hr. avg.	153.2			104.8
		Ann. avg.	38.3	84.2		26.2
100	305	1-hr. avg.	397	881	107	223
		3-hr. avg.	357.3			
		8-hr. avg.	277.9		74.9	
		24-hr. avg.	158.8			89.2
		Ann. avg.	39.7	88.1		22.3
75	305	1-hr. avg.	413	927	346	240
		3-hr. avg.	371.7			
		8-hr. avg.	289.1		242.2	
		24-hr. avg.	165.2			96
		Ann. avg.	41.3	92.7		24
50	305	1-hr. avg.	361	786	673	269
		3-hr. avg.	324.9			
		8-hr. avg.	252.7		471.1	
		24-hr. avg.	144.4			107.6
		Ann. avg.	36.1	78.6		26.9

Table 5-9

Summary of Screening Analysis

Pollutant	Averaging Interval	Impact ($\mu g/m^3$)
SO_2	3-Hour 24-Hour Annual	412 183 45.8
NO_x	Annual	103
PM_{10}	24-Hour Annual	108 26.9
CO	1-Hour 8-Hour	980 686

Table 5-6

GT Modeling Parameters

Stack Height (m)	Stack Diameter (m)	Load Condition		Stack Velocity (m/s)	Stack Temperature (k)	Emissions (g/s) [(1)]			
						NO_x	CO	PM	SO_2
10.7	3.72	59°F	100%	25.2	756	12.05	1.96	2.27	2.122
			75%	18.0	676	9.64	5.48	2.27	1.698
			50%	15.9	598	7.29	8.05	2.27	1.283
		90	100	24.0	766	10.94	1.33	2.27	1.927
			75	18.3	729	8.76	3.27	2.27	1.542
			50	15.1	605	6.62	5.37	2.27	1.167

(1) Emissions are short-term peak emissions rates not prorated for annual fuel consumption limitations.

Table 5-7

Interactive Source Parameters

Source	Stack Height (m)	Stack Diameter (m)	Stack Velocity (m/s)	Stack Temperature (k)	SO_2 Emissions (g/s)	NO_x Emissions (g/s)	PM Emissions (g/s)	CO Emissions (g/s)
Stock Island Medium-Speed Diesels	30.48	1.67	30.48	588	1.27	39.2	5.0	13.0
Stock Island Steam Unit	31.7	1.52	44.8	460	150.6	38.4	5.5	1.8
Stock Island High Speed Diesels	6.1	1.8	11.6	617	0.32	19.8	1.3	5.2

Table 5-10

Summary of Refined Analysis - SO_2

	3-hr Avg.	X (m)	Y (m)	24-hr Avg.	X (m)	Y (m)	Annual Avg.	X (m)	Y (m)
NAAQS (1)									
85	675.0	100	300	138.2	-3,000	2,000	25.1	-2,000	1,000
86	552.3	-200	-50	130.4	-3,000	2,000	27.8	-2,000	1,000
87	753.8	-200	-50	149.4	-200	-50	25.4	-3,000	2,000
88	775.8	-200	-50	148.4	-200	-50	24.1	-1,000	1,000
89	566.0	-200	-50	128.6	-3,000	2,000	27.0	1,000	1,000
NAAQS	1,300			365			80		
Class II Increment (2)									
85	41.8	-88.0	-5.4	6.6	23.2	-139.2	0.1	-2,000	1,000
86	21.5	43.2	-139.2	4.9	33.2	-139.2	0.1	-2,000	1,000
87	42.8	33.2	-139.2	9.9	33.2	-139.2	0.1	23.2	-139.2
88	33.2	80.1	33.1	4.9	3.2	-139.2	0.1	-6.8	-139.2
89	20.2	13.2	-139.2	5.0	3.2	-139.2	0.1	-3,000	2,000
Class II Increments	512			91			20		

(1) All Stock Island sources, including background.
(2) GT and MSD.

Table 5-11

Summary of Refined Analysis - PM_{10}

	24-hr Avg.	X (m)	Y (m)	Annual Avg.	X (m)	Y (m)
NAAQS (1)						
85	176.5	100	50	4.6	100.0	50.0
86	110.9	100	50	3.6	100.0	50.0
87	146.2	85.1	71.4	4.8	100.0	50.0
88	94.6	100	50	3.2	85.1	71.4
89	84.3	100	50	2.2	85.1	71.4
NAAQS	150			50		
Class II Increment (2)						
85	9	23.2	-139.2	0.3	-2,000	1,000.0
86	8.7	43.2	-139.2	0.4	-2,000	1,000.0
87	14.6	33.2	-139.2	0.3	-3,000	2,000.0
88	8.0	3.2	-139.2	0.3	-6.8	-139.2
89	9.7	-6.8	-139.2	0.4	-3,000	2,000.0
Class II Increments	37			19		

(1) All Stock Island sources, no background included.
(2) GT and MSD.

Table 5-12

Summary of Refined Analysis - NO_x

	NAQQS (1)			Class II Increment (2)		
	Annual Avg.	X (m)	Y (m)	Annual Avg.	X (m)	Y (m)
85	104.9	100	50	2.57	-2,000	1,000
86	89.4	100	50	3.22	-2,000	1,000
87	106.8	85.1	71.4	2.6	-2,000	1,000
88	83	85.1	71.4	2.2	-2,000	1,000
89	68.3	85.1	71.4	3.0	-3,000	2,000
NAAQS - 100				Class II Increment Standard - 25		

(1) All Stock Island sources, including background.
(2) GT and MSD.

Table 5-13

Summary of Refined Analysis - CO

	NAQQS (1)			NAAQS (1)		
	1-hr Avg.	**X (m)**	**Y (m)**	**8-hr Avg.**	**X (m)**	**Y (m)**
85	14712.8	100	50	6698	100	50
86	14060.9	100	50	6428.8	100	50
87	13624.1	85.1	71.4	6783	100	50
88	13136.5	85.1	71.4	6300.7	100	50
89	13104.4	100	50	6406.2	85.1	71.4
NAAQS - 40,000				NAAQS - 10,000		

(1) All Stock Island sources, including background.

Table 5-14

Summary of Monitoring De Minimus Analysis

Year	Month	Date	X (m)	Y (m)	C $\mu g/m^3$
SO_2 - Monitoring Exemption Level is 13 $\mu g/m^3$					
1988	11	22	77.6	13.9	15.1
PM_{10} - Monitoring Exemption Level is 10 $\mu g/m^3$					
1985	7	23	72.6	-24.3	10.9
1985	11	1	77.6	13.9	10.0
1985	11	1	80.1	33.1	11.1
1985	11	19	-83.4	52.9	11.4
1985	11	19	-80.9	32.3	14.6
1985	11	19	-78	8.4	14.6
1985	11	19	-83	1.5	16.3
1985	11	19	-88	-5.4	14.9
1985	11	19	-100	0	12.8
1985	11	19	-100	50	11.2
1985	11	19	-100	0	12.8
1987	10	12	23.2	-139.2	12.2
1987	10	12	33.2	-139.2	12.5
1987	12	29	33.2	-139.2	12.2
1988	11	22	77.6	13.9	20.2
1988	11	22	80.1	33.1	15.4
1988	11	22	100	50	12.7
1988	12	2	-16.8	-139.2	12.5
1988	12	2	-6.8	-139.2	15.6
1988	12	2	3.2	-139.2	10.3
1989	10	20	-6.8	-139.2	10.9

Table 5-15

Everglades Class I Receptors

	Radial (deg)	Distance (m)
1.	10	148,000
2.	20	140,000
3.	30	122,000
4.	40	99,000
5.	50	100,000
6.	60	92,000

Table 5-16

Everglades Class I Impacts
(μg/m³)

Revised June 24, 1994
Key West Meteorology, 59°F, 50% Load

Pollutant	Emissions (gm/sec)	Averaging Interval	Key West (KW) Impact [1]	Stock Island (SI) Impact [1]	Difference (SI-KW)	Class I LOS [2]	Class I LOS [3]
SO_2	12.83	3-hr 24-hr Annual	1.18 0.19 0.0055	1.47 0.24 0.0051	-0.31 0.05 -0.0004	0.48 0.07 0.025	1.23 0.275 0.1
NO_x	7.29	Annual	.0031	0.0029	-0.0002	0.025	0.1
PM_{10}	2.27	24-hr Annual	0.034 0.0010	0.043 0.0009	-0.009 -0.0001	0.33 0.1	1.35 0.27

(1) *Highest impacts were found to be at the condition of 59°F - 50% load.*
(2) *National Park Service (NPS)*
(3) *USEPA accepted values.*

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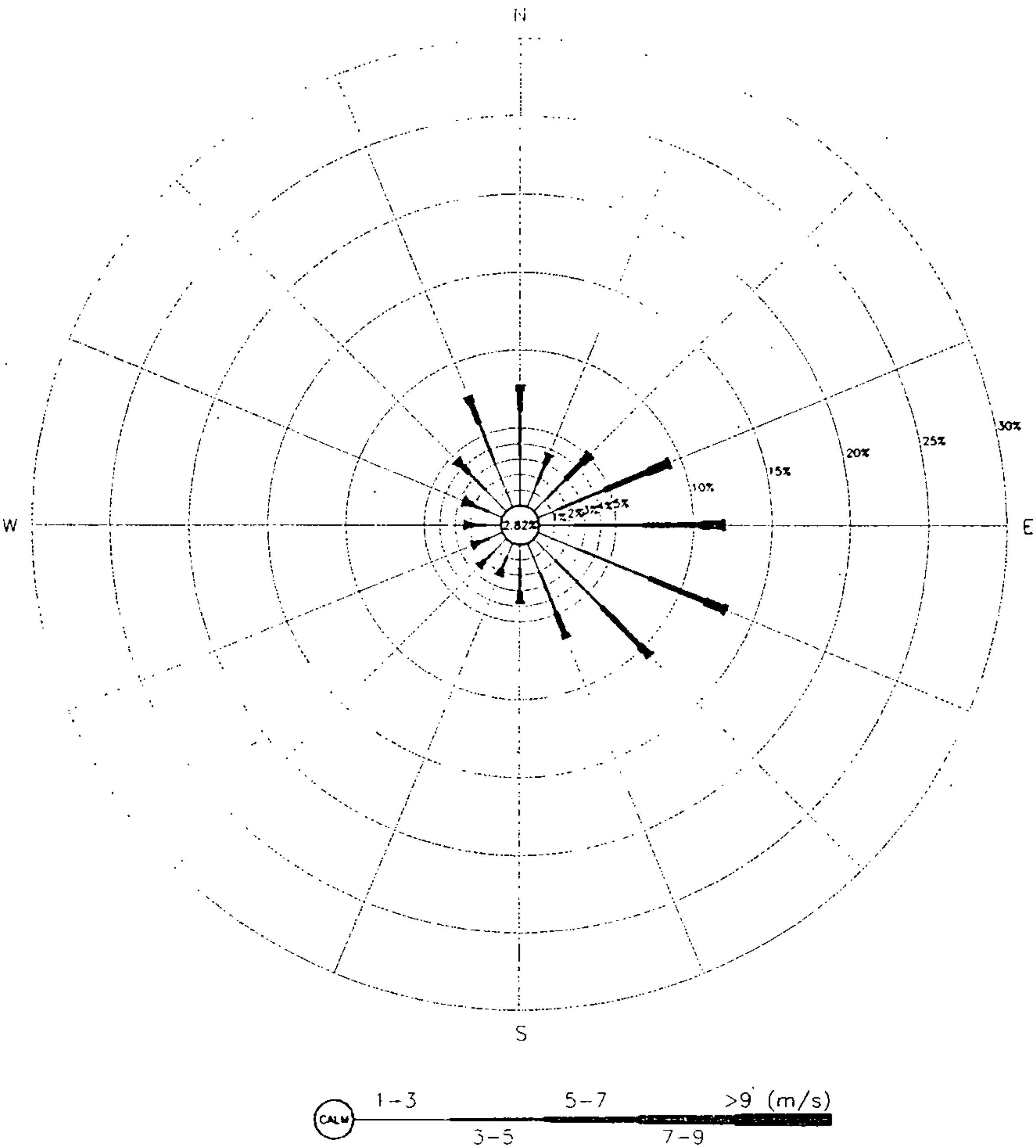

REVISIONS	DATE	BY	CKD.	APP.	APP.	DRAWN CHECKED APPROVED APPROVED DATE	R.W. BECK AND ASSOCIATES

STOCK ISLAND GENERATING FACILITY	FIGURE 5-1 MIAMI WIND ROSE (1981-1985)	SCALE NO. 3068-SK-3	REV. 0

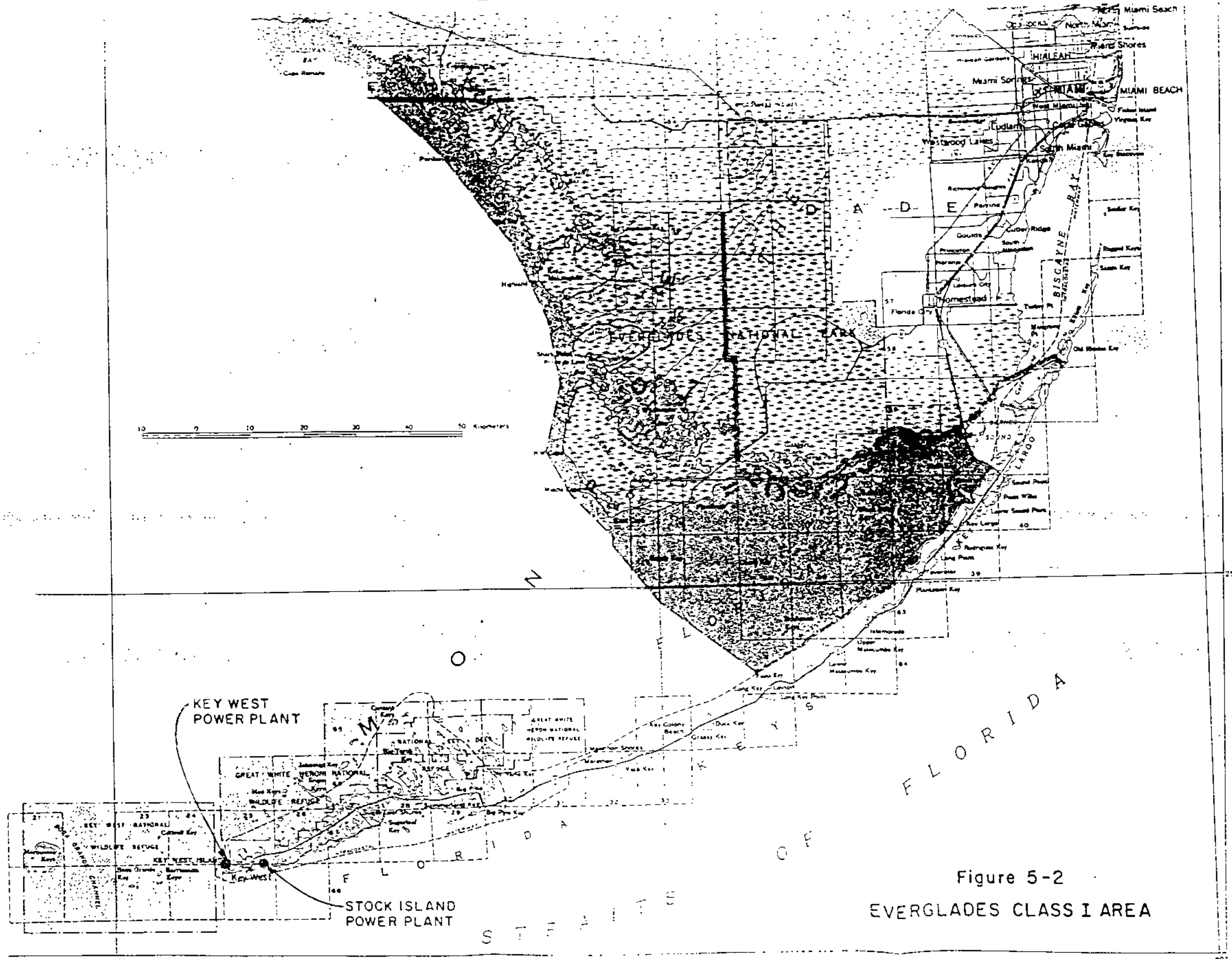

Figure 5-2

EVERGLADES CLASS I AREA

Is your RETURN ADDRESS completed on the reverse side?

SENDER:
- Complete items 1 and/or 2 for additional services.
- Complete items 3, and 4a & b.
- Print your name and address on the reverse of this form so that we can return this card to you.
- Attach this form to the front of the mailpiece, or on the back if space does not permit.
- Write "Return Receipt Requested" on the mailpiece below the article number.
- The Return Receipt will show to whom the article was delivered and the date delivered.

I also wish to receive the following services (for an extra fee):

1. ☐ Addressee's Address
2. ☐ Restricted Delivery

Consult postmaster for fee.

3. Article Addressed to:
Skip Jansen
Util. Board of the City of
Key West
PO Drawer 6100
Key West, Fl 33041

4a. Article Number
Z 127 632 527

4b. Service Type
☐ Registered ☐ Insured
☒ Certified ☐ COD
☐ Express Mail ☐ Return Receipt for Merchandise

7. Date of Delivery
OCT 03 1995

5. Signature (Addressee)

6. Signature (Agent)
10/3/95

8. Addressee's Address (Only if requested and fee is paid)

PS Form 3811, December 1991 ★U.S. GPO: 1993—352-714 **DOMESTIC RETURN RECEIPT**

Thank you for using Return Receipt Service.

Z 127 632 527

Receipt for Certified Mail
No Insurance Coverage Provided
Do not use for International Mail
(See Reverse)

UNITED STATES POSTAL SERVICE

Sent to: Skip Jansen	
Street and No.: City of Key West	
P.O., State and ZIP Code: Key West, Fl	
Postage	$
Certified Fee	
Special Delivery Fee	
Restricted Delivery Fee	
Return Receipt Showing to Whom & Date Delivered	
Return Receipt Showing to Whom, Date, and Addressee's Address	
TOTAL Postage & Fees	$
Postmark or Date: 9-28-95 AC44-245399 PSD-Fl-210	

PS Form 3800, March 1993